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XXI International Scientific and Professional Meeting

Ecological Truth

PROCEEDINGS

Edited by
Radoje V. PANTOVIC
and
Zoran S. MARKOVIC

EcoIst '13

Hotel "Jezero", Bor Lake, Bor, SERBIA
4 -7 June 2013

UNIVERSITY OF BELGRADE
TECHNICAL FACULTY BOR

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ORGANIC FOOD MARKET DEVELOPMENT IN SERBIA

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ABSTRACT

Turnover of organic products in Europe has reached several billion euros and annual growth rates are close to 10%. Demand is growing faster than domestic production. This is a trend that initiates the world economy to initiate development of organic food production. Serbia has recently became a candidate for joining EU, and in this context, an area that requires the most significant changes is the agricultural sector With its abundance of agricultural land and long Agro-industrial tradition, Serbia has advantages and opportunities to boost export and strengthen domestic organic food market. Serbian National Action Plan for Organic Agriculture shows that the Serbian political decision-makers understand the importance of organic agriculture in Serbia.

Key words: organic food, organic food market, agricultural products, the World organic market.

INTRODUCTION

After spending many years in the “green” ecological niche, organic food and beverages entered mainstream markets and became part of the global megatrend in lifestyle, health, and sustainability. For this growing consumer group, organic food is a way to provide healthy food for themselves and their families, to support smaller food manufacturers and farmers, and to protect the environment. Increasingly the aspect of regionality is added to the concept, with the result that the ideal product is not only organic but also seasonal and produced locally or at least regionally. However, people adhering to the prevalent lifestyle are not likely to sacrifice their pleasure and enjoyment, so organic products must be available to the same extent, and in similar convenient packages and outlets, as conventional food.

Organic food markets worldwide are guided by the same economic principles as other industries. CAP - Common Agricultural Policy is regulating the European market and mechanisms for many agricultural products in European Union, including organic production. [1]

Action plan for development of agricultural production in Serbia reflects the political will for setting of strategic objectives in this area, as well as engaging all relevant national actors to accomplish them. The ultimate goal of the Action Plan is to increase the total area of arable land by the year of 2014, as certified organic or in conversion process up to 50.000 ha. In order to achieve the primary objectives of the Action Plan, it is necessary to take into account the interests of all sides in organic production, and increase public awareness of the importance of organic farming to improve the health and sustainable use of resources. Organic production is an opportunity for Serbian producers to achieve significant demands in the EU market, as well as in the world market, by producing larger quantities of high quality certified food and attains the health and biological standards.

SIGNIFICANCE AND BASIC TRENDS IN ORGANIC FARMING IN THE WORLD

As of the end of 2010, 10 million hectares of agricultural land in Europe were managed organically. Twenty-seven percent of the world's organic agricultural land is in Europe. In Europe, 2.1 percent of the agricultural area, and in the European Union, 5.1 percent of the agricultural area is organic. In Europe, there were almost 280.000 organic farms, in the European Union almost 220.000. Compared to 2009, organic land increased by nearly 0.8 million hectares. The countries with the largest organic agricultural area are Spain (1.5 million hectares), Italy (1.1 million hectares), and Germany (0.99 million hectares). [2] There are six countries in Europe with more than ten percent organic agricultural land: Liechtenstein (27.8 percent), Austria (19.7 percent), Sweden (14.1 percent), Estonia (12.5 percent), Switzerland (11.4 percent), and Czech Republic (10.5 percent). Sales of organic products were approximately 19.6 billion euros in 2010. The largest market for organic products in 2010 was Germany with a turnover of 6 billion euros, followed by France (3.4 billion euros) and the UK (2 billion euros). A new research project on transparency of organic market data was launched in early 2012. It is expected that this will be a major step forward to improve European market data.

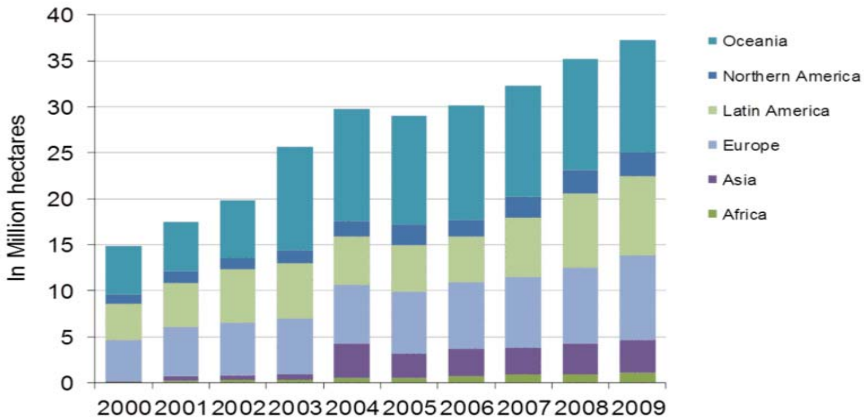


Figure 1. The World of Organic Agriculture 2009. (http://www.fibl.org)

According to the latest FiBL-IFOAM Survey on certified organic agriculture worldwide (data as of end of 2010), data on organic agriculture are available from 160 countries. There are 37 million hectares of organic agricultural land (including in-conversion areas). The regions with the largest areas of organic agricultural land are Oceania (12.1 millionhectares), Europe (10 million hectares), and Latin America (8.4 million hectares). The countries with the most organic agricultural land are Australia, Argentina, and the United States.Currently 0.9 percent of the agricultural land is organic. By region, the highest shares are in Oceania (2.9 percent) and in Europe (2.1 percent).

In the European Union, 5.1 percent of the farmland is organic. However, some countries reach far higher shares: Falkland Islands: 35.9 percent; Liechtenstein: 27.3 percent; Austria 19.7 percent. In seven countries, more than ten percent of the agricultural land is organic. Compared with the previous survey (data per end of 2009), the organic agricultural land decreased slightly (by 50'000 hectares, -0.1 percent). There was strong growth in Europe, where the area increased by 0.8 million hectares (+9 percent). In Asia, however, the organicarea decreased, mainly due to a major decline of organic farmland in India and China. Thecountries with the largest increases were in Europe: France (+0.17 million hectares), Poland (+0.15 million hectares), and Spain (+0.13 million hectares). Apart from agricultural land, there are further organic areas, most of these being areas for wild collection. Other areas include aquaculture, forests, and grazing areas on nonagricultural land. They constitute 43 million hectares. In total, 80 million hectares (agricultural and non-agricultural areas) are organic. There were 1.6 million producers in 2010. Thirty-four percent of the world's organic producers are in Africa, followed by Asia (29 percent), and Europe (18 percent). The countries with the most producers are India (400'551), Uganda (188'625), and Mexico (128'862). About one third of the world's agricultural land (12.5 million hectares) and more than 80 percent of the producers are in developing countries and emerging markets. For almost 90 percent of the organic agricultural land, land use details were available. About two-thirds were grassland/grazing areas (23.7 million hectares). With a total of at least 6.1 million hectares, arable land constitutes 17 percent of the organic agricultural land. An increase of six percent compared with 2009 was reported.

Most of this category of land is used for cereals including rice (2.5 million hectares), followed by green fodder from arable land (2 million hectares), oilseeds (0.5 million hectares), protein crops (0.3 million hectares), and vegetables (0.2 million hectares). Permanent crops account for approximately seven percent of the organic agricultural land, amounting to 2.7 million hectares. Compared with the previous survey, this is an increase of six percent. The most important permanent crops are coffee (with 0.64 million hectares), constituting almost one-fifth of the organic permanent cropland), followed by olives (0.5 million hectares), cocoa (0.29 million hectares), nuts (0.26 million hectares), and grapes (0.22 million hectares). Regarding the wild collection area (including areas for beekeeping), most of this is in Africa (39 percent of the global total) and Europe (30 percent). Not much detail on the crops harvested is available. Wild berries, medicinal and aromatic plants as as well wild fruit are among the most important ones.

In the business world, organic food is even more popular. The trade in organic products in the last 4 years only, has increased from 23 to 40 billion US dollars. Prices of organic products remain high despite increased sales and they are on average 15-30%

higher compared to products made by using conventional methods. In the last 10 years the demand for organic products has increased by 15-20% in the USA. Germany is also a country with a long tradition and high reputation in the field of organic farming. Germany is one of the leading producers of organic products and one of the largest markets in the world with an annual turnover around 3.9 billion euros.

There are more than 1,800 companies that offer over 35,000 organic products labeled "Bio", which has been an official state sign in Germany since 2001; USDA adopted a sign for organic products just a year later in the USA, while Canada published the national logo in 2006. At the global level, sales of organic products (food and drinks) increased by 43% from 2002 to 2005 (from 17.8 billion euros to 25.5 billion). In 2006 sales reached 30.9 billion euros. Europe and North America have the largest demand for organic products.

The country with the largest share of organic products in the market, compared to other products, is Switzerland with 4.5% and it also has the largest consumption of organic products per capita (on average over 100 euros per inhabitant). The fertile land area under the organic production is growing on an annual basis. However, it is still a small part of the total agricultural fertile land both viewed from the global and country perspective.

The prices of organic products compared to conventional products are:

- Germany: on average 20% higher;
- France: over 20-30% (in specialized shops up to 50%, domestic products having the advantage);
- Italy: 25% compared to supermarkets and up to 30% in specialized shops;
- Sweden: 15% higher, unprocessed products with even larger differences in price;
- Denmark: 20-30% higher.

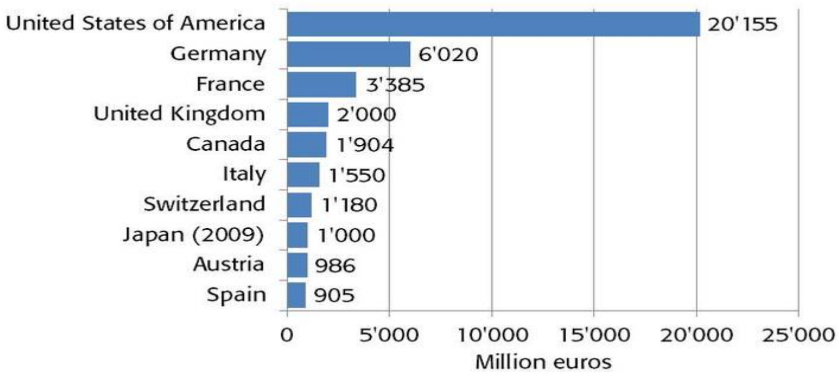
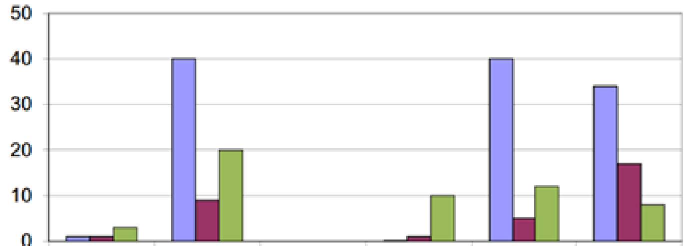


Figure 2. Ten cuontries with the largest organic markets 2010
(total 44.5 billion Euros) (http://www.organic-world.net)

On a global scale nowadays, there are 395 organizations which provide services of organic products certification according to different regulations and standards. Most of them are located in Europe (160), Asia (93) and North America (80). Countries which have the largest number of certification organizations are USA, Japan, China and Germany. [3]



	BiH	Croatia	Mace-donia	Monte-negro	Serbia	Slove-nia
Turnover 2010 (mio €)	1	40		0.1	40	34
Average per capita expenditures (€)	1	9		1	5	17
Market growth2010/2009	3	20		10	12	8

Figure 3. Organic markets in Eastern Europe 2010. (www.ekoconnect.org)

- Total population: 20 million
- Average expenditures for organic food: from 1 to 17 €/ capita
- Estimated organic market size: 120 million €

SIGNIFICANCE AND BASIC TRENDS IN ORGANIC FARMING IN SERBIA

Analyzing the data of the Ministry obtained from control bodies by February 2009, the following conclusions can be made: The total number of producers, i.e. agricultural farms applying organic production methodology amounts to 224 entities (out of this number, 37 producers have direct contracts with authorized certification organizations and the remaining 187 producers cooperate with the following firms: Sirogojno, Berry Frost, Bio cooperative farm Mileticevo, Bio co-operative farm Bašaid, Žitohem, Eko Telecka. The total area covered by organic production methodology by February 2009 amounts to 596 ha. Out of this number:

- Authorized certification organizations certified the area of 330 ha under organic production. 89 ha are used for growing specific plant cultures and 240 ha are meadows, pastures and forests;
- The area of 265 ha is in the process of conversion.

It is important to notice that in Serbia there is no official methodology for calculating data related to wild collection areas.Out of total agricultural land under organic cultivation, perennial crops are planted on almost 40% and annual crops on 16%. The balance (44%) goes to grassland and pasture. Within the category of perennials apples dominate, then go plums, followed by various berries, notably raspberries. Cereals, soybeans and vegetables are the main annual crops grown. Although berries are the main export crop, it appears that farm ers are diversifying to other crops, opting mostly for apples and plums. There is also a significant increase of land under annual crops. The survey data suggest that almost 4,000 small-scale farmers are involved in organic production. Yields on such farms cannot be the same as in conventional agriculture, and prices obtained are usually not identical to those obtained for conventional crops. In the absence of clear empirical data, a first approximation comes to the conclusion that the farmgate value of all organic crops grown in 2009 ranges from €20 to €25 million.

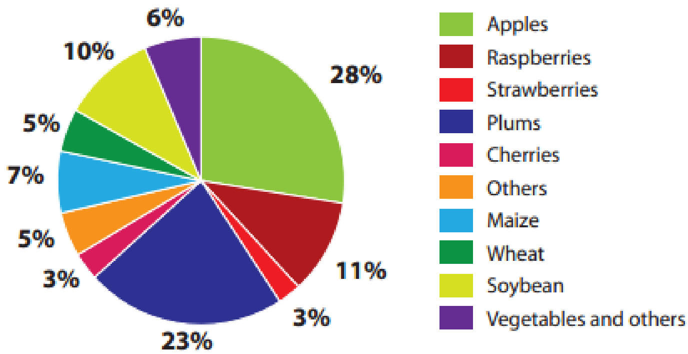


Figure 4: Agricultural land organically certified by crop in Serbia (2010)

Legal regulations and supporting legal acts define what is considered to be an organic product. Besides the production conducted according to provisions, a certain number of producers apply private standards of certification organizations and they do not report their production to authorized certification organizations. Therefore, they cannot be found in the data of the Ministry. The market in Serbia does not have declared seeds, nursery plants, i.e. seed material produced according to organic production methods.

The data of the Ministry updates having been analyzed, it has been determined that only the Institute of Field and Vegetable Crops in Novi Sad reported 7,7 hectares (ha) of soya in the period of conversion. Due to a small number of organic producers in Serbia, registered foreign producers of seeds, nursery plants and seed material, as well as traders of products for protection and nurturing of plants, i.e. importers, do not have an economic interest to import these inputs into Serbia. In order to encourage organic production, it is necessary to provide financial support to registered producers and physical entities that sign contracts regarding joint production with them. In the period from 2004 to 2009, there could be noticed an increased number of land areas where organic production methods were being applied. Organic products in Serbia are being sold in supermarkets, "healthy nutrition" shops and green markets. The Statistical Office of the Republic of Serbia does not keep record on the prices of organic products. [4]

The retail sector for organic food in Serbia is still underdeveloped. There are only a few outlets in Belgrade and Novi Sad. Organic food can be found on not too many green markets, specialized health food stores, and in a few supermarket chains. Although organic products have found their way to supermarket chains, not much has been done to promote them and indicate their availability. It seems that consumers are left to discover organic products on their own, and to compare their advantages in regard to the conventional ones. In Serbian supermarkets, there is a growing number of health counters where in products claiming health advantages are intermixed with organic products, without any explanation, however, what organic really means. Research and interviews with different stakeholders from this sector, as well as with consumers, indicates that the average Serbian consumer relates the term organic to health. Therefore, promotion and public awareness campaigns should focus on this aspect. Value can be added to organic products by insisting on their naturalness and environmental protection. For further development of the local organic market, strong and intensive campaign with clear communication strategy, directed towards defined target consumer groups, are definitely needed. [5]

CONCLUSION

There are many different labels and brands like natural, eco, bio, etc, some not having any connection with organic production. Only a small number of consumers care, and the authorities have no capacity or desire to prevent fraud. The government is now planning to introduce a common organic label that will be mandatory for all organic products with the goal of introducing consumers to organic products and separating organic from non-organic products. This initiative would contribute to the development of the domestic market. It is not clear, however, when the implementation of this regulation will start and how it will function in practice. Some of the measures that can help organic farming:

- Support for organic farming as an integral part of national agricultural policy and rural development policy
- Legislation Serbia regulated organic production in accordance with the requirements of EU
- Establishing and operating an agreed system of control in organic production inaccordance with EU standards
- A functional and viable National association for organic production
- Affordable and market requirements facing advisory service that provides modernized and professional support to producers
- Establishment of applied research in organic farming
- Inclusion of organic agriculture in formal education (long-term goal)
- Creating of the organic farming sector in the Rural development sector of the Ministry of Agriculture, as well as clusters of organic producers, processors and manufacturing and trade unions
- Development of local market
- Promotion of exports - Serbian traders in the foreign market
- Subsidized credit lines for farmers in organic production
- Implementation and monitoring of National Action Plan for the development of organic production in Serbia.

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ACTIVITY LEVELS OF ^{7}Be, ^{40}K AND ^{137}Cs IM MOSS SAMPLES COLLECTED IN THE SOKOBANJA REGION IN 2012

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ABSTRACT

Moss samples were collected in the Sokobanja region in 2012. Activity levels of ^{7}Be in Lepterija moss were 70-144 Bq/kg (mean 105), and in Ozren moss they were 60-132 Bq/kg (mean 103). Activity levels of ^{40}K in Lepterija moss were 101-267 Bq/kg (mean 131), and in Ozren moss they were 56-402 Bq/kg (mean 185). Activity levels of ^{137}Cs in Lepterija moss were 2.15-41 Bq/kg (mean 17.7), and in Ozren moss they were 3.08-12.4 Bq/kg (mean 6.37). Compared to the period from 2002 to 2012 activity levels of ^{7}Be and ^{40}K have not changed, while activity levels of ^{137}Cs have reduced significantly.

Key words: moss, ^{7}Be, ^{40}K, ^{137}Cs, Sokobanja.

INTRODUCTION

Cosmic radionuclides (^{3}H, ^{7}Be, ^{10}Be, ^{14}C, ^{26}Al, ^{32}Si, ^{36}Cl) form as the result of cosmic radiation on particles in the atmosphere or Earth surface by appropriate nuclear reactions. Beryllium–7 forms by cosmic irradiation of oxygen and nitrogen in the atmosphere. About 75% ^{7}Be is produced in the stratosphere and about 25% in higher levels of the troposphere. Fall brings ^{7}Be to lower layers, surface waters and seawater. It is used as a carrier when investigating air mass movement through the atmosphere. The radioisotope ^{7}Be has a physical half-life of 53.12 days. Natural radionuclides (^{235}U, ^{238}U, ^{232}Th, ^{226}Ra, ^{222}Rn and ^{40}K) formed before planet Earth. The natural radionuclide ^{40}K is an essential radionuclide and is part of the human organism. The physical half-life of ^{40}K is 1.28×10^{9} years, while the biological half-life is 58 days. Anthropogenic radionuclides (^{3}H, ^{131}I, ^{129}I, ^{137}Cs, ^{90}Sr, ^{99}Tc, ^{239}Pu and others) were created by human activity and have a different physical half-life and formation[1,2]. Pollution by these radionuclides mainly has a regional character, but it can be wider in the case of strong nuclear explosions. Radiocesium-137 can form: as a fission product, be produced in the process of production and testing of nuclear weapons and in nuclear reactors. The physical half-life of ^{137}Cs is 30.2 years. It most often reaches plants through dry and moist fall. Physical-chemical characteristics of ^{137}Cs are such that it actively enters the food chain of humans and animals via plants as it metabolically replaces potassium.

Mosses are bioindicators of environment pollution with radionuclides and other pollutants. They are organisms with a special build and specific ecology compared to higher flora. Investigation of radionuclide activity levels in mosses enables a reliable insight into the contamination degree of ecological systems by radioactive isotopes[3-8].

The purpose of this work was to establish whether there is radionuclide pollution of the environment using moss collected in the Sokobanja region, thus enabling establishment whether there is a risk of radioactive loading of consuming organisms.

Sokobanja is located in the central part of eastern Serbia and is at 43° 38' 36" Latitude North and 21° 52' 16" Longitude East. Most of the municipality is part of the spacious Carpathian-Balkan mountain system, while a smaller region in the west is part of the old Rodopi mass zone. Sokobanja is in the low altitude spa zone (alt.) (300 - 600 m alt.), i.e. is of the low-mountain-basin type. It has no industry or dirty technology.

MATERIALS AND METHODS

Moss samples were collected by the random sample method on the Sokobanja territory at the beginning of April 2012. Samples were dried, cleaned from impurities, homogenized and measured in 1L Marinelli vessels. Gammaspectrometric measurements were performed on an ORTEC-AMETEK HPGe detector with 8192 channels, resolution 1.65 keV-a and relative efficiency of 34% at 1.33 MeV-a for ^{60}Co. The measurement time for one sample was 60000s. The relative measurement error was up to 10%. Spectra analysis was performed using the Gamma Vision 32 software package. Activity of the ^{7}Be readionuclide was measured via the γ-line at 477.6 keV relative intensity 10.56%; ^{40}K via the γ-line at the energy of 1460.75 keV, relative intensity 10.67% and ^{137}Cs via the γ-line at the energy of 661.6 keV-a, and high relative intensity of 85.1%.

RESULTS AND DISCUSSION

Table 1 shows activity levels of ^{7}Be, ^{40}K and ^{137}Cs in moss samples collected on the Sokobanja territory (Lepterija and Ozren) at the beginning of April 2012. The results presented in Table 1 indicate that these radionuclides are present in all analyzed moss samples.

Activity levels of ^{7}Be in Lepterija moss are 70-144 Bq/kg, and in Ozren moss they are 60-132 Bq/kg. Average activity levels of ^{7}Be in Lepterija moss was 105 Bq/kg and in Ozren moss it was 103 Bq/kg. A comparison of our research results with other available data in Serbia enables the conclusion that the average activity level of ^{7}Be in Sokobanja moss is lower than measured activity levels of ^{7}Be in moss in Serbia[9,10].

Table 1. Activity levels of 7Ba, 40K and 137Cs (Bq/kg) in moss samples from the Sokobanja territory collected at the beginning of April 2012

SampleNo.	Locality	Activity level (Bq/kg)		
		^{7}Be	^{40}K	^{137}Cs
1	Lepterija, restaurant	104	131	3.60
2	Lepterija, restaurant	120	144	4.46
3	Lepterija, restaurant	136	163	7.10
4	Lepterija, restaurant	104	267	2.15
5	Lepterija, I barbeque cave	144	101	5.49
6	Lepterija, I barbeque cave	132	103	8.96
7	Lepterija, I barbeque cave	96	110	6.41
8	Lepterija, Hajduk Veljko's cave	92	102	25
9	Lepterija, H. Veljko's cave	112	110	10.1
10	Lepterija, H. Veljko's cave	76	125	24
11	Lepterija, H. Veljko's cave	120	116	30
12	Lepterija, Vodomar spring	88	145	27
13	Lepterija, Vodomar spring	112	134	38
14	Lepterija, Vodomar spring	122	117	35
15	Lepterija, Vodomar spring	74	115	41
16	Lepterija, Vodomar spring Soko city	108	108	16
17	Lepterija, Vodomar spring Soko city	70	142	18
18	Lepterija, old elm	80	132	16
19	Ozren, hospital	80	118	5.41
20	Ozren, hospital	129	209	6.06
21	Ozren, hospital	122	402	12.4
22	Ozren, hospital	60	275	9.59
23	Ozren, hospital	100	204	4.96
24	Ozren, hospital	100	173	6.06
25	Ozren, hospital	88	172	7.48
26	Ozren, hospital	132	184	5.35
27	Ozren, hospital	120	157	4.21
28	Ozren, canal	78	141	3.08
29	Ozren, canal	116	179	4.61
30	Ozren, canal	78	141	3.08
31	Ozren, canal	116	179	4.61
32	Ozren, canal	96	173	4.63
33	Ozren, fishery	110	56	3.80
34	Ozren, fishery	104	247	10.6
35	Ozren, fishery	116	132	12.3

The stated average activity levels of ^{7}Be in Sokobanja moss from April 2012 are higher than the average activity levels of ^{7}Be in moss collected in May 2006 (61 Bq/kg, Lepterija 91 Bq/kg, Ozren 58 Bq/kg) and similar to activity levels of ^{7}Be in moss collected in August 2010 (119 Bq/kg, Lepterija 114 Bq/kg, Ozren 120 Bq/kg) (Table 2).

Average activity levels of ^{40}K in Lepterija moss is 131 Bq/kg, and in Ozren moss it is 185 Bq/kg. Activity levels of ^{40}K in Lepterija moss are 101-267 Bq/kg, and in Ozren moss they are 56-402 Bq/kg.

Average activity levels of ^{137}Cs in Lepterija moss is 17.7 Bq/kg, and in Ozren moss it is 6.37 Bq/kg. Activity levels of ^{137}Cs in Lepterija moss are 2.15-41 Bq/kg, and in Ozren moss they are 3.08-12.4 Bq/kg.

Table 2. Average activity levels of 7Be, 40K and 137Cs (Bq/kg), standard deviations, minimum and maximum activity levels of these radionuclides in 2002, 2006, 2008-2010.

Year	**Radionuclide**		
	^{7}**Be**	^{40}**K**	^{137}**Cs**
	(Bq/kg)		
2002.	---	255 ± 106 **min** 119 **max** 414	88 ± 56 **min** 25 **max** 177
2006.	61 ± 29 **min** 14 **max** 104	214 ± 109 **min** 83 **max** 427	35 ± 35 **min** 2.70 **max** 107
2008.	122 ± 45 **min** 54 **max** 219	210 ± 69 **min** 65 **max** 352	22 ± 18 **min** 2.90 **max** 51
2009.	---	172 ± 77 **min** 25 **max** 263	12.3 ± 12.7 **min** 2.50 **max** 49
2010.	119 ± 43 **min** 33 **max** 210	217 ± 68 **min** 101 **max** 417	18.4 ± 13.1 **min** 0.87 **max** 54
2012.	104 ± 21 **min** 60 **max** 144	157 ± 64 **min** 56 **max** 402	12.2 ± 10.8 **min** 2.15 **max** 41

A comparison of average activity levels of ^{7}Be, ^{40}K and ^{137}Cs given in Table 2 enables the conclusion that there are no significant changes for ^{40}K in moss in the period 2002-2012. The highest difference in average activity levels is 98 Bq/kg, i.e. 62%, that is most probably the consequence of climatic changes (fall, temperature etc.)[11,12] and also their reflection on the biological behavior of moss. The same conclusion can be reached for changes in ^{7}Be content, as the highest difference in average activity levels was 61 Bq/kg, i.e. 100%. This is supported by the very high differences in activity levels in individual samples used for calculation of average activity levels. However, for ^{137}Cs the difference in activity levels is the highest and it is 76 Bq/kg, for the observed time period resulting in 633%. This is the consequence of the fact that this artificial isotope polluting the terrain undergoes a content reduction as it is not geochemically nor climatologically balanced as the previous two natural isotopes. Reduction of its content is also an indicator of reduction of environment pollution by this isotope and that there have been no new pollutions.

Analysis of the stated activity levels of ^{137}Cs and ^{40}K, which we know are metabolically similar leads to the question whether there is a correlation between the content of these two radionuclides. The determined relation between activity levels of these two radionuclides is such that no correlation can be made.

CONCLUSION

Analyses of obtained results showed that ^{7}Be, ^{40}K and ^{137}Cs were present in all samples.

Average activity levels of ^{7}Be in Sokobanja moss collected in April 2012 are in agreement with the results of previous investigations. The average activity level of ^{40}K in Sokobanja moss in 2012 was 157 Bq/kg and has not changed significantly from the results of previous years. The average activity level of ^{137}Cs was 12.2 Bq/kg, and this is significantly reduced compared to the results of previous years, indicating that there was no new contamination with radiocesium on these localities, but a certain level of contamination is still present.

The ratio between activity levels of ^{137}Cs and ^{40}K in investigated samples is such that no correlation of content can be made.

Constant monitoring of activity levels of radionuclides in bioindicators of environment pollution is necessary to enable evaluation of environment pollution.

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APPENDIX DISTRIBUTION OF FRESHWATER JELLYFISH (*CRASPEDACUSTA SOWERBYI LANKESTER*, 1880) IN SERBIA

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ABSTRACT

For the past 50 years in Serbia *Craspedacusta sowerbyi* was detected at five locations for the first time in early October 1958 in a pond near the Velika Morava. In the period 1993 to 2012 *Craspedacusta sowerbyi* was recorded at 13 sites, of which only the location of the lake, near Bela was measured three times. From a total of 13 localities dominated biotope lake at seven locations, followed by a 5 instream sites and one swamp biotope. Active *Craspedacusta sowerbyi* was from late June to mid-September, and most of the findings in August. Some sites appear during *Craspedacusta sowerbyi* The considerable activity and the number of shrimp and other zooplankton. Water temperature ranged from between 21-31^{0}C and pH showed a neutral to slightly alkaline reaction (7-8). These data complement the information on the prevalence *Craspedacusta sowerbyi* in Serbia.

Key words: *Craspedacusta sowerby*, distribution, Serbian.

INTRODUCTION

Phyllum Cnidaria is represented mainly marine organisms and has over 9000 species, of which only a few freshwater species. This filum includes three classes: *Hydrozoa, Scyphozoa* and *Anthozoa*. In the classes *Hydrozoa*, ordo *Hydroidea*, subordo *Limnohydroidae*, familia *Olindiidae* located in marine and brackish as well but to a much lesser extent freshwater species.

In the Balkans, and therefore in Serbia is known representative of a freshwater jellyfish called *Craspedacusta sowerbyi* Lankester, 1880 (syn.*Microhydra rydcri* (Potts), *Limnocodium victor*, *Limnocodium kawaii*, *Craspedacusta rayder*, *Microhydra germanica*,..) inhabiting the land water (rivers, lakes, ponds, swamps, canals, reservoirs quiet, gravel, and underground facilities in mines). (Krunic,et.al, 1990)

As Harry & Borm, (1981) states in the swimming pool, open areas with warm water and ponds. *Craspedacusta sowerbyi* established in most countries and on nearly every continent, but it still occurs sporadically and unpredictably from year to year. This jellyfish has a transparent or translucent body whitish or greenish in color and begins life as a small polyp, which lives in colonies attached to underwater vegetation, rocks, trees, stumps, etc..,Where they feed and reproduce asexually in spring and summer. Some of these sexuallyproduced offspring reproductive jellyfish. According Krunic,et.al,(1990) polyps are not tenctils, up to 2 mm, attached to the sediment surface. In the right conditions the nutrition side grows a budding new polyps develop, the less fortunate 3-7 polyps together.

At very low temperatures the lateral offset of the developing jellyfish. Jellyfish up to 2 cm in diameter *sowerbyi* and the two subumbreli developed gonads. Velum at rest hangs down parallel to manubriums. *Craspedacusta sowerbyi* a predator, usually hunting zooplancton daphnia and copepods. It hunts prey tentacles, which contain thousands of cells containing knidocistnes nematocists and use them to capture prey. When the tentacles touch careless shrimp they wrap around it and and inject a toxin that paralyzes him.

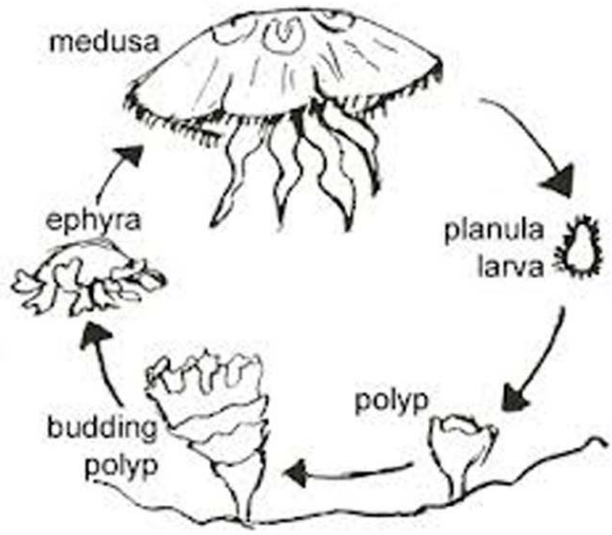

Figure.1. Development cycle *Craspedacusta*

Tentacles and then returns prey into the mouth, where digestion begins, and at the same aperture and expel waste products of digestion. In daily (diffuse) light *Craspedacusta sowerbyi* developing its normal activity: swimming the surface of the water, and goes back to the bottom. Daily an external factor that keeps this jellyfish in the active state, but it does not determine the direction of swimming. Before one could say that this jellyfish is heavily influenced by gravity, as it swim on its negative geotaxis shows up, and when it sinks to the bottom geotaktices behave positively, especially when sinking in the twisted position to perform contractions velum. It is characterized by its behavior according to the temperature. At a temperature of 19^{o}C, she made 72 contractions per minute, and at a temperature of 10-13^{o}C, its activity is reduced to a minimum that. reduced. If jellyfish which the rhythmic contractions rises to the surface of the water hits the gouts of an object or a leaf aquatic plants, it will react to contractions of the entire body in the form of balls sink to the bottom. In the wild such strong mechanical stimuli. Resulting fluctuation of water will cause sinking to the bottom of the entire population of jellyfish. (Grozdanić & Manojlovic, 1958) The purpose of this paper is to contribute to the current knowledge of the findings and distribution *Craspedacusta sowerbyi* in Serbia.

MATERIALS AND METHODS

During his stay on the ground where the presence of jellyfish were recorded by the standard data (date, location, biotopes, the number of individuals and some observations). From the physico-chemical parameters were recorded temperature and pH value of water. The determination was carried out according to the following literature: Krunić,et.al.,(1990), Harry&Borm,(1981), Didžiulis,V.(2006).

RESULTS AND DISCUSSION

According to Todorovic, et al, (2010) for the past 50 years *Craspedacusta sowerbyi* was detected at five locations:

- Velika Morava near Ćuprija
- Sava Lake near Belgrade
- Large reservoir sands near Zrenjanin
- Miloševo lake near Jagodina
- Šumarice lake near Kragujevac

For the first time in Serbia *Craspedacusta sowerbyi* was recorded in early October 1958 in a pond near the Velika Morava, where high school students in Čuprija found and collected 30-odd copies that were made in the Zoological Institute in Belgrade. (Grozdanić&Manojlović,1958)

Between 1993 and 2012 *Craspedacusta sowerbyi* was recorded at 13 sites, of which only the site lake near Bela Crkva was measured three times. Summary of sites on which is recorded *Craspedacusta sowerbyi* is given in the table 1 and the figure 1.

These data indicate that the activity was *Craspedacusta sowerbyi* from late June to mid-September, and most of the findings in the warmest period of the year and this is the month of August, which corresponds to the period from July to October, which stated Todorovic,et al, (2010). It must be noted that usually occurs *Craspedacusta sowerbyi* mass, these data indicate that the specimens were found a single or small groups, and the possible reasons for this are:-the room was on the ground near the end of its activities for which we know that usually does not last long or because of the large bodies of water were noted only individuals closer to the coast and those on the open water and the middle flow remained unnoticed and unrecorded

At 13 sites, lake biotopes is present in seven locations, followed by a 5 instream sites and one swamp biotope. In the case of SNR Zasavica Batar at the site it is a wetland biotope created after partitioning Batar river dam made by beavers, so that is one of the shallow, cold running water and less established pond with wetland and aquatic vegetation. In Petničko, Bošnjačko and Manđeloško lake but at the mouth of the river Poreč and on the Batar at the time of occurrence *Craspedacusta sowerbyi* observed an increased activity and number of shrimp, especially cyclopes. Water temperature ranged from between 21-31 ^{o}C and pH showed a neutral to slightly alcalies reaction (7-8). The water temperature values differ somewhat from those cited by Todorovic,etal,(2010) but it is still within the optimal values for this species. Located *Craspedacusta sowerbyi* to instream was generally calmer parts of the river flow at inlets and bays. It must be noted that some sites, such as beef, Ribničkog and Bošnjačkog lakes, then rivers Bagrda and Jezava visited only once so we do not know whether there were jellyfish in the coming years or not. Since the data of earlier investigators, and these data indicate that *Craspedacusta sowerbyi* occurs most often in the summer when the water is warmer than initiate the occurrence of sexual reproduction in meduses generation, and water rich in zooplancton gives them a good nutritional basis.

Table 1. Summary of sites on which is recorded *Craspedacusta sowerbyi* in Serbia for the period 1993. to 2012.

Ordinal number	Locality	Date	Number of indivi-duals	Chemical parameters of the water		Remark
				t^{o}C	pH	
1.	Petnička lake	25.06 1993	M	26	8,4	C
2.	Lake Ćelije of the Suvaja	17.08 1993	3	27	8,8	
3.	Goveđe jezero on Zlatar	23.07 1994	3	24	7,4	
4.	Jezava River near Smederevo	09.08 1994	4	23	7,7	
5.	Ribničko lake near Čajetina	29.06 1995	M	24	7,8	
6.	Bagrdanska gorge of the Vojska	18.08 1995	6	24	8,4	
7.	Danube near Apatin	13.07 1995	5	25	7,8	
	Bay Motel on the Danube near Apatin	30.07 1998	10			O[1]
8.	Bovan lake near the village of Bovan	24.08 1996	10	27	8,6	
9.	Manđeloško lake on Mount Fruska	14.09 2000	20	22	7,8	
10.	Bošnjac lake of the Bošnjace	25.06 2002	1	21	8,0	
11.	Lake near Bele Crkve	17.08 2004	6	29	8,2	
		27.08 2005	3	31	8,6	
		14.09 2009	M			O[2]
12.	Batar in places Radenkovic in reserve Zasavica	11.07 2005	1	28	7,8	C
13.	Porec river estuary of the Mosna	25.08 2008	3	26	8,2	

Note: M- mass appeared; C- The sample in the collection; O- oral statement [1] (Perić,R)[, 2] (Stević,R)

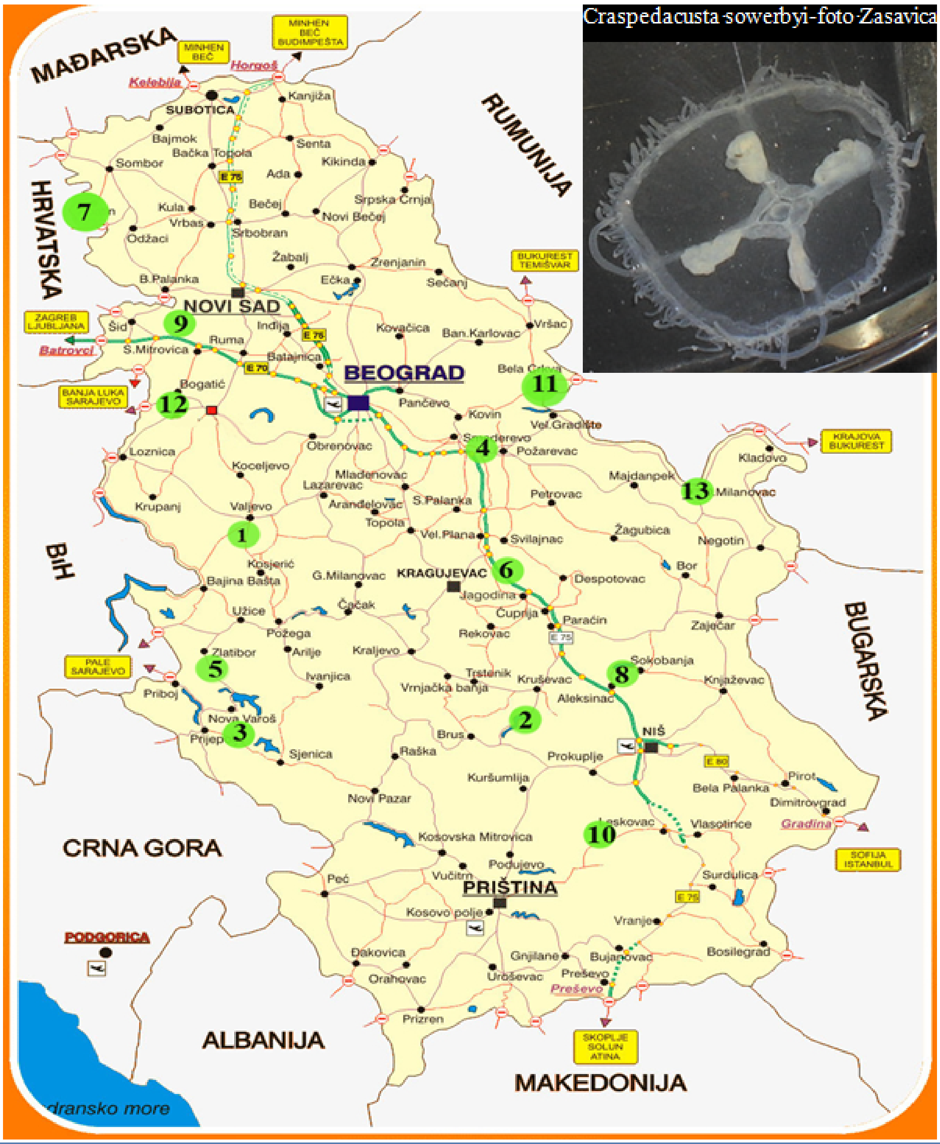

Figure 1. Overview of sites on which is recorded *Craspedacusta sowerbyi* in Serbia for the period 1993. to 2012.

Note: ordinal numbers in the table correspond to the numbers on the map

CONCLUSION

For the past 50 years in Serbia *Craspedacusta sowerbyi* was detected at five locations for the first time in early October 1958 in a pond near the Velika Morava. Between 1993 and 2012 *Craspedacusta sowerbyi* was recorded at 13 sites, of which only the site lake near Bela Crkva was measured three times.. At 13 localities lake biotops is present in seven locations, followed by a 5 instream sites and one swamp biotops. Active *Craspedacusta sowerbyi* was from late June to mid-September, and most of the findings in August. Some sites appear during *Craspedacusta sowerbyi* observed increased activity and number of shrimp and other zooplanctons. Water temperature ranged from between 21-31^{o}C and pH showed a neutral to slightly alcalies reaction (7-8). These data complement the information on the prevalence *Craspedacusta sowerbyi* in Serbia.

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A REVIEW OF BATS IN THE BROADER AREA OF VRSAC MOUNTAINS AND STRAZA

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ABSTRACT

Bats have long been postulated to play important role in preservation of the ecosystems they inhabit. On the territory of Vršac Mountains and Straža 18 bat species have been recorded. In order to introduce the current state of bat's presence in these areas it was used existing expert research. Also, several roost inspections were performed with the goal of monitoring.

Key words: Bats, Vršac Mountains, Straža.

INTRODUCTION

Monitoring bats, as reliable indicators of the ecological conditions, is integral part of management of protected areas. In Vršac Municipality there are two important protected areas, Vršac Mountains and forests in village Straža, where are bats monitored.

The Vršac Mountains, Landscape of Exceptional Features is located in the Banat District of southeast Vojvodina. A total of 4408 ha are under general protection, while 190 ha enjoy the highest degree of protection. Oak and linden trees dominate this mostly forested landscape. There are a total of 1016 plant species registered here, of which 23 are protected species and two are included on the European Red List of Endangered Species. Vršac Mountains are abundant with wildlife, including birds, amphibians, reptiles, rodents and mammals.[1]

The Monument of Nature "Straža" is situated near the regional road Vršac-Bela Crkva, in the village Straža. The basic value is preserved English oak, field ash and hornbeam forests surrounded by remains of valley meadows and steppe pastures. Nearby the forest, on the right side of the Karaš River there was built an old mill. The fundamental value of the fauna of this region is ground squirrel, which is highly endangered because of replacement of steppe habitats with arable land.[2]

Serbia had ratified the following International conventions and agreements related to bat conservation[3]:

- Convention on Wetlands of International Importance especially as Waterfowl Habitat;
- Convention on the Biological Diversity;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora.

MATERIAL AND METHODS

In order to monitor bats species in the region of two protected areas, a survey of existing studies was conducted. Methods and techniques which were applied in the aforementioned explorations were: inspections of roosts, visual monitoring, marking, ultra sound audio-detection, both stationary in census points and by moving along transects.

RESULTS AND DISCUSSION

In habitats in region of Vršac Mountains and Straža, 18 species of bats have been identified: Rhinolophus ferrumequinum (Schreber, 1774), Myotis emarginatus (Geoffroy, 1806), Myotis nattereri (Kuhl, 1817), Myotis daubentonii (Kuhl, 1817), Myotis dasycneme (Boie, 1825), Myotis mystacinus (Kuhl, 1817), Myotis myotis (Borkhausen, 1797), Myotis blythii (Tomes, 1857), Myotis brandtii (Eversmann, 1845), Barbastella barbastellus (Schreber, 1774), Pipistrellus kuhlii (Kuhl, 1817), Pipistrellus nathusii (Keyserling and Blasius, 1839), Pipistrellus pipistrellus, (Schreber, 1774), Nyctalus leisleri (Kuhl, 1817), Nyctalus noctula (Schreber, 1774), Vespertilio murinus (Linnaeus, 1758), Eptesicus serotinus (Schreber, 1774) and Plecotus austriacus (Fisher, 1829)[4]

Figure 1. *Rhinolophus ferrumequinum* in the ruins of an old watchtower at the peak of Vrširor in Vršac Mountains (photo: Vučanović, M. 2010)

Rhinolophus ferrumequinum (Schreber, 1774) - greater horseshoe bat is a widely distributed and common species in Serbia[5]. Five species of Rhinolophus occur in Europe and all are included in The 1996 IUCN Red List of Threatened Animals. Like other temperate-zone bats they show typical insectivorous dentition.[6] In September of 2010th a few individuals were found in disused watchtower in Vršac Mountains, near the borderline with Romania.

Myotis emarginatus (Geoffroy, 1806) - Geoffroy's bat is relatively common and widespread species, but not particularly abundant in Serbia.[5] Geoffroy's bat inhabits an area with a high diversity of available habitat types. In the attic of the building in natural landmark "Straža" the large colony was monitored last time in summer of 2007th. This colony has been formed from more than 500 individuals.

Myotis nattereri (Kuhl, 1817) – Natterer's Bat was rarely found in Serbia.[5] During 2012th in region near village Straža this species was determined by the ultrasound audio-detection. Also, in August 25th of same year, one specimen was captured by nets.[4]

Myotis daubentonii (Kuhl, 1817) – Daubenton's Bat is widely distributed species, mainly near water bodies. It is highly dependent on aquatic insects for food, hunting over large water bodies and taking prey from the surface waters[7]. This species have been detected in broader area of river Karaš.

Myotis dasycneme (Boie, 1825) – Pond Bat has been insufficiently explored in Serbia, primarily because of the specific way of life and the preference of open water spaces[5]. From March to November 2012th in explored area was detected 3 individuals[4].

Myotis mystacinus (Kuhl, 1817) - Whiskered Bat is relatively frequent, particularly in suitable woodland regions[5]. The region in vicinity of Natural Monument "Straža" was recognized as the hunting area of this species, where it was captured by nets[4].

Myotis myotis (Borkhausen, 1797) - Greater Mouse-eared Bat is one of the most abundant and widespread cave-dwelling bat species in Serbia. Throughout the year it can be found in natural and artificial underground shelters, churches and buildings[5]. Presence of this species in the area of Vršac Mountains and village "Straža" are based upon information provided by previous researches.

Myotis blythii (Tomes, 1857) - Lesser Mouse-eared Bat mostly inhabits natural underground shelters – caves[5]. It forages in scrub and grassland habitats, including farmland and gardens. Identification of this species has been performed by several inspections of roosts.

Myotis brandtii (Eversmann, 1845) - Brandt's Bat is recently found in Serbia for the first time[5]. Due to the uncertainty in identification of these species: Myotis myotis, Myotis brandthii and Plecotus species, by analysis of echolocation calls it is supposed their presence in research area, during the one year monitoring, particularly because the fact that 68 individuals were detected[4].

Barbastella barbastellus (Schreber, 1774) - Barbastelle is relatively rare and scarce species with roosts within altitudinal ranges from 70 to 1000 m. For the first time in 2010th, both the hunting areas and moving corridors for this species was registered in this region[4].

Pipistrellus kuhlii (Kuhl, 1817) - Kuhl's Pipistrelle forages over variety of habitats, including agricultural and urban areas (including around street lights). Summer maternity colonies are located in crevices in buildings. Winter sites include rock crevices and cellars[8]. This is the most abundant species in researched area, what have been concluded by counting the roosts and by the ultra sound audio-detection.

Pipistrellus nathusii (Keyserling and Blasius, 1839) - Nathusius' Pipistrelle was often recorded during summer and in transitory periods[5]. Its populations are promoted by foraging habitats near woodland, wetlands and open parklands.

Pipistrellus pipistrellus (Schreber, 1774) – Common Pipistrelle is a common and widespread species, but it's evident a lack of information on its biology and ecology in Serbia.[5] Foraging sites have been recorded by ultrasound detectors in whole area.

Nyctalus leisleri (Kuhl, 1817) – Leisler's Bat is rare, although it was recorded in a broader area of Vršac Mountains and village "Straža".

Nyctalus noctula (Schreber, 1774) – Noctule is widespread and abundant. Hibernating colonies were found in cracks and cavities in buildings and bridges, hollow-trees and in fissures in rocks at cave entrances[5]. This is another species which was recorded in great number during the monitoring.

Vespertilio murinus (Linnaeus, 1758) – Particoloured Bat was first time recorded in this area in 2010th by using the ultrasound technique[4]. It forages in open areas over various habitat types (forest, semi-desert, urban, steppe, agricultural land). It feeds on moths and beetles[10].

Eptesicus serotinus (Schreber, 1774) – Serotine has been found throughout Serbia, in a variety of habitats such as forested regions, hedgerows, pastures, gardens…. It feeds on larger beetles, moths and flies[9]. In order to assess environmental impact of planned wind farm in this area it has been recorded nearly 700 flybys of this species[4].

Figure 2. Biologist Milan Paunović is holding in his hands the Geoffroy's bat in the forest near the village Straža (photo: Vučanović M.2007)

Figure 3. Myotis emarginatus in the attic of the building in village Straža. (photo: Vučanović M.2007)

CONCLUSION

The majority of bats are insectivorous, and play an important role in the control of insect. Also, their diversity reflects the status of plant population. Bats are important indicators of a healthy environment which can be used in monitoring of protected areas. Bat populations appear to be declining almost everywhere in the Europe, presumably in response to a series of environmental threats, many of which are induced by humans. There is great number of rare and endangered species of bats forages in broader area of Vršac Mountains and forests in Straža. We must provide the protection of bats, because their future is directly linked to quality of life and environment of inhabitants of the town and surrounding villages.

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INFLUENCE OF CHANGED CLIMATE CONDITIONS ON THE ADAPTABILITY OF 'PLENIFLORA' TYPE POMEGRANATE IN BELGRADE

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ABSTRACT

The paper contains analysis results of taxa pomegranate cultivar 'Pleniflora' adaptability in changed climate condition parameters in Belgrade. We analysed 77 *Punica granatum* 'Pleniflora' specimens grown in public and private green spaces at Banovo Brdo. Absolute height, vitality, decorative value, and flowering phenophase were noted and analysed parameters. General look, resistance to climate change, functionality, and visual-esthetical value of the surveyed specimens show good phenotypic and biological characteristics, which is confirmed by this research. The study was done during five consecutive years and it confirmed that all specimens flower bountifully, which is why this taxa can be recommended for a wider use in landscaping and horticulture practice in changed conditions of temperate-continental climate.

Key words: *Punica granatum* L., allochthonous dendroflora, cultivar, introduction.

INTRODUCTION

Examination of allochthonous dendroflora, by investigating biological, physiological and esthetical characteristics, is of high importance for implementation in landscaping and horticulture practice, especially in last decades during which global warming and significant climate changes happened. Increase in average annual air temperature in Belgrade has created conditions similar to the ones in which thermophile species thrive in. These changes have influenced successful adjustment of many Mediterranean floral element exotic plants, and pomegranate is one of them. Researches done in Turkey have confirmed that climate change also has important influence on chemical contents and fruit quality other than gene pool, fruits' ripeness, location, and soil type (Halilova & Yildiz, 2009).

Punica granatum L. (Fam. *Punicaceae* Link.) is monoecious deciduous species (height raging between 2 and 4 m) with wide ramified oblong treetop that has vertical wriggly branches (Ocokoljić et al., 2003). The name of the species comes from Latin word *puniceus*, which means bright red indicating the colour of the flower and the fruit. *Punica granatum* flowers during summer, in June and July. The flowers are singly or 2 to 4 appear together. Size of red-orange flowers is as much as 3 cm. The fruit is the shape of a berry with leathery dark red shell. The fruits are rip in autumn, and stay on branches during winter as well (Ocokoljić et al., 2003). Extract from all parts of pomegranate has positive therapeutic characteristics, thanks to the antioxidants (Jurenka, 2008).

Pomegranate is ancient and mystical plant that originated in West and South Asia (Iran, Northern India, and Himalayas). As a notable fruit culture pomegranate was cultivated in Asia, whole Mediterranean region, as well as in North and South America. Pomegranate is one of Mediterranean floral elements furthering itself the most from the sea. In Nepal, the plant grows at altitudes between 700 and 2700m (Adhikari & Kumar Adhikari, 2010), and it is often seen in very cold parts of Turkey (Muradoglu et al., 2006). Even though it is a thermophile species it is noted in large numbers in areas with temperate-continental and continental climate.

In South, West, and East Asia, as well as in Mediterranean countries pomegranate fructifies successfully and is used in fruit growing. However, in our studied region, ornamental sterile cultivars, which do not form fruit, are grown. There are over 800 different pomegranate cultivars (Behzadi Shahrbabaki, 1998). On the researched location 'Pleniflora' type cultivar is grown. We noted three cultivars: 'Judai Zakuro' – scarlet red flowers with plentiful petals, 'Alba Plena' – plentiful white petals, and 'Legrellei' – full variegated flowers (double red petals with white border).

In order to confirm hypothesis of successful adaptability of 'Pleniflora' - Mediterranean floral element *Punica granatum* type in changed climate conditions of Belgrade's urban environment, vitality and flowering phenophase studies are very important.

MATERIAL AND METHOD

Cultivated pomegranate specimens, a floristic material at Banovo Brdo (South West of Belgrade), were included in this research. The researching area is located in Moesian phytogeographical province where predominant floral elements are Pontic-Central Asian and Sub-Mediterranean. Average altitude of Banovo Brdo is 159 m. Soil is changed and degraded significantly under the influence of anthropogenic factors. Types of soil on the researched area are degraded chernozem, eutric cambisol, and alluvial deposit. In native habitat, pomegranate grows on alkaline soils (Orwa et al., 2009). Moreover the plant appears in tropical and subtropical climates, while the climate of the researched area is temperate continental with worm summers and cold winters. Climate information for Belgrade is based on meteorological data from Republic Hydro-meteorological Service of Serbia for the period from year 2007 until 2011. Mean yearly air temperature was 13.5 ˚C, which is 6.5 ˚C lower than in natural habitat of pomegranate. The coldest month in Belgrade for a five-year period was January with 2.5 ˚C, while the hottest month was July. Pomegranate flowers in June and July; mean air temperatures for those months were 22.0 and 24.2˚C. From year 2007 until year 2011 on average there were 2250.8 sun hours in Belgrade. The end of spring and the beginning of summer bring most precipitation in Belgrade. Yearly average for precipitation in Belgrade for five years (2007-2011) was 718.9 mm, while average yearly relative humidity was 66.7%. Frequent droughts and rare precipitations are usual environmental conditions in countries where pomegranate grows naturally.

The field research covered: identifying *Punica granatum* L. taxa on green spaces at Banovo Brdo, measuring height with a tape, while decorative value, vitality and flowering abundance were rated visually on a scale ranging from 1 to 5, where 1 is a specimen without esthetical value, with low vitality and minimal flowering abundance, and 5 is a specimen with exceptional esthetical qualities, excellent vitality and maximal flowering abundance. Phenological research of flowering was also conducted. We noted beginning of flowering, full bloom, and end of flowering dates, as well as flowering length for a five-year period (2007-2011).

RESULTS AND DISCUSSION

During the research of green spaces at Banovo Brdo in Belgrade 77 *Punica granatum* 'Pleniflora' taxa specimens were recorded, which grow as a tree or as a bush. There were 84.4 % of bushy specimens, while there were 15.6 % of the ones that grow as a tree. Majority of analysed pomegranate specimens were grown on private green spaces (77.9 %), while smaller number of specimens was recorded on public green spaces (22.1 %).

Table 1. demonstrates values of statistical parameters as indicators of variability of analysed characteristics. Absolute height, grades for vitality, decorative value and flowering phenophase abundance have a significant variable features between specimens.

Table 1. Analysed parameters for 77 pomegranate specimens at Banovo Brdo in Belgrade

Parameter / Specimen	Total Number	$\bar{x}$ absolute height (m)	$\bar{x}$ vitality (1-5)	$\bar{x}$ decorative value (1-5)	$\bar{x}$ flowering abundance (1-5)
Tree	**12**	**1,8**	**4.6**	**4.1**	**4.3**
Bush	**65**	**2.4**	**4.5**	**3.9**	**4.3**

Punica granatum 'Pleniflora' in the researched area had an average height of 2.3 m. The lowest height was 0.5 m, and the highest was 5 m. Recorded heights show us that pomegranate in fact exceeds 4 m, the heights that are mentioned for this species in the literature (Ocokoljić *et al.*, 2003). No wild specimen of pomegranate was recorded in the field. Cultivars of pomegranate were marked on public green spaces, but they were not planned to be there by "JKP Zelenilo".

Average grades of vitality and decorative value are 4.5 and 3.9 respectively; while minimal and maximal grades are 3 and 5, and 2 and 5, respectively. None of the specimens were graded with 1 (neither vitality nor decorative values), which show very good adaptability of pomegranate on green spaces at Banovo Brdo. These very good average grades show us that pomegranate has adapted to temperate continental clime conditions of Belgrade. Pomegranate specimens with bigger vitality grades were the ones recorded in private yards. Average grades for vitality of private yards (4.1) were lower than the grades for public green spaces (4.8). Tenant questionnaire of surrounding buildings confirmed this, as the owners care intensively of their open green space. Average grade for decorative values of specimens, which grow in private gardens, is somewhat lower than average grade of specimens, which are grown on public green spaces (3.9:4.0). Average grade for vitality of bushes and trees are 4.5 and 4.6 while average grade of decorative values of bushes is 3.9 and 4.1 for trees.

Flowering depends on light and temperature, while pollination depends on air humidity and precipitation. Adhikari & Kumar Adhikari (2010) recorded period, date, and lasting of pomegranate flowering in Kathmandu in Nepal. They determined that 20 days are necessary for full bloom, from a bud to a mature - open flower. These authors also said that first buds were opening around April 24th, full blooming was happening around April 30th, and flowers were shading off around May 10th. Average dates were recorded for three phenophases: beginning of flowering – May 18th, full flowering May 24th, and finishing of the flowering August 24th, in Belgrade during five years (2007-2011). Length of flowering was 10 to 12 weeks and sometimes longer, depending of geographical situation, in Tunisia (Mars, 2000). Average lasting of bloom at Banovo Brdo was 98 days (2007-2011), which is almost 14 weeks, due to high air temperature in summer period. Flowering abundance was very good and had average grade of 4.3 in researched area. Both pomegranate life forms, bushes and trees, had lush flowering abundance (4.3). Specimens on public spaces had the same average grade of flowering abundance, as did the private yards (4.3).

CONCLUSION

Through analysis of green spaces at Banovo Brdo 77 specimens of *Punica granatum* 'Pleniflora' were recorded. Majority of these specimens (77.9 %) were grown on private green spaces, and only 22.1 % was grown on public green spaces.

On the basis of the observation of reached heights of pomegranate on green spaces at Banovo Brdo it was determined that pomegranate in Belgrade reaches maximal heights which the species reaches in natural habitat, and sometimes even exceed it. Through comparative grade analysis of vitality of all the specimens we determined very high average grade of 4.5 that demonstrates good adaptability of pomegranate in environmental conditions of researched area. Relative analysis of decorative values' grades of all the specimens showed somewhat lower average grade in comparison to vitality grades (3.9). Average grade of flower abundance is 4.3. Specimens, which were grown on private green spaces, had same grades for flowering abundance as specimens on public green spaces. It has been noticed that grades of vitality and decorative values of specimens in private yards were somewhat lower than grades of specimens on public green spaces.

The research has confirmed that large number of specimens have lush flowering abundance, which shows successful acclimatization and adaptability to changed conditions in temperate continental climate. Superior phenotypic and biological characteristics of pomegranate cultivars are confirmed by good general appearance, resistance to diseases and pests, functionality, and esthetical value. Appearance of abundant and long flowering in conditions of surveyed area during the summer has special significance, because small number of plants are flowering during that period. This characteristic can recommend pomegranate and its cultivars for a wider usage in Landscape Architecture and Horticulture practice in changed conditions of temperate continental climate. Crops with a specific purpose can be formed on protected areas for pharmaceutical industry need.

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Rosa banksiae Ait. – NEW SPECIES IN BELGRADE DENDROFLORA

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ABSTRACT

The introduction of ornamental, especially the decorative flowering exotic plants, enriches tree diversity of Serbia, which has a special importance in practice of landscape architecture and horticulture. Lady Banks' Rose was recorded and analysed in Belgrade, which completes floristic overview of Serbian allochthonous dendroflora. Statistical analysis of morphometric characteristics as well as vitality and decorative values of Lady Banks' Rose, at two different locations, confirmed that analysed specimens could be basic material for synthetic breeding and cultivating roses.

Key words: Lady Banks' Rose, allochthonous species, vitality, acclimatization .

INTRODUCTION

Until the second half of the 20th century, around 500 new taxa were introduced in Serbia (other than a large number of already present autochthonous plants) purposely or accidentally by human factors (Jovanović, 2000). In the first decade of 21st century, and later, intensive expansion of some plants is recorded outside of their natural habitat borders; in the same period we noted the appearance of *Rose banksiae* Ait. in Belgrade for the first time. Lady Banks' Rose is evergreen thornless climber, originating from central and western China, where it grows at altitudes between 500 to 2200 m. This species was introduced to Europe by gardener William Kerr, who named this species Lady Banks' Rose, after the wife of Sir Banks. Sir Josef Banks was an English explorer, naturalist, plant collector and William Kerr’s patron. He also financed Kerr’s eight-year research in China (Šilić, 1990; Brittain, 2006).

This species abundantly flourishes in May and June (rarely from April till August). The colours of flowers, that have fragrance like violets, are yellow or white. The most common varieties are *R. banksiae* var. *normalis* – with small, simple white flowers and *R. banksiae* var. *banksiae* (syn. *R. banksiae* 'Alba Plena') – with double white flowers. The colours and the number of petals differentiate the cultivars. The most widespread cultivars are 'Lutea' with double yellow flowers and 'Lutescens' with simple pale yellow flowers (Šilić, 1990). *Rosa banksiae* Ait. is not resistant to low temperatures, because of this it is frequent in Mediterranean gardens (mediterranean and sub-mediterranean condition). The most famous Lady Banks' Rose old age specimens of the region can be found in Trsteno in Croatia (Šilić, 1990).

The recording of Lady Banks' Rose at Banovo Brdo region in Belgrade, for the first time in the year 2011, is very significant, because of thermophilic nature of this species. During a three-year observation, it was determined that this evergreen climber became semi-evergreen in this area, adapting to environmental conditions. Therefore, this paper analyses morphometric characteristics, adaptability and vitality of Lady Banks' Rose in changed temperate continental climate condition.

MATERIAL AND METHOD

The specimens of Lady Banks' Rose were researched in private yards at two locations at Banovo Brdo in Belgrade. The specimen number 1 was grown in 19 Pere Todorović Street, and the specimen number 2 was grown in 27 Steve Todorović Street. Both studied specimens are of a similar age, around 8 years.

The field research covered recording specimens of *Rosa banksiae* Ait. on green spaces at Banovo Brdo. Analysed morphometric characteristics are: length of the stem (done by tape measuring), length and width of leaflets and flower diameter (measured with a ruler). The parameters were statistically analysed (Table 1). The arithmetic mean ($\bar{x}$), the standard deviation (S), the coefficient of variation (V) and their errors ($S_{\bar{x}}$, S_S, V_V) were calculated. Decorative value, and vitality were rated on a scale ranging from 1 to 5, where 1 is a specimen without esthetical value and with low vitality, and 5 is a specimen with exceptional esthetical qualities and excellent vitality.

RESULTS AND DISCUSSION

About 400 species of wild roses belong to genus *Rosa* L. and they are spread only in the Northern Hemisphere. The exact number of rose cultivars is not known, but it is believed that there are around 20,000 (Vukićević, 1996). In Serbian flora, 21 species of rose are described and identified (Josifović, 1972), and Lady Banks' Rose is not mentioned in that list. The analysed specimens were grown at Banovo Brdo. The geological formations are limestone, clay and grainy clay in researched area. Both specimens grow on degraded chernozem soil type. According to Šilić (1990) Lady Banks' Rose is a fast-growing species, which tolerates drought and can grow on all types of soil, but it achieves best vitality on rich and well-drained soil. It demands full sun and sheltered position for abundant blooming. The specimen number 1 is positioned on altitude of 151 m. The length of its climbing stem is 5.2 m, and its width is 2.1 m (picture 1). While, the specimen number 2 is positioned on altitude of 173 m. The length of its climbing stem is 3.0 m, and its width is 1.2 m. The recorded heights show that both specimens of Lady Banks' Rose reached heights of 3 to 6 m (Šilić, 1990) that are mentioned for this species in the literature. No wild specimen of this species was recorded in the field.

Picture 1. The specimen number 1 of the species Rosa banksiae Ait., in Belgrade

The bark is rusty-brown and smooth, and it peels finely with the age (Šilić, 1990), which is verified by this research also. According to literature leaves are pinnate, compound and alternate. The leaves have 3 to 5 lance-shaped leaflets. The leaflets are 25-50 mm long and 10-30 mm wide. In the base leaflets are wide acute, while their tip is sharp and the edge is finely denticulate. The leaves are leathery and shiny. The upper surface of the leaf is dark green, the lower surface is dark green, and with hairs at the beginning of the middle vein. The average length and width of leaflets are determined with statistical analyses of two morphometric parameters of leaves (picture 2) for specimen number 1: 46.50 mm and 15.30 mm; and for specimen number 2: 47.75 mm and 16.65 mm (table 1). The identified values confirm that both specimens of Lady Banks' Rose at Banovo Brdo have same values for analysed characteristics, as it is mentioned in the literature for the species.

Picture 2. Leaves of Rosa banksiae Ait. – the specimen number 2

The flowers are bisexual, yellow or white, their diameter is 25 mm, and flowers are formed on the top of the branches as irregular corymb (Vukićević, 1996). The specimens at Banovo Brdo have double yellow flowers with the diameter of 20.60 mm (the specimen number 1) and 21.65 mm (the specimen number 2). The aggregate fruit (*hypanthium*) is orange or brown-blackish, and round with diameter 5-7 mm. Lady Banks' Rose propagates by seeds, but fruits are rarely formed so vegetative propagation by hardwood cuttings is recommended (Gu et al., 1811; Cheers, 2004). This analysis did not involve fruits, because the specimen number 1 did not form fruits, and the specimen number 2 was pruned after flowering (in this period the practice confirm that this type of maintaining improves flowering phenophase for the next growing season).

Through comparative grade analysis of vitality and decorative values for both specimens and parameters, we determined the highest grades 5, which show that this species has good adaptability in environmental conditions of researched area. Based on the presented data, similarity of both specimens is evident. Both specimens confirm successful acclimatisation to changed temperate continental climate of Belgrade. The age of the specimens (8 years) prove this hypothesis.

Table 1. Morphometric statistical features of Lady Banks' Rose, in Belgrade

The researched location	$\bar{x} \pm S_{\bar{x}}$	$S \pm S_S$	$V \pm S_V$
(a) the length of leaflets (mm)			
Pere Todorović 19	46,50 ± 0,93	9,87 ± 4,65	21,22 ± 2,12
Steve Todorović 27	47,75 ± 0,95	10,90 ± 4,77	22,83 ± 2,28
(b) the width of leaflets (mm)			
Pere Todorović 19	15,30 ± 0,31	4,35 ± 1,53	28,43 ± 2,84
Steve Todorović 27	16,65 ± 0,33	4,74 ± 1,66	28,47 ± 2,85
(c) the diameter of flowers (mm)			
Pere Todorović 19	20,60 ± 0,41	3,67 ± 2,06	17,82 ± 1,78
Steve Todorović 27	21,65 ± 0,43	2,80 ± 2,16	12,93 ± 1,29

CONCLUSION

The breeding of the plants (outside their natural range) depends on the physiology of the species and environmental conditions in which survival is possible. Two exotic specimens of *Rosa banksiae* Ait. were identified at Banovo Brdo in Belgrade. The age of the recorded specimens was 8 years. The highest grades (5) for vitality and decorative values verify good adaptability of the specimens. Giving that analysed values of morfometric parameters for both specimens of Lady Banks' Rose at Banovo Brdo are within the limits found in the literature, the research confirms adaptability of this species in changed conditions of temperate continental climate. Nevertheless, it is asserted that this evergreen climber changed its nature and become semi-evergreen.

The analysed specimens of *Rosa banksiae* Ait. are marked out as superior, i.e. they are recommended as a base material for synthetic breeding and production of roses. The research proved that this species could have wider usage in landscape architecture practice in Belgrade. The dendroflora of Serbia is enriched with additional highly regarded, alien species, with Lady Banks' Rose and its successful acclimatisation.

Acknowledgement

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EARLY RESPONSE OF DIFFERENT *Medicago truncatula* GENOTYPES TO CADMIUM TOXICITY

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ABSTRACT

Accumulation of heavy metals in the environment and agricultural soils represents an increasing global problem. The main strategy in reducing harmful effect of cadmium is to select plants tolerant to it. Objectives of this study were to analyze the Cd-ion uptake in the early stage of growth of a plant model *Medicago truncatula*.

The effect of Cd-stress was determined by root growth suppression in $CdCl_2$ solution. Data obtained showed a significant root growth inhibition effect for all six tested genotypes. However, some of them were less susceptible to Cd-treatment, which indicates promising perspectives in the future use of this plant.

Key words: Cadmium, *Medicago truncatula*, Root growth inhibition.

INTRODUCTION

The accumulation of pollutants in the environment, especially heavy metals, represents an increasing global problem today, since their uptake by plants, and entrance into the food chain, leads finally to human consumption, creating health problems. Among these heavy metals, cadmium (Cd) is of particular concern to nature and human health, due to its increasing occurrence in the environment[1], its accumulation in soil, water and thus in food chain in general, but also because of its well-known toxicity, at the cellular, organ and organisms levels[2]. It reduces the crop biomass production, by generating physiological and morphological alterations in plants (reduction of shoot and root growth and photosynthesis[3], chlorosis in leaves[4], etc.), while in mammals and humans it causes renal and liver dysfunction, anemia, cardiovascular problems and even cancer[5].

Cadmium is considered to be one of the most frequently encountered heavy metals of environmental concern, because of its cumulative nature[6], since it has a high solubility and mobility in soils, thus making it easily available for soil-plant-animal transfers and bioaccumulation in biological systems[7]. It is naturally present in earth's crust and naturally occurring in soils, with estimations of its content to be 0.06-0.5 mg/kg[8]. However, most of its today's high concentrations in the environment come from anthropogenic sources, i.e. human activities such as mining, industry (surface coating, anti-corrosive pigment formulation, manufacture of Ni-Cd batteries, stabilization for polyvinylchloride plastics, production of barriers for nuclear fission), agriculture (phosphorous fertilizers and pesticides), and military activities[1,9].

To minimize the damage from exposure to nonessential (and potentially toxic) metal ions, plants have evolved many adaptive mechanisms to cope with heavy metal stress[1,2,10], two main strategies being "avoidance" (by which they protect from the toxic influence externally, preventing the ion uptake) and "tolerance" (by which they survive the effect of internal stress). This has been often considered as a criterion in selection of different plant genotypes for their introduction in contaminated areas. With the purpose of phytoremediation, and most importantly, phytoextraction (in which plants decontaminate soil through uptake of heavy metals into their aerial parts, making them easily removable from the site)[11], selection of tolerant, but highly accumulating genotypes, preferably with high biomass production is needed. On the other hand, for agronomical purposes, cultivars are not selected in a way to reduce the soil contamination, but rather those that are tolerant but do not accumulate metal ions, at least not in the eatable plant parts.

A genetic variation for tolerance to different heavy metals has been emphasized in various plant species. However, the attention of recent studies has been directed to leguminous plants, as they represent important crop species, with high protein content, but also with the ability to fix atmospheric nitrogen, through their symbiotic relationship with rhizobia bacteria and nitrogen fixing fungi, thus improving the soil quality. *Medicago truncatula*, commonly known as barrel medic, is an annual leguminous plant, closely related to many important legumes (pea, clover), and it shows a high genome similarity with alfalfa (*Medicago sativa*), a very commonly used agricultural specie. It is considered both as a forage crop, and an important model plant for investigating legume genetics, as it has a small genome size, a diploid structure (2n=16chromosomes), and a short seed to seed generation time (3-4 months)[12].

Objectives of this study were to analyze Cd toxicity to early stage of root growth, and to quantify the extent of genetic variation for Cd-tolerance in six different *M.truncatula* genotypes, with the overall goal of defining the future profitability of using these plant lines on Cd-contaminated soils.

MATERIAL AND METHODS

Two factors of Cd treatment (control and Cd-stress condition), and six different *M. truncatula* genotypes (A17, A20, F83005.5, DZA315.16, TN1.11 and TN1.21), with 5 seedlings per treatment, per genotype, per repetition (3 repetitions total), were used for phenotyping the response to Cd-toxicity and quantification of Cd-tolerance.

Seedlings were grown in controlled laboratory conditions, in square Petri dishes, at 25^0C/20^0C (day/night) temperatures, in dark for first 36 hours, after which with an 18h/6h (day/night) photoperiod for shoots, while roots were grown merely in dark. The effects of 100μM $CdCl_2$ solution were determined by root growth suppression in

Cd-stress condition, compared to its control (distilled water), after 144 hours of the treatment. The observed parameter was root length[13], which was measured with "ImageJ" software, from pictures taken on a 48h interval. Relative root growth rate was determined with ratio of root growth during the period of observation (from 0 to 144 hours) of Cd treatment, and growth of the same genotype, during same period, in control condition.

Differences in Cd-tolerance among genotypes and treatments were tested using "R software"[14]. All the results of the root length and root growth dynamics, for different repetitions, treatments and among all the genotypes, were subjected to analysis of variance (ANOVA).

RESULTS

Measurements of root lengths in control and Cd-stress conditions, for six *Medicago truncatula* genotypes (average for all the repetitions), are presented in Table 1. Percentage of root growth inhibition, obtained from root growth ratio in Cd-stress and control condition, is presented in Figure 1.

Table 1. Average root length from 0 to 6 dpt (days per treatment) in control and Cd-stress condition, for 6 M. truncatula genotypes

Average root length 6-0 dpt (mm)			
Genotype	**Control**	**Cd-stress**	**Cd/H_2O**
A17	25.3166	12.7974	**0.5055**
A20	17.2288	13.1190	**0.7615**
DZA315.16	35.3018	13.7460	**0.3894**
F83005.5	29.3110	8.8954	**0.3035**
TN1.11	34.4576	11.9942	**0.3481**
TN1.21	27.1580	9.3782	**0.3453**

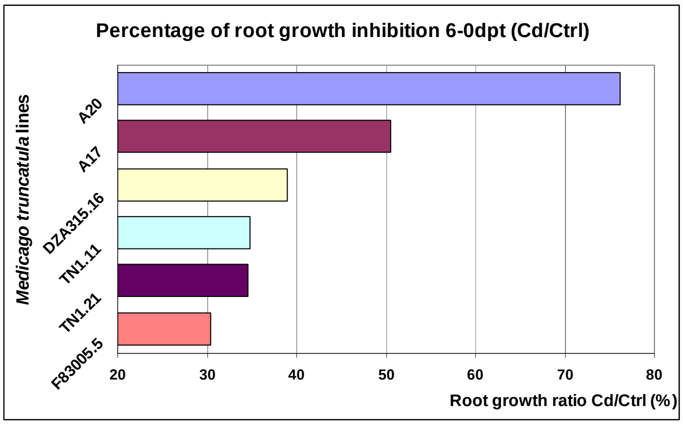

Figure 1. Percentage of root growth inhibition in Cd-stress condition, after 6 dpt

The ANOVA of the data obtained at 6 dpt (days per treatment), for root growth of six *M. truncatula* genotypes, showed a highly significant interaction (P=5.36e-05) between the treatment and the genotypes. Analysis of root growth dynamics showed that Cd-treatment had highly significant root growth inhibition effect, for all the genotypes. Comparison of the root growth inhibition in Cd-stress condition (compared to control), among six different genotypes, with A17 as a referent one, is presented by slope coefficients of root growth from 0 to 6 dpt, in both control and Cd-treatment (Table 2).

Same differences in root growth rates between 0 and 6 dpt, for two treatments and six genotypes, are presented graphically, with a fitted linear regression model (Figure 2).

Table 2. Root growth rate of 6 genotypes in control (Ctrl) and Cd-treatment (Cd), presented by slope coefficients, and with the significance level of test (P).
Slope ratios between Cd and control conditions are presented in the right column

Genotype	**Slope (Ctrl)**	P [A17]	**Slope (Cd)**	P [A17]	**Slope ratio** (Cd/Ctrl)
A17	2.9698		1.4938		**0.5030**
A20	2.3344	0.3964	1.7959	0.3762	**0.7693**
DZA315.16	3.9013	0.2139	1.3257	0.2994	**0.3398**
F83005.5	2.9499	0.9782	0.6514	0.4243	**0.2208**
TN1.11	3.7319	0.2806	1.1003	0.2474	**0.2948**
TN1.21	2.8860	0.9055	0.7925	0.5364	**0.2746**

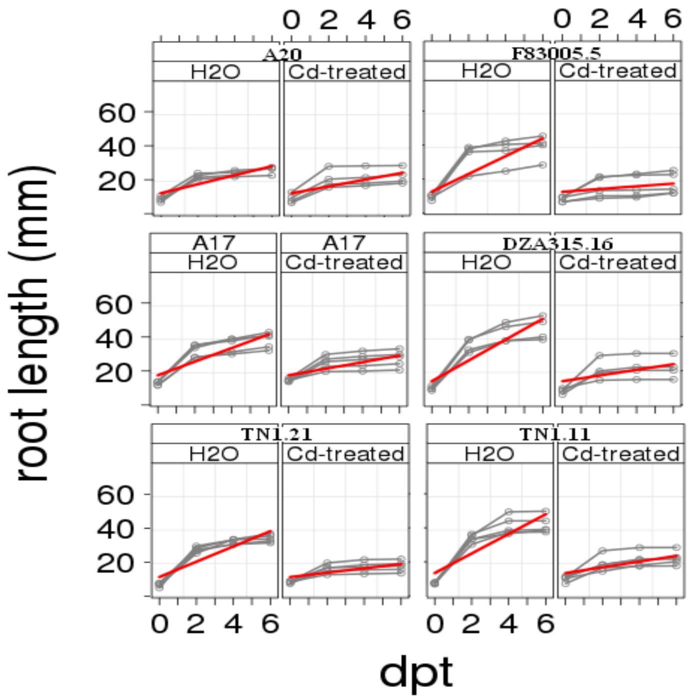

Figure 2. Fitted linear regression model, for root growth dynamics in control (left) and Cd-stress (right) conditions, compared for each of 6 genotypes

DISCUSSION

Inhibitory effects of the Cd-treatment on root growth are well known[13]. In this study, seedlings growth, of all genotypes, was very strongly negatively affected by the cadmium treatment (Table 1, Figure 1), i.e. the analysis of variance for root growth after 6 days of treatment, showed that the interaction between the treatment and different genotypes was very highly significant.

Based on comparison of root growth, of the same genotype, in control and Cd-stress conditions, our results have shown that among the tested genotypes, A20 was the least inhibited in Cd stress condition, i.e. the most resistant to Cd-contamination. On the other hand, F83005.5 was the most susceptible to Cd-contamination (Figure 1).

Results obtained by root growth rate measurements (Table 2, Figure 2) show a clear influence of Cd-treatment on root inhibition compared to control conditions. Calculated slope ratios show the actual inhibition rate in stress conditions. Genotypes with higher slope ratios show less difference between their growth in control (graphics on the left) and Cd-stress conditions (graphics on the right), which means that they are less affected by the Cd treatment, and thus show higher tolerance to Cd contamination.

The root growth and the cross-examination of slope ratios of six tested genotypes have also shown that genotypes that grow better than others in control conditions, i.e. without the contamination (TN1.11 for example, Table 1), tend to grow much less than others when found in stress conditions (TN1.11 is, in Cd-stress condition, much more affected than other genotypes). On the other hand, genotypes which grow much less than others in control (A20 and F83005.5 for example) tend to be less affected, compared to other genotypes, in Cd-stress conditions. These results can be easily explained with the "cost" and "trade-off" effect, of allocation of energy and resources in plants - either to their higher growth (production of biomass), or in their mechanisms of tolerance. However, further research is needed to determine the best criterion in selection among these genotypes, for their introduction in potentially Cd-contaminated areas.

CONCLUSIONS

The obtained results of this study showed only a limited tolerance of the investigated legume to cadmium, but a great difference among genotypes regarding their response to this stress. Among the investigated genotypes of *Medicago truncatula*, A20 and A17 were the most tolerant to Cd stress, while genotypes TN1.21 and F83005.5 showed the highest susceptibility, manifested through severe root growth inhibition. Furthermore, in comparison of each genotype's growth in stress and control conditions, genotype A20 showed less affectedness by Cd than others, even though it did not express the highest growth rate in the "stress-free" environment.

Although further research is needed in this field, all the presented results of the early expressed tolerance to cadmium in tested genotypes indicate promising perspectives in the use of the *Medicago truncatula* lines on cadmium contaminated soils. However, the impact of cadmium to other plant parts (not just small roots), and older plants (with possibly different mechanisms of defense), as well as the amount of cadmium accumulation (Cd-ion uptake and its compartmentalization within the plant), stay yet to be studied.

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ALIEN MACROINVERTEBRATE SPECIES OF THE VELIKA MORAVA RIVER

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ABSTRACT

The aim of this paper is to present the distribution of the non-indigenous macroinvertebrate species along the Velika Morava watercourse. The field research was carried out in April, August, October and November of 2010, at five sampling sites. During the investigation six non-native macroinvertebrate taxa were detected. Three species belong to Crustacea, two to Mollusca and one species to Annelida. Number of recorded alien species, their distribution and abundance indicate moderate level of biological invasions within investigated river. Presented results are the basis for further research in order to develop risk assessment procedures for aquatic invasions.

Key words: Velika Morava River, allochthonous macroinvertebrates, invasive taxa, SBC index, Serbia.

INTRODUCTION

The 175 km long Velika Morava River originates from Zapadna and Južna Morava Rivers which join near settlement Stalać in Western Serbia. With its catchment area of 37.444 km² and mean annual flow of 230 m^3s^{-1} (gauge station Ljubičevo, near the mouth of the Danube) [1], the Velika Morava is one of the major tributaries of the Danube in Serbia. Numerous settlements and intense agriculture characterizing the area through which the Velika Morava runs. The region is also under the influence of various pollution (organic, nutrient, as well as other substances originating from industry) and hydromorphological pressures (cutting of the meanders, shortening, channeling, gravel and sand extraction).

According to available data, investigation of the macroinvertebrate community was only a subject of a few studies [2, 3]. Allochthonous aquatic macroinvertebrate species of the Velika Morava River were studied only as a part of the comprehensive survey of the Danube River – Joint Danube Survey 2 [4].

MATERIAL AND METHODS

Material was collected in April, August, October and November of 2010 at five sampling sites (Figure 1), as follow:

- **Site VM 1** – Varvarin, elevation of 130 m above sea level, river kilometer 170, coordinates 43°43.022' N latitude and 21°23.053' E longitude. The substrate is predominantly composed of gravel and fine sediment, with small fractions of rocks.
- **Site VM 2** – Ćuprija, elevation of 135 m above sea level, river kilometer 115, coordinates 44°56.921' N latitude and 21°21.873' E longitude. The substrate is composed of fine sediment, small and large stones and sand.
- **Site VM 3** – Bagrdan, elevation of 102 m above sea level, river kilometer 109, coordinates 44°05.099' N latitude and 21°11.377' E longitude. The substrate is composed of fine sediment with a small fractions of rocks and gravel.
- **Site VM 4** – Markovac, elevation of 95 m above sea level, river kilometer 82, coordinates 44°13.485' N latitude and 21°09.215' E longitude. The substrate is equally composed of small and large stones, gravel and send.
- **Site VM 5** – Ljubičevo, elevation of 72 m above sea level, river kilometer 22, coordinates 44°35.182' N latitude and 21°7.748' E longitude. The substrate is predominantly composed of fine sediment with a small part of large stones.

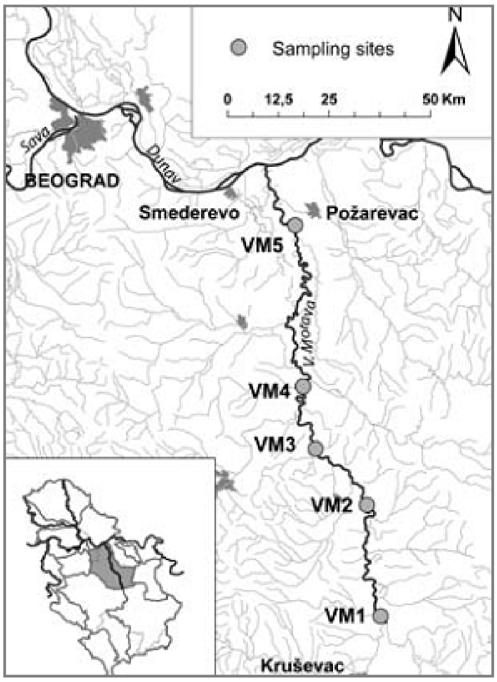

Figure 1. Sampling localities along the Velika Morava River

Benthic samples were taken by benthological hand net (mesh size 500 µm). Samples were collected from all available habitats represented with more than 5% of total habitats area on the sampling stretch (multi-habitat sampling procedure).

In order to evaluate the level of biological invasions of the Velika Morava River SBC and IBC indices were calculated. SBC index (Site-specific Biological Contamination Index) estimates biological contamination of the specific sites within Assessment Unit – AU [5]. It can be used for comparison of biological contamination of different localities and for estimation of Integrated Biological Contamination Index – IBC Index [5]. IBC Index is used to evaluate impact of alien species on entire AU and it integrates information on SBC Indices in the AU.

RESULTS AND DISCUSSION

During the investigation of the Velika Morava River, the presence of the 6 allochthonous macroinvertebrate species belonging to the 3 different groups has been recorded (Table 1). Alien species were detected at all five examined sites.

Table 1. Distribution of recorded alien macroinvertebrate species along the watercourse of the Velika Morava River

Taxa/Sampling site	VM 1	VM 2	VM 3	VM 4	VM 5
OLIGOCHAETA					
Branchiura sowerbyi Beddard, 1892	+	+	+	+	+
MOLLUSCA					
Corbicula fluminea (Müller, 1774)	+	+	+	+	+
Sinanodonta woodiana Lea, 1834	+	+	+	+	
CRUSTACEA					
Dikerogammarus villosus Schäferna, 1922					+
Corophium curvispinum (G. O. Sars, 1895)					+
Jarea istri Valkanov, 1936			+	+	

The most widespread species were *Branchiura sowerbyi* and *Corbicula fluminea* registered at all five sampling sites. Another frequent species, recorded at four localities, was the Chinese pond mussel *Sinanodonta woodiana*. The isopod crustacean *Jaera istri* was registered at two sampling sites, while amphipods *Dikerogammarus villosus* and *Corophium curvispinum* were detected at only one. Regarding quantity of the allochthonous species the most frequent species (*B. sowerbyi* and *C. fluminea*) were also the most abundant, while the rest of the species were significantly less represented.

Considering the distribution of alien species in relation to the bottom substrate it was expected that the most widespread species were those with sand and silt substrate preference (*B. sowerbyi* and *C. fluminea*). Also, the presence of amphipod species *Dikerogammarus villosus* and *Corophium curvispinum* only on the Ljubičevo site was expected having in mind that bottom is characterized by artificial stones, which provide suitable conditions for the development of the amphipod species.

According to our study, the highest SBC index (4) was obtained for the locality Ljubičevo in August and November, where three alien species with overall percentage participation of 60.19% and 71.12% respectively, were recorded. At sampling sites Ćuprija in August and Ljubičevo in April none of the allochthonous species were detected. For other localities SBC index varied from 1 to 3. Therefore, results of the IBC calculation presented in Table 2, reveal moderate biological contamination of the Velika Morava River.

Table 2. Calculated values of SBC and IBC indices.

index/month	April	August	October	November
IBC	**1**	**2**	**2**	**2**

Biological contamination: **0** – No, **1** – Bad, **2** – Moderate, **3** – High, **4** – Severe

Results presented in this study are the basis for future investigation having in mind that there are no previous reports concerning alien macroinvertebrate species of the Velika Morava River. Also, in the light of growing colonization of allochthonous macroinvertebrates already observed within Serbian waters [4, 6, 7, 8, 9] the importance of this investigation is greater due to the fact that biological contamination of inland waterways may lead to irreversible changes of fauna composition.

The evaluation of pressures and impacts from alien species on habitats and native communities must be considered within water management strategies in order to prevent, as much as possible, the further spread of unwanted invasive allochthonous species. In the near future should be expected that biocontamination will be a part of the standard methodology for water quality assessment.

Having in mind that samples were taken during only one year, this estimation should be considered only as preliminary. Future work should include continued monitoring in order to enable more accurate evaluation of biocontamination of the Velika Morava River.

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ECONOMICS OF NON-RENEWABLE RESOURCES AS A FACTOR PRESERVATION OF NATURAL VALUE

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ABSTRACT

The exploitation of non -renewable resources is a necessary precondition for the existence of today's civilization. The consequence is that mining activities as the holder of renewable resources exploatation management, in the context of economic and industrial growth, are inevitable. The standard response of this activities on these requirements is a rational management in the context of sustainable development. In order to achieve the requirements of the economy of the entire human community, the economy of non-renewable resources, in modern terms, is attracting much attention and is a discipline that has its place in the system of economic science.

Key words: ecological and economic systems, natural value, economy of non-renewable resources.

INTRODUCTION

Natural resources are all potentials, material or natural resources which are a prerequisite for the development of a country. With its production and consumption relations the economic system, using elements of the environment, produces final products that are anthropogenic link of economic and ecological relations, restoring the environment vast quantities of waste. In this way the economic system threatens the environment so that virtually smoothes its economic gain with environmental loss. However, such systems that are aimed to an unlimited development with limited resources, are unsustainable in long run. Starting from the assumption that natural resources can always be economically evaluated, transformed into products for final consumption and converted into money, Economics of natural resources is the science that studies alternative ways of use and skill of choosing the most productive combination of resource use. The fact that there is no possibility of recovery of non-renewable resources, this paper points to the importance of Economies of non-renewable resources from the point of optimum exploitation.

NATURAL ENVIRONMENT AS AN ECOLOGICAL AND ECONOMIC SYSTEM

Modern industry is necessarily viewed as a complex ecological-economic system. The field study of ecology are environmental systems, and ecological systems are based on natural elements of the environment. The two major subsystems are observed in the structure of such ecological-economic system: the economy and natural environment (ecology). The modern scientific understanding of the economic system function is related to the range of economic categorical definitions that are theoretically based and derived from the notion of the economy [1]. The natural environment is the totality of natural resources and conditions that are directly related to human society. These subsystems are part of so called ecospfere or biosphere.

Natural resources are all potentials, material or natural resources that can be used by man and are a prerequisite for the development of industry of a country. By its production and consumption relations, the economic system, using elements of the environment, produces final products that are anthropogenic link between economic and ecological relations, restoring the environment with vast quantities of waste [2]. In this way, the economic system threatens the environment to such an extent that virtually equals economic gain with environmental loss. Bearing this in mind, ecology has become a problem of most industries and the subject of economic theory and practice. This means that a portion of profit must be invested in environmental protection. So, today, there are three factors of production: capital, labor and environment. As long as the profit is higher than the production, higher than the cost of ecology, such growth can be considered justified [3]. One feature of the modern world is the existence of unclear demarcation between natural resources and environmental resources. Many resources of mineral extraction processes or deforestation has a direct impact on environmental quality and vice versa, there are many cases in which the degradation and / or environmental pollution affects the extraction process resources. Water pollution reduces the effects of the process of supplementing supplies of some natural resources, and air pollution reduces yields in agriculture. Some elements of the natural environment, such as wildlife, can be considered as a natural resource as well as an environmental attribute [4]. If, however, we consider the postulates of current system of trade economics and definitions of competitiveness, and compare them with the principles of sustainable development, we observe that they are contradictory. The former has the basic rule: making as many products and services as possible at competitive prices and quality, regadless the natural resources, since what is important is to keep increasing their number. With the strategy of sustainable development, it is limited the use of the natural sources, it is required the reduction and elimination of waste, as well as it means transition from non-renewable to renewable resources. Since, in economics, we have to rely on limited resources, the products friendly to the environment and large investments in the environment, it requires redefinition of the economisc postulates and competitiveness [5].

Heavily influenced by the ecological approach, modern economic theory expands the field of nature discussion on the sources of supply of natural resources, ecosystems, natural beauty, and are subject to institutional regulation, restrictions and safety at all social levels. The development complied with the requirements and limitations of nature implies the relationship of economic and environmental policies at all levels of society and its integration into contemporary international trends. Irrational use of natural resources can not serve the long-term development, and therefore systems that are directed towards the unlimited development with limited resources are unsustainable in long run. Given the fact that we have to conserve natural resources for future generations, while meeting the demands of the economy, the economy of natural resources gets its place in economic sciences.

THE ECONOMY OF NON-RENEWABLE RESOURCES

In a broad group of non-renewable resources are primarily mineral resources, metal ores and non-metals, energy resources, coal, crude oil and natural gas. These resources formed in the distant geological past are considered non-renewable, because millions of years were necessary for their creation. Hence we talk about fixed stock of non-renewable resources. Since there is no growth, ie. renewal, there is no possibility for the sustainable exploitation of resources, and the problem of optimal use is reduced to finding the optimal rate of depletion, ie. optimal rate of exploitation of resources [6]. Economics of natural resources is a science that studies alternative use and skills of selecting the most productive combination of resource use, which by nature are rare, and in relation to human needs, insufficient and limited. Therefore, it is assumed that resources can always be economically evaluated, transformed into products for final consumption and converted into money. This includes developed market economy system and the overall economic and technological communications between microeconomic agents [2]. In the assessment of the economy of non-renewable resources the large number of parameters that influence the optimal exploitation of resources must be taken into account. The most important parameters are [7]:

a) the level of demand for resources;
b) the price that leads to the emergence of alternative technologies, P_B;
c) the size of the known reserves of resources;
d) the cost of extracting resources, C;
e) discount rate, r.

Demand for resources may increase due to population growth, increasing incomes and living standards, technological development and so on. However, due to the technological changes, appearance of substitutes, etc., it may decline, which reflects the dynamics of the optimal exploitation of resources. Figure 1 shows the increase in demand for non-renewable resource, which leads to a rise in prices, but also to earlier exploitation of resources supplies, T '<T.

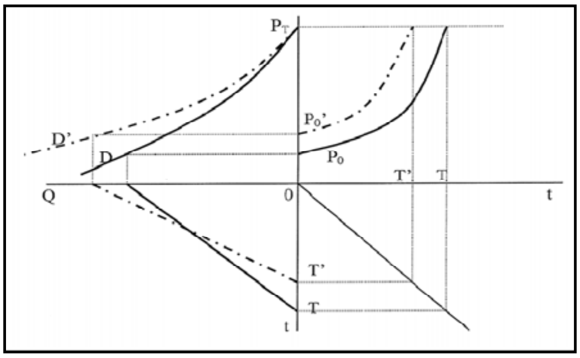

Figure 1. Influence of increasing demand for resources on its exploitation

The next step in the analysis refers to changes in ***prices***, leading to appearance of alternative technologies. One of consequences of technical progress is the emergence of alternative technologies that are becoming cheaper. However, the opposite is possible; however, since it is considered that the decline in prices, which leads to more alternative solutions is certain, in Figure 2 are shown the consequences of such changes in the parameter P_B. The Figure shows that the drop in prices of alternative technologies accelerates the use of existing supplies of resources. If the initial price of resource exploitation, P_0, would not be reduced, this would result in non-use of part of supplies at the time T', hence the decline of P_0 to the level P_0' is inevitable. If there is no change in the discount rate r, the pace of future rates growth will remain unchanged.

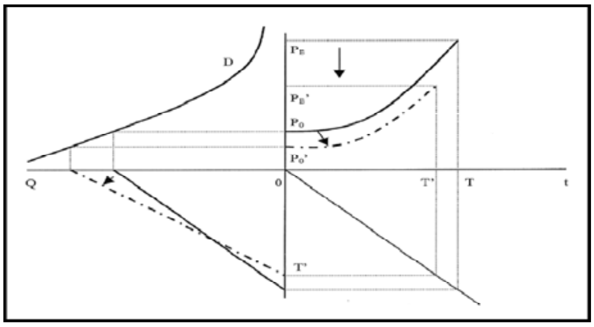

Figure 2. Impact of falling prices of alternative technologies

Due to advances in technology of exploitation, as well as by the discovery of new deposits, or deposits of ore, there was a constant increase in ***known reserves*** of non-renewable resources. Actually, its amount on the Earth does not change, but the level of knowledge and power of humanity to use specific resources changes. The influence of reserves' growth on the optimal exploitation of resources is shown in Figure 3. From Figure 3 it can be seen that due to the appearance of new reserves, resource prices fall, and time to full utilization will be extended T '> T. The level of reserves will rise, as seen in the second quadrant.

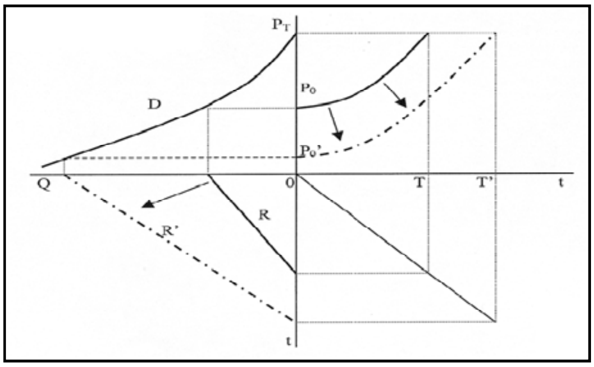

Figure 3. Effects of reserves 'growth on the optimal exploitation of resources

The fact that changes in the ***cost of extracting*** affects the dynamics of the optimal exploitation of resources, changes in the dynamics of exploitation are shown in Figure 5. The increase in costs will result in higher initial price, P_0, at which the extraction of resources starts, but will reduce the rate of increase in prices, which will lead to extension of reserves duration, T. The point is that with the rising of costs it is coming to an initial reduction of rent, ie., the difference between the gross rates and charges. Although rent will rise at the same rate as before the change of the cost, its initial level is lower. The increase of the initial gross price, with the demand unchanged, will lead to slower resource exploitation, so the moment of exhaustion of reserves will occur later.

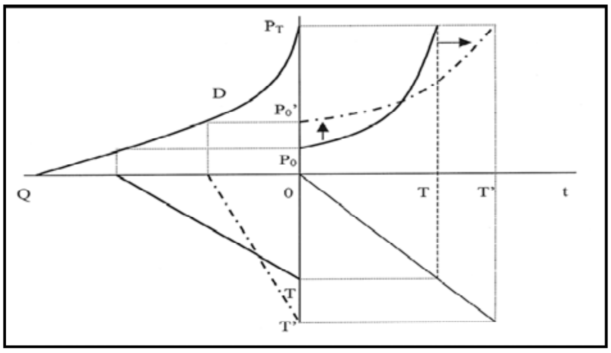

Figure 5. Influence of increased exploatation costs

In the case where the initial jump of extracting costs is so high that the initial gross price exceeds the level of P_T, then the exploitation of resources in general will not occur. In fact, it leads to the economic destruction of resources, even when it exists in an unchanged physical quantity. An example of this are the abandoned mines, in which due to the presence of water, methane, or other reasons, there was an increase in operating costs, and were abandoned. In the event that demand for resources increases sufficiently, the gross price increases, or cost of extracting resources decline, it may come again to activation of mines.

The influence of changing ***the discount rate*** on the optimal exploitation of resources can be seen in Figure 6. Suppose there was an increase of the discount rate from the level r, to the level of r' , where r' > r. Since, according to Hotelling rule, the price must grow at the same pace as the discount rate, it will result in faster growth rates. If the initial level P_0 does not change, the faster growth rates would lead to being part of the fund remains untapped. To prevent this from happening, and the entire fund of resources spent, the initial price must be reduced to the level of P_0' , ie. $P_0 > P_0'$. However, this leads to a shortening of the duration of resource reserves T.

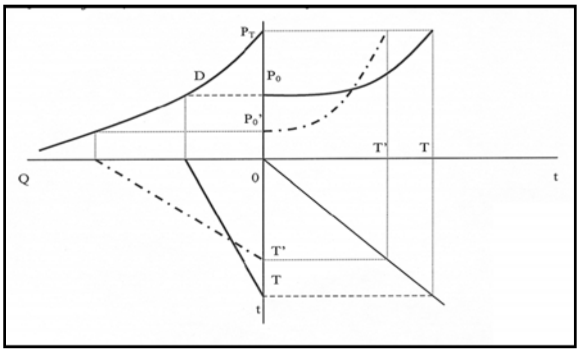

Figure 6. The influence of changing the discount rate on the optimal exploitation of resources

This view says that an increase in the discount rate leads to faster depletion of non-reproductive resources. A drop in prices in the initial period caused by an increase in the discount rate, will induce demand, while higher prices in the later period, will cause less demand. Because of that, the owners of resources will tend to come as soon as possible to benefit from the exploitation, so the extraction pace will be faster.

ECONOMIC MEASURES FOR THE RATIONAL USE OF NON-RENEWABLE NATURAL RESOURCES

Given the pace of exploitation of natural resources, all the more uncertain is that the amount of non-renewable natural resources on Earth is limited. This fact leads us to believe that humanity is on its way to definitely spend all the resources. The position of the depletion of non-renewable resources is most explicitly stated in a study titled "The Limits of Growth". In these conditions, more often, the question is how to use natural resources rationally. There are many answers, from the application of traditional instruments of economic policy, to a new philosophy of economic and social development. The term "new development philosophy" means the current set of views on sustainable social development, ecologically compatible economic growth and humanity's responsibility for their own future and the future of Earth. We have an increasingly insistence on the need of conceiving the social-state measures to preserve the natural environment in the context of the established state regulations and measures that define how to use natural resources. Most important economic instruments are taxes and subsidies. In addition to these instruments, great role in rational use of non-renewable natural resources belong to the recycling and substitution.

When it comes to taxes and subsidies, the main feature is that it can be applied to the net price, ie. rent, and the gross cost of resources. The literature considers that the taxes (or subsidies) to rent, will have no effect on the pace of resources extract, but will affect only the current value of the extracted resource. By this economic instrument the state collects rents, inventory utilization of resources, but with the same dynamics of exploitation. Based on these facts, we can say that a tax (or subsidy) on the annuity has a neutral impact on the dynamics of optimal resource extraction. However, the tax on rent will discourage, and subsidies will encourage, efforts to find new supplies of resources, changing the expected revenue from the exploitation of new bearings. When it comes to taxing the gross cost of resources, it is considered that the tax will have the same effect as an increase in the cost of exploitation, while introduction of subsidies will be equivalent to reducing operating costs. A tax on the cost of resources leads to slower utilization, ie. to long term supply of resources. Of course, subsidizing prices will have the opposite effect. All this suggests that taxation of natural resources prices can have an impact on the conservation of reserves and bearings of non-renewable natural resources. However, the introduction of taxes is slowing economic growth and resulting in negative effects, because the problem of exhaustion of resources is actually overloaded. Thus, revenue from taxes on rents should not be used for fiscal purposes, but must have a developmental purpose, in terms of encouraging scientific and technical progress. Instead of non-market efforts, such as artificial prolongation of life of exhaustible resources reserves on Earth, it is far wiser to encourage economic and technological development, which will, in turn, provide new possibilities of substitution of resources that are missing [7]. As for recycling, the fact is that some resources can indeed be efficiently re-used, if the ratio of their prices and costs of recycling permits. One of major gaina of the recycling is resource conservation. Another benefit of recycling is reducing the effects arising from the utilization and transformation of raw materials (environmental impacts, consumption of energy and natural resources) [8].

CONCLUSION

Economics of natural resources is a science that studies alternative use and skills of selecting the most productive combination of natural resources use, which by nature are rare, and in relation to human needs insufficient and limited. The fact that the depletion of natural resources results from the decisions of individuals, through the economic analysis we can understand the behavior of consumers and businesses and their decision-making under the influence of market information. If we accept the criteria of environmental sustainability as one of the goals of development policy, the success of measures is reflected in the avoidance of accidents that threaten the balance of the ecosystem. Therefore, it is assumed that resources can always be economically evaluated, transformed into products for final consumption and converted into money. Each of these economic instruments has its advantages and disadvantages, which makes them suitable or less suitable in applications, all with the goal of achieving the optimal rate of exploitation of renewable resources.

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INVASIVNESS DEGREE OF *ASTER LANCEOLATUS* WILLD. IN BELGRADE

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ABSTRACT

One of the most important river-side invasive plant species in Belgrad territory is *Aster lanceolatus*. In the present paper the analysis of invasiveness degree of *Aster lanceolatus* at some sites in Belgrade was done. To estimate invasiveness degree of *A. lanceolatus* it is applied two invasiveness assessment models. These models are composed of a series of questions evaluating spatial characteristics, known or potential impacts on resources of value, biological characteristics, and ease of control. According to scores that are given for each question and totaled to produce a final evaluation, *A. lanceolatus* is characterized as species with high invasiveness degree.

Key words: *Aster lanceolatus,* invasivness degree, invasiveness assessment models, Belgrade.

INTRODUCTION

Invasive plants are defined as alien species that sustain self-replacing populations without direct human intervention. Most non-native species that are introduced are poorly adapted to their new environments and are unable to establish viable populations. Of those that can establish, only a small subset proceeds to invade native ecosystems. Establishment is highly dependent on ecological and climatic conditions (Wainger and King, 2001).

The introduction of invasive non-natives threatens community structure and composition and ecosystem processes (Cronk and Fuller, 1995; Walker and Smith, 1997; Cox, 1999). Invasive plants produce offspring, often in very large numbers, at considerable distances from the parent plants, and thus have the potential to spread over a large area (Pyšek et al., 2004). It is important to emphasize that climate changes alter ecological processes and exacerbate a number of non-climate stressors such as the spread of invasive species. Invasive species will also respond to climate change, and their responses will have ecological and economic implications (Hellmann et al., 2008). Non-native plants have greater success invading regions that are climatically similar to their native ranges (Cronk and Fuller, 1995). The susceptibility of native plant communities to invasion is largely a function of the degree to which the communities are naturally or anthropogenically disturbed (Hobbs and Huenneke, 1992; Lake and Leishman, 2004) and the number of propagules that arrive in those communities (Richardson and Pyšek, 2006).

Aster lanceolatus is North American species introduced in European countries in 1830. (Branquart et al., 2007). Species *A. lanceolatus* occupies a significant position in the world and European lists of invasive species. Its spreading potential is conditioned by the species biology and the expansiveness by climate changes, anthropogenic impacts and the competitive interrelationships. In Serbia, *A. lanceolatus* as a dominant species forms communities in wetland and riparian habitats (Obratov-Petković et al., 2011).

As resources for managing invasive plants are limited, the need to evaluate and rank non-native species is a primary concern before expensive management is attempted, so that the most threatening species may be addressed first (Wainger and King, 2001). In accordance with that fact, the aim of this paper was estimation of invasiveness degree of *A. lanceolatus* in several localities in Belgrade. For this purpose it is applied invasiveness assessment models of Morse et al. (2004) and Carlson et al. (2008).

MATERIAL AND METHODS

To evaluate invasiveness degree of *A. lanceolatus*, in the area of Belgrade, previous made phytocenological relevés are used (Obratov-Petković et al., 2011). On the basis of these relevés and two protocols: NatureServe (Morse et al., 2004) and Invasiveness ranking system for non-native plants of Alaska (Carlson et al., 2008), the assessment of invasiveness degree of *A. lanceolatus* in Belgrade area is presented.

NatureServe protocol is designed to make the process of assessing invasive plants by using a specified set of questions and requiring documentation of the scientific information used to determine each species' rank. Species are assessed one at a time for a specified "region of interest" to determine an Invasive Species Impact Rank (I-Rank) categorizing the species' negative impact on natural biodiversity within that region as high, medium, low, or insignificant. The Protocol consists of two yes-no screening questions and 20 weighted multiple-choice assessment questions grouped into four sections which address four major aspects of an invasive species' total impact: ecological impact, current distribution and abundance, trend in distribution and abundance, management difficulty.

The Carlson et al. (2008) assessment models generally share a series of questions evaluating spatial characteristics, known or potential impacts on resources of value (e.g., biodiversity, agriculture, water resources, or aesthetics), biological characteristics, and ease of control. Namely, the questions are relating to ecological impact, biological characteristics and dispersal ability, distribution and feasibility of control of invasive species. Scores are given for each question and totaled to produce a final evaluation.

RESULTS AND DISCUSSION

Appling of NatureServe protocol for estimation of invasivness degree of *A. Lanceolatus*

According to Morse et al. (2004) estimation of ecological impact of invasive plants performs through five questions: (1) impact on ecosystem processes and system, (2) impact on ecological community structure, (3) impact on ecological community composition, (4) impact on individual native plant or animal species and (5) conservation significance of the communities and native species threatened. On the basis existing phytocenological relevés (Obratov-Petković et al., 2011), which show plants cover and density, it can be say that species *A. lanceolatus* has strong impacts on ecosystem processes. Above all, it has perceivable influence on soil nutrient availability. At analyzed localities it is noticed that *A. lanceolatus* has strong impact on ecological community structure, by altering the vegetation structure. Individuals form new canopy, changing layers of vegetation below. Also, this invasive species alters the composition of ecological communities, changing the relative abundance of native species. Due to intensive spreading of *A. lanceolatus*, reduction in abundance of several locally common native plants is described in the observed communities on the Belgrade area. Considering to abundance and number of *A. lanceolatus* in investigated localities, it can be concluding that this species strongly out-compete native species. One of the reasons can be fact that some essential oils of this invasive have strong allelopathic property (Dias et al., 2009). In accordance with that impact of *A. lanceolatus* on rare native species is, also, of high significance.

The aspect current distribution and abundance involves four questions: (1) current range size in region, (2) proportion of current range where species is negatively impacting biodiversity, (3) proportion of region's biogeographic units invaded and (4) diversity of habitats or ecological systems invaded in region. Based on previous researches (Obratov-Petković et al., 2009, 2011; Lakušić et al., 2005) and NatureServe criteria the spreading of species *A. lanceolatus* is moderate in Serbia (it occupies 10 – 30% of the region), but in Belgrade this species is widespread (it occupies over 30% of the Belgrade area). Within investigated area negative impacts of this invasive species on biodiversity occur in 20 - 50% of the species' current range. Considering all investigated localities belong to the same biogeographic unit, the question regarding proportion of region's biogeographic units invaded was excluded from the study. However, in the case of research of invasiveness degree of this species on the territory of Serbia, this question could be applied. The investigated natural habitats are classified in 8 different habitat types (according to the national and international EUNIS Habitat classification). This means that *A. lanceolatus* is invasive species of high significance (Morse et al., 2004).

The third aspect of NatureServe protocol is trend in distribution and abundance, which involves seven questions: (1) current trend in total range within the region, (2) proportion of potential range currently occupied, (3) long-distance dispersal potential within region, (4) local range expansion or change in abundance, (5) inherent ability to invade conservation areas and other native species habitats, (6) similar habitats invaded elsewhere and (7) reproductive characteristics. Our previous investigation (Obratov-

Petković et al., 2009; 2011) show that *A. lanceolatus* is invasive species of high significance whereas it expands in the most directions, and spreads into new habitats. Species *A. lanceolatus* has potential for long-distance dispersal by humans, by other animals, or by abiotic factors (such as wind). It reproduces asexually by rhizomes. Due to their strong vegetative development, *A. lanceolatus* can form dense and monospecific colonies displacing native plant species (Branquart et al., 2007). Comparing investigation of Jovanović (1994) withe investigation of Obratov-Petković et al. (2009, 2011) it can be seen that the species *A. lanceolatus* increas significantly in local range and abundance (cover, density, frequency). From this aspect, *A. lanceolatus* is also of high significance as invasive species. On the other hand, there is no data that this species invades undisturbed mature natural vegetation. It establishes in areas where major natural or human-caused disturbance has occurred. The habitats in many European countries, where this species is established, are the same type like these in Serbia (Feráková, 1994; Drescher and Prots, 2000; Sanz-Elorza et al., 2001; Dana et al., 2001). *A. lanceolatus* can spread easily by seed over a long distance and after their establishment can spread fast vegetatively monopolizing the space (Jedlička and Prach, 2006). According to NatureServe protocol criteria, and considering mentioned reproductive characteristics *A. lanceolatus* is invasive species of high significance.

The aspect management difficulty involves four questions: (1) general management difficulty, (2) minimum time commitment, (3) impacts of management on native species and (4) accessibility of invaded areas. Considering distribution trend and abundance increasing of *A. lanceolatus*, managing this species requires a major, long-term investment of human and financial resources. Also, in investigated localities species is abundant, well established and therefore minimum time for control of invasive *A. lanceolatus* is, at least 10 years, particularly as it is not known what method for control is the most acceptable. But for managing of *A. lanceolatus* is important that localities where species is established are not inaccessible.

Summarizing the results, on the basis criteria Nature Serve protocol (Morse et al., 2004) species *A. lanceolatus* can be estimated as invasive plant that presents great threat for native plants and phytocenosis. So this species possesses high invasivness degree in different sites in Belgrade.

Appling of Invasiveness ranking system for non-native plants of Alaska for estimation of invasivness degree of *A. Lanceolatus*

As with the NatureServ protocol, the assessment of *A. lanceolatus* invasivness degree, according to Invasiveness ranking system for non-native plants of Alaska, in this study was carried out on the basis previous floristic and phytocenological investigation on the Belgrade territory (Jovanović, 1994; Obratov-Petković et al., 2009, 2011; Lakušić et al., 2005).

Assessment of ecological impact of invasive plants Carlson et al. (2008) perform through evaluation of: (1) impact on natural ecosystem processes, (2) impact on natural community structure, (3) impact on natural community composition and (4) impact on higher trophic levels (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades). It may be noted the concept of ecological impact assessment in this protocol is very similar to ecological impact assessment according to NatureServe protocol. So the explanation of *A. lanceolatus* ecological impact is similar according to both protocols. Analyzing previous floristic and phytocenological research, it can be concluded that *A. lanceolatus* has the potential to cause significant alteration of ecosystem processes. Impact of *A. lanceolatus* on natural community structure has very strong. It has the potential to cause significant impact in, at least one layer, usually it forms new layer of vegetation. In investigated community this species significantly reduce the population size of more native species. For now, answer on question about impact on natural community composition and impact on higher trophic levels it cannot be given. In that purpose the research should be more detailed.

The second aspect of Invasiveness ranking system for non-native plants of Alaska is estimation of biological characteristics and dispersal ability of analyzed invasive plant. It is composed of nine questions: (1) mode of reproduction, (2) innate potential for long – distance dispersal, (3) potential to be spread by human activities, (4) allelopathyc, (5) competitive ability, (6) forms dense thickets, climbing or smothering growth habit, or otherwise taller than the surrounding vegetation, (7) germination requirements, (8) other species in the genus invasive in Alaska or elsewhere and (9) aquatic, wetland, or riparian species. *A. lanceolatus* reproduces sexual and vegetatively (Schmid et al., 1995), but vegetatively successfully invades many geographic regions (Pyšek, 1998). It is a rhizomatous species propagating clonally. Vegetative spread from the original introduction is probably of the utmost importance. Long-distance dispersal is by seeds (FOEN, 2006). *A. lanceolatus* produces large quantities of seed which spread easily over a long distance, because of adaptations. Actually, the seed of the species has pappus. Species can germinate in existing vegetation. Considering this reproduction strategy this species is considered to be moderately aggressive according to protocol criteria. Also, species has potential to be spread by human activities; this is decorative species (Halford et al., 2011). In European countries it was introduced because its decorative characteristics (FOEN, 2006). As mentioned, *A. lanceolatus* produces some essential oils that have strong allelopathic property (Dias et al., 2009), what make this species highly competitive for limiting factors. The stem of *A. lanceolatus* form dense thickets, which are taller than the most of surrounding herbaceous plants. Except the *A. lanceolatus* on the territory of Belgrade more three invasive species from *Aster* genus are described: *A. novi-belgii, A. salignus* and *A. tradescanti* (Jovanović, 1994). *A. lanceolatus* is invasive in riparian communities. On the basis of biological characteristics and dispersal ability of *A. lanceolatus,* and according to criteria of this protocol this invasive species is considered highly invasive.

Distribution is third aspect of Invasiveness ranking system for non-native plants of Alaska, and involves five questions: (1) is the species highly domesticated or a weed of agriculture, (2) known level of ecological impact in natural areas, (3) role of anthropogenic and natural disturbance in establishment, (4) current global distribution and (5) extent of the species U.S. range and/or occurrence of formal state or provincial listing. *A. lanceolatus* is not highly domesticated or a weed of agriculture. It is known that this species causes moderate impact in natural areas in similar habitat in many European countries (Halford et al., 2011). According to our observation this invasive species may occasionally establishs in undisturbed areas, but can readily establish in areas with natural disturbances. It develops its populations on moist meadows, riverbanks, openings and edges of floodplain forests, damp thickets and fields, roadside ditches. Also, it grows in mesic to humid neglected fields and poorly managed pastures (FOEN, 2006). *A. lanceolatus* is native to North America and naturalized in Europe. On the basis existing data, it estimates that *A. lanceolatus* occupies over 21 % territory in Belgrade.

The last part of this protocol is feasibility of control, composed of three questions: (1) seed banks, (2) vegetative regeneration and (3) level of effort required. Seeds remain viable in the soil for less than 3 years. It is resprouting from extensive underground system. Management requires a major, long-term investment of human and financial resources, especially that there is no specific management options are described for this species.

The results of application of Invasiveness ranking system for non-native plants of Alaska show that species *A. lanceolatus* is highly invasive species on Belgrade area.

Accordingly, these protocols confirm that A. *lanceolatus* is highly invasive species on Belgrade territory. Both protocols are simple for usage and applicable for Belgarade area. The form of the protocols is designed so that there was no need for adjustment issues for our area. Protocols can be of great importance for solving problems of monitoring and management of invasive plants in Belgrade. The future investigation will include usage of these protocols for estimation of invasiveness degree of other invasive plants in Belgrad, but in Serbia too.

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EFFECTS OF THE INVASIVE SPECIES *ASTER LANCEOLATUS* WILLD. ON SOIL PROPERTIES

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ABSTRACT

Invasive species are one of the main threats to biodiversity. The purpose of this research was to determine whether invasive species *Aster lenceolatus* Willd. has impact on soil properties and thus becomes the dominant species on the invaded sites. Invaded and adjacent uninvaded plots with native vegetation were compared on each location. Soil pH, electrical conductivity (EC) and heavy metals were analyzed. Results showed that invasive plant *A. lanceolatus* have influence on soil properties, possibly creating conditions that favor *A. lanceolatus* over native plants.

Key words: *Aster lanceolatus* Willd., invasive plants, plant-soil interaction.

INTRODUCTION

In recent years, human impacts on ecosystems and their functions are growing. As urbanization, long-distance transport and deposition of emissions continue, plant communities are facing numerous challenges. Changing landscape is nature's response to these influences.

Urban and suburban habitats are particularly susceptible to shift in plant community structure and therefore the most vulnerable to plant invasion.

Vitousek *et al.* (1) point out that invasive plant species have the potential to change basic ecosystem functions and processes. The research of invasive plants has tended to focus on plant features, which promote invasiveness, and community features that make the community susceptible to invasion of alien plants. Invasive plants are capable of modifying soil properties, thus to promote their own growth (1).

This research was based on observation that analyses of pre- and postinvasion measurements of soils are the most direct evidence of the effect of invasive plants (2) and that comparison of topsoil of invaded and adjacent uninvaded plots with native vegetation will show the impact of invasive plants on soil properties (3, 4).

Aster lanceolatus Willd. is one of the widespread invasive species in Serbia (6). The purpose of this research was to investigate whether species *A. lenceolatus* causes changes in the soil properties and thus becomes the dominant species on the invaded sites.

MATERIAL AND METHODS

Study species *Aster lanceolatus* Willd.

The studied species was identified as *Aster lanceolatus* Willd. based on standard floristic methods, using relevant literature and Online data base of Flora Europaea (6). This species was selected since in recent years, *A. lanceolatus* has become the dominant plant along riverbanks and in some urban areas, suppressing other species and reducing the floristic species diversity (6). *A. lanceolatus* usually grows in the pioneer communities of variable floristic composition and is rarely present in the shrub and forest associations (7).

Study sites

To compare soil properties of invaded and adjacent uninvaded plots, plant material and soil samples were taken from different localities: two islands, Ada Međica (on Sava River) and Veliko Ratno Ostrvo (on Danube River); Kumodraž area in the valley of the creek of Kumodraški potok; Makiš, Živača and Jakovo on the alluvial plain of the Sava River; Veliko Blato and Krnjača on the alluvial plain of the Danube River; and Košutnjak hill close to Sava River.

Sampling methods

Soil was sampled from October to November 2010 and 2011. At each site, several 1 m^2 plots were selected in invaded patches and adjacent uninvaded patches with native vegetation. The aboveground biomass of the plots was harvested, dried for 48 h at 70°C, weighed and grounded prior to chemical analyses. In each plot five soil samples 10 x 10 cm, at a depth of 10 cm were collected. Roots and rhizomes were removed from soil. These five soil samples were air dried, sieved (< 2 mm) and 200g of each sample were mixed up to single sample for each plot. Soil parameters such as pH value, electrical conductivity (EC) and heavy metals in soil and plants were analyzed in 68 samples.

The milled soil (3 g) was digested with aqua regia under reflux for 2 hours using water-cooled condensers on a digestion block using the standard procedure (8). The digest was cooled, filtered and diluted with 0.5 M HNO_3. Contents of Zn, Cu, Pb, Ni, Cr, Mn, and Fe were determined by flame atomic absorption spectrophotometer (AAS) using an Thermo MSeries AA instrument (USA). Mercury was determined by cold vapor.

The pH is determined on a 1:5 soil:deionised water suspension using a pH meter MA 5730 ISKRA standardized against known buffer solutions (9). The EC was determined from the same suspensions using Milwaukee Sharp C66 Waterproof EC Conductivity Tester calibrated with Milwaukee 1413 µs/cm calibration solution. (6).

RESULTS AND DISCUSSION

Soil pH and electrical conductivity

Data from several sources have identified changes in soil pH as a result of plant invasion. Kourtev *et al.* (10, 11) and Ehrenfeld *et al.* (12) have been reported increased pH in soils under invasive plants. In contrast Boswell and Espie (13) and Scott *et al.* (14) showed decreases of pH in soils infested with invasive species.

Table 1. Mean values of soil pH and electrical conductivity in invaded (I) and uninvaded (UI) patches on 9 sites

Location	pH I	pH UI	EC I	EC UI
Kumodraž	6.89[a] ±0.13	6.50[a] ±0.07	0.16[a] ±0.01	0.09[b] ±0.00
Krnjača	8.26[a] ±0.01	8.24[a] ±0.03	0.22[a] ±0.01	0.17[a] ±0.01
Makiš	7.98[a] ±0.01	7.94[a] ±0.02	0.23[a] ±0.01	0.25[a] ±0.00
Veliko Ratno Ostrvo	8.02[a] ±0.01	8.10[b] ±0.02	0.23[a] ±0.00	0.21[b] ±0.00
Ada Međica	8.32[a] ±0.00	8.34[a] ±0.00	0.23[a] ±0.00	0.22[a] ±0.00
Živača	8.43[a] ±0.03	8.30[a] ±0.07	0.27[a] ±0.01	0.23[b] ±0.00
Jakovo	8.12[a] ±0.03	8.01[a] ±0.04	0.24[a] ±0.01	0.38[b] ±0.01
Košutnjak	7.11[a] ±0.05	7.16[a] ±0.03	0.11[a] ±0.00	0.17[b] ±0.00
VelikoBlato	8.20[a] ±0.07	8.30[a] ±0.05	0.24[a] ±0.01	0.17[b] ±0.01

In this study, soil pH in invaded patches ranged from 6.89 to 8.43, and in adjacent uninvaded patches from 6.50 to 8.34 (Table 1). Although, there were no significant differences between invaded and uninvaded patches, except on Veliko Ratno Ostrvo, five increases and four decreases of pH value were noticed in invaded areas (Table 2). Therefore, according to these results *A. lanceolatus* had small impact on soil pH.

Table 2. Number of increases and decreases in the value of analyzed soil parameters in invaded patches compared to adjacent uninvaded patches

	pH	EC	Zn	Cu	Pb	Ni	Cr	Mn	Fe	Hg
Number of increases	5	6	5	5	5	6	5	5	5	4
Number of decreases	4	3	3	4	4	3	4	4	4	5

The electrical conductivity in invaded patches ranged from 0.11 to 0.27, and in adjacent uninvaded patches from 0.09 to 0.38. EC values showed significant differences between invaded and uninvaded patches on 6 locations. The EC of soil in invaded patches was higher than in uninvaded patches on 6 locations and on three locations EC values were lower in invaded patches.

Species *A. lanceolatus* tends to have higher biomass, to have higher growth rates and to create dense continuous ground cover than co-occurring native plants. Higher EC values in invaded patches are in accordance with the measured biomass that was higher in patches with *A. lanceolatus.* There are, however, other possible explanations. Xuan *et al.* (15) suggested that EC is strongly related to chemicals and toxic compounds exuded into the soil during decomposition. In *A. lanceolatus*, germacrene D, bicyclogermacrene and umbelliferone derivatives were isolated from the roots (16). The flavonoids quercetin and kampferol were extracted from various tissues (16). *A. lanceolatus* produces and releases secondary compounds and unique combinations of compounds through litter and root exudates and volatiles and thus may increase EC values.

Invaded patches with lower EC value and lower aboveground biomass and those with approximate EC values and biomass on both types of patches are hard to explain. This rather contradictory result may be due to site condition, anthropogenic influence, community composition or age of community.

Heavy metals in soil and plants

Total Zn content in unpolluted soils range between 10 and 300 mg kg^{-1} (17). According to the Regulation for the program of systematic monitoring of soil quality (18) critical concentrations for Zn in the soil is 140 mg kg^{-1}. The measured average values of Zn were within the limits, except concentrations measured at the site Veliko Ratno Ostrvo, Ada Međica and Jakovo both in invaded patches and in control patches. In those samples, measured average values of Zn are greater than the concentration limit.
Natural concentrations of zinc in plants range from 12 to 47 mg kg^{-1} by Kabata-Pendias and Mukherjee (19). According to Kabata-Pendias (20) the deficient content of Zn in plants is establish as 10-20 mg kg^{-1}. Measured values of Zn in the invaded and uninvaded patches do not exceed the natural values. However, the measured values at the two sites, Kumodraž and Košutnjak in univaded patches showed deficit of this element in plant tissue.

Based on the Regulation for the program of systematic monitoring of soil quality (18) critical concentrations for Cu in the soil is 36 mg kg^{-1}. According to this criterion, the copper content in all samples were within limits, except on Ada Međica where higher concentrations of copper are measured on patches with native flora.

Kabata-Pendias (20) identifies up to 30 mg kg^{-1} of Cu in plat tissue as the normal concentration. Measured concentrations were below the critical limit.

Critical concentrations for Pb in the soil is 85 mg kg^{-1} according to the Regulation for the program of systematic monitoring of soil quality (18). Soil from all sites had lower concentrations of Pb than the critical concentration.

Kabata-Pendias and Mukherjee (19) suggest that the normal concentration of Pb in the plant material is up to 10 mg kg^{-1}. De Vries and Bakker, (21) has reported the normal natural concentration intervals of Pb in plants as 0.1 to 5 mg kg^{-1}. Measured Pb concentrations do not exceed critical values, except in plants from invaded patch on site Živača.

Critical concentrations for Ni in the soil is 35 mg kg-1 (18). Mesured values of Ni in Kumodraž, Makiš, Ada Međica, Živača and Jakovo, in both invaded and uninvaded patches, were greater than critical concentration.

Normal concentration of Ni in the plant tissue range from 0.1 to 5 mg kg-1 by Kabata-Pendias (20). All measured values were in the range of normal concentration.

Critical content for Cr in soil is 100 mg kg-1(18). Kabata-Pendias (20) indicate that the critical concentration of Cr in the soil range from 5 to 30 mg kg-1. All measured values were in the range of normal concentration.
According to Kabata-Pendias (20) normal concentration of Cr in plants range from 0.1 to 0.5 mg kg-1, and concentration limits for toxicity of Cr range from 5 to 30 mg kg-1. On

the contrary, Kloke et. al (22) found that even low concentrations of Cr (1-2 mg kg-1) can cause damage to plants. All measured values were above the range of normal concentration except on Krnjača and Makiš in patches with native vegetation.

On the world scale, the range of Mn average contents in soil range from 270 - 525 mg kg-1 (19). Measured concentrations of Mn were above world average in 5 locations in invaded patches and in control patches. On three sites, Krnjača, Makiš and Veliko Blato measured values were in the range of world average.

Measured concentration of Mn in plant samples were in the rage of normal concentration (30-300 mg kg-1), according to Kabata-Pendias (20). By the same author, the deficient content of Mn in plants is 10-30 mg kg-1. Low concentration of Mn was observed in Makiš, in invaded patches.

Concentrations of soil Fe vary in a wide range of 100-100000 mg kg^{-1} (23). Measured Fe concentrations in soil were in the rage of normal concentration.

The natural Fe content in plat tissue ranges from 18 to 1000 mg kg^{-1}. All analyzed samples were in the rage of normal concentration.

Critical concentrations for Hg in the soil is 0.3 mg kg^{-1}(17). All measured Hg concentrations were below the critical concentration.

As presented by Kabata-Pendias (20), toxic Hg concentration in plan tissue ranges from 1 to 3 mg kg^{-1}. Compared to this criteria, measured Hg concentration in samples in all locations, were below critical range.

The results showed high variability. On some locations, heavy metals in soil had higher values in invaded than uninvaded patches, and on the other locations result show opposite trend. However, the number of increases in soil heavy metal stock was higher in invaded then in uninvaded patches (Table 2).

Table 3. Number of increases and decreases in the value of analyzed parameters of plant from invaded patches compared to adjacent uninvaded patches

	Zn	Cu	Pb	Ni	Cr	Mn	Fe	Hg
Number of increases	8	7	5	7	7	4	7	4
Number of decreases	0	2	4	2	2	5	2	5

Rapid growth of invasive *Solidago canadensis* L. in Pb polluted soil might be result of its ability to exclude Pb or reduce the uptake of Pb compared to non-invasive species (24). However, in this study, plants on invaded area had higher tissue concentration of heavy metals compared to the native vegetation (Table 3).

This was especially pronounced for Zn concentration, which increased in plants at all invaded sites, and for Ni and Pb in Živača. A higher concentration of heavy metals corresponds to increased biomass on invaded patches. pH value has significant effect on the sorption of heavy metals (20). Since the changes in pH value of soils in invaded area were not pronounced, this was not the reason for higher concentration of trace elements in plants tissue. Elevated concentrations of heavy metals in the soil on analyzed locations can be explained by geological layer and anthropogenic pollution because all analyzed locations were on urban and suburban lands. No damage was observed on plants that could be caused by the increased content of heavy metals in the soil.

Arbuscular mycorrhizal fungi can alter heavy metal accumulation of host plants (25). *A. lanceolatus* is mycorrhizal (26) and this could be the reason for higher heavy metal uptake by plants in invaded patches. This results could support findings that arbuscular mycorrhiza promote process of plant invasion (26).

This research raise possibility that reason for *A. lanceolatus* invasivness is due to his capability to effect soil properties and high competitive ability for soil nutrients. To better understand impacts of *A. laceolatus* on community structure and composition, future research will involve analyses of soil nutrients.

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ARSENIC IN INDUSTRIAL WASTE WATER FROM COPPER PRODUCTION TECHNOLOGICAL PROCESS

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ABSTRACT

Investigation of arsenic in industrial waste water is of a great importance for environment. When discharing non-treated waste water produced in copper production technological process into water streams, surface water becomes significantly polluted, which directly affects flora and fauna, as well as humans. There is a need for efficient and environmentally acceptable treament of waste waters which contain heavy metals. The paper contains an analyisis of the waste water from the Smelter Combine which is discharged into the river of Bor. The expected arsenic content in treated waste water after using HDS procedure is also presented below.

Key words: industrial waste water, arsenic, treatment .

INTRODUCTION

Industrial development has significantly affected the environment and a change in the social environmental conditions. The outdated copper production technology in Bor includes uneconomical consumption of water, a high degree of pollution and a high degree of water steam pollution. Waste industrial water goes into a collector, without prior treatment, from where, after mixing with other waste waters, it is conveyed to the river of Bor which severely pollutes the river itself and affects the quality of the Timok [1].

Toxisity of arsenic in surface waters [2] is reflected in its effect on the river sediments [3,4] plant and animal world, as well as health of humans [4,5,6]. The U.S. EPA recently decreased the maximum concentration level (MCL) of arsenic in drinking water from 50 to 10 μg/l [7].

A constant increase in production of copper in the world and more strict environmental standards require improvement of the existing and development of new technologies [8,9,10]. This initiated the construction of a New Smelter and Sulphuric Acid Plant in Bor and use of BAT technology [11,12] which also accounts for waste water treatment.

MATERIAL AND METODS

The Institute of Mining and Metallurgy in Bor tested the waste waters, quantities and content of the effluents that are discharged into the river of Bor after accumulation in the industrial collector and mixing with other waste waters [13]. The aim of this paper is to determine adequate solutions for waste water treatment.

Weak acid effluent from the Sulphuric Acid Plant was sampled once a day, at the facility outlet point, for 11 days in total.

Effluents from the Cooper Electrolytic process was sampled once a day, for 11 days in total, at three measuring points:

1. Measuring point – Cathode Copper Production – Refinery,
2. Measuring point – Copper-Sulphate Production – Regeneration
3. Measuring point – Precious Metals Production – Gold Production Plant

Effluent samples were analysed by using the AAS method. This analysis presented current and real concentrations of arsenic in waste waters from the coper production technological process.

Introduction of new technologies, smelting copper in flash furnace, will bring to generation of waste water from the flash furnace gas scrubber, converter gas scrubber, wet electrostatic precipitators in Sulphuric Acid Plant and Copper Electrolytic Refinery.

Removal of disolved metal ions from waste water will be produced by residue in the form of hydroxides. By adding alkali to the solution a new pH value is achieved, metal hydroxsides go into undisloved state and depositate in the solution. A modified HighDensitySludge (HDS) process will be used for treatment of the waste water from the Copper Smelter Plant. This process brings to neutralization of acid and percipitation of heavy metal hydroxides. The process will have two stages, in two reactors, with supplying calcium(II)hydroxide (slaked lime) as a means of deposition. The process consists of the following technological operations:

- flow/ quality equalization in a raw waste water storage tank,
- neutralization of acidity using lime and precipitation of calcium sulphate down to its solubility level,
- air oxidation and precipitation of metals as metal hydroxides by sparging air and adding lime to the reaction tanks to elevate the pH to 7,2 in first reactor and to about 9,5 to 10 in second reactor to precipitate metal hydroxides down to their solubility product levels,
- coprecipitation of arsenic with ferric hydroxide,
- deposition in the settler,
- flocculation by adding flocculant to the settler tank, in order to ensure and accelerate deposition of particles,
- discharge of the clarified effluent to a polishing pond before discarging the treated effluent to the receiving steam; the polishing pond has two purposes, one is to archieve quality equalization of the effluent, and the other, to provide a storage reservoar and pump well to house water reuse pumps, should an opportunity for re-using the water exist.
- waste sludge treatment and stabilization

Neutralization of acid, deposition of iron and coprecipitation of arsenic occur in the first reactor with $Fe(OH)_3$ [14,15].

$$H_3AsO_4 + Fe(OH)_3 = FeAsO_4 + 3H_2O$$

In order to ensure deposition of arsenic together with iron, 46,6 mas% $Fe_2(SO_4)_3$ solution is supplied to the first reactor.

In the second reactor, the achieved pH value is 9,5-10,0 with addition of 13mas% $Ca(OH)_2$ suspension, which causes full deposition of the remaining iron and other heavy metals. Treated water is discharged into the settler where the solids, consisting of deposited heavy metals in the form of hydroxides, arsenic and calcium-sulphate, created during neutralization of acid are separated [15,16]. After neutralization and treatment of waste waters in the Effluent Treatment Plant, sludge and treated water are separated.

RESULTS AND DISCUSSION

Waste water from the Sulphuric Acid Plant occur as a result of cleaning of the gas created during the copper production process.

Waste water from Copper Electrolytic Refinery is created from three technological units: production of cathodes, production of copper sulphate and production of precious metals.

Figures 1,2 and 3 present concentrations of As and quantities of weak acid effluents and electrolytic process effluents which are discharged into the industrial collector with no prior treatment.

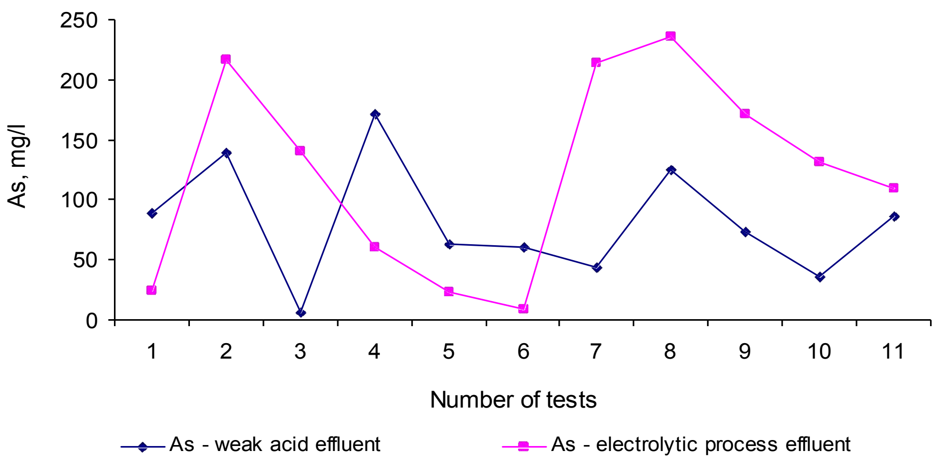

Figure 1. Concentration of As in weak acid effluent and electrolytic process effluents

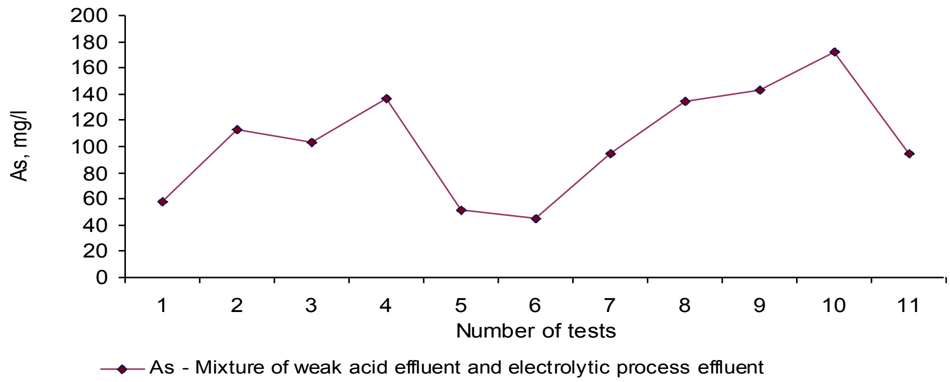

Figure 2. Concentration of As in the mixture of weak acid effluent and electrolytic process effluents

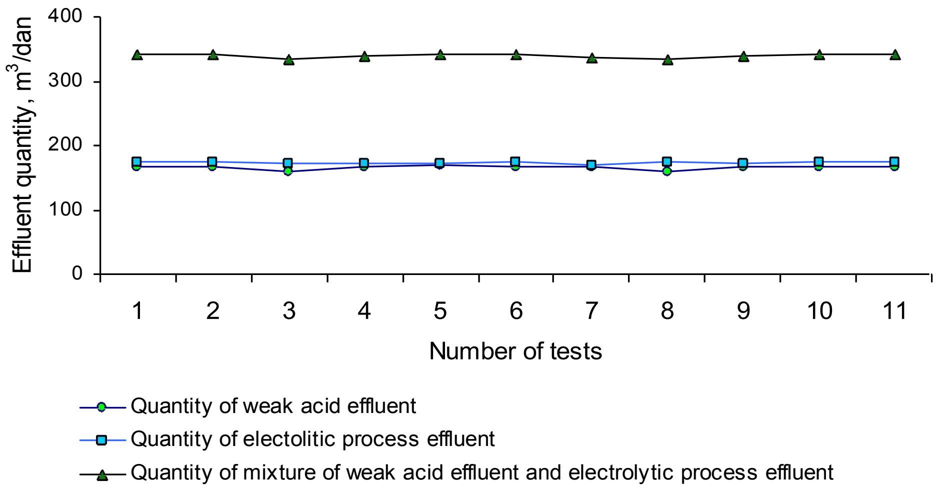

Figure 3. Weak acid effluent and electrolytic process effluents content at the facility's outlet

Table 1 presents average arsenic content in the Smelter Combine waste waters.

Table 1. Smelter Combine waste waters [13]

Type	Quantity, m^3/h	Average content of As in waste water, g/l	Final inflow
Sulphuric Acid Plant wast water	6,857	0,081	The river of Bor
Copper Electrolytic Refinery waste water			
• Copper Electrolytic Refinery	3,125	0,013	The river of Bor
• Electrolytic regeneration	2,250	0,280	The river of Bor
• Gold Production Plant	2,083	0,028	The river of Bor

Under the New Smelter and Sulphuric Acid Plant Project in Bor, SNC-Lavalin and Outotec, based on the various concentrat contents and design information for flue gas generated in the flash furnace and converter, provided the waste water quality for weak acid effluent (SNC-Lavalin 2012).

Table 2. Weak Acid Effluent Tretment Plant – waste water characteristics [16]

Type	Quantity, m^3/h	Average content of As in waste water (Waste Water Plant inlet), g/l
Flash furnace gas scruber and converter gas scruber	8,66	1,467
Copper Electrolytic process waste water	7,45	0,1

Table 3. Expected arsenic content after treatment in the Effluent Treatment Plant [15,16,17,18,19]

Type	Unit	Expected As content	Republic of Serbia regulations, GVE	EU regulations, parameter limit	EU Tolerance limit
Treated outlet water	mg/l	<0,1	0,01	0,01	0,015

CONCLUSION

Based on the available data, it can be concluded that waste water is conducted in the manner that is not in accordance with the standards of the Republic of Serbia. For this reason, treatment of this water needs to be done in a separate facility which will be constructed within the New Smelter and Sulphuric Acid Plant Project. Even after the treatment in the Waste Waster Effluent Treatment Plant, the quality of water does not comply with the surface water discharge criteria but it is recirculated and used in the copper production technological process. Arsenic in treated water requires additional treatment so that the water treated in that manner could be discharged into a recipient.

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SUSTAINABLE MANAGEMENT OF MINING WASTES AND WASTE MINIMIZATION

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ABSTRACT

During the extraction of minerals exists a conflict between quantities of extracted raw material from one side and the accumulation of grand volumes of waste products and the environment protection from another. In situations of global financial crisis one of the few industrial branches that function with bigger capacity are the metalliferous and non-metalliferous minerals and energy minerals extraction that save the national economies of many countries. The paper presents an analysis of ecological management of nonrenewable natural resources and technogenic raw materials. Characterized are the methods of management of wastes and are noticed the possible applications of products, produced as a result of techno gene raw materials reprocessing.

Key words: mineral resources, waste, management, environment protection.

INTRODUCTION

The contemporary mining companies are a complex aggregate of interrelated technological objects, existing and developing in decades. The optimized management of a mining company includes a reasonable amount of systems with many connections inside the company and the environment. The goal is to decrease to minimum the negative impact, which the mining and production activity does to environment.

As a result of the production activity of a given mining object is performed an active interaction between production complexes and the nature. The processes of eco systems and components of environment impact such as air, water soil etc that are undergoing as a result of mining company activities lead to creation of a new technogenicenvironment. The consumption of materials and energy resources, the disposal of production emissions, causes decrease in earth resources, destruction of eco systems, violation of dynamic balance and normal functioning, deterioration of the nature components.

One part of the problems of the environment related to the minerals processing cover: pollution of surface and underground water, caving of surface over shallow mining works, non reclaimed waste dumps with big volume of rock mass and none conditioned ore content, active erosion processes, sedimentation in river beds etc [1].

The effective, complex and long term utilization of underground resources in each country should correspond and be in compliance with the requirements for sustainable development of mineral resources industry, that covers three aspects: economical, ecological and social.

REASONS FOR WASTE ACCUMULATION

Within many decades the human society is neglecting the wastes, because of the small volumes in the past. The huge areas that it takes now require the investigators to search for technologies to recovery and disposal. The growing population of planet Earth forces upon an accelerated intensification of agriculture and industry. As a result the volume of wastes continues to increase dangerously. The tragic results of the wrong approach of the human to the wastes force the statement that is necessary a whole and argument approach to this problem.

The application of modern and effective technologies in the geologic-exploration, exploitation and processing activity for extraction of mineral resources gave the opportunity to uncover the mineral resources potential of Bulgaria. As a result of these big scale activities lots of waste products have stockpiled, with different chemical and physical properties. They contain valuable and rare resources and raw materials. The content of some metals in waste is almost equal to the deposit themselves. The question for recovery of the valuable ingredients from waste is complex and difficult thing. The effective answer to it depends on the level of technological and economic development of a given country.

No doubt is that the quantity of wastes is in direct dependence on the level of usage of natural resources. At the territory of Bulgaria are stockpiled billions tons of industrial and domestic wastes. In it there are lots of precious and rare resources.

Huge amount of the metals could be extracted from wastes by up to date physical, chemical and microbiology approaches. In wastes there are rare metals such as: thallium, germanium, vanadium, cadmium etc.

WASTE CHARACTERIZATION REQUIREMENTS AND METHODS

The technogenicraw materials are accumulated as a result of geologic activities, extraction and recovery, storage of mineral resources or exploitation of quarries.

The mining waste management of waste from exploration, extraction and recovery of underground resources is achieved to prevent, decrease or limit the negative impact on the components of environment, health and safety of society. The main idea is to prevent breakdowns and to protect environment by mining waste management plans, hazard waste control and clean characteristics of the conditions that the equipment for recovery and handling of mining waste should meet.

The technogenicresources are characterized to determine and evaluate their properties and behavior, after which are selected methods for management ensuring prevention, decrease and limit of their hazardous impact.

The characterization of wastes is made on the basis of technological and geological characteristics of the deposit, geotechnical and geochemical characteristic of mining wastes. The geochemical characteristic includes [2]:

- Evaluation of grading, mineral and chemical composition of mining waste;
- Forecast of possibilities for draining and leakage of substances, that is dangerous for environment by investigating the leaching behavior of waste.

The sampling of hard mining wastes is an important stage of the research. The correct and authentic results that are the real picture of the technogenicproduct characteristics depend on it.

A possibility to determine the mineral composition of monolithic mining wastes exists by mineralogy and petrography analysis with polarization microscope. The mineral composition of the samples taken may be punctually analyzed by a complex x-ray-thermic analysis and x-ray-spectral microanalysis (micro-probe analysis).

The application of complex and methodical approaches in the research of wastes from mining industry is in the basis of the systematic and profound research of industry wastes not only in Bulgaria. Conducting such researches leads to the planning of effective activities to limit the hazard impact of wastes and creation of suitable technologies to utilize them [3].

UTILIZATION OF ASHES AND METALLURGY SLAGS

As a result of coal burning ashes a formed from the mineral part. The main components of ash are: SiO_2, Fe_2O_3, CaO, FeO, MgO, up to 80% from the total mass. The coal power plants wastes utilization can evolve in various directions, such as: portland cement clinker production (active mineral additive in cement), clay compounds (large quantities are utilized for bricks, construction and ceramics items, mineral wadding etc.) and recovery of metals and rare elements, when they are present in vast quantities (magnetite extraction 2 to 5%, by wet magnet separation).

Ashes with high content of CaO are used to neutralize and ameliorate soils. The chemical content of granulated ash from coal power plants depends on the nature of coal: Al_2O_3 – 25%, CaO – 50%, SiO_2 – 36%. Depending on the chemical composition the ashes contains crystal phase up to 80% unburned particles. The utilization of unused ash is to fill galleries.

Large amounts of power plants ash can be used in agriculture to neutralize acid soils, and also to disperse microelements – B, Cu, Zn, Mo and Mn. Other direction is the application of this waste for soilsreclamation. The fly ash from the electro filters of coal power plants is very suitable for soils reclamation in open pit mining. The as that is used has a content of 15% CaO and sulphates less than 4%. When the ash contains unnecessarily many burned particles their removal is required.

From the metallurgy and energetics are a produced lot of mineral effluents: metals, skimming, slag and ashes. For one tone steel are used up to five tons of ore and is separated 0,6 tons solid wastes. The common between solid wastes from power plants and metallurgy is that they are silicic mixtures. The separation, transportation and storage of wastes require expenses that lead to more expensive production. For storage are used fertile lands and the pollution level of environment increases.

The metal slags are divided in three groups – slags from black or ferrous metallurgy. The blast furnace slags have application as: granulated slags, pumice slag, light slag products, slag wadding, cement etc. In Bulgaria is used flotation method to process waste copper slags. The method includes breaking of slag, milling, flotation and water removal from the copper concentrate, which is yet again used in metallurgy. The flotation waste is used in cement production.

UTILIZATION OF WASTES FROM MINING AND MINERAL PROCESSING PLANTS

During excavation of mineral resources is accumulated a vast quantity of waste mining mass from the overburden. As a result from the growing extraction of resources is growing the volume of solid waste – rock mass, clay etc. Depending on the character of the extracted and processed ore, the different wastes contain lots of precious components: quartz, oxides, sulphides of ferrous metals, rare and dispersed elements etc. In lots of occasions this turns them suitable resource for reprocessing, production of various products and potential raw material for extraction of some precious elements at time when the high condition main ore resource becomes scarce.

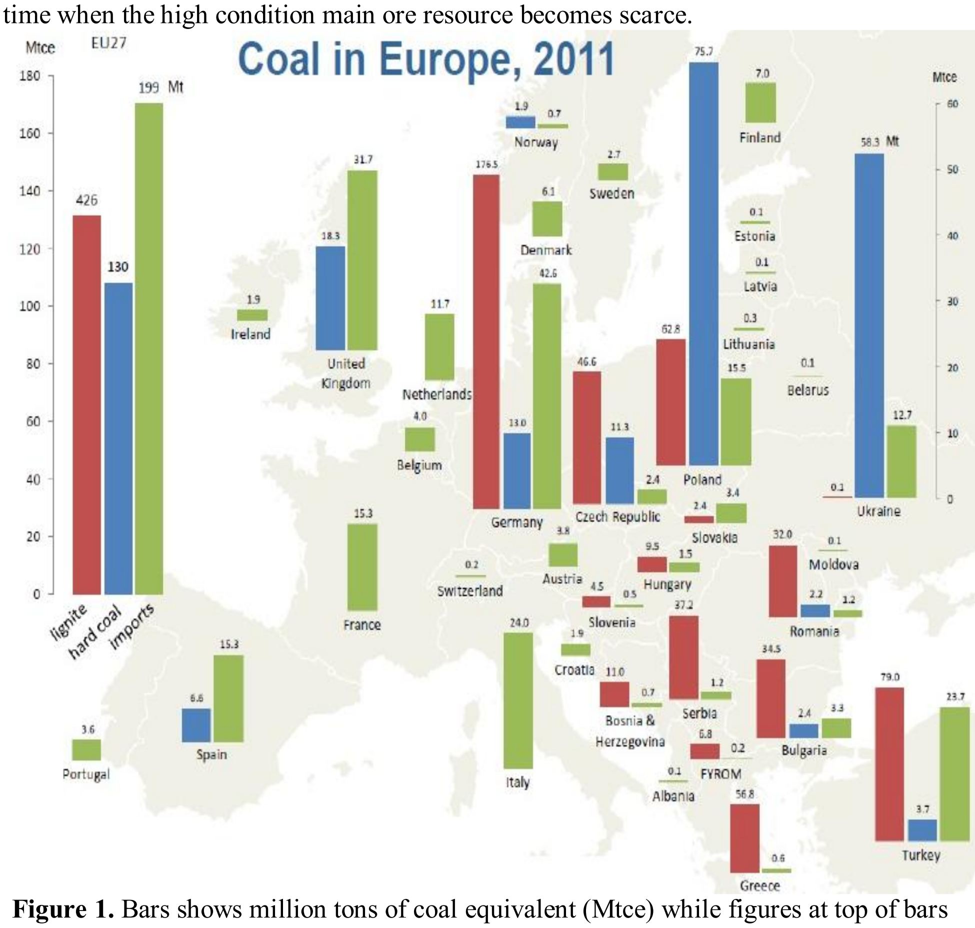

Figure 1. Bars shows million tons of coal equivalent (Mtce) while figures at top of bars shows millions of physical tons (Mt), [4]

The waste often generated during mining is low melting clay. It is a perfect raw material for production of ceramzit (porous filler of lightweight concrete), but as well has thermal and sound insulating properties. The exit clay is additive to pore generating substances – this is because of sulphide – spirit lye, that is formed in granules, dried and then baked.

Almost every waste from processing of coal contains some fuel. These wastes are suitable for processing to construction materials, solely or in mix with clay enclosures to produce bricks, blocks, ceramic products and others. In many countries is set production of aglo pyrite (light porous filler for concrete it is a residue from extraction and processing of coal and oil shales).

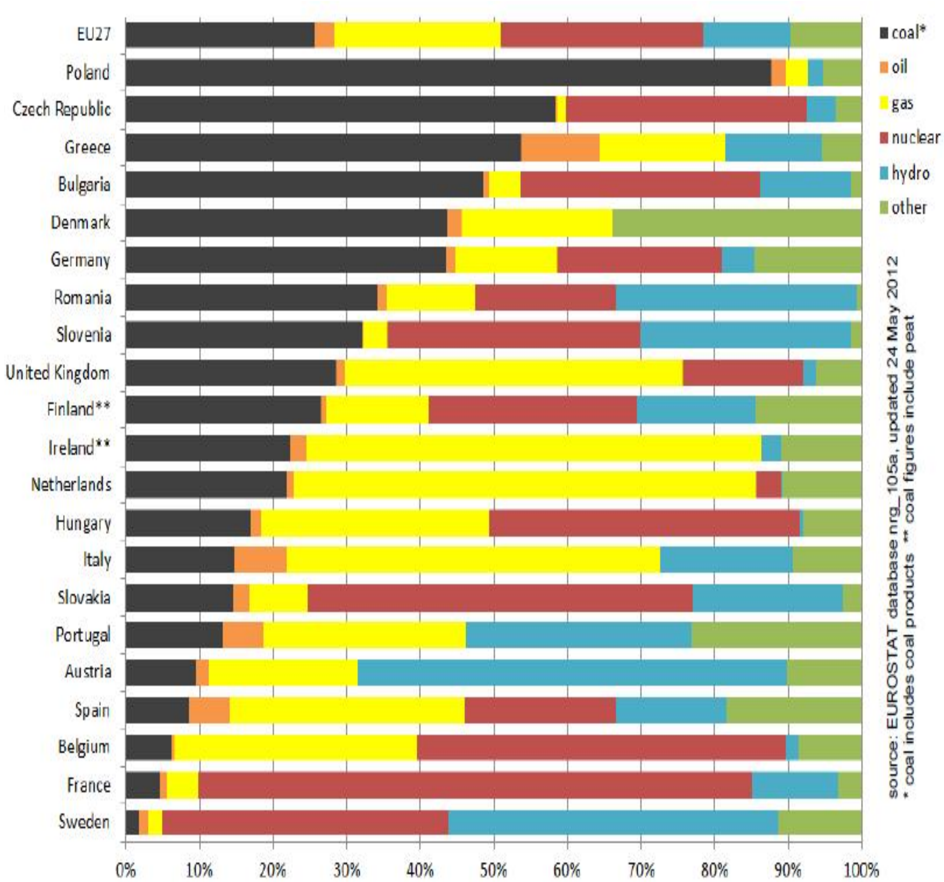

Figure 2. Coal-fired power generation in the EU, 2010, [4]

CONCLUSIONS

The damage that man does to environment often is global and irreversible process. The industry is what makes humanity responsible for destruction of nature. In many occasions the hazard for environment is not directly born by the main production process, but is a result of by processes of depletion of nonrenewable natural resources and waste stockpiling.

The energetics is one of the industrial branches that produce the biggest quantities of solid waste, therefore the top priority task is to provide technologies that utilize it and rationalize the energy use.

One of the main directions in the environmentally friendly technologies is the application of waste from one type production in other production processes. In that manner is achieved in the same time prevention of pollution of environment and rational use of natural resources that grants long term raw materials security for production.

But in most cases it is not possible the wastes from one production to be used in another, and is necessary to pretreat them to achieve certain quality levels. Usually this treatment includes processing of the resource, cleaning of undesirable impurities and/or influence on some physical properties.

In order for one technology to be applicable in practice, it needs to not only be environmentally friendly but to be highly economically feasible, i.e. to produce a competitive product by quality and quantity at low cost price. This imposes to concentrate the efforts of the scholars towards a study of the possibilities for management and optimization of the processes and the main task is – maximum efficiency of technologies.

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METHODOLOGICAL APPROACHES TO NUMERICAL MODELLING OF PHASE TRANSITIONS (CASE STUDY OF TAILING AND DUMP HANDLING)

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ABSTRACT

The paper presents methodological approaches to give solution to some challenges in tailing and dump handling when it is necessary to consider "water-gas" or "ice-water" phase transitions. The results of numerical experiments are shown for process modelling of variable water saturation in porous materials with physical characteristics of tailings from "Kovdorsky GOK". The calculation methods and prediction of thermal state of frozen rock dump are considered for long-lasting thawing period.

Key words: tailing impoundment, dumps, phase transitions, numerical modelling.

INTRODUCTION

During open-pit mining under the northern climatic conditions the challenges occur related to, e.g. moisture content in tailings while reusing mineral mining and processing wastes. The prediction of thermal state of the rock mass or rock dumps is of interest after long-lasting nordic frosts and thawing. The physical and mathematical methods are known to make modelling of indicated above non-stationary processes taking into account "water-gas" or "ice-water" phase transitions. This paper deals with description of methodology and modelling examples near real ones.

MODELLING OF "WATER-GAS" PHASE TRANSITION

The goal is to learn how to model non-stationary processes of dehydration and water saturation of porous materials (tailings in the sites of tailing impoundment) that can be of particular interest when giving solution to technological tasks. The possible moister transfer prediction in problem of two-phase system filtration can be applied in problems related dusting in tailing impoundments of mining and processing enterprises and when reusing mining and processing wastes. Both dusting and reuse significantly depend on parameter of material volumetric water content θ being the subject of this study.

National research is well-known of studies related variable moister transfer, e.g., widely known paper of Shestakov V.M. and Pozdnyakov S.P. [1], exhaustive and bulky edition of Rumynin V.G. [2] that considers the indicated problem as well. Author's comprehension of the problem, some results of numerical experiments verification based on PORFLOW [3] and COMSOL [4] can be found in the published paper [5]. It should be reminded that physical processes of aeration zone are described by common rules of moister transfer in non-saturated materials (Richard's equation).

Porous material dehydration study with physical characteristics of Kovdor complex deposit baddeleyte-apatite-magnetite ores has been carried out in the model when evaporation in the upper boundary of the square area (1x1 m) is varied by moister flow assigned. Range of dehydration flow was selected of $0.5 \cdot 10^{-7} \div 2.0 \cdot 10^{-7}$ m/sec. Indicated flow provides evaporation velocity per square unit equal to gram fractions per second. The rest three boundaries of modelling area are supposed to be moister-resistant.

Results of drying process calculations obtained using COMSOL code for two values of moister flow ($1.0 \cdot 10^{-7}$ и $2.0 \cdot 10^{-7}$ m/sec) in terms of effective saturation distribution in depth are presented in Figure 1a and 1b, correspondingly. The process of material drying was considered during the day with time step of 6 hours at a height of capillary lift of 0.06 m. The comparative analysis of curve behavior on Figure 1a and 1b results in the following:

- drying flow augmentation significantly advances dehydration process in porous space. Indicated fact can be clearly seen at small depths (e.g., 0.04 m), when drying velocity at a maximum flow is higher 0.1 of effective moister for each 6 hours;
- for the finite calculation time (24 hours) the depth of full saturation at a minimum flow is about 0.09 m, at a maximum flow ~ 0.15 m.

During computations it was revealed that COMSOL prevents from carrying out numerical modelling for a time that is more than moment of the first achieving of remaining moister content. Therefore, it is suggested to model long-term process of porous material dehydration using PORFLOW code. Table 1 exemplifies the spatial distribution of relative moister content in porous environment for 10 days.

Table 1. Spatial distribution of relative moisture content to the time moment of 10 days

Coordinate in depth, m	Relative water content, -	Comments
0.0	0.0450	Dry state
-0.1	0.0450	Dry state
-0.2	0.0450	Dry state
-0.3	0.0452	Dry state
-0.4	0.2110	Near dry state
-0.5	0.6650	Humidified state
-0.6	1.0000	Absolutely wet state
-0.7	1.0000	Absolutely wet state
-0.8	1.0000	Absolutely wet state
-0.9	1.0000	Absolutely wet state
-1.0	1.0000	Absolutely wet state

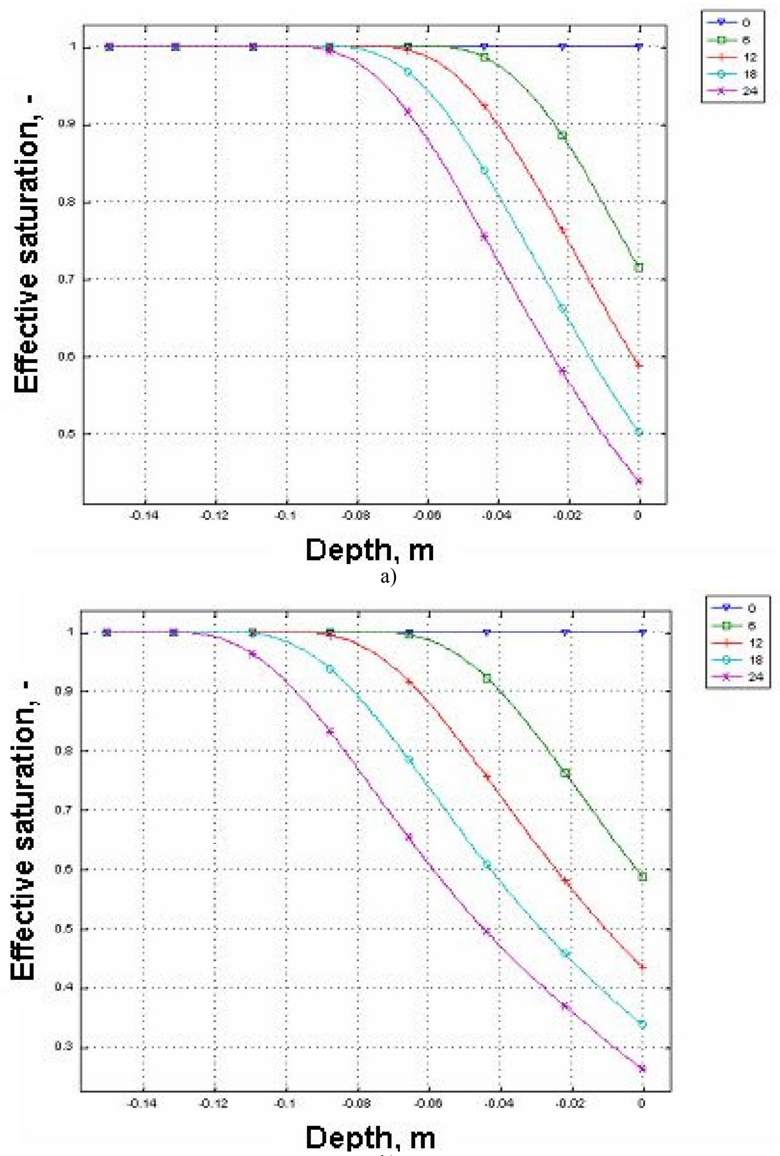

Figure 1. Distribution of effective saturation by porous material depth for different time points (0, 6, 12, 18 and 24 hour) for two values of dehydrated flows in the upper model boundary: a) $1.0 \cdot 10^{-7}$ m/sec; б) $2.0 \cdot 10^{-7}$ m/sec.

The obtained result was verified for physical characteristics. Using formulae of effective saturation [1-3], with known value of relative moister content, volumetric water content θ (thus, dehydrated porous space) can be assessed at depths of -0.4m and -0.5m.

Further on the space which fails to be "wet state" type can be integrated "manually" by height. As a result, about 0.172 unit of volume for calculation time point is filled with air. But in fact, the same integrated quantity can be obtained by simple fundamental operation: multiplication of given dehumidifying flow in the upper boundary ($2 \cdot 10^{-7}$ m/sec) by duration time of calculation (10 days or 864,000 sec). The difference is in four decimal place!

Obtained results show that predictions of long-term numerical modelling using PORFLOW code are reliable thus can be recommended for giving solution to specific mining-technological problems of tailing dehydration.

MODELLING OF POROUS MATERIAL THERMAL STATE CONSIDERING "ICE-WATER" PHASE TRANSITION

The study aims at development and verifying the algorithm of numerical modelling of thermal processes in porous environment with phase transition "ice-water". In principle, studies of permafrost rocks thermal state could be carried out based on well-known software as PORFLOW [4] or COMSOL [5]. Both codes allow giving solutions to similar or like problems (e.g., spent nuclear fuel disposal in permafrost rocks).

One of the versions of software applied in the Mining Institute KSC RAS for more than 20 years has been upgraded (developer: senior researcher A.V. Naumov); it helps to give solution to thermal conductivity equation (finite-difference method, Patankar's algorithm)[6]. Calculations of phase transition were performed according to algorithm stated in the multi-author book of N.V. Chersky Institute of Mining in the North, Siberian Branch RAS [7].

Code was verified using the following model. We have frozen (-20 ^{0}C) porous (10%) rock of 1x1 m size. Boundary conditions are the following: in three boundaries (lower and two side) there are isolation conditions, in the upper boundary – fixed value of temperature (100 ^{0}C). Comparative analysis is given to central vertical distribution of temperature for 24 hours of thawing.

Obviously, initially described problem was completed using indicated above verified codes and, to the authors' view, good agreement of results was achieved (see Table 2). Yet, the model parameters that describe phase transition are set as default according to software developer recommendations.

Let's consider approach applied by Dr. Kurilko A.S. et al. [7]. In two-dimensional statement, heat transfer in the rockmass taking into account phase transition is described by the following system of equations and conditions:

$$\left[C(T) + LW\rho\delta(T - T^*)\right](\partial T / \partial t) = \partial\left[\lambda(T)(\partial T / \partial x)\right] / \partial x + \partial\left[\lambda(T)(\partial T / \partial y)\right] / \partial y$$

$$C(T) = \begin{cases} c_1\rho_1, & T < T^*, \\ c_2\rho_2, & T > T^*, \end{cases}$$

$$\lambda(T) = \begin{cases} \lambda_1, & T < T^*, \\ \lambda_2, & T > T^*, \end{cases}$$

$$0 \le x \le H_x, \qquad 0 \le y \le H_y, \qquad t > 0,$$

where T – rock temperature, K; T^* – temperature of moister phase transition in the rock, K; t and x, y – temporal (sec) and spatial coordinates (m); L – heat of fusion (freezing) of ice (water), J/kg; W – rock moisture, units of fraction; ρ – water density, kg/m^3; c_1, ρ_1, λ_1 (c_2, ρ_2, λ_2) – specific heat capacity (J/(kg·K)), density (kg/m^3) and thermal conductivity coefficient (W/(m·K)), correspondingly for frozen (thawed) rocks; $\delta(T - T^*)$ – δ-Dirac function; H_x and H_y – boundaries of modelling area by coordinate axis, m.

Among many existing variants of approximation of effective thermal capacity there are widely-used methods where δ-Dirac function covers only two neighboring points of spatial grid (in this case, by two along longitudinal and transverse axis) and variant when effective thermal capacity is continuous at points $T^* - \Delta T$ and $T^* + \Delta T$.

According to the leveling method, δ-Dirac function is approximately changed to δ-like function $\delta(T - T^*, \Delta T)$ which is different from zero in interval ($T^* - \Delta T$, $T^* + \Delta T$) and satisfies

normalization requirement $\int_{T^*-\Delta T}^{T^*+\Delta T} \delta(T - T^*, \Delta T)dT = 1$.

The effective thermal capacity is written $\overline{C(T)} = C(T) + LW\rho\delta(T - T^*, \Delta T)$ and further on it is integrated within the range of ($T^* - \Delta T$, $T^* + \Delta T$).

As a result, the following assumption of enthalpy consistence in interval of leveling is

$\int_{T^*-\Delta T}^{T^*+\Delta T} \overline{C(T)}dT = LW\rho + (c_1\rho_1 + c_2\rho_2)\Delta$.

The effective thermal capacity is noted down as follows

$$\overline{C(T)} = \begin{cases} c_1\rho_1, \\ (c_1\rho_1 + c_2\rho_2)/2 + (c_1\rho_1 - c_2\rho_2)(T - T^*)/2/\Delta T + LW\rho\left(1 - \left|T - T^*\right|/\Delta T\right)/\Delta T, \\ c_2\rho_2, \end{cases}$$

$$T \le T^* - \Delta T;$$
$$\left|T - T^*\right| < \Delta T;$$
$$T \ge T^* - \Delta T.$$

Thermal conductivity coefficient discontinuity is eliminated by point conjunction $(\lambda_1, T^* - \Delta T)$ and $(\lambda_2, T^* + \Delta T)$ by straight line

$$\overline{\lambda(T)} = \begin{cases} \lambda_1, & T \le T^* - \Delta T; \\ (\lambda_1 + \lambda_2)/2 + (\lambda_2 - \lambda_1)(T - T^*)/2/\Delta T, & \left|T - T^*\right| < \Delta T; \\ \lambda_2, & T \ge T^* - \Delta T. \end{cases}$$

Therefore, the initial equation of thermal conductivity in numerical implementation is changed by the following equation

$$\overline{C(T)}(\partial T / \partial t) = \partial\left[\overline{\lambda(T)}(\partial T / \partial x)\right]/\partial x + \partial\left[\overline{\lambda(T)}(\partial T / \partial y)\right]/\partial y,$$
$$0 \le x \le H_x, \qquad 0 \le y \le H_y, \qquad t > 0.$$

In the initial instant the temperature distribution is assigned

$$T(x, y, 0) = T_0, \quad 0 \le x \le H_x, \qquad 0 \le y \le H_y.$$

In the problem selected for verification the following boundary conditions are applied:

in the upper boundary – $T(x, H_y, 0) = T_{up}$, $0 \le x \le H_x$, (Dirichlet condition);

in the lower and side boundaries – $\lambda(\partial T / \partial y)\big|_{y=0} = 0$, $0 \le x \le H_x$ и $\lambda(\partial T / \partial x)\big|_{x=0, x=H_x} = 0$, $0 \le y \le H_y$ (Neumann condition, in particular, heat zero flow).

The results of numerical experiments using all software products are summarized in the Table 2.

According to author's view the obtained results allow to be optimistic in relation to possible appliance of software developed in the Mining Institute for calculations. In fact, the agreement is good, although there is minor discrepancy. For example, code of the Mining Institute gives underestimated positive temperature values (relative error by module is 7.8%) but in phase change area our calculations fall within the interval mid-point of verified codes.

Additionally the authors made an attempt to determine frozen rock thawing velocity when thawing starts. In plane geometry in the model of 30x20 m size, the "frontal" advance of zero temperature depthward rockmass was observed when giving condition of 3d kind in the surface. The assessment allowed to obtain thawing velocity at the level 3-4cm/day for the time of 60 days. The result is objective and corresponds to the initial parameters.

Table 2. Spatial distribution of temperature for 24 hours of thawing process, ^0C

Coordinate, m	COMSOL code	PORFLOW code	MI KSC RAS code
0.0	-17.2	-17.1	-17.6
0.1	-16.7	-16.6	-17.1
0.2	-14.7	-15.0	-15.6
0.3	-12.3	-12.1	-12.7
0.4	-7.9	-7.7	-8.1
0.5	-1.8	-0.9	-1.3
0.6	10.7	10.9	9.7
0.7	28.2	28.2	26.0
0.8	49.6	49.6	47.2
0.9	74.1	74.0	72.5
1.0	100.0	100.0	100.0

CONCLUSIONS

Solution of test problems related to moisture filtration using PORFLOW and COMSOL software suggested their application for modelling of non-stationary processes of moisture transfer in materials of tailing impoundment.

The results of verification are presented for software developed in the Mining Institute to solve non-stationary problems of heat transfer taking into account "ice-water" phase transition. Obtained computation accuracy of temperature in comparison to results obtained using PORFLOW and COMSOL codes allow authors to recommend developed software for numerical modelling of heat transfer processes with "ice-water" phase transition.

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RECOVERY OF ZINC FROM IRON-MAKING DUSTS BY NaOH LEACHING

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ABSTRACT

The hydrometallurgical recovery of zinc from recycled blast furnace dust from a steel plant was investigated. The dust contained 22 % of Fe, 17 % of Zn, and 0.2 % of Pb. X-ray diffractometry showed that main components were hematite and magnetite in combination with zinc oxide. Individual particles were generally were generally spherical and ranged in size from 10 to 150 microns; 63 % were less than 33 microns in diameter. En effective hydrometallurgical approach proved to be by caustic leaching and electro-winning. Recovery of zinc in the form of zinc powder was over 90 %. This material can be used for cementation of impurities in the conventional hydrometallurgical process of zinc production.

Key words: zinc, zinc recovery, hydrometallurgy, recycling.

INTRODUCTION

The problems associated with treatment and disposal of steel plant dust have became more acute since it has been classified by EPA as a hazardous waste material because of leachable compound of Zn, Pb, Cd and Cr. Classification of dust as hazardous material would mean that prior to disposal the dust would have to be either encapsulated, or transported to a controlled landfill site. Considering the gradually diminished ore reserves, it is obviously better to recover the zinc content of such materials.

Several studies have been carried out to examine various techniques of dust treatment, e.g. by flash smelting [1-3]. Agglomeration can be applied to the dusts containing impurities at a relatively low level. Pyro-metallurgical plants treat electric arc furnace dust in the Waelz kiln to recover lead and zinc in the form of an impure oxide product (typically containing 50-55 % Zn and 6-7 % Pb). In this process dust particles are flash-smelted to produce zinc oxide and a chemically-inert slag for disposal as landfill. Hydrometallurgical processes for dust processing are directed to the recovery of zinc and lead, leaving a residue that can be recycled.

Many leaching media have been tested including strong mineral acids and bases. However, it was concluded that the caustic leach – electro-winning process is feasible and can be applied to the small and large-scale operations [4-5].

This paper examines the technical feasibility of using caustic leach – electro-winning process to recover zinc from the blast furnace dust in the form of zinc dust. Zinc dust obtained in this way may then be used for cementation of impurities in the conventional leaching-electro-winning process. This process has been studied in the laboratory and in small pilot plant and preliminary engineering studies indicated that it is economically viable.

CHEMICAL AND MINERALOGICAL CHARACTERIZATION OF DUST

The composition of investigated blast furnace dust is given in Table 1. Chemical analysis was performed by atomic absorption spectrometry, after dissolution of the samples in concentrated hydrochloric acid.

Table 1. Chemical composition of blast furnace dust

Element	Wt (%)	Element	Wt (%)
Fe	21.970	Pb	0.200
Zn	17.280	Mn	0.190
Si	8.250	Cd	0.003
Al	0.310	Cr	0.011
Ca	4.220	Ti	0.006
Mg	5.775	Cu	0.014
Na	0.185	S	0.920
K	0.400	C	39.50

The average annual concentration values or zinc and iron, over a period of ten years are shown in Table 2.

Table 2. Average annual concentration of iron and zinc for period of ten years.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Zn (wt, %)	6.26	49.57	53.59	3.05	7.03	12.21	17.21	2.80	8.15	12.54	17.28
Fe (wt, %)	19.24	8.35	1.33	43.24	36.28	31.92	28.18	21.28	21.24	13.68	21.79

It can be seen that the principal constituents are iron and zinc; the relative proportion depends on the feed of the furnace. Particle size analysis was carried out according to the Tyler classification (Table 3.). The dust particles are generally spherical and vary in size. Nearly 63 % of them are less than 33 microns.

Table 3. Particle size distribution.

Fraction, (μm)	150-100	100-74	74-63	63-44	44-23	23-15	15-11	11-0.00
Wt. (%)	5.80	7.38	6.86	7.80	13.03	11.28	8.82	30.04

The zinc and iron content in four size fractions is shown in Table 4. Recycling or disposal of dust is complicated by fact that the dust is extremely fine and difficult to handle. As it can be seen from Table 4., with decreasing particle size, the content of zinc increases, while the iron concentration decreases.

Table 4. Zinc and iron content in four size fractions.

Fraction, (μm)	M (%)	Zn (%)	Fe (%)	%D Zn	%D Fe
- 63	25.13	9.74	8.38	14.66	14.19
63 - 33	11.70	6.69	36.30	4.68	28.62
33 – 11	33.13	17.00	19.76	33.66	37.41
11 – 0.00	30.04	26.19	9.77	47.03	19.78
	100.00	19.69	12.73	100.00	100.00

Dust samples were examined by X-Ray powder diffractometry in order to identify the most abundant phases. The results showed that the major components were hematite and magnetite, in combination with zinc oxide. A background of smaller peaks was attributed to the small quantities of other present oxides.

Blast furnace dust is considered to be composed primarily of a self-agglomerated collection of ultra-fine dust, physically and chemically complex particles, consisting basically of iron and zinc oxides. A high amount of iron in the dust means that certain fractions display magnetic properties. Dust samples were subjected to the magnetic separation and the results are shown in Table 5.

Table 5. Analysis of dust after magnetic separation treatment.

Fraction, (μm)	Wt. (%)	% of Zn	% of Fe	%D of Zn	%D of Fe
Magnetic	16.13	11.46	34.21	14.32	40.28
Non-magnetic	83.87	13.19	9.37	85.68	49.72

EXPERIMENTAL PROCEDURE

Laboratory leaching tests: bench scale experiments on caustic leaching of the dust were first carried out to determine the optimum parameters for leaching process. The influence of leaching time, concentration of sodium hydroxide, temperature and solid/liquid ratio on the leachability of zinc from blast furnace were studied.

Pilot leaching tests: for conducting pilot-scale experiments, a 2 m^3 mixer and a 5 m^3 tank were used. The optimum conditions for leaching were established in the bench scale tests and were then applied and tested in the pilot scale.

Laboratory and pilot tests on zinc electro-winning: A small PVC cell (30 cm long x 180 cm high x 120 cm wide) was used for bench scale tests on the electrolysis of sodium zincate solution. Two stainless steel anodes (15 cm x 10 cm) and one stainless steel cathode of the same size were used. The distance between electrodes was approximately 3 cm. the sodium zincate solution obtained in the leaching step was electrolyzed at 3.4 – 3.6 V and a current density of 250 – 350 A/m^2. A deposit of fine zinc dust was obtained. This deposit was stripped off every four hours, washed with water and dried in a nitrogen atmosphere. The zinc content of the deposit was determined by atomic absorption spectrometry.

A DC rectifier (400 A) was used in the pilot scale electro-winning tests. The PVC cells (70cm x 50 cm x 40 cm) were connected in a series of electro-deposition. The optimum conditions for electrolysis were established in bench scale tests and were then used in the pilot tests.

EXPERIMENTAL RESULTS AND DISCUSSION

Caustic leaching experiments were performed to determine the effects of leaching time, concentration of sodium hydroxide in leaching medium, temperature and solid/liquid ratio, on leachability of zinc form blast furnace slag. Some of the experimental results are shown in Table 6. On the basis of these results, the optimum conditions for caustic leachings were established as follows: (1) strength of caustic solution 30 % NaOH (by weight); (2) leaching temperature 40 °C; (3) solids/liquid ration 1:5.

The results showed that high recoveries of zinc from the blast furnace dust were possible without requiring any additives or elevated temperatures. Under the proper operating conditions, recoveries of over 90 % of the zinc in the dust were obtained in a leaching period of three hours. The results of the pilot tests were in agreement with the bench scale tests.

Due to the relatively high viscosity of the pulp after leaching, and the risk of precipitation of zinc with cooling of the leachant, in the pilot tests the zinc-rich solution was separated from solids by centrifuging.

After centrifuging, lime was added to the leach solution to precipitate the small amount of partly dissolved silica, according to the following reaction:

$$Na_2SiO_3 + Ca(OH)_2 \rightarrow 2NaOH - CaSiO_3$$

Table 5. Effect of operating conditions on zinc removal from blast furnace dust.

Time, (hours)	Leaching medium (wt %)	Temperature (°C)	S/L ratio	% Zinc recovery
0.5	10	35	1 : 10	29.0
1.0	10	35	1 : 10	29.1
3.0	10	35	1 : 10	32.9
6.0	10	35	1 : 10	32.9
9.0	10	35	1 : 10	32.9
24.0	10	35	1 : 10	32.9
3.0	20	35	1 : 10	66.4
3.0	30	35	1 : 10	70.7
3.0	30	35	1 : 10	30.1
3.0	30	35	1 : 10	91.5
3.0	30	35	1 : 10	91.4
3.0	30	35	1 : 3.5	62.5
3.0	30	35	: 4	59.4
3.0	30	35	1 : 5	90.9

Following the precipitation of silica, the purified solution was subjected to electro-winning. The main reactions are as follows:

Cathode: $Na_2ZnO_2 + 2H_2O + 2e^- \rightarrow Zn + 2NaOH + 2OH^-$

Anode: $2OH^- \rightarrow H_2O + 1/2O_2 + 2e^-$

Overall reaction: $ZnO_2 + H_2O \rightarrow Zn + 2NaOH + 1/2O_2$

In the bench scale electro-winning tests, at distance of 3 cm between anode and cathode and a voltage less than 3.2 volts. a black sticky deposit was obtained. The optimum voltage for obtaining a fine zinc dust deposit was found to be 3.4 – 3.6 V. The effect of applied current density on the form of the deposit was also studied, at current densities ranging from 100 A/m^2 to 900 A/m^2. At low current densities (100-200 A/m^2) a grey-color slimy deposit was obtained wile at densities above 350 A/m^2 flakes or needles were formed. A current density of 250-350 A/m^2 was maintained in all subsequent experiments, under these conditions, the deposit obtained was in the form of a fine dust powder. Table 7 shows chemical composition of a typical deposit of zinc powder.

Table 7. Chemical analysis of zinc dust deposit.

Constituent	Wt. (%)
Total zinc	99.5700
Metallic zinc	97.3000
Lead	0.0250
Copper	0.0010
Iron	0.0080
Cadmium	0.0001

CONCLUSION

The chemical characterization of blast furnace dust used in this investigation showed that its zinc to iron ration depended on the type of feed material to the blast furnace. individual particles are generally spherical and vary in size, with the majority being less than 33 microns in size.

The caustic leach electro-winning process appears to be a technically feasible method for zinc recovery from blast furnace dust. Zinc can be leached very successfully from blast furnace dust in 30 % sodium hydroxide solution for 3 hours at 40 °C and solids/liquid ration 1 : 5.

The sodium zincate obtained by caustic leaching was subjected to electro-winning at 3.4-3.6 and at current densities of 250-350 A/m^2 to produce a fine dust that can be used for cementation of impurities in the hydrometallurgical process. The leached material and residues can then be recycled to the blast furnace. The process is environmentally sound.

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TREATMENT OF SIMULATED SUGAR REFINERY WASTEWATER BY FERRATE(VI)

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ABSTRACT

Treatment of the artificial sugar rafinery effluent water,5 g dm^{-3}sucrose with COD value of 5.622 g O_2 dm^{-3},with ferrate(VI) has been explored.The influence of water acidity at pH values between 7 and 1.65 on the sucrose oxidation rate was followed by water COD value and visual light colorimetry. The increased effect of ferrate(VI) on sugar removal from the wastewater in respect of the expected theoretical value is explained by a highly developed surface of the formed iron (III) hydroxide characterized with high adsorption capacity.

Key words: Sucrose, wastewater, oxidation, ferrate(VI).

INTRODUCTION

Wastewater from sugar refinerycontains large amount of sucrose, which significantly increase chemical oxygen demand (COD) of recipient waterover the acceptable limit from the standpoint of biodiversity protection in water flows and quality of the environment. Therefore,the COD of such wastewater should be diminished to the acceptable level before discharge into the recipient by the appropriate process of decontamination.[1-3]

The most frequently used procedure of wastewater from sugar refineries purificationis biological treatment process which is proved to be inexpensive.The disadvantages of this process are the extensiveareautilization, the slow rate of sugar decompositionand a low effluent water quality. Other processes such as oxidation with chlorine and its derivatives, ozonation or UV oxidation are not acceptable because of the formation of harmful decontamination products, or the high cost of treatments. [1]

Since the ferrate(VI) ion has been proved to be environmentally friendly very strong oxidant and disinfectant, the process of effluent water from sugar refineries treatment by ferrate (VI) could be the procedure of choice for oxidation of mono and poly saccharides. [4–7]

Sucrose is formed by a glycosidic bonding between the carbon-1 atom of glucose and the carbon-2 atom of fructose. Both the carbon-1 atom of glucose and the carbon-2 atom of fructose are the reducing ends of those respective molecules. The reducing ends of the molecules are the reactive ends, capable of further reaction. Because in the sucrose molecule the bond is formed between the reducing ends of the monosaccharides, sono further linkages are possibleand further bonding reactions are inhibited.This is a unique chemical property of sucrose among disaccharides,because in other disaccharides, such as maltose, the reducing end of one glucose molecule links to the non-reducing end of another glucose molecule forming a disaccharide with a reducing end available to a further reaction. The process of sucrose hydrolysis is possible but slow and needs high activation energy. However, the enzyme sucrase greatly reduces the activation energy and the hydrolysis proceeds quite rapidly.[1-3]

It has been already shown thatferrate(VI) oxidizes sucrosemuch harderin the respect of reducing sugars (glucose, fructose and maltose).[4-5]

In this paper the treatment of simulated sucrose wastewater from sugar refinery by the electrolitically suthetized solution of disodium ferrate(VI)is exploredbecause of development of the feasible decontamination process.

EXPERIMENTAL

Dinatrium ferrate(VI) solution is electrochemically synthesized by transpassive anodic oxidation of electrical steel in 10 M NaOH.[7]

Simulated sugar refinery wastewater is made by dissolution of sucrose from commercial white sugar (purity ≥ 99%) in demineralized water.

Corresponding ferrate(VI) solution for simulated wastewater treatment was dosed into the stirred sucrose solution. Solution was agitated with magnetic stirer first at speed of 300 min^{-1} for 3 – 4 min. and then with speed of 30 – 40 min^{-1} up to totally 30 minutes, before vacuum filtration and analysis of the filtrate.

The efficiency of ferrate(VI) as oxidant and coagulant in the decontamination of simulated sucrose wastewater process is determined by the quantitative determination of sucrose concentration in water before and after water treatment by ferrate(VI) solution.Concentration of sucrose was determined using standard COD method as the most appropriate methodbecause the sucrose wasthe lone organic compound in simulated water. COD value was measured according to standard chromate open reflux method[8] Concentration of ferrate(VI) and kinetics of the reaction process between ferrate(VI) and sucrose was measured and followed by standard chromite method and ferrate(VI) solution colorimetry with Colourwave CO 7500 UV/Vis colorimeter, UK. The solution transparency were measured at light wavelenght of 520 nm which correlates with ferrate(VI) maximum absorbance.[9-10]

All experimentshave beendoneat temperature 20±2°C.

RESULTS AND DISCUSSION

Concentration of sucrose in sintetic wastewater of 5 g $dm^{-3}$with COD value of 5.622 g $dm^{-3}O_2$which correlates with values recorded in sugar refineries wastewater, where COD varies between 0.5 mg $dm^{-3}O_2$and 20 g $dm^{-3}O_2$.[1-3]

Efficiency of decontamination process, reduction of sucrose concentration in simulated wastewater, is measured by COD determination of the filtrate.It is found in the separate experiment that blind probe of iron(III)hydroxide, possibly present as impurity in the filtrate, cannot be oxidized by chromate in experimental conditions of COD determination.

Stoichiometric and experimental dependences of COD of the treated simulatedwastewater filtrate on the dinatrium ferrate(VI) quantity added for decontaminationare presented in Fig. 1.It is evident that the effect of ferrate(VI) addition on COD decrease is much greater then expected on the base of stoichiometry, Eq. (1).

$$16\ Na_2FeO_4 + C_{12}H_{22}O_{11} + 17H_2O \rightarrow 12\ Na_2CO_3 + 8\ NaOH + 16\ Fe(OH)_3 \quad (1)$$

The increased effect of ferrate(VI) on sucrose removal from the wastewaterrelated to the expected theoretical valuecould be explained by the sucrose sorption a highly developed surface of the formed iron(III)hydroxide characterized with high sorption capacity.[4-6]

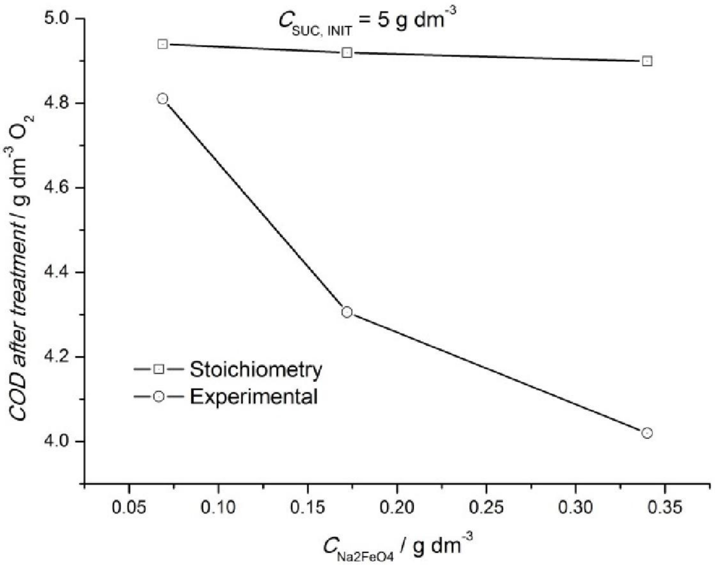

Figure 1. COD of the simulated wastewater after treatment with different concentrations of Na_2FeO_4 in reactor (initial COD value was 5.622 g dm^{-3} O_2).

This is even more evident in Fig. 2, where experimental values of sucrose concentrationdifferencein the treated wastewater between initial and final values,ΔC,are nearfour times greater than stoichiometric values.

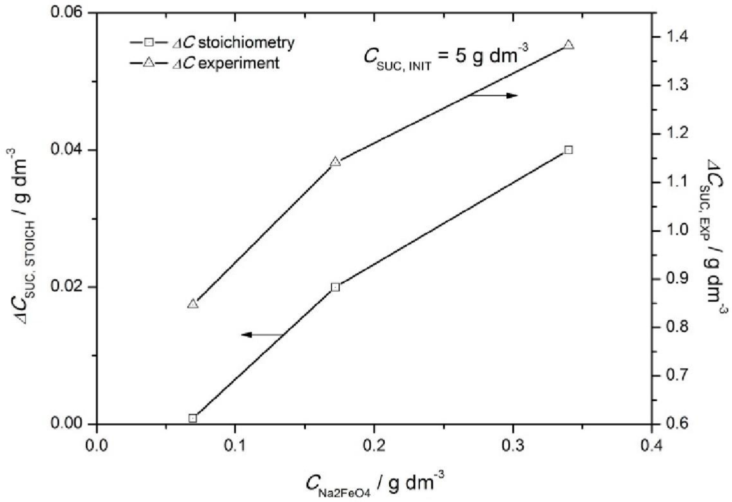

Figure 2. Stoichiometric and experimentally determined decrease of sucrose concentration in the wastewater (ΔC) after treatment with different concentrations of Na_2FeO_4 in reactor (initial concentration of sucrose $C_{SUC,INIT}$ = 5 g dm^{-3}).

The ferrate(VI) application efficiency in theprocess of sucrose decompositionin sintetic wastewater was calculated as ratio between stoichiometric oxidation of sucrose, Eq. (1), and experimentally determined reduction of sucrose concentration after farrate(VI) application, and presented in Fig. 3 as dependance on sucrose initial concentration. Obviously, the ferrate(VI) efficiency rapidly increases with decrease of sucrose concentration as the result of the sucrose sorption in the surplusof formed iron(III)hydroxide.[4-6]

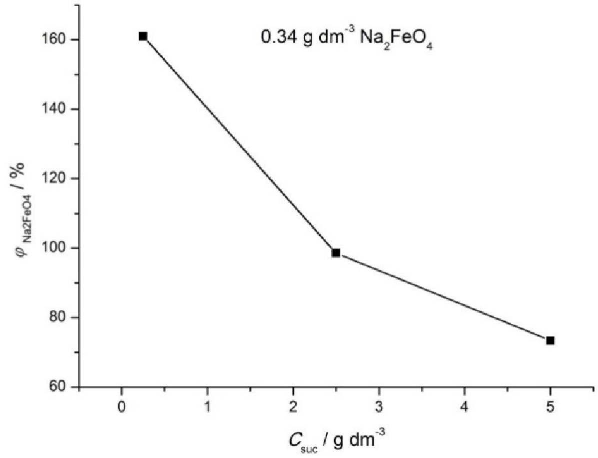

Figure 3. Dependence of the efficiency of wastewater treatment on the sucrose concentration.

The influence of wastewater pH value in the reactor on the kinetics of the sucrose oxidation by means of ferrate(VI) solution was followed as the time dependence of visible light absorbance at $\lambda = 520$ nm, Figs. 4 and 5.[9]

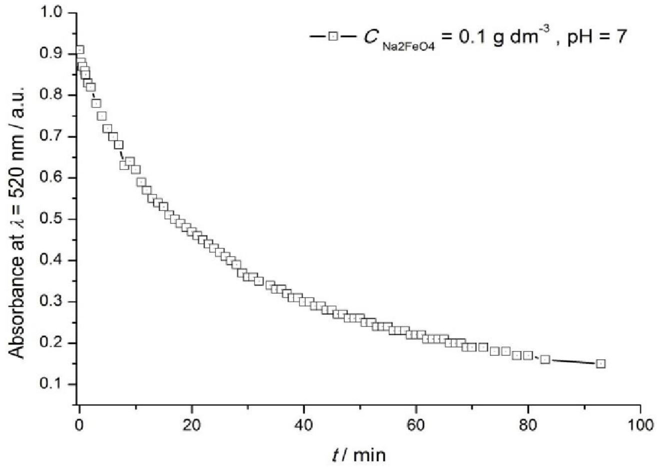

Figure 4. Absorbancedecay of the 0.1 g dm^{-3}Na_2FeO_4phosphate buffered water solution.

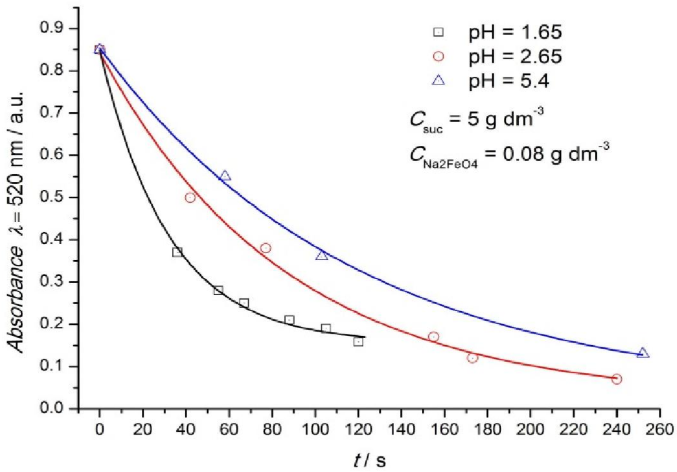

Figure 5. pH dependence of the absorbance decay with time of simulated sucrose wastewater treated with Na_2FeO_4solution.

The effect of sucrose on the decomposition rate of ferrate(VI) is clear from the dependencies shown in Figs. 4 and 5,from whichfollows that ferrate(VI) decay is 30 to 80 times faster in the simulated sucrose wastewater, depending on the pH value, in respect of buffered ferrate(VI) water solution.

Also, it is obvious from Fig. 5 that the decrease of the simulated wastewaterpH value provokes the increase offerrate(VI) decay rate, which is expected because of the ferrate(VI) redox potential and instability increase with increase of the solution sourness.[4-6]

CONCLUSION

The simulated wastewater from sugar refineries can be succesfully treated with electrochemical sunthesized solution of Na_2FeO_4. The experimental results have shown that the full effect of sucrose wastewater COD reduction is much more result of the sucrose sorption in the iron(III)hydroxide, generated in the proces of ferrate(VI) reduction, than of the process of sucrose oxidation with ferrate(VI) alone. Also, the positive influence of wastewater acidification on reaction rate of sucrose oxidation by ferrate(VI) is confirmed.

Acknowlegment

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INFLUENCE OF THE REBURNING ON NO_X REDUCTION

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ABSTRACT

Implementation of stringent regulations of NO_x emission requires the development of technologies for NO_x removal from exhaust gases. Different strategies to reduce the amount of NO_x realized into the environment from combustion devices have been developed. Among the so-called primary methods of the decrease of the NO_x emissions, the flue gas recirculation and the reburning are by far the most widely used in industry because they prevent NO_x formation in accordance with the limit level of the regulation at a lower cost acceptable to manufacturers. In this paper the implementation of reburning was analysed on the test combustion facility regarding its reduction effectiveness in the course of combustion process. The natural gas is used as a primary gaseous fuel and as reburn fuels – natural gas and synthesis gas (wood-gas), produced by biomass (wood-wastes) gasification in the gasifier. Standard industrial partially premixed gas burner is considered as a candidate for implementing strategies for control of the pollutant emissions. The reburning was shown as the very effective method resulting in a reduction of the NO_x emissions by up to 40% with natural gas and up to 24% with wood gas as the reburn fuel.

Key words: combustion process, natural gas, NO_x emissions, reburning.

INTRODUCTION

Nitrogen oxides are a significant threat to the environment, and combustion systems are a major source of these pollutants. Bearing this in mind, the development of efficient, low polluting combustion systems is a major goal of combustion researchers. Burner is always one of the key components of any combustion system. There are many factors related to the design of a burner that have significant impact on the emissions from its flame.

Many so-called “advanced” combustion techniques, such as the High Efficiency Combustion (HEC), are new developed combustion technologies that combine high thermal efficiencies with reduced NO_x emissions. Given their high investment costs at replacement the existing combustion systems, the focus of this paper is given on retrofit measures using commercially available technologies for lowering NO_x emissions on the existing furnaces equipped with conventional combustion technologies.

Different strategies to reduce the amount of NO_x realized into the environment from combustion devices have been developed, where the reburning is one of the so-called primary methods used to prevent NO_x formation in accordance with the limit level of the regulation at a lower cost [1]. The air and fuel staging method, called also reburning or fuel staging, was applied in this paper as the staged combustion technology unlike other primary methods based on decreasing the temperature in the combustion zone. Nowadays, reburning is shown as one of the most efficient and attractive NO_x reduction techniques [2–4].

Reburning is a combustion that takes place in three stages (Fig. 1):

- In the first stage (main or primary combustion zone) a greater part of fuel is burned, in little air excess: combustion is almost completed, with few unburnt hydrocarbons;
- In the second stage (reburn zone) only "secondary" fuel is injected, to create a reducing zone (with fuel excess, i.e. air-fuel-ratio $n < 1$). NO is reduced via reactions with hydrocarbons and hydrocarbon intermediates, such HCN. The chemistry of the reburning process is very complex and involves a large number of reactions of formation and consumption of many different species. Several kinetic models have been reported to describe the reburning process with different levels of detail and prediction [6–9], providing an overall understanding of the interaction among hydrocarbon and nitrogen species. Natural gas is shown as the most efficient reburn fuel, but also other fuels such as synthesis gas produced by biomass gasification can be used [10-12];
- In the third stage only air is injected (over fire air, OFA), to provide the final burnout of the reburn fuel.

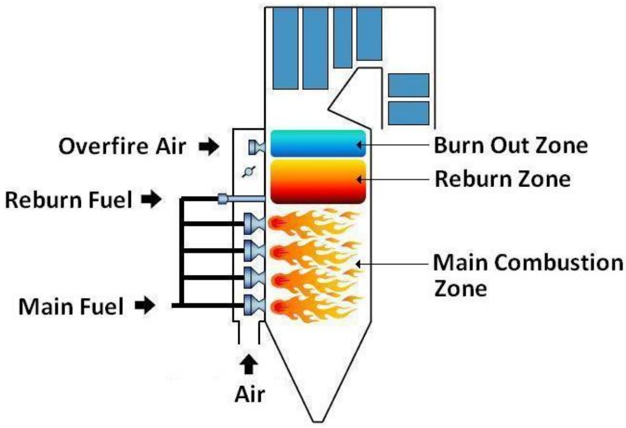

Figure 1. Industrial boiler equipped with reburn NO_x control [5]

This paper presents the result of a series of laboratory tests to determine the emissions of nitrogen oxides from the standard conventional partially premixed gas burner, which is applied very often in industrial practice. Natural gas was used as a fuel. The natural gas and synthesis gas (wood-gas), produced by biomass (wood-chips) gasification in the gasifier, were used as the reburn fuels. The objective of this work was to investigate the effect of the quantity of the reburn fuels on pollutant emissions of nitrogen oxides.

EXPERIMENTAL FACILITIES

Experimental data were obtained from the experimental facility (**Fig. 2**) intended for testing the efficiency of reburning as one of the main primary methods of the decrease of the NO_x emissions. It is composed of a ceramic cylinder with an internal diameter of 0.1 m, external diameter of 0.18 m and height of 0.28 meters. The total height of reburning facility is 1.7 m. In the main combustion zone natural gas was burned as a main fuel and as oxidant was used non-preheated atmospheric air. After the main combustion zone, a reburn fuel (first natural gas, and then wood gas) is injected into the reburn zone, thereby establishing fuel-rich conditions.

The temperatures of the flue gases were measured by means of thermocouples in seven points: T1 and T2 in the main combustion zone, T3 at the beginning of the reburn zone, T4 at the end of the reburn zone, and T5, T6, T7 in the rest of flue duct. Combustion product samples were taken continuously using a multi-point stainless steel probe. The major gas-phase species concentrations were detected by the chemical measuring cells in Testo flue gas analyzers: at the position A1 TESTO 325 (CO, O_2, CO_2 and *n*), and at the position A2 TESTO 350 – XL (NO_x, CO, O_2, CO_2 and *n*).

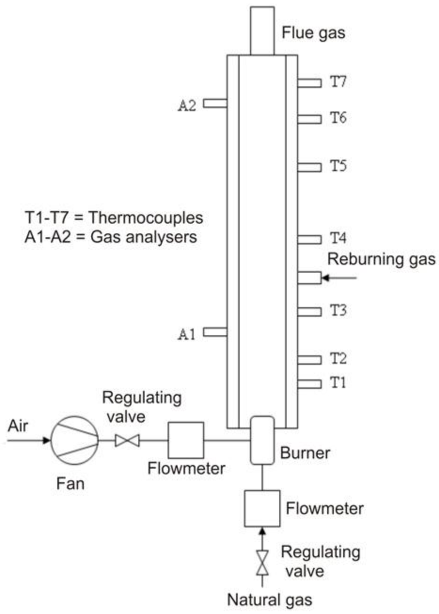

Figure 2. Scheme of the test combustion facility with measuring equipment

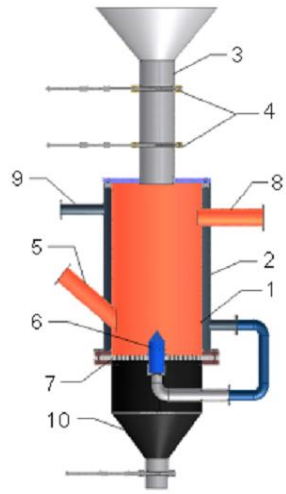

Figure 3. Schema of fixed bed gasifier:
1 - reactor, 2 - air preheater, 3 wood feeding,
4 – fastening, 5 - ignition opening (pilot-igniter)
6 - nozzle, 7 - grid, 8 - wood gas exit,
9 - combustion air inlet, 10 - ash container

The wood gas generator is a gasification unit which due to the incomplete combustion of biomass produces the combustible gases consisting of atmospheric nitrogen, carbon monoxide, hydrogen, traces of methane, and other gases. The resulting gas mixture is called *wood gas* or *syngas* (from *synthesis gas* or *synthetic gas*) or *producer gas*. Lower heating values of wood gases are generally around 4-6 MJ/m^3.

The gasification system, presented in Fig. 3, is the simplest type of gasifier consisting of a cylindrical space for fuel feeding unit, an ash removal unit and a gas exit. In such a counter-current fixed bed ("up draft") gasifier the producer gas is drawn out from the top of the fuel bed while the gasification reactions take place near the bottom. The fuel bed moves slowly down the reactor as the gasification occurs. As the producer gas passes through the fuel bed, it picks-up volatile matter (tars) and moisture from the fuel. Therefore, the gas from the updraft gasifier contains condensable volatiles. The design and operation of the gasifiers is such that the max. fuel supply is 55 kg/h, the temperature in the reactor is in the interval of 250÷350°, the temperature of preheated combustion air is around 250°C, and the gas comes out with the flow rate of 120÷150 m^3/h at 200÷350°C temperature. At this temperature of the producer gas, most of the volatile hydrocarbons are in vapor form, which add to the energy content of the gas. As in this case, it is most appropriate to utilize updraft gasifiers in close-coupled-hot gas mode for direct combustion applications, i.e. without a gas cooling and cleaning system. The characteristics of produced wood gas are shown in Table 1.

Table 1. Characteristics of wood gas

Outlet temperature	Heating value	Volumetric flow	Content, %					
t, °C	h_{LHV}, MJ/m^3	q_V, m^3/h	H_2	CO_2	CO	CH_4	O_2	N_2
200÷350	4.7	120÷150	10.6	12	23	3.33	0.52	48.9

EXPERIMENTAL RESULTS

The experimental investigations were done at the flow rate of natural gas of 1.4 m^3/h and 1.6 m^3/h, varying at each flow rate the value of air-fuel-ratio in the range of n = 1.1; 1.15; 1.2 and 1.25.

The impact of the reburning process parameters on NO_x formation at reburn fuel input of 0-10-15-20%, in the temperature range from 1150°C to 1350°C, were investigated. Temperatures and concentrations readings were recorded over a period of approximately one hour for continuous operation at steady state conditions with regard to the set values.

Effect of the percentage of reburn gases on the measured peak temperatures of combustion gases at the flow rate of natural gas of q_V = 1.4m^3/h and n = 1.1 are shown in Fig. 4 and 5. As it can be seen, the temperatures (T1, T2, T3) in the main combustion zone are reduced after injection of reburn fuel, creating thereby a reducing atmosphere suitable for the reduction of NO_x emissions. Above the reburn zone, the temperatures T5, T6, T7 are increased as a result of mixing the combustion products of reburn fuel and main fuel. The temperature at the point of injection was around 1170 ° C.

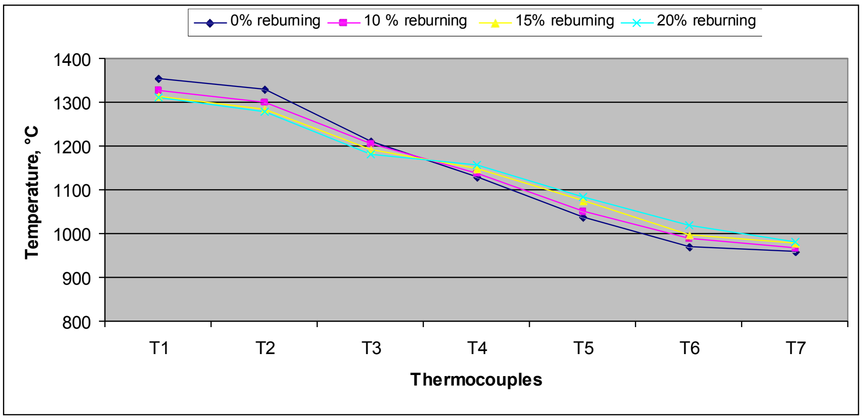

Figure 3. Effect of the percentage of natural gas on the peak temperatures of flue gases at $q_V = 1.4m^3/h$ and n = 1.1

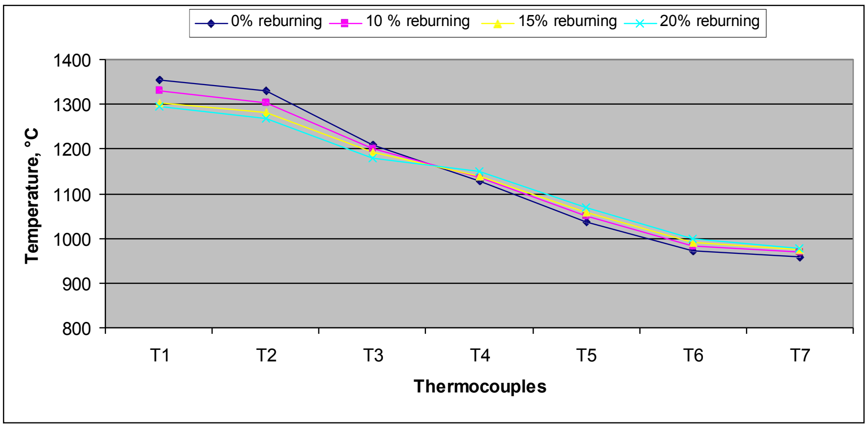

Figure 4. Effect of the percentage of wood gas on the peak temperatures of flue gases at $q_V = 1.4m^3/h$ and n = 1.1

In **Fig. 5** is shown the influence of the quantity of reburn gases on the NO_x emissions in flue gases and in **Fig. 6** the comparison of the reburning efficiency of natural gas and wood gas in the decreasing NO_x emissions at $q_V = 1.4m^3/h$ and $n = 1.1$.

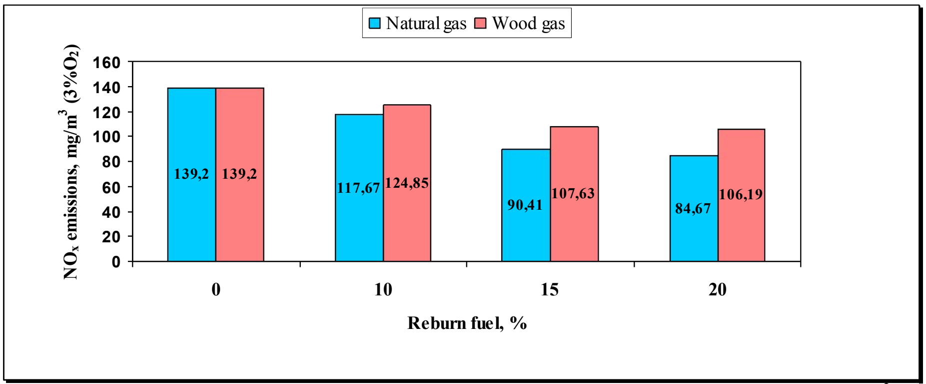

Figure 5. Effect of the percentage of reburn gases on NO_x formation at $q_V = 1.4 m^3/h$ and $n = 1.1$

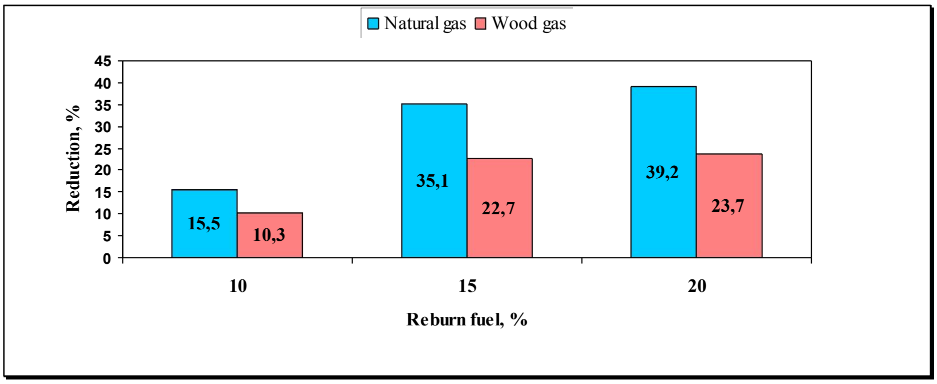

Figure 6. Comparison of the reburning efficiency of natural gas and wood gas in the decreasing NO_x emissions at $q_V = 1.4 m^3/h$ and $n = 1.1$

Using natural gas as a reburn fuel the lower emissions of NO_x in the flue gases are achieved. The lowest emissions, i.e. the maximum reduction of NO_x emission of 39.2 % with natural gas and 23.7 % with wood gas were achieved at a percentage of reburn gases of 20%.

CONCLUSION

At the present time, the advances made in the standard burners have succeeded in lowering NO_x emissions to levels below 200 mg/m^3 for natural gas, without using any special techniques. With regard to regulations lowering emissions thresholds to 100 mg/m^3 or less, where such changes made, this would give rise to the development of low-cost technologies for further lowering oxides of nitrogen.

According to the study results, the reburning was shown as the very effective method resulting in a reduction of the NO_x emissions by up to 40% with natural gas and up to 24% with wood gas as the reburn fuels. Regardless of the lower reburning efficiency compared to natural gas, the energy derived from biomass gasification and combustion of the producer gas is considered to be a source of *renewable energy*, since the gasified compounds were obtained from biomass. Accordingly, biomass gasification and combustion could play a significant role in a renewable energy economy, because biomass production removes the same amount of CO_2 from the atmosphere as is emitted from gasification and combustion.

Gasifiers, besides for reburning purpose, offer a flexible option for thermal applications, as they can be retrofitted into existing gas fueled devices such as ovens, furnaces, boilers, etc., where syngas may replace fossil fuels.

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QUALITY OF LIMESTONE-BASED MATERIAL IN ENVIRONMENTAL PROTECTION

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ABSTRACT

Limestone is a sedimentary carbonate rock composed of calcite and aragonite as minor element. Application of limestone exceeds overall application of all other nonmetallic minerals together. Limestone-based assortments have a very wide range of applications. This paper is a review of limestone-based materials which are used in some segments of environmental protection. It also presents a review of quality parameters these materials are required to meet in order to be used in those segments of environmental protection.

Key words: limestone, assortments, quality parameters, environmental protection.

INTRODUCTION

Calcium carbonate raw materials appear in various forms, which is a consequence of structure and texture depending on primary the genesis and subsequent changes. The degree of frequency and shape of crystal phase (calcite) also depend on these conditions. Apart from calcite, some other mineral components which decrease limestine quality appear frequently.

Limestone is sedimentary carbonate rock composed of calcite and aragonite as minor element [1]. Depending on the mineral composition and the content of impurities in limestone, there are dolomitic, marl, silicified, bituminous and other varieties of limestone. Impurities or minor minerals in limestone are dolomite, siderite, opal, chalcedony, quartz, clay minerals, iron oxides and hydoxides etc. Limestone is of light gray color, its texture is massive and homogenous. Its fracture is flat or fossil shells can be seen, surface is sugary, and fracture borders are sharp. It reacts vigorously with 5% HCl. When determining the possibility of its use, technical properties and chemical composition of limestone are being evaluated. Technical properties of limestone which are investigated are usually mass density without pores and hollows, mass density with pores and hollows, absolute porosity, absorption of water into rock, dry condition compressive strength, wet condition compressive strength, compressive strength after freezing, flexural strength, mechanical abrasion resistance, resistance to freezing etc.

Determination of chemical composition includes analyses of calcination losses, undissolved SiO_2 content, Al_2O_3, Fe_2O_3, P_2O_5, CaO, MgO, MnO, K_2O, SO_2, S, pH, undissolved in HCl.

Author Brzaković in his book says: "The importance of limestone in respect to all other rocks of any origin is proven by the fact that its use exceeds total use of all other rocks together". Limestone in construction material industry is used for:

- lime and Portland cement
- architectural stone
- stones and stone aggregates for construction of hydraulic structures, civil engineering construction and railway substructure
- aggregatesfor concrete (building construction and precast concrete elements)

APPLICATION OF LIMESTONE-BASED MATERIALS IN ENVIRONMENTAL PROTECTION

Application of limestone-based products depends on physical and chemical properties of limestone. Products (assortments) based on limestone are used in a large number of industries. It is most widely used in construction industry for preparation of mortars, concrete mixtures, in production of various types of cements, lime and as crushed stone of various sizes in civil engineering construction [3].

Table 1. presents a review of possible applications of limestone-based materials in environmental protection.

Table 1. A review of possible applications of limestone-based materials in environmental protection.

Ecosystem		Application of limestone-based materials
1	Air	Material for desulfurization of flue gasses in thermal power plants (SO_2)
2	Water	Material for neutralization (pH regulation) of acidic waters
3	Soil	Soil recultivation material Soil calcification material
4	Animal feed	Animal feed supplemet as Ca (animal flour or animal chalk)

Application of limestone-based materials in air protection

Limestone-based materials are used in flue gas desulfurization in termal power plants (SO_2). Desulfurization system consists of equipment for flue gas cleaning by wet process, so called flue gas scrubbing by limestone suspension. This process requires large amounts of limestone brought from limestone quarries [4]. Limestone for desulfurization is obtained in mines and it is processed in quarries until the required parameters are obtained. After processing it is transported to storage houses in plants. Gypsum suspension which is obtained as a byproduct of flue gas desulfurization in wet limestone process is a potential raw material for gypsum obtaining. Quality of gypsum depends on several factors, primarily on raw material quality (limestone and water).

Quality requirements which limestone-based materials are suposed to meet in order to be used for flue gas desulfurization (FGD) in thermal power plants are presented in Table 2 [5].

Table 2. Quality requirements for limestone for FGD

Parameters	Units	Sample condition	Powdered (bulk) gypsum	Gypsum blocks
Humidity	Weight %	On delivery	$\leq$5.0	$\leq$5.0
Total $CaCO_3$	Weight %	Dry	$\geq$89.0	$\geq$94.0
Total $MgCO_3$	Weight %	Dry	$\leq$4.0	$\leq$3.0
Undissolved residue including SiO_2 (acid insoluble)	Weight %	Dry	--------	
SiO_2	Weight %	Dry	$\leq$5.0	$\leq$3.0
Fe_2O_3	Weight %	Dry	---------	$\leq$0,8
Inert substances (including $MgCO_3$)	Weight %	Dry	$\leq$11.0	$\leq$6.0
Granulometric analysis	Millimeters	Dry	-19.05+0	-19.05+0
Bond Work Index	kWh/T	On delivery	$\leq$ 12.0	$\leq$12.0

Application of limestone in soil conservation

Materials for soil calcification are obtained from limestone, among other minerals. There are over 50% of acidic soils in Serbia, which are one of the important causes of low herbal productivity [6]. This is the reason why in spite of the increased investments into standard agrotechnical measures no desired results are obtained due to the decreased fertility caused by lack of calcium. Adding limestone induces reaction with carbon dioxide and water from soil and produces calcium and magnesium carbonates. There is also a reaction with acidic colloid complexes in which calcium and magnesium replace hydrogen and aluminum. In these reactions carbon dioxide is produced and pH value of the soil is increased to the required level. Alkaline soils with pH over 7 benefit form limestone adding, too, since nitrogen fertilizers, which induce acid reactions with soil, are better utilized when in combination with limestone [7]. As for this application powdered limestone from variouf filters is used, it is agglomerated by pelletizing and briquetting processes [7]. This provides material of the required size, convenient for transport, manipulation and application, and at the same time of the size small enough to be dissolved under the influence of weathering and evenly distributed in soil.

Quality requirements for evaluation of applicability of calcium carbonate products for application in neutralization of acidic soils ("Official Gazette of the Republic of Serbia" No. 60/2000) are presented in Table 3 [8].

Table 3. Quality requirements for evaluation of applicability of calcium carbonate product for application in neutralization of acidic soils

Property	**Quality requirements, ("Official Gazette of the Republic of Serbia" No. 60/2000**		**Investigation according to the standard**
Appearance	Powder, beige color, no odor		
Moisture content at	0.06		SRPS B B8 050
Sollubility in HCl, in %	97.8		SRPS B B8 081
Granulation, in %	+0.5 mm	82	SRPS L J0 002
	-0.5+0,1mm	18	
Chemical composition (biogenic components)			SRPS B B8 070
Components	Content		
$CaCO_3$, in %	94.00		
CaO, in %	53.62		
MgO, in %	0.40		
P_2O_5, in %	0.014		
K_2O, in %	0.00		
Fe, in mg/kg	276		
Mn, in mg/kg	44		
Zn, in mg/kg	21		
Cu, in mg/kg	7		
Co, in mg/kg	12		
Heavy metals impurities			
Cr, in mg/kg	8.0		
Pb, in mg/kg	12.0		
Ni, in mg/kg	1.1		
Cd, in mg/kg	0.0		

Application of limestone as animal feed supplement

Animal chalk and animal flour are used as animal feed supplements. These are limestone-based materials. Quality requirements for evaluation of applicability of calcium carbonate products in animal feed production ("Official Gazette of the Republic of Serbia" No. 31/78, 6/81, 2/90, 20/00 i 38/2001) are presented in Table 4.

Table 4. Quality requirements for evaluation of applicability of calcium carbonate products in animal feed production

<table>
<tr><th>Property</th><th>Investigation according to the standard</th><th colspan="3">Quality requirements ("Official Gazette of the Republic of Serbia" No. 31/78, 6/81, 2/90, 20/00 i 38/2001)</th></tr>
<tr><td>Color</td><td></td><td colspan="3">White or light gray</td></tr>
<tr><td>Odor</td><td></td><td colspan="3">No odor</td></tr>
<tr><td>Class content</td><td>SRPS L J0 002</td><td colspan="3">100</td></tr>
<tr><td>$CaCO_3$, (%)</td><td rowspan="7">SRPS B B8 070</td><td colspan="3">Min. 94</td></tr>
<tr><td>Water, (%)</td><td colspan="3">< 2</td></tr>
<tr><td>Mg salts, (%)</td><td colspan="3">< 2</td></tr>
<tr><td>CaO, (%)</td><td colspan="3">53</td></tr>
<tr><td>MgO, (%)</td><td colspan="3">1</td></tr>
<tr><td>SiO_2, (%)</td><td colspan="3">5</td></tr>
<tr><td>Fe_2O_3, (%)</td><td colspan="3">0.2</td></tr>
<tr><td>IMpurities (sand, clay etc.), (%)</td><td>SRPS B B8 038</td><td colspan="3">< 1</td></tr>
<tr><td rowspan="2">Pb, ppm</td><td rowspan="9">SRPS B B8 070</td><td colspan="2">Animal feed</td><td>10</td></tr>
<tr><td colspan="2">Phosphate mineral feed</td><td>30</td></tr>
<tr><td rowspan="5">Cu, ppm</td><td rowspan="5">Animal feed for</td><td>Calves up to 6 weeks</td><td>30</td></tr>
<tr><td>Sheep</td><td>12</td></tr>
<tr><td>Pigs up to 16 weeks</td><td>200</td></tr>
<tr><td>Other categories of pigs</td><td>125</td></tr>
<tr><td>Other domesticated animals</td><td>50</td></tr>
<tr><td>Mn, ppm</td><td colspan="3">250</td></tr>
<tr><td>Zn, ppm</td><td colspan="3">2000</td></tr>
</table>

CONCLUSION

This paper shows that limestone-based assortments can be used for environmental protection. Materials used in ecosystem protection protect water, air and soil, and some assortments (animal chalk and animal flour) are used as animal feed supplements. Limestone used for these purposes must fulfill quality requirements of standards for the exact field of application. In order to analyze limestone application from a particular location for these purposes, the first and the basic requirement is minimum 94% of $CaCO_3$ content.

Acknowledgements

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INHIBITION OF ARTIFICIAL SEAWATER INDUCED BRASS CORROSION BY AMINO ACID

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ABSTRACT

Corrosion of brass in artificial seawater, as a potential threat to the environment, was studied by electrochemical methods. In order to avoid toxic organic compounds cysteine was used as a promising environmentally friendly corrosion inhibitor. Results indicated that cysteine can be efficient inhibitor of brass corrosion in seawater. The inhibition efficiency increases with cysteine concentration increase. Mode of its action includes adsorption and formation of complex with Cu^{+} ions. Cysteine acts predominantly as cathodic inhibitor.

Key words: brass, electrochemical corrosion, artificial seawater, cysteine.

INTRODUCTION

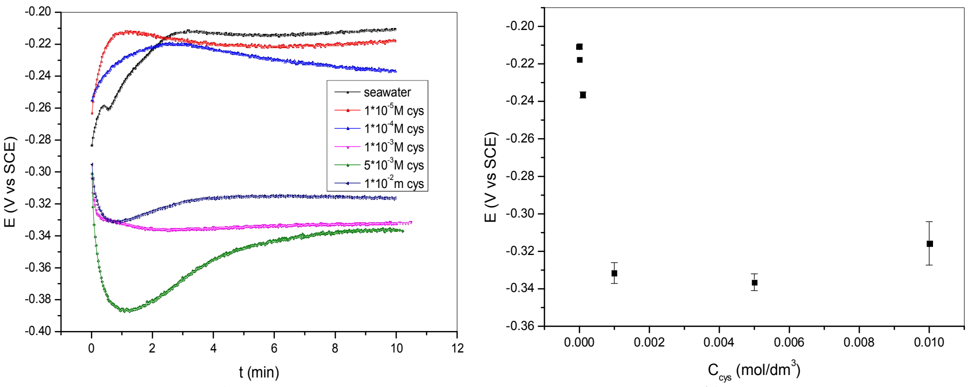
Brass is one of the most widely used copper alloys, primarily due to its stability in various aggressive media. Marine environment, i.e. seawater, presents very wide area where metals and alloys are used for various applications. However, it is very corrosive environment causing brass dissolution [1]. This process may pose a threat to the environment; hence, diminishing corrosion of metals is of extreme importance. One of the most efficient and economical ways of achieving this is by using organic compounds [2]. However, the application of the organic compounds can be limited due to their toxicity. Thus, in the last few years, investigations have been conducted in order to find corrosion inhibitors having no harmful effect on the environment. Amino acids [3,4] and amino acids derivative [5] have shown to be promising environmentally friendly inhibitors. Among the investigated amino acids, cysteine occupies a special place [6,7] and was shown to be good brass corrosion inhibitor [8].

MATERIALS AND METHODS

The working electrode was made of Cu37Zn brass. The reference electrode was a saturated calomel electrode (SCE), whereas the auxiliary electrode was made of platinum. The experiments were conducted in artificial seawater (the exact composition (g dm^{-3}): 24.530 NaCl; 5.200 $MgCl_2$; 4.090 Na_2SO_4; 1.160 $CaCl_2$; 0.201 $NaHCO_3$; 0.101 KBr; 0.027 H_3BO_3), and in seawater containing various concentrations of cysteine ($1\cdot10^{-2}$ M; $5\cdot10^{-3}$ M; $1\cdot10^{-3}$ M; $1\cdot10^{-4}$ M; $1\cdot10^{-5}$ M).The following methods were applied: the open circuit potential (OCP) measurements, potentiodynamic polarization in the form of linear and cyclic voltammetry. The open circuit potential was determined for 10 min upon which polarization curves were recorded. Linear voltammograms were recorded from the open circuit potential to 0.15 V (SCE) in the anode direction and to -0.7 V (SCE) in the cathode direction, at a scan rate of 1 mV s^{-1}. Cyclic voltammograms were recorded between the open circuit potential and 0.85 V (SCE), at a scan rate of 10 mV s^{-1}. All measurements were done at room temperature in naturally aerated solutions. The potential was expressed relative to the saturated calomel electrode (SCE).Detailed procedure of electrode preparation and description of apparatus are given elsewhere [8].

RESULTS AND DISCUSSION

Brass behaviour in artificial seawater solution with and without the addition of the inhibitor was examined employing several methods, one of which was the open circuit potential measurement. The initial increase of the E_{OCP}value in the seawater with $1\cdot10^{-5}$ and $1\cdot10^{-4}$mol/dm^3 cysteine points to the retardation of the cathode process, most probably caused by theinhibitory effect of the amino acid present in the medium and deposition ofcorrosion products[9]. However, an initial decrease in $E_{OCP}$is observed in the solutions with higher cysteine ammount ($1\cdot10^{-3}$-$1\cdot10^{-2}$mol/dm^3) due to the dissolution of the electrode oxide films, after which E_{OCP} slightly increase to the steady values (Figure 1A). That increase of the E_{OCP}corresponds to the formation of a protective layer on the electrode surfaces[6]. Moreover, Figure 1B shows that with the addition of cysteine within the studied concentration interval ($1\cdot10^{-5}$-$1\cdot10^{-2}$mol/dm^3), the open circuit potential becomes more negative in the whole interval. This shift of the OCP can be accounted for by the adsorption of cysteine molecules on the metal surface [7] and the formation of a complex between cysteine and copper oxidation products [10].



a) b)

Figure1. Open circuit potential of Cu37Zn brass in artificialseawater with and without the addition of various cysteine concentrations

Cyclic voltammetry curves (Figure 2) recorded upon brass polarization in artificialseawaterreveal that cysteine acts like corrosion inhibitor in the investigated conditions.Results suggest that cysteine in concentration of $1\cdot10^{-4}$mol/dm^3 promote dissolution of brass to potential of 0.2 V vs SCE and then current density decrease below the value of current density in blank solution of artificial seawater. Further increase of cysteine concentration decreases current density, which is indicating an increase in inhibitory activity with increasing concentration of the inhibitor.Since zinc is a more electronegative metal than copper, the dissolution of zinc is expected to occur at lower potentials according to the equation [11]:

$$Zn = Zn^{2+} + 2e^-$$

After that, at higher potential, in the environments with chloride ions the accepted anodic reaction is the dissolution of copper through oxidation of Cuto Cu^+[4]:

$$Cu = Cu^+ + e^-$$

Afterwards Cu^+ reacts with Cl^-:

$$Cu^+ + Cl^- = CuCl$$

CuCl has poor adhesion and can't provide enough protection for the further brass dissolution, insteadsoluble $CuCl_2^-$is formed[12]:

$$CuCl + Cl^- = CuCl_2^-$$

Also, Cu_2O can be formed, due to precipitation reaction or direct electrochemical or chemical formation from the cuprous chloride[12]:

$$2CuCl_2^- + 2OH^- = Cu_2O + H_2O + 4Cl^-$$

Besides, in the presence of cysteine, Cu^+ ions react with cysteine when it is present in somewhat higher concentration in the solution and form a protective complex [13]:

$$Cu^+ + cysteine = Cu(I) - cysteine + H^+$$

According to the cysteine structure it can be said that the mercapto group has a significant role in the protective activity enabling cysteine adsorption on the metal surface [14].On the basis of these results the experiments were continued in order to determine corrosion potential and corrosion current density.Cathodic and anodic polarization curves recorded in artificial seawater in the presence of cysteine in the wide concentration range ($1\cdot10^{-5}$-$1\cdot10^{-2}$mol/dm^3) are presented in Figure 3.

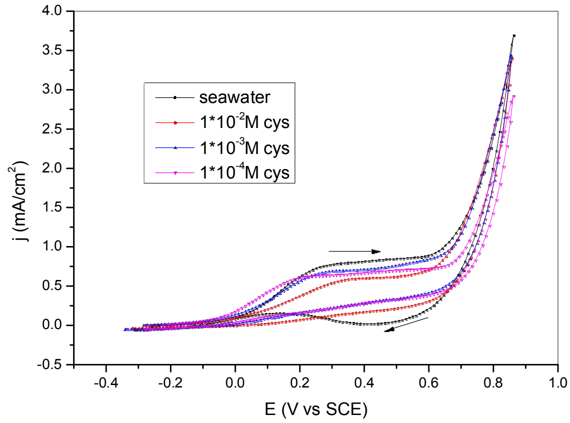


Figure2. Cyclic voltammograms for brass in artificial seawater with the addition of cysteine. v=10mV/s

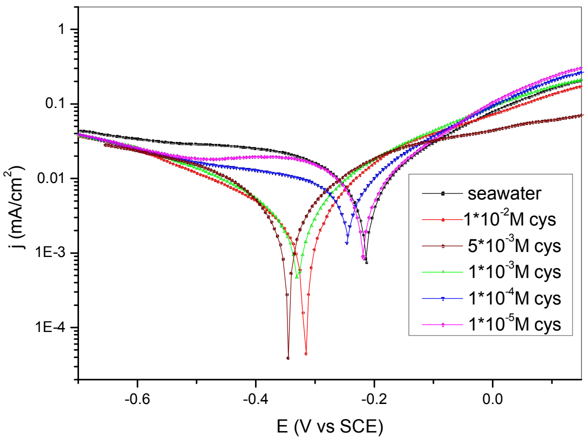


Figure3. Polarization curves of brass in artificial seawater with the addition of cysteine. v=1mV/s

The addition of cysteine decreases significantlycathodic current density especially in the vicinity of the open circuit potential. Electrochemical parameters, such as corrosion potential (E_{corr}), corrosion current density (j_{corr}) and cathodic and anodic Tafel slopes ($b_c$andb_a), of brass corrosion are presented in Table 2.

Besides the kinetic parameters inhibition efficiency (IE) is given in Table 2. IE is calculated according to the following equation:

$$IE = \frac{j_{corr} - j_{corr(inh)}}{j_{corr}} \times 100[\%]$$

Wherej_{corr} and $j_{corr(inh)}$ represent corrosion current density, without and with the addition of the cysteine, respectively.

Table 2. Electrochemical parameters of brass oxidation in artificial seawater in the presence of varying cysteine concentrations

C_{cys}, mol/dm^3	E_{corr}, V vs SCE	j_{corr}, μA/cm^2	b_c	b_a	IE, %	θ
/	-0.214	9.1	-0.347	0.221	/	/
$1\cdot10^{-5}$	-0.216	5.9	-0.210	0.151	35.16	0.3516
$1\cdot10^{-4}$	-0.244	4.6	-0.231	0.135	49.45	0.4945
$1\cdot10^{-3}$	-0.333	3.4	-0.270	0.179	62.64	0.6264
$5\cdot10^{-3}$	-0.345	2.7	-0.191	0.158	70.33	0.7033
$1\cdot10^{-2}$	-0.318	2.1	-0.230	0.130	76.92	0.7692

According to the polarization curves and shift of E_{corr} values in the negative direction, in solutions with inhibitor addition in comparison with inhibitor free solution, it can be concluded thatcysteine has been adsorbed at cathodic active sites and acts ascathodic inhibitor[3].The pronounced change in inhibited cathodic and anodic Tafel slopes in the presence of cysteine, reveals the effect of inhibitors on the cathodic and anodic reactions. Also, results present in Table 2 show that the corrosion current density decreased with increasing concentration of cysteine, indicating an inhibitory effect.Cysteine is adsorbed on the brass surface and according to literature data[3, 14] a model which potentially describes adsorption mechanism is the Langmuir adsorption isotherm:

$$\frac{C}{\theta} = \frac{1}{K} + C$$

where K represents adsorption constant, C stands for cysteine concentration, whereas θ represents the degree of surface coverage. The relationship between the adsorption constant and adsorption energy can be expressed as:

$$K = \frac{1}{55.55} e^{\frac{-\Delta G_{ads}}{RT}}$$

where ΔG is adsorption energy, R stands for a universal gas constant and T is thermodynamic temperature (298 K). The collected experimental data can be fitted in a way to express a linear corelation between cysteine concentration added to testedsolution and the ratio c/θ (Figure 4), which confirms the adequacy of the proposed Langmuir model. This means that each cysteine molecule replaces one water molecule on the brass surface. The slope of the Langmuir isotherm corresponding to the analysed data shows a small deviation from the ideal case as the result of the interaction between the adsorbed molecules [15].

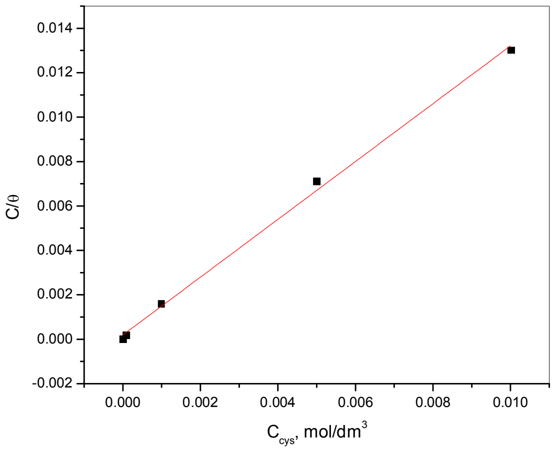


Figure 4. The Langmuir adsorption isotherm obtained from the data on brass behaviour in artificial seawater containing various cysteine concentrations

Based on the established adsorption model it is possible to calculate the Gibbs free energy of adsorption. It can be seen that the value of -31.6kJ/mol points to a strong physical adsorption with slight chemisorption of cysteine on the brass surface under these conditions.Such behaviour can be expected considering the form and structure of cysteine in neutral and alkaline solutions, since the pH value of artificial seawater is around 8.

CONCLUSION

Brass behaviour in artificial seawater solution with and without the addition of the inhibitor was examined by several electrochemical methods and the results are:

- The addition of cysteine within the studied concentration interval shifts the open circuit potential towards more negative values, which can be accounted for by the adsorption of cysteine molecules on the metal surface and the formation of a complex.
- Cyclic voltammograms reveal that cysteine acts like brass corrosion inhibitor in the investigated conditions. Increase of cysteine concentration decreases current density, i.e. increases inhibition efficiency.
- Cathodic and anodic polarization curves recorded in artificial seawater in the presence of cysteine and the shift of E_{corr} values in the negative direction, indicate that cysteine acts as cathodic inhibitor.
- Cysteine is adsorbed on the brass surface according to the Langmuir adsorption isotherm.

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REHABILITATION THE POST-MINING LANDSCAPES AND OPTIONS FOR APPLICATION IN SERBIA

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ABSTRACT

Mining usually have a strong negative impact on environment. Exploitation of mineral resources destroys vegetation, causes extensive soil damage and alters microbial communities. This paper is review of activities implemented in Serbian open pit mines for rehabilitation of the damages caused by mining and mineral proccesing to the environment. A special attention is paid to the most efficient and largely applied technologies used to rehabilitation of post-mining landscapes and options for using that area in future.

Under the remediation of degraded areas implies complex works, aimed to establish the productivity or value of previously damaged soil, and to enhance economic and aesthetic conditions of the environment.

Key words: rehabilition, remediation, post-mining, environment.

INTRODUCTION

The process used to repair the impacts of mining on the environment is rehabilitation. The long-term objectives of rehabilitation are converting an area to a safe and stable condition and restoring the pre-mining conditions as closely as possible to support the future sustainability of the location. Methods and procedures for rehabilitation of degraded land vary depending on the nature of the land, the local geographical, hydrological, climatic and economic conditions.

Rehabilitation normally comprises the following [1]:

- developing designs for appropriate landforms for the mine site
- creating landforms that will behave and evolve in a predictable manner, according to the design principles established
- establishing appropriate sustainable ecosystems.

Rehabilitation requires a comprehensive approach of mining operations, where each operational stage and each component of the mine is part of a plan which considers the full life cycle of a mine such as planning operations and final end use of the rehabilitated land. During active mining, this landscape type is labeled as destroyed landscape. After initiation of mining, the ongoing landscape development is disrupted, the original ecosystems are removed, the original topography is significantly changed, the fundamental ecological relations are irreversibly disturbed, and biodiversity is rapidly reduced [2].

Maximum planning reduces site disturbance. The emphasis is on getting and analyzing as much information as possible about the mining area. Such research provides baseline data for mine planning and essential information for the rehabilitation, when the mine area is being restored to an agreed post-mining use.

Poorly rehabilitated mines in Serbia are a big problem for government, communities and companies, and ultimately tarnish the reputation of the mining industry. Badly planning increases the costs of remediation and mine closure and decrease overall profitability. Effective mine rehabilitation can be achieved with a more integrated approach to mine rehabilitation, and if remediation is doing progressively.

It should not be assumed that the objective of all rehabilitation is some form of natural ecosystem approximating what existed prior to mining [1]. In more densely populated areas of Serbia (such as agricultural areas or sites close to population centers) a greater range of land-use options are available. In Serbia, there are a large number of coal mines, quarries, clay pits, and similar surfaces that are left after the exploitation of natural reclamation - a process that is very slow, measured in decades, and in some locations is not possible. The proper approach involves reclamation planning process, based on the databases.

A BRIEF OVERVIEW OF REHABILITATION TREATMENT IN SERBIA

The issue of rehabilitation of degraded areas by mining activity, was treated through: the Law on Environmental Protection, Law on Planning and Construction, the Law on Geological Exploration, Mining Law, the Law on Agricultural Land, Water Law, Forest Law, Regulations on the classification and categorization of minerals and their record keeping, rules about the content of mining projects, rules on the criteria for determining the location of the landfill and waste materials. Development of the project of reclamation of degraded areas is one of the mandatory environmental measures. Table 1. presents the priorities for post- mining rehabilitation.

Table 1. Post-mining rehabilitation priorities for Serbia

Restoration of land surface of sufficient quality to support pre-mining land use potential
Restoration of the ecological function of mined land and in the case of previously degraded land, the ecological function must be improved
Efficient alternative use of mine infrastructure should be encouraged where this can be economically justified; where no economic alternative uses exist, mine infrastructure must be removed and the site rehabilitated to pre-mining condition
Minimization of current and potential future impacts on water quality and supply is imperative
Job creation through education and stimulation of economic activity
Development projects to enable equitable participation in post mining economies by all members of the community
Skills and literacy training for community members

REMEDIATION OF OPEN-PIT MINES

The common practice in Serbia for rehabilitation of post-mining areas consist of formation of covers which will prevent the pollution of environment and will make possible the development of ecosystems suitable for the relevant areas.

The formation of such covers starts after suitable changes in the shape and surface of the dumps and heaps, aiming their incorporation in the surrounding landscape. In some cases even the location of some small heaps is changed [3]. This stage of technical rehabilitation is carried out in accordance with essential geo-mechanical properties of mining wastes at degraded areas. The composition and structure of the covers depend of: quantities, chemical and mineralogical composition, particle size, water, physical and chemical properties of the wastes, the local climatic conditions, the character of the future utilization of the rehabilitated area, available financial resources.

In many cases, the basic material for covering is soil transported from a location that is rather close to degraded lands by mining activities. In any case, it is first necessary perform technical reclamation and than approach to biological reclamation. Anyway, the top layer consists of a vegetative soil that is rich in humus, mineral nutrients and has its own micro flora. Such land is usually a subject of melioration processes in order to improve its quality (fertilization, ploughing, grassing, mulching and irrigation).

As the result of different mining activities, especially opencast mining and development of industries, this region had been repeatedly damaged and transformed which seriously affected the landscape's natural balance and visual characteristics. The adverse changes, processes and consequences required parallel works on rehabilitation, i.e. revitalization, recultivation and, in general, works on the management of the disturbed natural units [4]. According to some estimates, Serbia has about 300,000 ha of degraded areas, and this area is necessary to use as wiser.

The remediation of open-pit mines usually starts with stabilization of their bottoms and walls. In some cases, the pits are filed by sterile rock materials, or even low-grade ores and then the surface of pit filled in this way is recultivated some of the above specified methods. On the other hand, when the hydraulic conductivity of the bottom and walls of the pits is very low, the pits are flooded with water and become lakes. In Serbia, best examples of reclamation of surface mines are coal mines Kolubara and Kostolac. Figures 1 and 2 shows the reclaimed area of the coal mines in Kolubara and Kostolac.

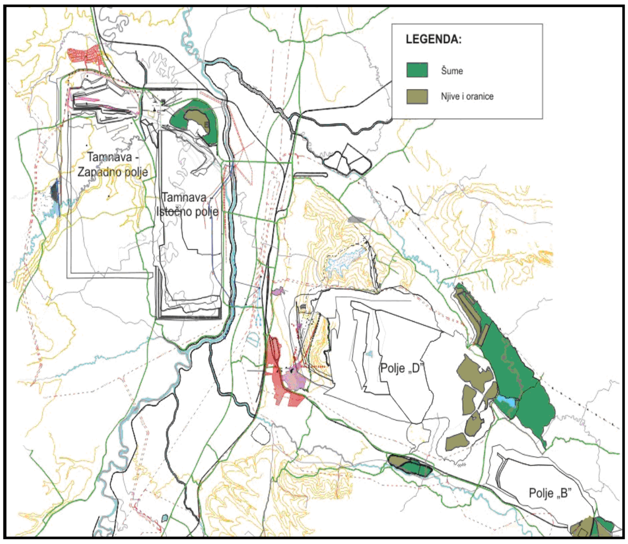

Figure 6. Recultivated areas in Kolubara coal basin

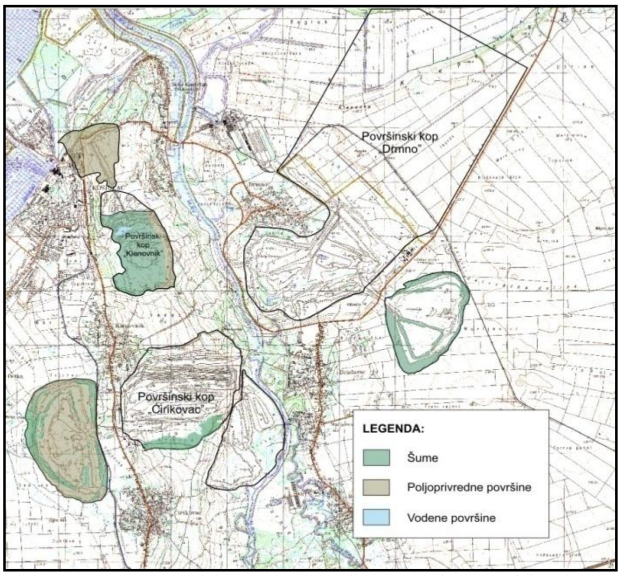

Figure 7. Recultivated areas in Kostolac coal basin

Open pits and tailings ponds from Kolubara and Kostolac mining-energy basins degraded nearly 25,000 ha of land. Of these natural and artificial reclamation covers less than 20% of the area [5]. Considering this problem is getting more and more important, especially when it comes to the development and introduction of new technologies reclamation should be noted that the current practice of reclamation post exploitation area surface mines and dumps are characterized by two groups facts: unselectively dumping of overburden and most of the forestry reclamation is carried out correctly without having completed technical reclamation (design field, landscaping slopes, carrying out of drainage works, construction of infrastructure and take other measures [6].

First planted forests in Kolubara have been raised since 1984 until today in reclaimed areas covering 897 ha. Experimentally were planted fruit raised in 1986. at the disposal site in Rudovci. On the overburden dump in Kolubara was planted Miscanthus, which has twice the energy value of lignite, it can be an excellent feedstock for biodiesel, and to help recultivation of land that man destroyed his actions. In 2008, on the reclaimed areas it was 600 ha of forest, 130 ha of arable land and 7 ha under fruits. On the experimental plots was planted more crops: alfalfa, red clover, ryegrass, tall gyrus, wheat, soybeans, barley, rye, triticale, sunflower, sorghum. In 2012 was built the experimental plantations for biomass production in the village Junkovac.

By the 2010th was established vegetation on the 623.40 ha of degraded land in Kostolac which is 22.1% of the total area of 2817,1 ha that are occupied in the past period for the exploitation of lignite. On the former landfills in Kostolac growing vineyards (experimental site on the 2 ha and area planned for planting is 15 ha), different type of fruit, alfalfa (30 ha planted), canola. More than 1.400 ha of tailings was again revived for agriculture.

The rehabilitation of ponds containing tailings from mining and mineral processing is also a big problem for Serbia. The rehabilitation of tailing ponds can start only after the complete drainage of tailings. Consolidation of the solids is performed by making and reinforcement of ballast pads. Ballast pads are reinforced by using different geosynthetic materials (geonets and geotextile). Finally, the surface of the stabilized ponds is capped, covered with soil and subjected to melioration, grassing, and reforestation [7, 8]. Figure 3 shows phases of recultivation of flotation tailing pond "Veliki Krivelj" in Bor.

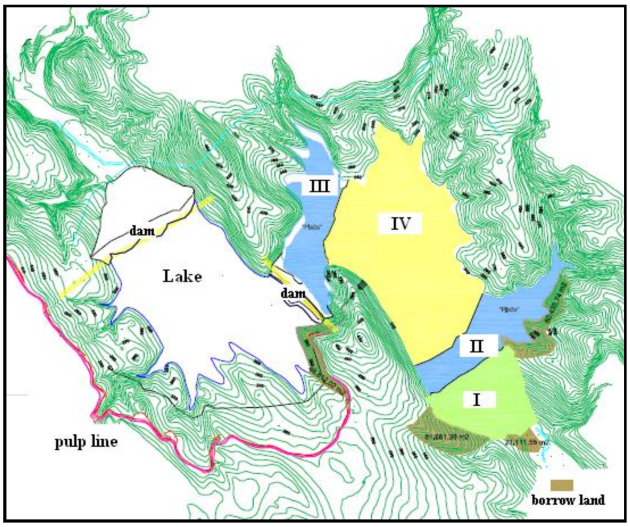

Figure 8. Recultivation of flotation tailing pond Veliki Krivelj in Bor

OPTIONS FOR USE OF THE REHABILITATED LANDSCAPES

Usually is not possible, nor necessary, to restore the landscape reclamation in identical condition before mining. Chosen form of post land use must satisfy the needs of the local population, the needs of habitats, characteristics of newly formed land, post-exploitation stratigraphy, apropos cost of [9]. Furthermore, post mining landscapes in Serbia have numerous possibilities to create a reasonable environment. This includes among others: areas for agriculture and forestry use, integrated and special areas for nature conservation and development of areas for recreation.

Part of destroyed areas in Kolubara are rehabilited. Hilly areas are reforested, and in the valleys are small lakes, which makes this area suitable for recreation. On this territory there are over 20 small lakes surrounded by colorful woods. These are all resources that can be used for recreational and sports tourism. A possible direction of development of tourism in mine areas is industrial tourism. Tours of surface mines, buildings of importance for the development of mining, old technologies (cable cars, steam locomotives and blacksmith) proved to be attractive for tourists. Kostolac already has a significant historical object Viminacium, which can only help the development of industrial tourism. Part of the reclaimed area will be used for agriculture, forestry, orcharding and viticulture.

The first time since the coal is exploited in this area of Lazarevac, will be built one village, ecological-educational area on reclaimed surface. The plan is to build 20 objects that would be constructed entirely of environmentally-friendly materials. For now, at remediate area is built amphitheater that has a surface of 1 ha. In the background, an amphitheater, with its western side, there is an excellent location in which could be formed ski slope, slight fall the length of about 400 meters. Possibilities of using reclaimed terrains are shown in Figure 4.

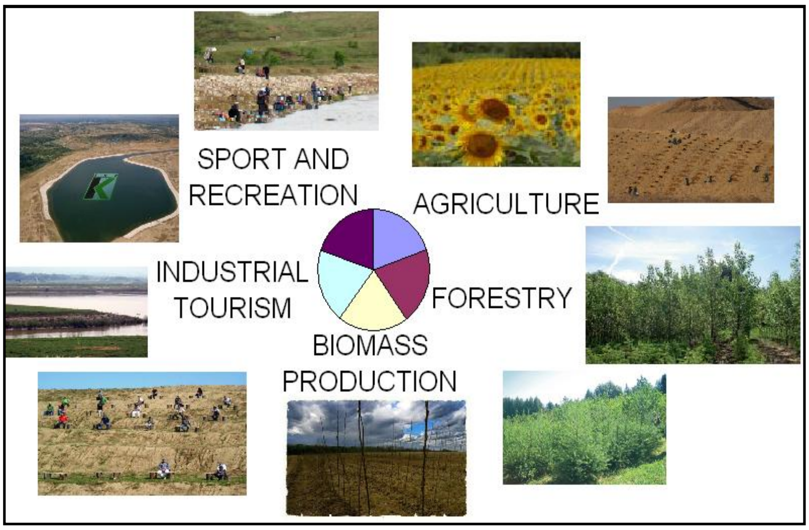

Figure 9. Options for use recultivated and rehabilited post-mining landscapes

CONCLUSION

Remediation is the principal process used to mitigate the long-term impacts of mining on the environment. Post mining rehabilitation is an essential part of developing mineral resources in accordance with the principles of leading practice sustainable development. Remediation is not a process that should be considered only at, or just before, mine closure. Rather, it should be part of an integrated program of effective planning and management through all phases of mine development and operations.

The mining industry in Serbia, indeed any industry group, is often judged by the public on the basis of its worst performers. The implementation of mine rehabilitation will result in a more satisfactory social and environmental outcome, but it can also reduce the financial burden.

In order to improve the situation and the successful development and introduction of new technologies remediation and reclamation of post mining area surface mines and dumps is necessary to establish following measures:

- Modeling spatial changes of land (geological model with the initial physical-mechanical and chemical parameters and the technological model of mine with a vertical separation of levels)
- Establish a system for monitoring land use and reclamation with the goal of improving land use and includes sampling, measurement and data processing factors and fertility toxicity of soil, especially heavy metal content
- An estimate of the pits and external dumps nine months after reclamation, measuring density of indigenous plant species developed on reclaimed land. In addition, 15 months after reclamation estimated and diversity of plant species.

Rehabilitation and restructuring of degrades areas offers many opportunities in the selection and structuring of land for the purpose and goals of human and natural communities. Selection of post-mining land use should be based on functional and cultural needs of the community environment. Previous experiences confirm the existence of the knowledge and capabilities to the areas of mining basin Kolubara and Kostolac areas and facilities provide multi-functional value.

Acknowledgements

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ACETYLENE PRODUCTION AND ITS IMPACT ON THE ENVIRONMENT

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ABSTRACT

Acetylene is produced in Montenegro only in a facility that is owned by the company "Progas" from Nikšić, and the location for production is situated within the Shipyard "Bijela" in Bijela.

At regular temperatures and atmospheric pressure acetylene represents colorless gas of weak ethereal odor. Technical acetylene, due to the presence of additives, especially hydrogen phosphorus has a pungent specific odor.

Since acetylene is unstable it cannot be transported to consumers compressed as other technical gases, but only dissolved in acetone and smashed into the porous mass called "disugas".

Bottles in which gas is transported are made of steel, filled with porous mass and acetone at a certain ratio. Bringing together acetylene and acetone under pressure gas is absorbed by acetone, which is finely distributed into pores of the porous mass. The use of acetylene is accomplished by reducing the pressure whereby acetone discharge adsorbed acetylene.

Possibility of explosion in such bins for acetylene is small, since the porous mass in the bottle in the case of early dissolution of acetylene will stop and localize the same, so that the bottle is also a safety device.

This paper will provide a brief description of the technological process of obtaining acetylene, with a description of possible impacts of this type of production on environmental quality.

Key words: acetylene, environmental impact.

INTRODUCTION

Acetylene is a compound of carbon and hydrogen, and belongs to the group of unsaturated hydrocarbons. It is a colorless and flammable gas, slightly lighter than air. Pure acetylene is odorless, but technical acetylene has a characteristic pungent odor due to additions in itself. When mixed with air it ignites at 505 ^{o}C. Combustibility with air is from 2,5 to 80% in oxygen from 2,3 to 93% by volume.

Temperature of acetylene-oxygen flame is 3160 ^{o}C. At higher pressures and acquired conditions acetylene is prone to explosive decomposition.

Main purpose of the facility for producing acetylene is:

- production of acetylene (C_2H_2) with gas washing
- drying, purification from mechanical and chemical additives of acetylene gas
- compression (compress) and cooling of gas
- charging the acetylene into bottles and storing bottles.

PROCESS FOR PRODUCING ACETYLENE

Production of acetylene takes place in the generator developer (Picture 1) in the wet process - calcium carbide and water are automatically dosed. Developer is low pressure one with P = 0.05 bar at the outlet of the generator acetylene is washed by squirting water. Gas from the developer passes through a water circuit which prevents kickback from possible ignition gas - threat developers. From water circuit gas goes into gas holder where manufactured gas is collected in the bell floating above the water and serves as a buffer, or the gas source for quiet operation of the compressor. From the gas holder gas goes to drying into batteries with calcium carbide which separate moisture from acetylene (Picture 2), then the gas goes into the chemical cleaning machine with a pad of feri chloride ($FeCl_2$), where the gas is protected from chemical additives of hydrogen sulfur and phosphorus hydrogen. Then acetylene passes through the battery for neutralization with the pad of calcium oxide (CaO) - lime, and then through the battery for the fine-drying, and finally through a filter with a pad of steel rings immersed in compressor oil, where the gas is released from mechanical impurities, the filter is the last cleaner of gas at low pressure before entering the compressor.

Picture 1. Developer's generator

Picture 2. Batteries with calcium carbide

The compressor compresses the acetylene through three stages, and each stage, through a special heat exchanger cools acetylene with water to a temperature of 20 $^{\circ}$C, then it goes to batteries for drying acetylene at high pressure, with pads from calcium chloride ($CaCl_2$), where the gas is dried from condensed moisture and impurities as the last cleaning before putting into bottles at the filling station (Picture 3). In the filling station where the bottles are connected to 2 x 36 connectors, they are filled alternately to maximum pressure of 24 bars for cooling with water over the so-called necklaces with small holes for water. Full bottles are removed from the collector, which is previously relieved from the pressure by return pipeline and measured on a scale (Picture 4); each bottle is recorded in a specially formed book with all the data and quantities of acetylene and submitted to the warehouse of full bottles (Picture 5).

Lime sludge as a by-product is discharged from the developer and through the canal in the floor (Picture 6) ends in a lime pit outside the building for deposition

(Picture 7). Accumulated water in the pit returns again to the process only for the purpose of developing acetylene in the developer.

In the filling station equipment for refilling of bottles with acetone is also set up - pneumatic device with a pump.

Picture 3. Space for bottling acetylene

Picture 4. Scales for measuring full bottles of acetylene

Picture 5. Warehouse of full bottles of acetylene

Picture 6. Canal for discharge of lime sludge from developer

Picture 7. Lime pits for deposition of lime sludge

Hourly production (q_h) of acetylene is:

q_h = 36 kg/h or 31 Nm^3/h of acetylene.

Daily production (qd) in a single shift, which lasts 7-8 h, 36 bottles are filled with an average of 7.5 kg of acetylene, resulting in:

q_d = 36 bottles x 7,5 kg/bottle = 270 kg/day of acetylene,

while monthly production (q_m) during an average of 22 working days

q_m= 22 days x 270 kg/day = 5.940 kg/m or 792 bottles/m.

Annual production (q_g) is:

q_g = 12 m x 5.940 kg/m = 71.280 kg or 9.504 bottles/year.

Calculation of capacity of volume of lime pits

Reaction of calcium carbide with water in the reactor is active, whereby acetylene gas and slaked lime are being formed by heat release and the reaction proceeds by the following formula:

$$\mathbf{CaC_2 + 2H_2O = C_2H_2 + Ca(OH)_2 + Q}$$

calcium carbide + water = acetylene + slaked lime + heat

For a complete decomposition of 1 kg of pure calcium carbide 0.562 kg of water is required. Thereby 0.406 kg of acetylene is created and 1.156 kg of slaked lime remains.

The amount of heat developed is 63.5 KJ/mol or about 1640 KJ/kg of calcium carbide.

To produce 1 kg of acetylene 3.2 kg of calcium carbide is required, i.e. from 1 kg of calcium carbide about 0.312 kg of acetylene is obtained.

Calculation of the amount of sludge produced by 1 hour of operation of the facility:

- capacity of the facility is 36 kg/h of acetylene
- consumption calcium carbide: 36 kg/h x 3.2 k.k./kg C_2H_2 = 115.2 kg/h
- water consumption: 115.2 kg/hk.k. x 10 lv/kgkk = 1152 l/h

Total volume of produced lime sludge during 8 h of operation of the facility is 8.21 m^3.

The amount of accumulated water from the lime sludge is 60% of which 80% is returned to the process.

The amount of accumulated water for operation of the facility in one shift: 8.21 m^3 of lime sludge x 60/100 = 4.93 m^3, of which 80% is recirculated, so that the rest is in the lime pit for 8 hours of operation of the facility: 4.93 x 20/100 = 0.986 m^3. It is approved that the quantity is 1 m^3. The rest is also the residue, which occasionally needs to be cleaned and medium-sized pit is sized to it.

POTENTIAL IMPACTS ON AIR, WATER AND LAND IN THE PROCESS OF ACETYLENE PRODUCTION

Impacts on air

During operation of the facility for acetylene production with filling station, as well as in calcium carbide storage, from hazardous and harmful substances that can get into the air through emission there is only acetylene. Acetylene can get into the air from the installation of the facility occasionally and in small quantities, up to 1 Nm^3 in the following manner:

- When safety valves on the compressor or the developer are opened, if automatic cancels, which is nowhere observed as occurrence, and the gas is discharged above the roof of the building, and since acetylene is lighter than air, in a vertical stream it mixes with air and neutralizes.
- When it comes to an excess in the filling station, an increase in pressure above 25 bars in the installation, or when aluminum membranes burst on 45 bars, the same gas is discharged above the roof of the building. This occurrence was not observed in any facility, and if it happens to discharged amount of acetylene is small.
- Quantities of acetylene which can leak out in the premises of the facility during discharge from the bin separator leaked moisture and oil minor amounts of acetylene are discharged in the space as well. Since acetylene is lighter than air and ventilation is natural, acetylene goes through blinds of lanterns on the roof of the building, where openings are at 1 m above the highest point of the roof, so they can never be rid of the dangerous mixture of acetylene and air.
- In the storage of calcium carbide it can come to emission of acetylene into the room just in case of failure of one of metal casks, pulling in moisture from the surrounding air and from the reaction with calcium carbide it comes to the appearance of small amounts of acetylene. However, by ventilating through lanterns in the roof, the room is protected from occurrence of dangerous mixture.

If acetone is used for refilling bottles that have lost unallowed amount, this operation is done occasionally, when enough bottles are assembled for this procedure.
The entire system for refilling of bottles with acetone is closed and it cannot come to emissions of acetone vapors into the air or spilling liquids.

Nitrogen gas is used as an anti-fire nitrogen for pneumatics in a closed cycle. In the case of expulsion into the atmosphere as its main component it is immediately neutralized in the immediate vicinity of the air.

Operation of the facility cannot impact on air pollution, because all gases that are emitted into the air such as acetylene, acetone vapor, and nitrogen are in very small quantities, and good natural ventilation ejects them into the atmosphere above the facility.

Impacts on waters

In the technological process of acetylene production with the filling station water is used in the process of reaction with calcium carbide in the generator, where acetylene is produced, and where the use of water is essential for the process of acetylene production and in addition to calcium carbide one of the main participants in the process. Other use of water in the facility is only cooling, as follows:

- cooling compressor
- cooling gas through a heat exchanger to the compressor and
- cooling bottles at the filling station during filling.

Water which is inserted into the generator leaves the generator with excess water of the required amount of water in a lime pit, as a solution of lime in the water, where the lime is precipitated, and accumulated water returns to the generator and thus constantly circulates by adding clean water of about 20%. Thus the waste water from this process can not impact the environment, since the same are disposed of with lime sludge in municipal waste landfill Dugunja, where the lime sludge is used as a disinfectant. The amount of waste water that is disposed of annually in this landfill is 336 m^3.

As for the waste water from the cooling process all the water is collected from the compressor department and filling station department into the concrete pit. This water contains no additives except for the dust particles that are removed from the bottles during pouring down the bottles.

Pure water is used for cooling. Accumulated water from the concrete pit is returned again to the cooling process, and by overflow drains excess water in the pit for accumulated water from lime sludge from which it is fed to the generator, thereby reducing the need to add "clean" water in the process.

It cannot come to contamination of water, whether surface or underground, during operation of this facility, because all process water and cooling water is recirculated in a closed system and there is no runoff of water from the system. Pits in which lime sludge is deposited are waterproof, so there is no way there will be water pollution.

Impacts on land

During normal operation of the facility for acetylene production it cannot come to the pollution of the land for the following reasons:

- In the process of operation of the facility and filling of bottles the only waste is lime sludge. The lime sludge is not a hazardous waste, and after deposition it is being shipped with auto-cistern to municipal waste landfill Dugunja where it is used as a disinfectant material.
- Municipal waste is disposed of in the containers, and the waste that occurs during maintaining of the facility and ancillary facilities (waste oil and metal drums) is temporarily deposited in a warehouse, from where it is in accordance with the Treaties taken over by authorized companies and transported from the site.

CONCLUSION

Described technological process of production of acetylene, which uses calcium carbide as raw material, and which occurs in the wet process, shows that it is a clean production and that there is no significant environmental impact.

An explosion of acetylene mixed with air is hypothetically possible, although in these facilities explosions are very rare and of local character.

In case of local initial fires, considering that there are almost no conditions for the occurrence of major fires, fire extinguishing is made with portable fire extinguishers CO_2 -5.

In case of major fires, overground hydrants are used which are properly placed around the building of the facility. Buildings are made of solid brick-type material, with light metal roofing, so no toxic or aggressive substances can be developed during fire extinguishing.

In the case of acetylene explosion, the explosion would still be limited within a single department, and the energy of the explosion itself would be relatively low because practically there are small amounts of gas in the installation.

Besides the described possibility of risk of accidents, special attention should be paid to the risk assessment of employees at certain work positions, primarily in the facility for production of acetylene.

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ENVIRONMENTAL IMPACTS OF CRTs WASTE PROCESSING

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ABSTRACT

Waste Cathode Ray Tubes (CRTs) were marked as dangerous waste regarding the presence of toxic substances. In this paper the possible environmental impacts of CRTs processing methods were considered. The main methods employed for CRTs management were presented. Due to the lowest level of environmental impacts the recycling technologies demonstrate a significant advantage. By CRTs waste glass recycling the environmental and economical benefits can be achieved. To decrease the environmental impacts a further improvement of CRTs management is necessary.

Key words: CRTs waste, environmental impacts, recycling, glasses.

INTRODUCTION

Waste electric and electronic equipment (WEEE) was identified as one of the fastest growing waste stream in the word. In the European Union the growth rate of such waste is almost three times higher then that of average municipal solid waste (MSW) [1]. Because of complex composition (plastic, glasses, metals, oxide coatings, etc) and content of highly toxic elements WEEE were marked as very dangerous waste regarding to the possible impacts on environment and human health. Therefore, the common techniques including the incineration and land filling employed frequently are not appropriate solution for WEEE management Based on modern approach of waste management the recycling of WEEE must have priority. According to the waste hierarchy defined by EC directive 2008/98, the 'recycling' means any recovery operation by which the waste materials are reprocessed into products, materials or substances whether for the original or other purposes [2]. In The Directive of European Communities, the WEEE (Waste Electrical and Electronic Equipment) is classified and amount of materials and substances which should be reused and recycled were determined [3]. It is important to note that the recycling does not fully eliminate the negative impacts of WEEE. Only sophisticated processing of WEEE may decrease the risks to workers and environment.

Cathode Ray Tubes (CRTs) generated from TV sets and computers devices are most common components of discarded electronics and in this paper the environmental impacts of their processing was presented.

COMPOSITION OF CRTs

The mass contribution of CRTs originated from TV and PC devices is more than 50 % of their weight. Cathode Ray Tubes (CRTs) are composed of non-glassy (metals and different oxide functional layers) and glassy components. In Fig.1 the general construction of a typical color CRT and the main glass component are shown. CRT consist mainly of glass (85%), and as may see in Fig.1 a four type of special glasses are present:

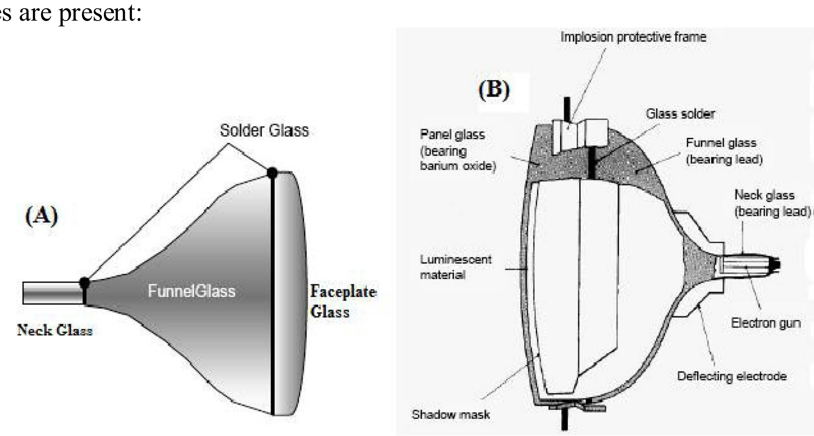

Figure 1. Schematic diagram showing: (A) the main glass components, (B) the general construction of a typical colour CRT [4].

(1) faceplate (65%), a barium strontium glass, (2) funnel (30%), a lead glass, (3) frit (solder glass), a low melting temperature lead glaze and (4) neck (5%), a very rich lead glass. The chemical composition of CRT differs between different manufacturers, when produced and whether used for colour or black and white TV sets or PC monitors [4,5]. In Table 1 the lead content in CRTs was shown.

Table 1. Approximate lead content of the CRT glasses (wt %).

Glass type	Lead content	
	Color CRTs	Monochrome CRTs
Faceplate	0-3	0-3
Funnel	22-25	4
Neck	30-40	30
Solder	60-85	N/A

Because of high content of lead which is highly toxic the CRTs are marked as very dangerous waste regarding to the possible impacts on environment and human health. Beside the lead the other substances of environmental concern present in CRTs are: antimony, barium, beryllium, cadmium, chlorine, bromide, lithium, mercury, arsenic and phosphorus. All these substances can cause significant air, soil and groundwater pollutions during processing of CRTs waste.

WASTE CRTs PROCESSING METHODS

Open burning of WEEE including CRTs from TV and PC devices is one of the cheapest methods but highly dangerous. The extensive environmental and health studies performed on the burning site in China revealed a significant air and soil pollution caused by lead and other chemicals. As reported the exposure of employees and nearby residents to unsafe level of these chemicals can induce serious health problems (nervous, cardiovascular, immune systems) [6,7].

As less dangerous alternative methods the incineration, land filling and recycling can be considered. Nevertheless, all these methods have impacts on environment and human health.

The incineration process must be controlled by measuring the levels of heavy metal concentration (lead, cadmium, mercury) and PCDF emission. The concentrations of these substances in air should be in accordance with the maximum values prescribed by appropriate standards.

Even though the volume of WEEE in landfills is a small part of waste the contribution of the heavy metals (lead, mercury, cadmium) released into the environment is 70%. In such a way the environmental risk can be high due to the leaching of these toxic substances into the soil and additionally into the ground water. Unfortunately, in most countries because of lack of regulation and WEEE management strategy , the land filling is a common method employed.

In the case of CRTs recycling some negative environmental and health impacts were documented but their level is markedly smaller than for the methods noted above. However, beside the environmental benefits the recycling of CRTs enables the obtaining of valuable waste glasses which can be used for production of new CRTs and as a secondary raw materials in different industries. Therefore the natural raw material resources can be preserved and also an economical benefit can be attained. Overall, it may be concluded that the recycling is best method for CRTs management.

RECYCLING OF WASTE CRTs

Due to complex construction of WEEE the recycling is a challenging task for technologist. In practice, two main methods can be employed in recycling of waste CRTs: shredding and dismantling. The first method refers to shredding the complete device and further separation of metal, plastics and glass parts. By shredding the mixture of panel and funnel glasses which are different in chemical composition was separated. Regarding to environmental and health benefits a fully automated shredding process is most acceptable but because of high cost the dismantling process is employed frequently. Despite some differences the process of disassembling of CRTs devices shows very little variation in different countries. In Fig.2 the flowchart of waste CRTs recycling process is shown. As seen in Fig. 2, two different routes can be employed for recycling :closed-loop and open-loop. Closed-loop method is common in practice and it is referred to utilization of waste glass for the production of new parent glass (glass to glass recycling). In contrast, in open-loop recycling the waste glass is used for other application (new material fabrication) [8].

As a first stage of the dismantling method the CRT is removed from the devices and then the panel is separated from funnel. The glasses are then crushed, cleaned, and sorted in an automated process that produces separate streams of glasses. It has been noted that during removal of CRTs from devices and further separation of panel and funnel the worker can be exposed to toxic substances (functional layers, lead). Also, the operation of glass crushing and screening can generate fine dust and due, the adequate filtering units must be installed on the plant. To avoid potential leaching of waste glasses separated the safe storage of these materials is necessary.

Regardless the higher environmental and health impacts of open burning, incineration and land filling processing the improvement of CRTs recycling technologies remains permanent assignment.

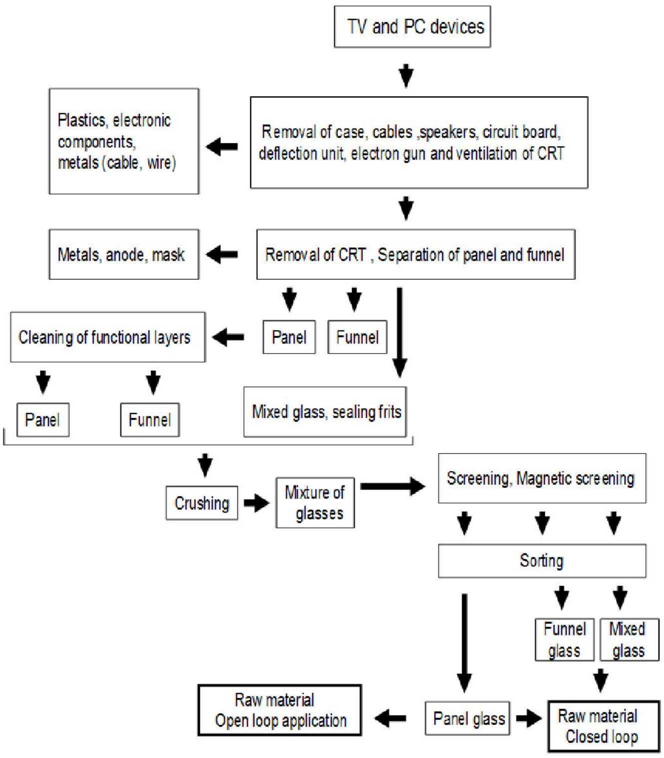

Figure 2. Waste CRTs recycling flowchart [8]

CONCLUSIONS

Due to significant environmental and health impacts the management of waste CRTs from TV and PC devices requires special attention. In most countries because of the lack of regulation and management strategy the inadequate processing of this dangerous waste is applied. High environmental and health impacts were confirmed for open burning and land filling of waste CRTs. The recycling technologies were marked as best solution for CRTs management despite some negative ecological impacts documented. Moreover, by recycling a new valuable waste glasses which can be used as a secondary raw materials in different industries can be obtained. Therefore, it is important for every country to recognize high ecological and health benefits of waste CRTs recycling and improve regulation and waste management strategy in this area.

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REMOVAL OF LEAD BY COMPOST OF *Myriophyllum spicatum*

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ABSTRACT

At the present time, the growing interest for heavy metal removal from wastewater by submerged aquatic plants and a need for application of their compost, as well, can be noted. Compost was characterized by Scanning Electron Microscopy (SEM). In this work sorption of Pb(II) ions by *Myriophyllum spicatum* compost was investigated in batch experiments. Metal sorption was fast and equilibrium was attained within 20 min. The kinetic study indicated that sorption process of lead ions on compost followed pseudo second order. Data obtained from the batch adsorption studies have indicated that compost is efficient in lead removal from solution.

Key words: biosorbent, compost, *Myriophyllum spicatum*, lead.

INTRODUCTION

The contamination of water with heavy metals from various industrial sources is a problem of global concern. Lead is introduced to water as spare product from industry of: mining, metal plating, paint production, fertilizer production, paper production etc. Lead is hazardous heavy metal because it interferes with a variety of body processes and it is toxic to many organs and tissues including the heart, bones, intestines, kidneys, and reproductive and nervous systems (Zhu *et al.*, 2008).

Biosorption can be defined as the removal of selected ions or other molecules from solution by certain biomolecules (or types of biomass). Conventional techniques for heavy metals removal from water effluents, such as: coagulation-precipitation, ion exchange, electrolytic extraction, filtration, complexation, reverse osmosis, evaporation, sorption, flotation etc., have certain limitations that are reflected through high operational cost, high energy requirements, sensitive operation conditions and secondary sludge production. For this reasons there is a need to develop alternative methods like biosorption [1, 2].

It has been well-known that aquatic plants, both living and dead are heavy metal accumulators, thus the application of aquatic plants for the removal of heavy metals from wastewaters has gained considerable interest [3, 4]. *Myriophyllum spicatum* (Eurasian water milfoil) is a submerged aquatic plant, native to Europe, Asia, and north Africa and it was introduced into North America where is invasive species [5]. *M. spicatum* reproduces primarily by vegetative fragmentation and it can quickly recolonize areas that have been cleared of the species because of the viability of even small fragments [6]. The control methods for grow *M. spicatum* can be classified as physical (**mechanical harvesters and chopping machines)**, chemical, and biological.

Over the past two decades more waste is recycled as compost, so there is necessity to find alternative uses for compost [7].

Compost consists of a mixture of organic and inorganic matter and the organic matter can be divided into two classes: non - humic substances and humic substances. Humic substances have high molecular weights, are brown/black in colour and have a strong affinity to complex metal ions [7]. Many metals form complexes with humic substances and order of stabilities of the different metal complexes follow the Irving-Williams series (Beckwith, 1959): $Pb^{2+} > Cu^{2+} > Ni^{2+} > Co^{2+} > Zn^{2+} > Cd^{2+} > Fe^{2+} > Mn^{2+} > Mg^{2+}$. Moreover, the inorganic part of the compost may contain anions such as: Cl^- and OH^-, which can form complexes with metal ions and chemically bound groups such as hydroxyl groups that can take part in ion exchange reactions at the surface [7].

The aim of this work is to investigate adsorption of Pb(II) ions on *M. spicatum* compost in order to find one of the potential alternative uses of compost as an adsorbent for lead in waste waters.

MATERIALS AND METHODS

Preparation of the plant biomass, compost and chemicals

M. spicatum is harvesting from artificial Sava Lake every year. Sava Lake belongs to the capital of Serbia, Belgrade. It covers the area of 0.8 km^2 and it is 4.2 km long, 4 to 6 m deep with dominant spices of aquatic weed *M. spicatum. M. spicatum* is mowed with mechanical underwater harvester 3 - 4 times for year. With mowing amount of unwounted aquatic weed is significally reducing (around 35 m^3 per day). Harvested plant material is disposing to the open landfill used just for that purpose.

Samples of compost were taken from surface of landfill (1 year old). Compost was exposed to air and dried for couple days on room temperature and then dried at 60°C for 6 hours, crushed and sieved to give a particle size less then 0.2 mm. Analytical grade $Pb(NO_3)_2$ was used as sources of lead and stock solutions of Pb(II) ions were prepared in deionized water.

Batch experiments

In other to investigate the effect of pH, contact time a batch sorption experiments were conducted at room temperature 22°C±1 in 100 ml Erlenmeyer flasks with 50 ml of lead solution. using shaker. The effect of pH on sorption of Pb(II) ions onto compost was examined in pH range 2-6 where samples of 0.1 g compost were shaken in 50 ml metal solutions at initial Pb(II) concentration of 100 mg/l for 145 min. Using a precise pH meter (Sension MM340) the initial pH value was regulated to appropriate value with 0.1 $MHNO_3$ or 0.1M NaOH (analytical grade). Sorption kinetics study was investigated with initial Pb(II) concentration of 100 mg/l at initial pH about

5.0. After specified contact time, the contents of Erlenmeyer flasks were filtrated to separate compost from solution. Clear solutions were analyzed with atomic absorption spectrophotometer (Perkin Elmer AAnalyst 300) to determinate lead concentration.

Characterization of biosorbent Scanning Electron Microscopy (SEM)

SEM image was taken for samples before and after adsorption of Pb(II) on *M. spicatum* compost. SEM analyzes were performed with dried sample coated with gold and observed using JEOL JSM-6610LV SEM model.

RESULTS AND DISCUSSION

Figure 1 shows SEM micrographs of *M. spicatum* after sorption of Pb(II). The surface of compost particles is different, somewhere layered and somewhere swollen (Figure 1). These irregularities on the surface of particles, probably increase the contact surface. Metal aggregates are not visible on the surface of material, so there is no evident micro-precipitation, and lead is uniformly spread on the surface. Presence of diatoms has been observed

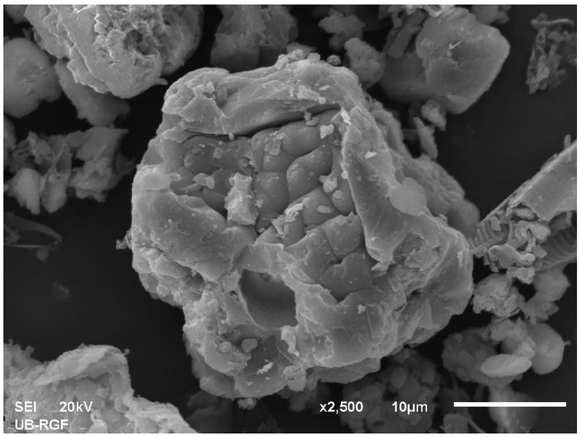

Figure 1. SEM micrographs of treated with Pb(II) 2500 times magnification

The effect of pH on sorption Pb(II) ions on compost was studied at pH range 2 - 6. The maximum of Pb(II) sorption was observed at pH 5.0, thus all sorption experiments were carried out at that pH value.

The effect of contact time *M. spicatum* and compost was studied with initial Pb(II) concentration of 100 mg/l, initial pH was around 5.0 and contact time ranged from 10 to 145 min (Figure 2). Sorption rate was very fast and contact time of 20 min was enough to reach equilibrium.

In this work three kinetic models were applied to the experimental data: Lagergren pseudo first order [8], Lagergren pseudo second order [9] and intraparticle diffusion [10] model. It was found that adsorption process was best described by the pseudo second order kinetic where lead binding capacity was proportional to the number of active sites occupied on the sorbent (*M. spicatum* and compost).

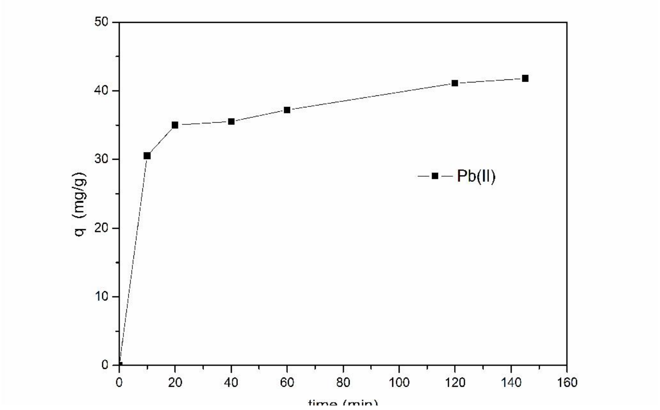

Figure 2: The effect of contact time Pb(II) onto M. spicatum compost (Pb(II) initial conc. 100 mg/l, dry weight of compost 0.1 g, pH 5.0)

Pseudo-second order model is obtained on the basis of the sorption capacity of the solid phase, expressed as:

$$\frac{dq_t}{dt} = k(q_e - q_t)^2$$

Where, k is the equilibrium rate constant of pseudo second order sorption kinetics [g/mg min], q_e the amount of metal ion adsorbed at equilibrium [mg/g], q_t the amount of sorbate on the surface of sorbent at any time t [mg/g]. Integration of this equation with boundary conditions $t = 0$, $q_t = 0$; $t = t$ and $q = q_t$ results in (linear form) [11]

$$\frac{t}{q_t} = \frac{t}{q_e} + \frac{1}{q_e^2 k}$$

On Figure 3 is shown a plot of t/qt versus time. In table 1 are listed rate constants and correlation coefficients for pseudo second order reaction model.

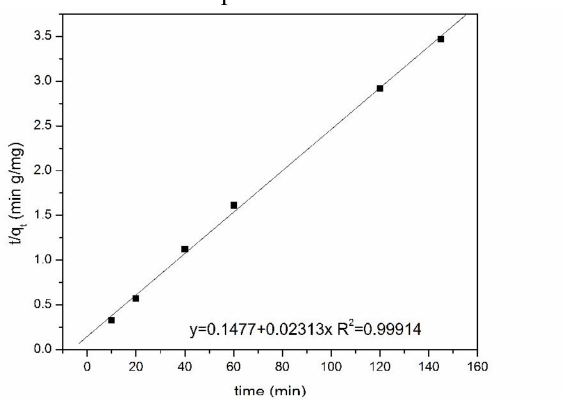

Figure 3: Pseudo second order kinetic of adsorption Pb(II) onto M. spicatum and compost (Pb(II) initial conc. 100 mg/l, dry weight of M. spicatum and compost 0.063 g, pH 5.0)

Table 1 Pseudo second order rate constants for lead

biosorbent	Reaction rate constant k (g/mg min)	Correlation coefficient R^2
compost	0.0036	0.99914

Obtained results for pseudo second order kinetic of adsorption Pb(II) onto *M. spicatum* comply with research of [2]

Grimes et al., 1999 identified two possible types of strong interaction between metals and compost phases: absorption of heavy metals within the lattices of the inorganic fraction and strong complexing interactions with potential organic ligands.

CONCLUSIONS

Data obtained from the batch adsorption studies have indicated that compost is efficient in lead removal from solution. Adsorption process was best described by pseudo second order kinetic. Although further investigation is necessary, on the basis of the obtained results, aquatic weed compost can be recommended as sorbent of lead from wastewaters, especially for developing countries such as Serbia. The main advantage of this sorbent is that it is low-cost, efficient and available.

Acknowledgment

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CHEMICAL AND ELECTROCHEMICAL CHARACTERIZATION OF GOLD COMPLEX BASED ON MERCAPTOTRIAZOLE IN ALKINE MEDIA

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ABSTRACT

Gold complex based on mercaptotriazole can be synthesized in a wide pH range (2-12). The aim of this work was chemical and electrochemical characterization of the gold complex in alkaline media. Raman spectroscopy, infrared spectrometry, inductively coupled plasma atomic emission spectroscopy and ultraviolet-visible spectroscopy were used for the chemical characterization of the prepared solutions. Electrochemical characterization is performed by open circuit potential measurement, cyclic voltammetry and polarization measurements.

Key words: gold complex, Raman spectroscopy, ICP, UV, alkaline media.

INTRODUCTION

Traditionally, gold has been plated from cyanide electrolytes, where (Au^+) is ligated with cyanide (CN^-). The cyanide electrolyte is exceptionally stable with the stability constant of AuCN being 10^{38} [1]. However, due to fears about safety and the disposal of process waste, there is a growing concern regarding the use of cyanide-based processes [1, 2]. The main problem with the use of cyanide electrolytes is their poor compatibility with many standard positive photoresists. The other principal disadvantage of cyanide is its high toxicity [1, 3, 4]. The interest in developing non-toxic gold electrolytes, such as those based on a gold sulphite complex, has grown rapidly in recent years [5].

Over the past few years there has been some interest in gold deposition from an electrolyte containing two different complexants, sulphite as well as thiosulphate. The possibility of electroplating soft gold especifically for the formation of micobumps on silicon wafers from a non-cyanide bath containing both thiosulphate and sulphite as complexing agents was proposed by Osaka and co-workers [6]. Liew, Roy, Scot and Green at Newcastle have developed an electrolyte for soft gold electrodeposition which has attempted to eliminate Na_2HPO_4 and Tl^+ [7].

The thiourea bath was developed and subsequently improved by a group of investigators at Hitachi Ltd. [8].

Richter and co-workers [9] developed a thiosulfate-sulphite mixed ligand bath with ascorbic acid as the reducing agent. Krulik and Mandich [10] reported that the Au(I) thiosulfate-sulphite mixed ligand system functions as an autocatalytic bath in the absence of any conventional reducing agent. At the Institute of Mining and Metallurgy Bor a completely new electrolytic bath based on a gold complex with mercaptotrizole was developed and tested. Studies have shown that the new electrolyte can by successfully used in electrolytic baths for hard and decorative plating.

The most important advantage of this electrolyte is ecological, as the gold could be regenerated by simply settling with hydrogen peroxide in which the sulfur is precipitated.

The gold complexes existing in solution have been examined by UV-vies spectrophotometry and compared with the spectra of other non-cyanide gold complexes. Electrochemical methods are used to determine the characteristics of the electrolyte at different pH.

EXPERIMENTAL

Chemicals

For the synthesis of the gold complex with mercaptotrizole the following chemicals were used: gold-Au powder (99.99% Mining and Metallurgy Institute Bor), hydrochloric acid p.a.-HCl (Zorka, Sabac), nitric acid p.a.-HNO_3 (Zorka, Sabac), and glycine-min. 99% H_2NCH_2COOH (Alkaloid Skopje), potassium hydroxide-KOH (Merck, Germany), distilled water (5 μS/cm) and mercaptotriazole. Mercaptotriazole-$C_2H_3N_3S$ was synthesized in our laboratory. Thiosemicarbazide-CH_5N_3S (for synthesis, min 98%, Merck, Germany) and formamide p.a. (Alkaloid, Skopje) were used in this synthesis.

Methods

Raman spectroscopy

Raman spectra were recorded in the "backscattering geometry", using a μ-Raman system with a Jobin Yvon T64000 threemonochromator, and a CCD (charge-coupled-device) detector. As a source for the excitation an Ar laser 514nm was used. All measurements were done at a laser power of 80 mW. Raman spectra were recorded in the frequency range 100–3500 cm^{-1} with a resolution of 4 cm^{-1}.

IR

Analysis of the samples was done by infrared spectrometry using a Perkin-Elmer 983G Infrared spectrophotometer using the KBr technique (finely pulverized sample), in the range 100–4000 cm^{-1}.

Inductively coupled plasma atomic emission spectroscopy (ICP-AES)

Inductively coupled plasma atomic emission spectroscopy (ICP-AES, Produced by: Spectre, Model: Ciris Visio, Detection limit: <0.0001 g/dm^3) and Atomic Absorption Spectrophotometer (AAS, Produced by: Perkins & Elmer, Model: 403, Detection limit: < 0, 0001 g/dm^3) were used in order to determine the content of gold in solution.

Ultraviolet-visible spectroscopy

The gold complex in solution was identified using ultraviolet-visible spectroscopy using a Perkin-Elmer Lambda 15 UV-vis spectrophotometer. In these experiments, the spectra were recorded using a standard quartz cuvvette with a particular electrolyte, and by performing a fast scan over the wavelength of 190–900 nm. The pH of the electrolyte was monitored using a pH meter (HANNA-Aldrich Sigma-Model C3724 1EA).

Electrochemical techniques and procedure

Electrochemical studies were carried out using cyclic voltammetry, open circuit potential measurement and polarization measurements in a system consisting of an electrochemical cell and hardware interface for computerized control and data acquisition. In a standard three-electrode electrochemical cell, the working electrode was a gold plated platinum electrode (surface 4.522 mm^2), whose potential was controlled against the saturated calomel reference electrode (SCE). Platinum foil (1×2 cm) served as a counter electrode.

The computerized control (National Instruments card, NI-6251) and data acquisition software (LabVIEW 8.2 platform and applications specifically developed for electrochemical measurements), fully developed by the Technical Faculty in Bor [11], were used to run the electrochemical experiments. The hardware consisted of an PC, AD/DA converter (PCI-E 20 428 produced by Burr-Brown) and an analog interface developed at the University of Belgrade, Technical Faculty in Bor.The electrolyte volume used in the experiments was 100 ml. All experiments were carried out at a temperature of 25 ± 0.5 °C. The pH of the electrolytes was measured before and after each electrochemical measurement.

The open circuit potential was monitored for a period of 60 s. Cyclic voltammograms were recorded with a scan rate of 100 mV/s, in the following potential ranges: for pH 7: (+1.5 ÷ -1.3) V vs. SCE, for pH 9: (+1.2 ÷ -1) V vs. SCE and for pH 12: (+1.5 ÷ -1.3) V vs. SCE. Polarization curves were recorded with a scan rate of 5 mV/s in the following potential ranges: for pH 7, 9 and 12: (0.0 ÷ -1.3) V vs. SCE. Potential ranges were ordered by the start of gaseous hydrogen (bottom) and gaseous oxygen (upper limit) evolution.

RESULTS AND DISCUSSION

Formulation of electrolyte

Under certain conditions gold, from aurochloric acid, reacts with organic compounds glycine (CH_2NH_2) and mercaptotriazole ($(C_2H_3N_3)SH$). Experimental investigations show that the quality of decorative gold plating, obtained from a gold complex based on mercaptotrizole, can by successfully used in an electrolytic bath for decorative and hard gold plating [12].

IR and Raman spectroscopy of mercaptotriazole

For synthesis mercaptotriazole method by the Bayer and Kroger [13] was used. The actual form of the mercaptotriazole may be determined with infrared and Raman spectra. Figure 1 shows the normal Raman spectra and Figure 2 the IR spectra of solid crystals of mercaptotriazole. The IR and Raman spectra show agreement with the spectra that can be found in the literature [14].

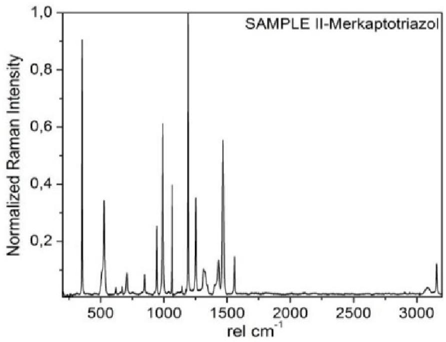

Figure 1. Raman spectra for mercaptotriazole

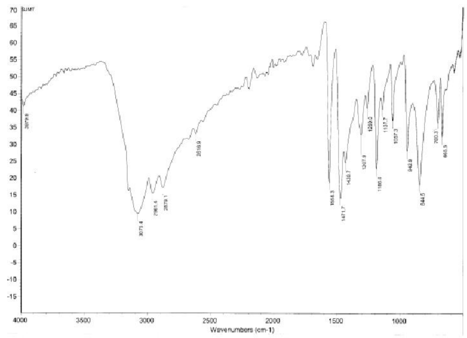

Figure 2. IR spectra for mercaptotriazole

Chemical characterization of complexes

Inductively coupled plasma atomic emission spectroscopy confirmed the concentration of gold in all synthesized electrolytes was 2.50 g/dm^3.

For Au-MT electrolyte chemical characterization, the UV-vis absorption spectra were recorded for glycine (6%), mercaptotriazole (6%), chloroauric acid (2.5 gAu/dm^3) and gold complexes with mercaptotriazole (pH 7 and 9) and are presented in plots of absorbance, A, against wavelength, λ, in nm in Figure 3. The solution of chloroauric acid ($HAuCl_4$) was used without an adjustment in pH (pH 1.25). The adjustment of the pH of the other solutions (pH 7 and 9) was performed with unimolar potassium hydroxide.

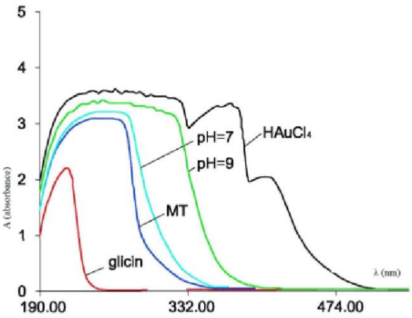

Figure 3. UV–vis apsorption spectra of: glycine (6%), merkaptotriazole (6%), chloroauric acid (2.5gAu/dm^3), gold complex with mercaptotriazole with different pH=7 and 9

An absorption peak at 216.8 nm was detected for the glycine solution, which is very close to the literature data for a solution of pH 9 (absorption peak at 210 nm) [5]. For the MT solution (6%, pH 4.50), the absorption peak was detected at 248.8 nm, which is also very close to the literature data (251nm) [15].

For the Au(III) chloride solution (C_{Au}=2.5 g/dm^3), several peaks were detected: 239.2 nm, 251.2 nm, 263.2 nm, 273.6 nm, 284.8 nm, 297.6 nm; and 308.8 nm, followed by shoulders at: 374.4 nm and 406.4 nm. Liew, Sorby and Roy [5] detected an absorption peak at 210 nm for an $HAuCl_4$ solution containing 0.6 mM Au(III) ions, followed by a shoulder at 280 nm. Some other authors detected absorption peaks at 240 nm and 313 nm [5]. These differences are probably due to the differences in concentration of Au(III) chloride salts, as well as in the pH values. The value of 253.6 nm, for the absorption peaks of the Au-MT electrolyte obtained at pH 7, respectively, were very close to the absorption peak of MT (248.8 nm). While the Au-MT electrolyte at pH 9 exhibited an absorption peak at 272.0 nm, which may suggest that the bond between MT and Au has only realized in this particular case. All this supports the fact that the electrolyte based on a gold complex with mercaptotriazole at pH 9 is the most stable, and the gold coatings obtained from this electrolyte provide the best characteristics [12].

Electrochemical experiments

Subsequent studies were carried out with the aim of investigating the electrochemical characteristics of the synthesized electrolytes over the whole stability range (pH 2–12) at the optimal concentration of gold in the electrolyte of 2.5 g/dm^3 [12]. Electrochemical characterization of the complex was conducted by measuring the conductivity of the electrolyte, the open circuit potential measurements, by cyclic voltammetry and by the recording of polarization curves. pH values of the electrolytes were measured before and after each polarization.

Open circuit potential

The change in open circuit potential of gold in solutions with pH values of 7, 9 and 12 was monitored over 60 s. Figure 4 and Table 1 show the values of the open circuit potential and pH of the electrolytes before and after electrochemical polarization measurements. Measurements were performed on freshly prepared electrolytes.

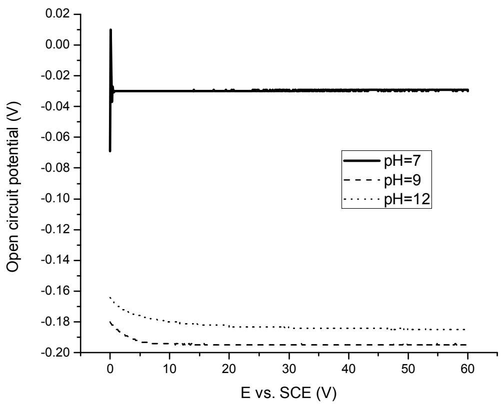

Figure 4. Open circuit potential for electrolytes with different pH values and gold concentration of C=2.5 g/dm^3

Table 1. Steady state values of open circuit potential and pH values of electrolyte before and after polarization measurements

Predicted pH	7	9	12
Open circuit potential (V vs. SCE.)	- 0.029	-0.185	-0.194
Measured pH (before)	7.10	8.96	11.80
Measured pH (after)	7.05	8.85	11.35

Figure 4 and Table 1 show that with an increase in the pH of the electrolyte, the open circuit potential shifts to more negative values. At pH 4 and pH 7 the measured values of the open circuit potential are almost equal: -0.028 or -0.029 V vs. SCE. At pH 9 the measured OCP value was -0.185 V vs. SCE

From Figure 4 it can also be noted that in alkaline solutions the establishment of the stable open circuit potential lasted more than 10 s, which indicates that the establishment of a stable structure of the electrochemical double layer included the slow diffusion of larger particles, their adsorption and desorption as well as the possible competitive adsorption. After electrochemical polarization measurements the pH values of the alkaline electrolytes decreased, as shown in Table 2. Minor changes in pH value were observed at pH 7 (from 7.10 to 7.05) and the greatest at pH 12 (from 11.80 to 11.35).

Cyclic voltammetry

Cyclic voltammograms recorded at different pH values of the electrolyte (pH 7, 9 and 12) are shown in Figure 5. Polarization curves for the electrolyte with a gold concentration of 2.5 g/dm^3 recorded at different pH values with a potential scan rate of 5 mV/s are presented in Figure 6. From these curves the limiting current densities can be determined.

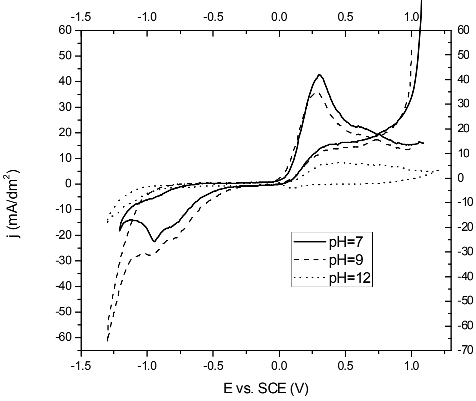

Figure 5. Cyclic voltammograms of the electrolytes with the gold concentration of 2.5 g/dm^3 at different pH values: pH=7, 9 and 12

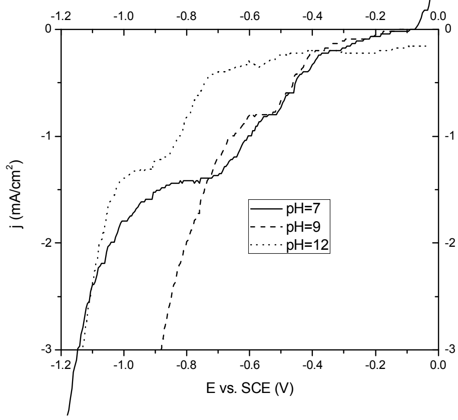

Figure 6. Polarization curves for the electrolyte with gold concentration of 2.5 g/dm^3 at pH = 7, 9 and 12

From the cyclic voltammograms for electrolytes with different pH values recorded with a potential scan rate of 100 mV/s presented in Figure 5, it can be noted that with an increase in pH the cathodic current waves shift to more negative potentials. In the anodic part, all the voltammograms are of a similar shape. The current density for pH 7 is the smallest over the whole course of the curve. On the cathodic part of the voltammograms recorded for the alkaline electrolytes (pH 9 and 12) no clear current peak appears, only folds in the locations corresponding to the reaction of gold reduction. However, there are major differences between the voltammograms for electrolytes with pH 9 and pH 12. Anodic and cathodic current densities are several times higher at pH 9, and the current waves on the cathodic part of the curve are at considerably more positive potentials, although the open circuit potentials for the two electrolytes are approximately equal. This indicates a lower overvoltage, i.e. less energy consumption in the process of gold electrodeposition.

The limiting current is an important parameter for the characterization of electrochemical systems. Two plateaus, the first being wide and the second narrower, are observed on the polarization curves. The first plateau current density is lowest in the electrolyte with a pH value of 9 and highest for the electrolyte with a pH value of 12. The values of the potential at which the limiting current densities were reached are also different. The first plateau current densities range from 0.02 mA/cm^2 (obtained for pH 9 and pH 7) to 0.16 mA/cm^2 (obtained for pH 12). Limiting current density values were higher than the limiting ones for the current density of cyanide (0.05 A/dm^2), and similar to the values of the limiting current density for the other non-cyanide electrolytes [5].

CONCLUSION

This study shows the method for formulation, chemical and electrochemical characterization of electrolyte based on gold complex with mercaptotriazole in alkaline media which could be used for decorative plating baths. At pH 9, the lines in spectrum appear at wavelengths close to the wavelengths for other non-cyanide electrolytes. With an increase in pH, the OCP value becomes negative, indicating the binding of gold in the form of stable complexes. It was proved by chemical and electrochemical methods that the bond between gold and mercaptotriazole is the strongest at pH 9, and that at this pH the complex is at its most stable complex. Also, the lowest value of limiting current density was observed for the electrolyte at pH 9. Cyclic voltammograms and polarization curves explain the reasons for the observed trends in gold coatings obtained from electrolytes based on mercaptotriazole where a value of pH 9 has resulted in the best characteristics, which were comparable to gold coatings obtained from cyanide electrolytes.

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PROPERTIES OF NOVEL ENVIRONMENTAL-FRIENDLY POLYESTERS BASED ON RENEWABLE RESOURCES

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ABSTRACT

Polyesters are an important class of polymers with unique mechanical and physical properties and the possibility of numerous applications. In this work novel copolyesters based on renewable resources were prepared. Linear poly(isosorbide-co-butanedioic acid) was obtained via melt polyesterification of 1,4-butanedioic acid with OH-functional monomer 1,4:3,6-dianhydro-D-glucitol (isosorbide) using titanium(IV) isopropoxide as a catalyst. The samples were prepared with different monomer molar ratio (r) of isosorbide and 1,4-butanedioic acid. Molecular structures of samples were estimated using FTIR spectroscopy, and thermal properties by differential scanning calorimetry. It was assessed that the glass transition temperatures of obtained materials are influenced by monomer ratio.

Key words: Biobased polyester, gel permeation chromatography, FTIR, DSC.

INTRODUCTION

Due to huge exploitation of oil for the chemical industry, manufacturing of polymer materials became simplified and cost-effective. The key feature of plastics is the attractive combination of low-price with easy processing. These materials are used as fibres, coating or as components for composites and thermoplastic elastomers. Most of the polyesters applied today are built up from monomers derived from fossil fuel. The oil exhaust could drastically impact the cost-effectiveness and competitiveness of plastics. For this reason the shifting chemical raw material production to renewable resources could safeguard plastics production against this expected new future oil crisis. In the twentieth century a paradigm shift from biostable to biodegradable materials occurs [1]. There are several reasons for the favourable consideration of biodegradable over biostable materials for many applications. Fast growth of the global population is paralleled by an arising demand for advanced, cost-effective polymers for special applications, enabling new technologies and securing a high quality of life. In fact, the amount of plastics produced during the first 10 years of the 21st century is almost as large as the amount produced throughout the entire 20th century [2]. But decreasing oil reserves, ecological problems and global warming endanger the future of polymer materials [3]. For these reasons the development of the technology to produce diversity of biobased polymers is a way to decrease the global ecological problems. The aim of this study was to investigate the potential of biobased monomers as starting component for polyester synthesis via melt polyesterification of 1,4-butanedioic acid with 1,4:3,6-dianhydro-D-glucitol (isosorbide). The thermal properties were assessed in order to obtain applicative window of obtained polyesters.

MATERIALS AND METHODS

1,4:3,6-dianhydro-D-glucitol (isosorbide) and 1,4-butanedioic acid were used as monomers. Titanium(IV)iso-propoxide was used as a catalyst. All compounds were supplied from Sigma-Aldrich and used as received. Polymerization was carried out in round bottom glass reactor fitted with a vigreux column and a Dean-Stark type condenser to collect the condensation product. Both monomers and a catalyst were weighed into the reactor and the stirred during 4h at 180 °C. After that, the reaction temperature was increased to maintain distillation of formed byproducts. After that the reeaction products were poured in square molds to cool and solidify. The obtained copolymers were characterised using FT-IR spectroscopy (Bomem Hartmann & Braun MB-series). The obtained material was milled and mixed with KBr before forming the tablets using a vacuum press. The data were recorded in ranging from 400 to 4000 cm^{-1}. Hydroxyl number of synthesized polyester was measured by the acetic anhydride/pyridine method. Reaction products in solvents was heated 1 h, washed with water and methanol and titrated with 1 M solution of KOH (with phenolphthalein as indicator). Thermal properties of materials were estimated by differential scanning calorimetry using DSC Q20 (TA instruments).

RESULTS AND DISCUSSION

FT-IR spectra of used monomer isosorbide had shown a band at 3400 cm^{-1}, come from the vibration of valent OH groups. In polyesters whose chains end with 1,4:3,6-dianhydro-D-glucitol (isosorbide) units this band is shifted to higher wavelengths (3490 cm^{-1}) due to interaction between OH groups from the chains end units and the carbonyl groups situated in the middle of the chains. From δ(OH) vibration band at 1450 cm^{-1} appears in the polyesters. Band at 1350 cm^{-1} from the vibration of the C–O–C ether group and asymmetrical and symmetrical vibrations of ether groups in the furan ring of isosorbide occur at 1070 and 920 cm^{-1}. The aforementioned bands appear also in the spectra of the obtained polyesters which confirmed presence of isosorbide in polymer. Carbonyl group in butanedioic acid shows absorption at 1790 cm^{-1}. Absence of this band in the polymer chain is due to formation of new ester carbonyl group in the polymer chain during reaction with isosorbide, which shows absorption at 1742 cm^{-1}. During reaction of butanedioic acid and isosorbide, new ester carbonyl bonds form, which causes occurrence of band at 1154 cm^{-1} in polyester, originating from the symmetric vibration of ester, C–O–C, bond in the aliphatic chain.

Table 1. The data of thermal properties for the synthesized poly (isosorbide-co-butanedioic acid) samples based on different monomer molar ratio r.

Sample	Monomer ratio r, isosorbide/1,4-buthanedioic acid	M* (OH)	Tg (°C)
Polyest-1.5	1.5	1,089	59.35
Polyest-1.4	1.4	2,025	56.32
Polyest-1.3	1.3	1,782	50.74

*molar mass calculated from equation $M(OH)=56100*f/OH_{\#}$; f-functionality, $OH_{\#}$- hydroxyl value gKOH/g

Since the structure of the poly(isosorbide-*co*-butanedioic-acid) consists of cyclic isosorbide and short aliphatic chain of butanedioic acid, polymer chains are very rigid and rotation around chemical bonds is obstructed. However, due to steric interference originated from isosorbide in polymers with higher content of isosorbide, it can be noticed the increase of *Tg* (Figure 1. table 1).

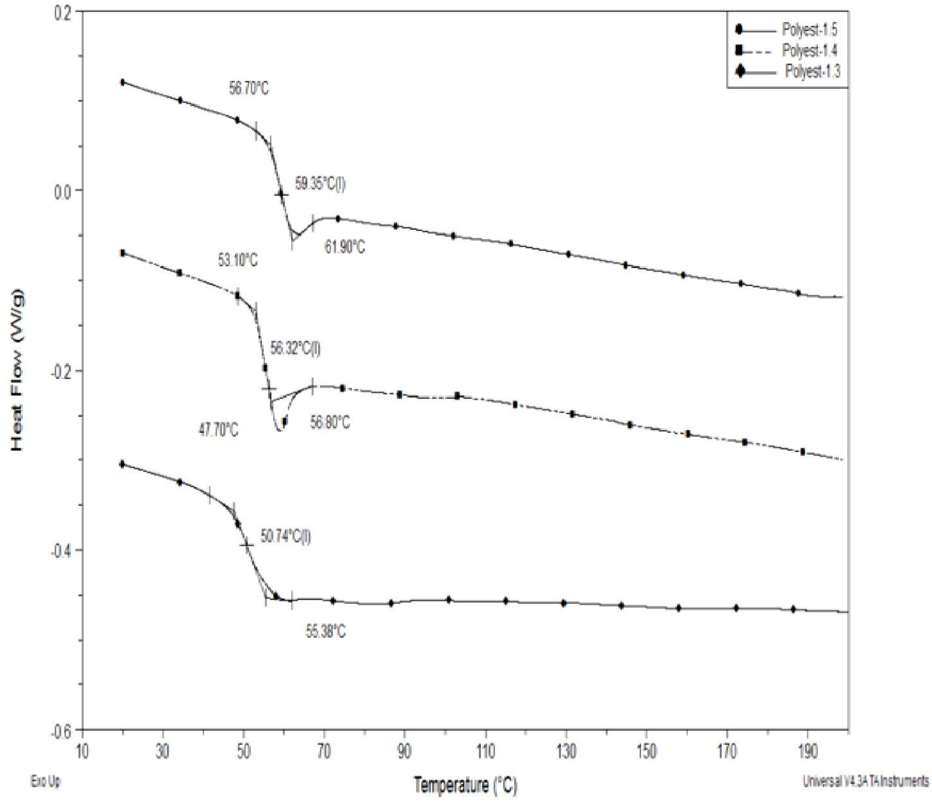

Figure 1. DSC thermograms for the samples of poly(isosorbide-*co*-butanedioic acid), Polyest-1.5 (●), Polyest-1.4 (■), Polyest-1.3 (♦)

CONCLUSION

A rapid increase in the application of polymers in practically all fields of human activities is obvious. The scientific community gives a great deal of effort to the development and application of biobased polymer materials, in order to solve the problem of solid wastes, and to reduce the consumption of fossil raw materials and emission of carbon dioxide into the atmosphere. Linear polyesters based on renewable resources were synthesized via bulk polycondensation from isosorbide and butanedioic acid to yield hydroxyl functional polymers. Chemical structures of prepared samples were assessed by FTIR spectroscopy, it was confirmed the incorporation of diacid monomer (adipic acid) in the structure of obtained polymers.

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FLY ASH BYPRODUCTS FROM TPP KOSTOLAC-B, SERBIA AND ITS USAGE

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ABSTRACT

In this study, the fly ash taken from the TPP Kostolac-B, Kostolac, Serbia, is characterized and separated from its byproducts. A systematic study is conducted to establish the optimum conditions for the separation of these materials from fly ash. In this context, concentration techniques such as magnetic, gravity separations (heavy liquids separation) and flotation are put forward. Finally the lightweight fraction, from which the magnetic minerals and the unburned coal substance were removed, as well as microspheres, is an excellent material for fly ash pelletization process using Portland cement binder, for the production of building materials – blocks and bricks, for concrete mixtures, cement additives, and other purposes.

Key words: lignitic fly ash, characterization, flotation, unburned coal, pelletization, building materials.

INTRODUCTION

Thermal power plants are at present the major generators of electricity in Serbia, fueled by the lignitic low-heat coals. Lignite burning produces large amounts of fly ash, which is a reason for focusing on this waste. Fly ash (FA) is not considered a waste any more, but a technogenous raw material continuously developed for various industrial uses. The benefits from its development are smaller amounts of the ash waste and therefore less polluted environment, on one hand, and an inexpensive raw material for building industries and road construction, on the other. This study is concerned with principal characteristics of the fly ash from the TPP Kostolac B with the view to its best uses.

The TTP Kostolac A comprises two blocks, block TEKO A1 and TEKO A2, and the Drmno unit blocks B1 and B2, 345 MW each (producing 710500 tons of FA every year). The latter two blocks began to use a new procedure for disposal of a dense aqueous mixture of ash and slag at Ćirikovac, while the former two blocks still discharge the water-abundant affluent of FA and slag into the old middle pond of Kostolac.

SAMPLES

Fly ash samples for this study were collected from electrofilters 1 through 4 of Block 2, Drmno. The primary FA sample, a mass of ~60 kg, consisted of the materials from two collections. The FA was comparatively uniform in composition over long period of time, composed of SiO_2 (46.64 %), Al_2O_3 (21.67 %), Fe_2O_3 (11.44 %), MgO (2.64 %), SO_3 (2.27 %), S* (0.88 %), Na_2O (0.51 %), K_2O (0.67 %), with LOI 1.98 % and SiO_2/AlO_2 2.15 %. The size distribution analysis of the FA sample was made on the standard Tyler series of sieves for wet and dry screening. Ash particles were finer than 1 mm, with the average grain diameter 0.114 mm and upper boundary size ($d_{5\%}$) 0.570 mm. Mineral composition of the FA is based on the X-ray diffraction analysis, DTA, TGA, SEM and other analytical methods of many FA samples from different samples [5]. Morphology of Fly Ash. Under an electronic microscope, the FA grains of non-magnetic fraction from Kostolac B (magnetic fraction and unburned carbon remuved) are sub rounded, partly regular spheres – rounded porous grains, sponge-textured, conospheres (shells of microspheric intergrowths) and pleospheres (sphere voids filled with other microspheres).

EXPERIMENTAL METHODS

The procedures and analyses used in this study to separate monomineral fractions of the FA from TEKO B and the methods for derivation of some products from this technogenous raw material are the following: •Sink and float analysis in water and heavy liquid separation. •Wet magnetic separation (Devi s analyzer). •Flotation concentration. •Complete concentrate or separation product characterization; possible uses of fractions. •Pelletization of fly ash; usable as aggregate, fill in lightweight concrete. •Manufacture (FA mixed with FGD gypsum and CaO) of bricks for the building material industry. •Some FA fractions (microspheres) usable for particular purposes.

The heavy mineral fraction was experimentally produced from FA, as well as the magnetic mineral fraction, which is magnetite-high and with some alloy elements can be used in the steel-making process (Table 3, 5). The sink and float analysis combined with the sieve analysis revealed hollow silicate microspheres, which may be a commercial product. The flotation concentration tests, combined with the gravity concentration, yielded an unburned coal concentrate (semi coke) of very high heat capacity, which may be returned into the process to improve coal combustion. The FA pelletization method is separately described as a pelletization process of a single fraction from which unburned coal (coke) and iron minerals (magnetic and heavy minerals) were removed in order to use the product (pellets) as aggregate in a lightweight concrete. This FA can also be used in the building industry in combination with quicklime (CaO) and waste gypsum (the TPP flue gas desulphation gypsum - FGD), for manufacture of the building blocks and bricks (5, 6, 2).

RESULTS AND DISCUSSION

Grain size and chemical composition. After sieve analysis, the sieve size fractions were chemically analysed for burned and unburned coal and their heat capacities. The lowest ash content (27.11 %) was found in the coarsest size fraction, -1.168+0.833 mm that increased to 96.10 % in finer size fraction of -0.041+0.00 mm. The proportion of burned coal varied in the opposite direction: it was as high as 64.36 % in the coarsest size fraction -1.168+0.833 mm (or 13.24 % according to recovery) decreasing with the lesser size fraction to 3.50 % (or 10.67 % according to recovery). Average burned coal content in the FA is therefore 5.71 %. The two coarsest size fractions had the heat capacities between 16357 kJ/kg and 7823 kJ/kg.

Ore microscopy of polished sections examined magnetic fraction and identified dominantly ferromagnetic spheres, affected by hematization, ilmenite and rutile, either in mosaic arrangement - texture or individual magnetite crystallites in silicate glass. Compact ferrospheres are scarce, whilst 'shells', mainly well-rounded and smooth, are common.

Gamma spectrometry of fly ash from the TPP Kostolac B, conducted in the Nuclear Institute Vinča, indicate radionuclide concentrations in FA below the allowed radioactive concentration level for the building materials; it may therefore be used in the interior and exterior components of buildings and in roads.

Light fraction of the fly ash (hollow microsphere density < 1.00 g/cm^3) was analysed using the polarizing microscope and the stereobinocular magnifying glass (Fig. 1). Hollow glass beads of extremely small bulk density, low density, are excellent heat insulators; also, their large free surfaces are used to absorb large amounts of water. Note that the extraordinary qualities of this FA fraction make it also the most expensive.

A.

B.

Figure 1. A. Microphotograph of light fraction of the fly ash (hollow microsphere density < 1.00 g/cm^3); **B.** Pelletized fly ash in different size fractions

Sink and float analysis of the FA of a sieve size fractions sample had the purpose of separating monomineral fractions: silicate microspheric fraction density <1 g/cm^3; unburned carbon fraction; semi coke fraction; heavy fraction; light non-magnetic fraction; and magnetic fraction. The combined, sizing and sink and float procedure results are given in Tab. 2. Densities within the range from 1.0 to 2.76 g/cm^3 form a fraction of the highest mass proportion, 93.96 %. Almost without burned coal, it consists dominantly of ash, or 96.23 % with respect to recovery. The density >2.76 g/cm^3 fraction has an elevated amount of ash, but due to the small mass proportion of 1.29 %, the distribution is 1.31 % and without burned coal. In addition to iron, chemical analysis identified many elements in the separated density fractions from 1.0 to 2.76g/cm^3 and >2.76 g/cm^3 (Tab. 3). Notable are the elevated lead, arsenic, antimony, etc. and silver and gold.

Fly ash samples were treated in Davi's magnetic analyzer for wet separation of strongly magnetic minerals. The resulting FA fractions and the distribution of total iron in the magnetic and non-magnetic fractions are given in Tab. 4. The table shows that the mean Fe content was 2.39 % in the sample with respect to 4.89 % in the magnetic fraction. Chemical analysis detected many elements (Tab. 5), some notably elevated (lead, arsenic, antimony, etc.), in the magnetic and in the non-magnetic fractions. Also elevated concentrations were noted of silver (0.12 g/t in magnetic and 0.19 g/t in non-magnetic fraction) and gold (1.14 g/t and 0.45 g/t, respectively).

Flotation concentration of unburned carbon from FA. The flotation tests were expected to separate unburned coal and any possible organic compound by using different collector and frothing agents. For repulping, one kilogram of FA and water were used for operation of a Denver type flotation cell. The pulp feed pH was 8.7 that in ten minutes rose to 11.17. After five-minute settling separation of the floating light fraction and the sinking heavy fraction, the light fraction was mechanically removed. The five-minute conditioning began with the addition (100 g/t of ash) of the frothing agent F 521, made by CYTEC. During the ten-minute main flotation, 400 g/t more F 521 was added, and the product was cleaned for five minutes. The cleaning flotation outflow was an middling product and the frothy product was the concentrate. The test results are summarized in Tab. 6. The products were chemically analyzed for the amounts of ash and unburned carbon and for its heat capacity (Tab. 6).

The concentrate 3.16 % by mass has the highest value of the lower heat capacity 12702.18 kJ/kg, in respect to 99.65% carbon distribution in feed. This is because the concentrate consists essentially of unburned carbon – a semi coke. Middlings product with weight of 2.14 % contain unburned carbon 11.81 % or with 4.60 % of recovery. Waste, which is the highest constituent of even 94.70 %, has the lowest amount of unburned carbon (only 4.29 %), but due to the large weight percentage distribution of unburned carbon is 73.86 % (Table 6).

Pelletization process agglomerates wet fine-powdered particles on a rotating disc with the addition of a binding agent during or after the process. Pellets of the FA are used as aggregate for lightweight concrete, filler in drainage channels, for soil stabilization and made up ground, stabilization of upper waste landfill layers, and the like (1). Pellitization controls porosity, grain shape, solubility, reactivity or thermal conditions. The equipment used for aggregation was a laboratory pelletization disc unit, Eirich TR.04 (made by Maschinenfabrik Gustav Eirich).

Physical and mechanical properties of FA pellets. Impact strength of pellets was tested for ten representative grains-from each size fractions. The pellets used in the tests had diameters from 5.90 mm to 7.39 mm and the number of drops exceeded 150, which suggests their high impact strength. Compressive strength of pellets was tested in modified Penetrometer LC 2, Soiltest Inc., Evanston, Illinois, USA. The binding agent used was cement type Titan PC 35 M. The test intervals were 7, 14 and 21 days. Compressive strengths of the pellets varied from 2.952 MPa to 9.264 MPa, or average 6.322 MPa.

Building material pilot tests. FA is a basic raw material to which were added waste gypsum (FGD gypsum semihydrate $CaSO_4$ x ½ H_2O) and quicklime (CaO) to produce building blocks and bricks. The test ratio of fly ash and waste gypsum was 1:1, with the quicklime proportion between 3% and 14% (optimum was about 6%) of the total sample mass. Test samples were homogenized, placed in a mould and tested for compressive strength after 28 days. The sample with previously remuved magnetic fraction, unburned carbon, and heavy minerals (heavy FA fraction) attained the highest compressive strength. Compressive strength of the prepared samples varied from 5 MPa to 10 MPa.

Table 6. Account of carbon flotation concentration (with respect to burned carbon)

Products:	W_t, %	Unburned carbon, %	Distribution of burned carbon D_c, %	Fly ash, %	Distribution of FA, %	Lower heat capacity, kJ/kg	Distribution of lower heat capacity, %
Light fraction (< 1 g/cm^3)	**2. 75**	**38.65**	19.32	57.66	1.69	**13483**	92.05
Concentrate	**0. 41**	**29.72**	2.22	67.57	0.30	**7465**	7.60
Middlings	2. 14	11.81	4.60	87.02	1.98	660	0.35
Tailing	94. 70	4.29	73.86	95.15	96.03	0.00	0.00
Feed:	100	**5.50**	100.00	**93.83**	100.00	402.80	100.00

Table 2. The combined, classification and sink and float procedure results (Size distribution and chemical composition of the fly ash, heavy liquid separation)

Products:	Size fractions, mm	W_t, %	Fly ash, %	Distri-bution of FA in < 1,0 g/cm^3, %	Distri-bution of FA in feed, %	Unburned carbon (W_t, %)	Distribu-tion of burned coal, D_c, %	Lower heat capacity kJ/kg	Fe, %	Distri-bution of Fe, %
Light fraction < 1,0 g/cm^3	+ 1.000	1.17	10.84	5.28	0.13	79.37	44.72	**22 071**	0.00	0.00
	- 1.000+0.500	1.72	35.56	25.46	0.63	56.38	46.70	**15 589**	0.00	0.00
	- 0.500+0.400	0.42	64.52	11.28	0.28	32.82	6.64		0.00	0.00
	- 0.400+0.315	0.36	91.54	13.72	0.34	7.18	1.24		0.00	0.00
	-0.315 +0.000	1.08	98.43	44.26	1.08	1.36	0.70		0.00	0.00
	Feed:	**4. 75**	**50.57**	100.00	**2.47**	**43.72**	100.00		0.00	0.00
1.0 – 2.76 g/ cm^3		**93. 96**	100.00		96.23	0.00	0.00		**2.50**	**92.58**
>2.76 g/cm^3		**1. 29**	100.00		1.31	0.00	0.00		**13.57**	**7.42**
Feed: Fly ash		**100.00**	**97.64**		100.00	**2.08**			**2.54**	100.00

Table 3. Chemical composition of fly ash (heavy liquid separation)

Products:	Pb, %	Sb, %	As, %	S, %	Bi, %	Ni, %	Cd, %	Zn, %	Mg, %	Ca, %	Mn, %	Cu, %	Ag, g/t	Au, g/t
1.0 – 2.76 g/ cm^3	0.0033	0.21	0.01	0.43	0.0043	0.0040	0.0001	0.0055	0.074	1.32	0.51	0.0054	1.74	0.11
> 2. 76 g/ cm^3	0.010	2.09	<0.01	1.07	0.0014	0.022	0.0004	0.015	1.19	6.36	0.33	0.010	1.67	0.33

Table 4. Wet magnetic separation (Devi s analyzer) of fly ash

Products:	W_t, %	Fe, %	Distribution of Fe, %
Magnetic fraction (M. F.)	**17.75**	**4.89**	36.32
Non-magnetic fraction (N. M. F.)	76.08	**2.00**	63.68
Light fraction (< 1 g/cm^3)	**6.17**	0.00	0.00
Feed: Fly ash	100.00	**2.39**	100.00

Table 5. Chemical composition of fly ash (electromagnetic separation)

Products:	Pb, %	Sb, %	As, %	S, %	Bi, %	Ni, %	Cd, %	Zn, %	Mg, %	Ca, %	Mn, %	Cu, %	Ag, g/t	Au, g/t
M. F.	0.020	0.013	0.020	0.94	0.0043	0.0091	0.0001	0.0063	0.074	1.82	0.12	0.0077	1.14	0.12
N. M. F	0.020	0.0083	0.010	0.94	0.0024	0.0044	0.0006	0.011	0.63	1.27	0.032	0.0071	0.45	0.19

CONCLUSION

Laboratory tests of this study suggest the following:

1. Separation of monomineral fractions from FA of the TPP Kostolac B was pilot tested and the obtained fractions analyzed for chemical and mineral compositions. The FA contained unburned carbon (semi coke) 5.77 % that decreased with the grain fining, as the coarsest size fractions contained 64.36 % and the finest only 3.50 %. The light fraction of grain size +0.315 mm had the mean heat capacity 13483 kJ/kg (from 22071 to 7900 kJ/kg).
2. Concentrate from the flotation separation had the heat capacity 7465 kJ/kg; mixed with the light fraction (< 1.00 g/cm^3) could give a product of FA 3.16 % by mass and 12702.18 kJ/kg heat capacity. This product has the smallest amount of ash or the greatest amount of unburned coal, and semi coke particles 37.49 %. Middlings with weight of 2.14 % contained unburned carbon 11.81 % and ash 87.02 %. The weight percentage of waste was 94.70.
3. Heavy fraction (> 2.76 g/cm^3) of the FA with 1.29 % of ferroshere s consisted mainly of magnetite, hematite, ilmenite and partly rutile.
4. Sieve undersizes fraction -0.315 mm, the light faction (< 1.00 g/cm^3), mainly of silicate microspheres, had the ash content of 98.43 %.
5. Light FA fraction (< 1.00 g/cm^3), a constituent of only 4.75 %, consisted of unburned carbon (semi coke) and silicate microspheres.
6. Fly ash can be palletized mixed with cement (10 % or 35 %). The compressive strength of pellets, for 30 % cement binder, was 9.264 MPa and the impact strength higher than 150 drops per pellet (4).

7. Fly ash from the TPP Kostolac B has constituents suitable for use in the building industry for production of bricks and blocks or for pellets as light-concrete aggregate. Some fractions of fly ash, specifically magnetic fraction or light faction of silicate microspheres also may be a commercial product, and thus contribute to the complex beneficiation of this technogenous raw material, therefore also to the environmental protection.

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ECOLOGICAL APPROACHES TO THE TREATMENT OF GALVANIC SLUDGE WASTE

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ABSTRACT

The methods for galvanic wastewater treatment which are commonty used in the Republic of Serbia belong the type of conventional treatment systems (chemical oxidation and reduction, neutralization, coagulation, flocculation and sedimentation). The consequence of these methods is the creation of waste sludge, which, if not properly stabilized, becomes a dangerous substance. The subject of this project is stabilization of waste galvanic sludge by incorporating it into a stable structure of a new-sintered material.

Key words: galvanic sludge, eco-sintered material.

INTRODUCTION

The technological process of electroplating is one of the biggest polluters, with about 25% of the total amount of industrial waste water, as it applies to the large amount of water for flushing. Wastewater may contain metal ions (Cu^{2+}, Ni^{2+}, Cr^{6+}, Cr^{3+}, Zn^{2+}, Cd^{2+}, Pb^{2+}, Fe^{2+}, Al^{3+}, etc.), cyanides, phosphates, acids, alkalis, fats and oils, organic solvents, surfactants and a variety of other pollutants. Heavy metals reached the surface water does not degrade biologically, but accumulate in the plant and animal world rivers, which are due in the food chain and thus indirectly affect the health of people.

Figure 1. Electroplanting systems

Wastewater from the electroplating process in our country treated with traditional conventional methods, such as chemical oxidation and reduction, neutralization, coagulation, flocculation, fluctuations, precipitation [1].

These processes and operations in the second phase of treatment, after reaction with lime milk has resulted in accumulation of toxic metals, pH = 9.5, with the creation of secondary pollution in the form of galvanic sludge (Me (OH) x), as shown nonstoichiometric following equation:

$$Me_2(SO_4)_3 \text{ or } MeSO_4 + Ca(OH)_2 \rightarrow Me(OH)_x\downarrow + CaSO_4$$

Where: Me=Cr, Cu, Zn, Cd, Ni, Pb, Al, Ni, Si etc.

If the resulting galvanic sludge exposed to the impact of precipitation in an acid environment, leads to a highly toxic and chemically active metal ions according to the following chemical reaction:

$$Me(OH)_{2\,(S)}+2H^+\rightarrow Me^{2+}+2H_2O$$

Toxic metals do not degrade biologically and permanently accumulate in the environment, which are due in the food chain and thus indirectly affect human life and health.

Stabilization of toxic metals from galvanic sludge performed various industrial processes, such as the incorporation of toxic metals in brick [2], recycling and re-use in the metallurgical industry [3], the implementation of ceramic clay [4], incorporation into borosilicate glass [5], incorporation of glass-ceramics with aluminum slag [6], the translation of the ash generated by burning coal and waste glass in glass-ceramics [7], [8], vitrification, solidification of galvanic sludge asphalt emulsion [9] etc.

Given the importance of this research, carried out the characterization of galvanic sludge, given the technological process of stabilization of beneficial eco-sintered material, and these methods are unconventional wastewater treatment systems that have no secondary pollution.

CHARACTERIZATION OF GALVANIC SLUDGE

Quantity and composition of galvanic sludge was determined by plating technological process and production capacity, concentration of components in the electrolyte and rinsing water. Sewage Sludge Management includes its monitoring since the moment of its creation to disposal, which is one of the main goals of environmental protection.

According to the Regulation on the Classification, packaging and storage of raw materials [10] sludges from electroplating plants from can be classified according to the Waste Catalogue index under 11, as well as wastes from chemical surface treatment of metals. Sludge classified under index 19 in the catalog of waste, the waste from treatment and wastewater treatment, are listed under index number 19 02 05, as sludge physico-chemical treatment containing dangerous substances.

Rules on the treatment of waste with hazardous substance [11] defines a way of documenting the types and quantities of hazardous materials in production, use, trade, transport, storage and their disposal. In the management of this type of waste, whether it is a temporary delay while awaiting recovery or a long delay, it is important to perform the analysis and characterization of leachate according to SRPS EN 12506:2007 [12]. Eluate is defined as the solution obtained after leaching test. Sludge samples are dissolved in accordance with the procedure laid BS EN 12457-1-4:2002 [13] relating to the determination of heavy metals extracted from samples of sludge with high solids content and particle size below 4 mm. In the world, great attention is paid to examination, collection, storage and transport of galvanic sludge. Declared as a hazardous waste, and its classified according to the dominant metal or physical properties. This type of waste under controlled conditions examined, because of its toxic properties [14].

INACTIVATION OF GALVANIC SLUDGE

Simplest way of inactivation of galvanic sludge's treatment filter press (Figure 2), which is obtained filter cake containing 75-80% water.

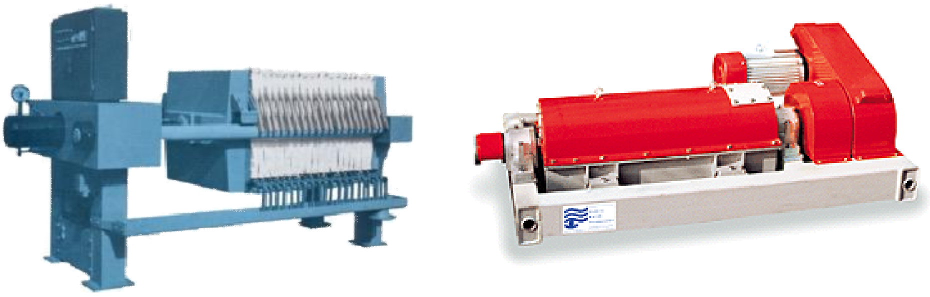

Figure 2. Filter presses of galvanic sludge [15]

In order to reduce the volume of sludge obtained and reduce the mass of sludge must be dried galvanic sludge. For this purpose, use a low-temperature drying with HEI batch dehydration system [16].

The HEI batch dehydration system is designed to meet the stringent environmental requirements for thermal extraction equipment. The design flexibility of the HEI batch dehydrator allows the system to be positioned directly beneath the filtration equipment whenever possible to save material handling. The dehydration process is accomplished by externally heating the dehydration chamber with steam, gas, or electric heat and carefully controlling the internal dehydration temperatures and the dehydration steam exhaust. Additionally, many wastes can be batch treated that are environmentally objectionable in a continuous dehydration system.

General operation of the HEI batch dehydration system consists of dropping a controlled amount of material through the dehydration chamber door. The process timer is set to the required dehydration time. A custom fabricated steel blender ribbon continuously turns the material exposing all surfaces for dehydration. When the preset dehydration time (typical cycle is 5 to 6 hours) has elapsed, the unit automatically shuts down. At this time, the operator switches to the discharge cycle to allow automatic emptying of the machine.

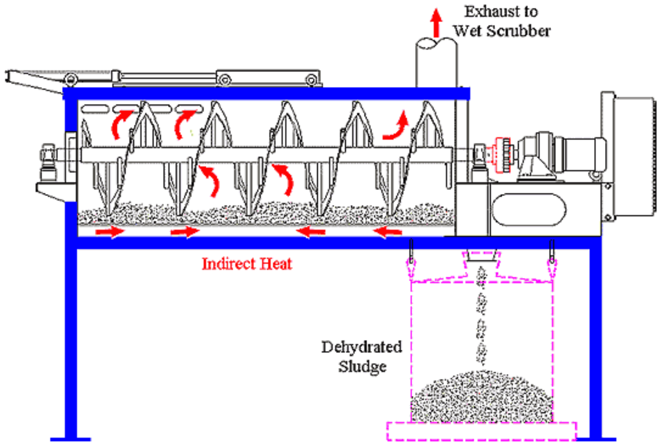

Figure 3. HEI batch dehydration system [16]

However, this is treated galvanic sludge must not be disposed of in the environment, it would at least allow for the release of atmospheric precipitation of toxic metals in the nearest receptors and thus increased the risk of damaging the environment.

Moreover, one of the ways inactivation of galvanic sludge and its incorporation into addition of clay pottery. A mixture of clay and galvanic sludge, with the addition of certain excipients, the heat treatment, whereby the metals embedded in a silicate material. The degree of inactivation galvanic sludge is usually accompanied by the amount of metal that is removed from the heat treated mixture. It was found that heat treatment of clay mixtures of Kaolin Oka, galvanic mud and sand may inactiviti all toxic metals except zinc and chromium [4].

Much better way is to incorporate toxic metals in eco-sintered product in the form of solid solutions, adding cullet and aluminum dross. Thus the chemically active substances (Cu^{2+}, Cr^{3+}, Cd^{2+}, Ni^{2+}, Pb^{2+}, Zn^{2+}) can be transformed, phase and chemical transformations in the very stable structure, where the pollutants can not run even under critical conditions such as high temperature, influence of acids and bases and the like.

The basic raw material that was used in this eco-technological procedure of the galvanic sludge, which are qualitatively hydroxides of toxic metals ($Cu(OH)_2$, $Cr(OH)_3$, $Zn(OH)_2$, $Pb(OH)_2$, $Cd(OH)_2$, $Ni(OH)_2$, etc.). Another material is aluminum die-slag waste, which contains a certain amount of aluminum oxides (Al_2O_3, BeO, TiO_2, CuO, Cr_2O_3, etc.), with a dominant content of Al_2O_3 and hardened salt refinery, which mainly include: KCl, $NaCl$, Na_3AlF_6, $MgCl_2$, CaF_2, MgF_2, etc. Third wastes are shavings and sawdust of iron, which forms the mechanical metal processing (turning, milling, drilling, etc.). As additional material were waste glass. The average composition of waste glass in percentages by weight, 76% SiO_2, 11% PbO, 8% ZnO, 2% B_2O_3, 2% BaO i 1% ZrO_2. In addition to the initial waste material was used and bortrioksid (B_2O_3), and flux for the synthesis of glass-ceramics.

Crucible with a mixture is placed in a furnace where it is heated to 1200-1400 °C. The melting point of the mixture depending on the proportion of each component used in the mixture. The increased proportion of glass will reduce the melting temperature, and reduce the strength of the obtained ceramics. Increasing use of aluminum slag increase the firmness of the ceramic structure, but it entails the provision of more melting temperature which can sometimes be difficult.

Should be noted that the introduction of non-conventional systems for wastewater treatment technological process of galvanization (electrochemical oxidation and reduction, ion exchange, as and membrane processes: reverse osmosis, ultrafiltration and electrodialysis) allows regeneration of toxic metals, mineral oils and colors in order to produce such quality effluent can be recirculated into the technological process of electroplating. The economic nature of the only reasons why these methods are not used in our country.

CONCLUSION

Galvanic sludge is legally declared as hazardous waste. If it does not perform its processing or improperly disposed, easily movable metal fractions are eluted from the rainfall and infiltration of polluting the environment. In this respect done inactivation of galvanic waste sludge and aluminum slag incorporation into a useful eco-sintered material. By using non-conventional systems for wastewater treatment technological process of galvanization no galvanic waste sludge and irreversible loss of valuable elements, thus creating requirements of clean technology.

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GRINDING AND CLASSIFICATION AS THE METHODS OF FLY ASH PROCESSING

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ABSTRACT

This paper presents a short description of grinding and classifying methods in fly ash processing. Therewith, the results of testing of pozzolanic activity and specific surface area of specified fly ash samples (initial, ground and classified) are also presented in this paper. Pozzolanic activity was determined using standard methods (with lime and Portland cement). Specific surface area is determined by Blain method. It was found that pozzolanic activity of grinded and classified fly ash was significantly higher than pozzolanic activity of initial fly ash sample.

Key words: grinding, classification, fly ash.

INTRODUCTION

Fly ashes are finely divided residue resulting from the combustion of ground or powdered coal. They are generally finer than cement and consist mainly of glassy-spherical particles as well as residues of hematite and magnetite, char, and some crystalline phases formed during cooling.

World trend of development of building materials demand the usage of high-quality fly ash in the construction industry. Chemical composition and physical-mechanical properties of fly ash must satisfy strict requirements of standards. Parameters that most often can affect the low quality of fly ash are reduced pozzolanic activity due to increased presence of coarse particles and large loss of ignition (corresponding to the amount of unburned carbon in the ash).

In the aim of application of fly ash as an admixture in the production of building materials, different technological procedures can be divided [1]:

- procedures which application results in decreased amounts of unburned coal in fly ash (reburning, electrostatic separation) and chemical methods by which unburned coal from the ashes is not removed, but reduction of its adsorption ability of different materials is reduced (especially of air entraining agents)

- procedures by which satisfied fineness of fly ash is achieved, with increasement of its pozzolanic activity (grinding and classification)

CLASSIFICATION OF FLY ASH

Fly ash classification (dry sieving and pneumatic classification) is a method of removal of coarse particles from fly ash. This procedure results in achievement of appropriate fly ash fineness as well as decreasement of unburned coal content.

Coarseness of classified fly ash should satisfy requirements of appropriated standard for fly ash quality. According to data of American Coal Ash Association, usual fineness of American coal fly ashes is over 50% of class -45+0 microns. Sieving of such ashes on the screens with opening size 150 microns and 180 microns can usually provide satisfactory mass content of corresponding class, prescribed by standard ASTM C618.

Method of pneumatic classification is more suitable for industrial application because this method can provide very fine fractions of fly ash. Therewith, pneumatic classification is more cost-effectiave then sieving on the screens with opening size 45 microns and less.

GRINDING OF FLY ASH

In dependence on required coarseness of fly ash (as an admixture in binder production), there are two grinding methods:

- fine grinding
- ultrafine grinding

The aim of fine grinding is reduction of fly ash particles to desired size, according to standard requirements.

Ultrafine fly ash belongs to very reactive pozzolanic materials. Fly ash ground to ultrafine levels takes on many improved properties over normal ash. This can be explained as follows. Ultrafine grinding process provides size reduction and also creation of new surfaces of fly ash particles. On that way calcium hydroxide becomes homogeneously distributed on the surfaces of the fly ash particles. Some investigations established that amorphous glass phase, which is carrier of pozzolanic properties, is more concentrated in internal layers of fly ash particles then in external. Besides that, additional amorphization of the fly ash particle surface takes place by mechanical activation process. These phenomena improve the pozzolanic activity towards a reaction with calcium hydroxide [2].

Ultrafine fly ash can be defined as d_{50} = 8 microns or less, with a top size in the range of 30 to as low as 5 microns [3]. If this fly ash is used as the replacement of cement in concrete production, compressive strength of such concrete after three months of hardening can be in the range of compressive strength after one year of hardening of concrete containing unprocessed fly ash. Ultrafine ground fly ash is an effective replacement for silica fume.

Usually, devices recommended to fly ash grinding process are vertical mills and trapezium grinding mills.

There are numerous examples of fly ash processing plants. Certain of them are mentioned in following text.

Schematic presentation of an industrial plant for grinding and classification of fly ash is presented in the Figure 1. Fly ash, as a raw material, is transported from feed hoper to ultrafine grinding mill. Ground product goes to the classifier where classification is performed. Coarse fraction returns to mill and fine fraction is transported to a cyclone. Overflow from the cyclone goes to the dust collector and underflow is collected as a final product.

In the Poland factory Cementownia "Chełm" cement marked as CEM II/B-V 32,5R is obtained by process of dry grinding and classification. Fly ash and cement are ground in cylinder mill with rollers as grinding media. Diameter of rollers is about 20 mm.

Company DIRK India Private Ltd produces commercial product named "Pozzocrete" which presents pozzolanic material based on fly ash with improved features. Pozzocrete essentially consists of spherical particles which improves the performance of concrete in its fresh state (such as consistence, stability and finish) and hardened state (such as strength, stiffness and drying shrinkage) as well as permeation and durability.

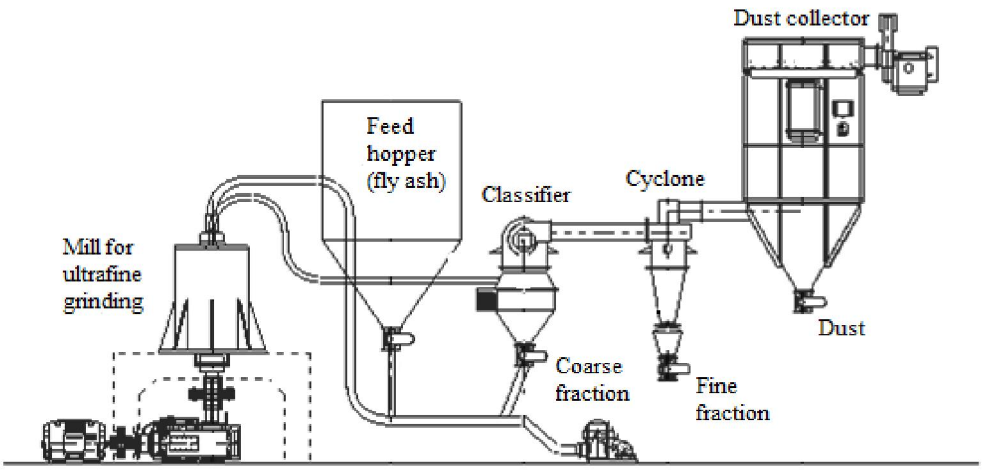

Figure 1. Schematic presentation of industrial plant for grinding and classification of fly ash (Company RSG Inc, Alabama) [2]

In addition, dry grinding and classification of fly ash are subjects of many experimental testing conducted by numerous researchers [4-8].

TESTING OF EFECTS OF GRINDING AND CLASSIFICATION ON THE POZZOLANIC CHARACTERISTICS OF SPECIFIED FLY ASH SAMPLE

Raw material

For the purposes of these studies a sample of siliceous fly ash from Thermal Power Plant "Kostolac" was used. Percentage contents of main oxides SiO_2, Al_2O_3, Fe_2O_3 and CaO in this sample were 50.38, 26.43, 8.77 and 7.18, respectively. Particle size analysis shown that the sample contained 62.5% of particles larger than 45 microns.

In order to improve characteristics of fly ash sample in terms of fineness and standard requirements (ASTM C618), the sample was treated by ultrafine grinding, grinding and classification methods.

Ultrafine grinding was performed in the vibrating ring mill for 30 minutes. Grinding was carried out in a laboratory ball mill during the 16,5 minutes. Classification is accomplished by dry sieving on the screen with opening size 75 microns.

Test procedure

Pozzolanic activity index with Portland cement is determined by standard procedure [ASTM C311; ASTM C618]. In this test method the 7 days and 28 days compressive strengths of a mortar prepared with a 20% fly ash substitution for cement on a mass basis are compared to those of a control mortar. While the control mortar is prepared with a water-to-cement ratio by mass (w/c) of 0.5, the water content of the test mixtures is adjusted to provide an equivalent flow to that measured for the control. The mixture with the fly ash should provide 75% of the strength of the control at 7 days or 28 days, according to the ASTM C618 specification.

Pozzolanic activity index (I_r) was counted by formula (1):

$$I_r = \frac{A}{B} \cdot 100\%$$

where:

A – compressive strength of mortar with fly ash, after 7 or 28 days settings
B – compressive strength of referential (control) mortar, after 7 or 28 days settings

Pozzolanic activity with lime was determined by mechanical method according to Serbian Standard [SRPS B.C1.018]. Examination was carried out on the prisms of mortar (dimensions 4×4×16cm) created from hydrated lime, fly ash, standard sand and water, in mass ratio 1:2:9:1,8.

Specific surface area was determined by Blaine method according to standard procedure.

The results are presented by table 1.

Results and discussion

Table 1. Specific surface area and pozzolanic activity of fly ash samples in dependence on the fly ash treatment

Sample	Specific surface area [cm^2/g]	Pozzolanic activity index [%]		Pozzolanic activity [MPa]	
		7 days	28 days	Flexural strength	Compressive strength
Initial	2550	61	69	2,4	7,8
Ultrafine ground	10800	96	101	4,5	17,7
Ground	5410	91	94	4,1	15,6
Classified	3850	87	88	3,8	13,6

As it can be concluded from the Table 1, pozzolanic activity can be significaly improved by different treatments of fly ash. The best result is obtained if the fly ash is treated by ultrafine grinding process. Ultrafine grinding can induce considerable increasement of pozzolanic activity index: 1,57 times after 7 days hardening and 1, 46 times after 28 days hardening. Grinding and classification of fly ash (to achieve the appropriate fineness) can also bring about enhancement of its pozzolanic activity.

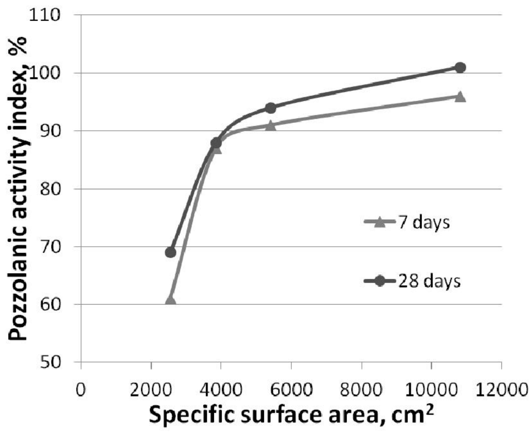

Figure 4. Pozzolanic activity index depending on the specific surface area of fly ash

Considering fly ash reaction with lime, it can be noticed that initial sample of fly ash can be classified into the lowest class of pozzolans (P5). After ultrafine grinding and grinding, fly ash samples can be classified into the highest class of pozzolans (P15). According to mentioned above, sieving treatment of fly ash also causes increasement of mortar strengths, therefore sieved fly ash can be classified into P10 class of pozzolans (Table 1).

Likewise, it can be concluded that pozzolanic activity of fly ash depends on its specific surface area (as confirmed in literature). Pozzolanic activity index obviously increases with increased surface area. Therefore, fly ash with the highest value of specific surface area (ultrafine fly ash) has the best pozzolanic properties (Figure 4).

CONCLUSIONS

World trend of development of building materials demand the usage of high-quality fly ash in the construction industry. Grinding and classification are the methods of improvement physical-mechanical characteristics of fly ash.
The results obtained in these examinations indicate that, after treatment of fly ash from TPP "Kostolac" by grinding and classification, its pozzolanic activity can be considerable improved. The best results are achieved by ultrafine grinding of fly ash.

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SOME ASPECTS OF FLY ASHES UTILIZATION IN BUILDING MATERIAL INDUSTRY

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ABSTRACT

Fly ashes from thermal power plants are usually used in building material industry, especially in cement and concrete production. For this utilization fly ashes must have appropriate chemical, physical and mechanical characteristics. This paper presents some aspects of fly ashes utilization in cement production in Serbia. Complete characterizations of siliceous fly ashes from TPP Kostolac B and TPP Nikola Tesla B in Serbia, as well as results of laboratory investigations aimed to obtain new type of cements, are presented. Also, Serbian and international standards that follow this usage are presented.

Key words: fly ash, characterization, standards, cement.

INTRODUCTION

The four largest producers of electricity in Serbia, thermal power plants Kostolac A and Kostolac B in Kostolac and Nikola Tesla A and Nikola Tesla B in Obrenovac, utilize lignite as the primary energetic fuel. Total installed capacity of thermal power plants in Kostolac and Obrenovac are 1006 MW and 2888 MW, respectively. Based on several years of practical experience, it is established that for the production of 1 kWh of electricity is necessary to combust about 1,4-1,5 kg of coal (1).

As the lignite burns, it produces emissions (gases like carbon dioxide, sulphur dioxide and nitrogen oxides) and ash. The gases, together with the lighter ash (fly ash), are vented from the boiler up the stack. Huge air filters called electrostatic precipitators remove nearly all the fly ash (also so-called electrofilter fly ash) before it is released into the atmosphere. The heavier ash (bottom ash) collects in the bottom of the boilers and is removed. About 90% of produced ashes are represented as fly ash, while about 10% is represented as bottom ash. Fly ash has great fineness (below 0.5 mm), while the bottom ash is a granular material, much coarser than fly ash, removed from the rost of the bottom of boiler (1, 2).

Thickened tailing technology for ash deposing is applied in practice few years ago in thermal power plants Kostolac B and Nikola Tesla B. Bottom ash is crushed in roll of hummer crushers to 100%-5mm, and then mixed mechanical or hydraulical with water and fly ash in solid to liquid ratio of 1:1, i.e. in 50% of solids. After that, mixture was hydraulically transported with series of centrifugal slurry pumps through pipeline in the form of thick hydromixture to open ash disposal sites. Taking into consideration the enormous annual production of fly and bottom ashes in TTP Kostolac B and Nikola Tesla B (more than 1.4 million tons and 1.75 million tons, respectively), these ashes are the major polluters of the environment - land, water and air.

This paper presents some aspects of fly ash utilization in the building material industry (in cement and concrete production) - complete characterization of fly ashes from TPP Kostolac B and TPP Nikola Tesla B and standards followed this usage. Beside this, results of laboratory investigations carried out on fly ash (from TPP Kostolac B) and portland cement (CEM I) aimed to obtain new type of cements (of different marks) are also presented.

UTILIZATION OF FLY ASH IN BUILIDING MATERIAL INDUSTRY

It is well known that fly ash has various applications in many industry. At 30's of last century in the United States fly ash added to cement in the construction of large dams. Application of fly ash has more positive aspects, which are reflected primarily in reducing the cost of deposit, as well as protecting the environment. The most important application of ashes is certainly in the building material industry, mining (for filling abandoned mine shafts, open pits), agriculture (for land reclamation and fertilization), metallurgy (for production of steel and other metallurgical sintered products), water treatment (for filters), gas desulphurization (producing of aqueous suspension), for the production of oxide-aluminum and aluminum (extraction of mullite for aluminum production). Today, fly ash – the most commonly used coal combustion product – is a remarkable material that cost-effectively improves the performance of products it is added. Fly ash is used in many applications to replace ordinary and naturally materials and raw materials and minerals. So, fly ash is also a cost-effective resource and using fly ash makes a positive contribution to the environment (1, 3).

Fly ash has the largest application in the production of cement, hydraulic lime, various types of concrete, lightweight sintered aggregate, brick products, in road construction. The reason of the fly ash usage is not only in the reducing of costs, but it seems in the fact that the ash, if it is used for the production of cement, for example, reduces the heat that is released during hydration of the cement, affects the consistency and strength as well as resistance to aggressive (corrosive) water. In road construction, for example, fly ash mixes with lime and represented material that is easily processed and compacted, become strong relatively fast and it has high compressive strength and slightly susceptible to erosion and the impact of frost. In mixture with lime ash can be used in road construction of embankment, the lower of carrying layers and subgrade of pavements, repairs to roadways. For instance, in making concrete, cement is mixed with water to create the "glue" that holds strong aggregates together. Fly ash works in tandem with cement in the production of concrete products. Concrete containing fly ash is easier to work with because the tiny, glassy beads create a lubricating effect that causes concrete to flow and pump better, to fill forms more completely, and to do it all using up to 10 percent less water. Because the tiny fly ash particles fill microscopic spaces in the concrete, and because less water is required, concrete using fly ash is denser and more durable. Fly ash reacts chemically with lime that is given off by cement hydration, creating more of the glue that holds concrete together. That makes concrete containing fly ash stronger over time than concrete made only with cement (3).

The utilization of fly ash in building construction is confirmed by the fact that in some European countries (for example in France, Italy, Poland) fly ash is not presented on disposal sites. The utilization of fly ash across European countries is different and is nearly based on national experience and tradition. In 2010 about 14 million tones of fly ash were utilized in the construction industry and for production purposes in underground mining. Most of these fly ash produced was used as concrete addition in road construction and as raw material for cement clinker production. Fly ash was also utilized in blended cements, in concrete blocks and for infill (that means filling of voids, mine shaft and sub-surface mine workings). In 2010, about 1.9 million tones of bottom ash were used in European countries in the construction industry. Out of this about 42% was used as fine aggregate in concrete, about 42% in road construction and filling applications and about 10% in cement production (4).

Because fly ash use displaces cement use, it also reduces the need for cement production – a major energy user and source of "greenhouse gas" emissions. For every ton of cement manufactured, about 6.5 million BTUs or 1904 kWh of energy are consumed. For every ton of cement manufactured, about one ton of carbon dioxide is released. Replacing that ton of cement with fly ash would save enough electricity to power the average American home for 24 days, and reduce carbon dioxide emissions equal to two months use of an automobile. Experts estimate that cement production contributes to about 7 % of carbon dioxide emissions from human sources. If all the fly ash generated each year were used in producing concrete, the reduction of carbon dioxide released because of decreased cement production would be equivalent to eliminating 25 % of the world's vehicles (3).

CHARACTERIZATION OF FLY ASH RELEVANT TO ITS USE IN BUILDING MATERIAL INDUSTRY

Depending on the type of coal and type of boiler, siliceous, silico-calcareous or calcareous fly ashes with pozzolanic and/or latent hydraulic properties are produced throughout Europe. According to chemical composition, fly ashes produced in all thermal power plants in Serbia belong to group of siliceous fly ashes.

Siliceous fly ashes are composed of highly aluminosilicate materials, which have a high content of active chemical SiO_2 (over 40%) and a high total content of acidic oxides (SiO_2 + Al_2O_3 + Fe_2O_3), a low content of basic oxides (CaO, MgO), they all give pozzolanic properties. Namely, these ashes must be pozzolanic active, and it's means that fly ashes (finely ground) react with hydrated lime in the presence of water giving insoluble compounds (Ca-silicates and Ca-aluminate), which gives great strengths. Beside this, fly ash must have appropriate physical properties, which are usually represented with particle size distribution, i.e. fineness. If fly ash hasn't sufficient fineness, it hasn't pozzolanic properties when mixed with water and couldn't become strong. Also, fly ash must have appropriate chemical and mineralogical composition, as well as physical and physical-mechanical properties. This last is usually known as bending strength and compressive strength. Properties of fly ash are important for its use in cement and concrete industry and usually it is defined with standards.

Our standard SRPS B.C1.018 defines the use of fly ash in the cement industry. This standard provides a classification, technical requirements and test methods of pozzolanic materials used as additive in the cement production. Standard specifies the classification of fly ashes according to the origin (siliceous fly ash classified as artificial pozzolan, mark V) and the classification according to mechanical properties (bending and compressive strengths), in other words pozzolanic activity. Pozzolanic activity is presented with bending strength and compressive strength of mortar test specimens after 7 days of their setting in water. For the highest class of pozzolanic materials, mark 15, bending strength after 7 days must be minimum 4 MPa, while the compressive strength must be minimum 15 MPa. Standard gives the requirements for quality (the impurities, free water, particle size distribution, chemical composition, mechanical properties, radioactivity, expansion). Fly ash must have the appropriate composition, which refers to the content of reactive SiO_2 (min. 25%), reactive CaO (max. 10%), active CaO (max. 2.5%) and loss on ignition (max. 5%). In addition, fly ash must have an appropriate particle size distribution determined by sieving on a series of sieves according to SRPS ISO 565. Fly ash is classified in group 1 pozzolanic materials, because of its size class - 50 mm. Also, fly ash must have the appropriate fineness after grinding, which should be 90-94% -0,063 mm (5).

Foreign standards also define the class of pozzolanic materials and fly ashes, their chemical composition, physical, mechanical and other properties. American Standard ASTM C618 defines two classes of fly ashes for their use in concrete, class C and class F. Class F fly ash is produced from burning anthracite and bituminous coals originating from hard coal and fly ash class C of lignite. Class C fly ash is pozzolanic and cementitious fly ash normally produced from burning lignite or subbituminous coal. The chemical requirements in the ASTM specification for class C fly ash are: min. 50% $SiO_2 + Al_2O_3 + Fe_2O_3$, max. 6% loss on ignition, max. 3% moisture content, max. 5% SO_3. Physical requirements are related to fineness or max. 34% retained on 325 mesh sieve (6).

When cement manufacturers intergrind or blend portland cement with fly ash or natural pozzolans or slag cement, the blended cement is specified under ASTM C595 (AASHTO M 240), Standard Specification for Blended Hydraulic Cements. Among these materials, type IP(X) is indicated as portland-pozzolan (P) cement. In this cement X denotes the targeted percentage of pozzolan expressed as a whole number by mass of the final blended cement. Typical replacement rates for blended cements are 15 to 25 percent. (7).

In United Kingdom pulverized fuel Ash or "fly" ash is the fine ash produced in the furnaces of coal-fired power stations. BS EN 450 is a harmonized European Standard for fly ash that replaced the former British Standard BS 3892: Part 1 in January 2007. Three categories of fly ash are permitted under BS EN 450 according to LOI: category A (LOI not more than 5.0%), category B (LOI 2.0% to 7.0%) and category C (LOI 4.0 to 9.0%). There are two categories for fineness: category N (not more than 40% retained on the 45 microns sieve and a limit of +10% on the supplier's declared mean value permitted) and category S (not more than 12% retained on the 45 microns sieve) (8).

Fly ash, beside other additives, such as tuff, slag, gypsum, can be added at different stages of the process of cement production, namely: at feed of the clinker furnace (as one of the raw materials, in addition to the marl, limestone and clay), at feed to the mill for clinker grinding (as pozzolan, slag and tuff) and at the end of the process, when fly ash can mix with cement. In addition, fly ash can be used in factories for the production of concrete, when directly mixed with all the components for the production of concrete. Fly ash is added in the part of clinker grinding process in cement factories in Serbia. In cement factory Titan in Kosjerić fly ash is added at the feed of the mill along with tuff and /or slag in different mass ratios (max. 35% by mass of all additives).

According to SRPS B.C1.011 (9) which is harmonized with European standard EN 197-1:2000, siliceous fly ash can be a component of 8 types of cements, including:

- portland cement with the addition of fly ash (6-35% by mass), (label PC 20V and PC35V, which are equivalent to European mark for cement CEM II/A-V and CEM II/ B-V);
- portland composite cement (6-35% by mass), (label 20M and PC 35M, equivalent to the European label for cement CEM II/A-M and CEM II/B-M);
- pozzolanic cement (11-55% by mass), (label P 35 and P 55, equivalent toEuropean label for cement CEM IV/A and CEM IV/B);
- composite cement (18-50% by mass), (label MP 30 and MP 50, equivalent to European label for cement CEM V/A and CEM V/B).

CHARACTERIZATION OF FLY ASHES FROM TPP NIKOLA TESLA B AND KOSTOLAC B

Fly ashes from TPP Nikola Tesla B and TPP Kostolac B belong to type of siliceous fly ashes. An average chemical composition of the fly ash samples taken from each of the 4 zones and one composite sample taken from one line of electrostatic precipitator at the end of the pneumatic trough are shown in Table 1. The content of chemical components are shown in the range from minimum to maximum values.

Table 1. Chemical composition of fly ash samples

Component	TPP Nikola Tesla B	TPP Kostolac B
SiO_2	50.57-61.63	44.82-47.46
Fe_2O_3	4.47-6.59	7.98-8.40
$Al_2O_3 + TiO_2 + P_2O_5$	20.39-26.74	24.11-27.87
CaO	4.11-8.35	7.01-8.70
MgO	1.86-3.02	3.74-4.30
SO_3	1.12-2.97	5.06-6.46
Na_2O	1.20-1.56	0.94-1.27
LoI	1.10-3.36	2.06-4.10

According to presented chemical composition it is obviously that these ashes are characterized with a high content of chemically active SiO_2 (more than 45%) and high total content of acid oxides (SiO_2+Al_2O_3+Fe_2O_3) (over 75%) and low content of alkaline oxides (CaO+MgO) and a low loss on ignition, which is below 5% as defined in the standard.

Mineralogical analysis has shown that the largest part of these ashes are composed of amorphous phase, represented by aggregates of thermically transformed clay, so called cenospheres. These cenospheres are occurred spherical, colorless or slightly colored, usually in hollow forms, at size classes below 0.03 mm.

Fly ashes are characterized by low densities (from 2.04 to 2.15 g/cm^3) and high specific surface area (3360-4000 cm^2/g). These ashes are characterized by high fineness, where fly ash from TPP Nikola Tesla B have greater fineness than flay ash from Kostolac B. Particle size distribution have shown that d_{50} are from 0.025 mm to 0.135 mm for TPP Nikola Tesla B, and from 0,085 mm to 0.20 mm for TPP Kostolac B, while d_{95} are from 0.20 mm to 0.34 mm for fly ash from TPP Nikola Tesla B and from 0.20 mm to 0.50 mm for TPP Kostolac B.

Table 2 shows the mass distribution of reference size class (-0.045 mm). Fly ash samples were taken from all four zones of electrostatic precipitator and also as composite sample in TPP Nikola Tesla B and Kostolac B.

Table 2. Mass distribution of reference size class (-0.045 mm)

Sample	TPP Nikola Tesla B	TPP Kostolac B
Zone 1	16.90	5.55
Zone 2	57.95	10.05
Zone 3	47.72	13.75
Zone 4	60.99	6.52
Composite	27.91	6.47

According to the data shown, mass of reference size class are different in all samples. The largest masses of -0.045 mm size class is established in the samples from 2nd, 3rd and 4th zones in TPP Nikola Tesla B (48-61%), until in same zones in TPP Kostolac masses of -0.045 mm size class amount only 6-14%. In the samples from 1st zone masses of reference size classes is significantly reduced, which is particularly important considering to the fact that largest content of total production by mass (about 70-85%) of fly ash is separated in the 1st zone. It is also obviously that the masses of reference size class (-0.045 mm) is below the requirements according to international standards (European EN450 Fly ash or American ASTM C618 for fly ash class C).

This leads to the conclusion that fly ashes, especially from the aspects of international standards, don't have satisfactory fineness, so fly ashes grinding and reduction to fineness according to standard regulations is necessary.

Experimental investigations are shown that siliceous fly ash from TPP Kostolac B can be succesfully used for production of various cement types, on different ways. So, investigations included three series of tests in which cement mixtures produced by grinding, by grinding and mixing and by classification and mixing portland cement and fly ash in different proportion by mass. Mass contents of fly ashes were 20, 35 and 55%. In first series of tests, cement mixtures are produced with common grinding of portland cement and fly ash, in second series with mixing of portland cement and pre-grinding fly ash and in third series with mixing of portland cement and pre-classified fly ash. All produced cement mixtures are marked as CEM II/ A-V 52,5N, CEM II/ B-V 52,5N, CEM II/ B-V 42,5N, and CEM IV/B 32,5 R.

CONCLUSION

Our investigations confirmed that siliceous fly ashes, originated from TPP Kostolac B, can be successfully used as pozzolanic aditive for production of various type of cements. All produced types of cement satisfied the requirements of standards.

Considering the fact that fly ashes from our thermal power plants mostly have satisfactory chemical and mineralogical composition and also physical and mechanical properties as pozzolanic aditives for cement and concrete productions, but they haven't necessary fineness (according to reference size class -0.045 mm), it is still necessary that fly ashes are treated in future. This treatment includes grinding according to standard requirements.

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DECREASE OF SULFUR OXIDE EMISSION ORIGINATING FROM POWER PLANTS

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ABSTRACT

Adopting a set of laws on environmental protection the process of harmonization of local regulations with the European Union (EU) has been intensified. One of the most important parts of this process refers to measures to reduce emissions of pollutants at the source of pollution. Taking into account the nature and their environment, following regulations concerning environmental protection in "Kostolac" power plants completed or initiated a number of projects that significantly improve environmental protection. This paper presents plant for flue-gas desulphurization and analyzed ecological aspects of the thermal power plants before and after installation of this plant.

Key words: environmental protection, desulphurization of flue gases.

INTRODUCTION

As an emitter of harmful gases, which are the product of the technological processes of electricity generation from coal plants, thermo energy plants have the greatest negative impact on the environment. Therefore, this activity requires a complex, holistic and comprehensive approach to environmental protection. Thermal power plants in Kostolac encompass "Kostolac A" thermal power plant (100+210MW) and "Kostolac B" (2x348,5 MW) that use coal from "Drmno" coal strip mine to produce electricity. In addition to producing electricity, these power plants produce thermal energy for heating Pozarevac, Kostolac and its suburbs. Taking into account the nature and its environment, following the proclaimed EU norms, in particular regulations concerning environmental protection, a number of priority activities and projects that significantly improve environmental protection have been completed or initiated. Of the measures to reduce the negative impact of "Kostolac" thermal power plant on the environment projects it is necessary to emphasize a modernization of all electrostatic precipitator plants, the project for flue-gas desulphurization plants, a modernization of transport system and disposal of the ash and the slag, and the introduction of continuous emission monitoring.

The reconstruction of the electrostatic precipitators in electric plant "Kostolac A", located in the city, particulate matter emissions was reduced by 54%, which provided total pollution in accordance with European standards of 50mg/m^3. Aligning of the electrostatic precipitators in EP "Kostolac B" with the requirements of EU regulations to reduce emissions of particulate matter is in progress, finished in B2. To bring the concentration of sulfur oxide emissions at the level of 400 mg/m^3, in accordance with the provisions of Directive 2001/80/EC, in EP "Kostolac B" up to 2015 will be installed plant for flue-gas desulphurization. Modernizations and introducing new transportation technologies and disposal of the ash, ended in EP "Kostolac B" and begin in EP "Kostolac A", in addition of reducing Aeolian erosion, will enable the reduction of pollution of ground waters.

ECOLOGICAL ASPECTS OF KOSTOLAC THERMAL PLANT

Operation of thermal power plants using coal has two effects on the environment:

- Direct, discharging of gaseous and particulate products of combustion and waste water and heat into the environment
- Indirectly, through the usage level of the plant

The most prominent problem in the environment relates to threats to the air quality. Coal combustion occurs in two combustion processes – combustion of organic matter and transformation of inorganic matter, thus creating gases, solid flying particles, ash and slag. Low quality coal, like ours, has high ash content (20-30%), so huge amounts of ash and slag generate during the work of thermal power plants, which may contain certain amounts of toxic and hazardous components. Flue gases from power plants, in addition to the basic components of CO_2, SO_2, NOx, CO and ash particles, contain a considerable number of substances harmful to the environment. These compounds alter the state of the atmosphere and have been designated as pollutants. First revealed adverse effects on the environment were of compounds SO_2 and NOx. Increased concentrations of CO_2 in the air affect the long-term climate change (greenhouse effect).

"Kostolac" thermal power plants with its four blocks are a significant source of environmental pollution. "Kostolac A" is one of our oldest power plants; it is also the first power plant in Serbia that used pulverized coal for combustion. Of the number of units that were built on the site, today operate only two, namely: A1 block 100MW commissioned in 1967, and 210 MW A2 block, put into operation in 1980. Given the length of their work, A1 block has lost its effectiveness not only in terms of electrostatic precipitators, but also of the whole block. This is reflected in the degree of electrostatic dusting, which ranged from 90% - 98% and which was reducing from year to year due to the aging equipment. Therefore, the revitalization of A1 block was made in 2007, extending its service life for fifteen years.

Once installed equipment to reduce pollution in the "Kostolac B" plant, in spite not being too old, from period 1987 – 1991, does not meet current legal requirements. The requirements currently being placed on environmental performance are much stricter than those from the time of building power plants are. During this period, there were no legal provisions on limitation of emissions at the national level, so at these objects measures to reduce emissions of sulfur and nitrogen oxides in the atmosphere were not applied. As the only measure for the protection of air quality, the electrostatic precipitators, high chimneys, and connect two blocks to one chimney processes were applied. In this way, the impact on the improvement of the dispersion of pollutants in the atmosphere was made, and the air quality in the area has been preserved in a legally permissible limits.

Characteristics of the emission of pollutants into the air from the chimney are given based on the results of periodic tests performed annually by an authorized institution. Table 1 shows the annual emissions of particulate matter, SO_2, NOx, and CO_2 for B1 and B2 blocks of "Kostolac B" and A1 and A2 blocks of "Kostolac A" before the modernization of the electrostatic precipitator systems.

Table 1. Summary of annual emissions of particulate matter, SO_2, NOx, and CO_2 for 2008

Pollutant emission per year	t/year			
	Particles	SO_2	NO_x	CO_2x10^3
Kostolac A				
A1 Block	826	13 277	1 725	755
A2 Block	1 715	36 168	5 059	1 628
Kostolac B				
Block 1	1 865	28 117	5 335	1 584
Block 2	3 857	31 453	5 242	1 779
Total Kostolac	8 263	108 960	17 362	5 748

A comparison of the measurement results shows the allowable emission limit values (ELVs) according to given national and EU regulations, the following can be concluded:

- SO_2 emissions in all blocks is above the ELV domestic and EU regulations,
- CO emissions is in the accordance with the domestic ELV regulation,
- Dust emissions is above the ELV national and EU regulations,
- NOx emissions in all blocks is above the ELV domestic and EU regulations

Immission of total particulate matter (TPM) is monitored at four measuring points (Stari Kostolac, Drmno, Kostolac, Bradarac) and SO_2 immission at three measuring points (Ostrovo, Kostolac, Bradarac). The distance between the measuring points is the maximum 4km of the power plants. Analysis of measurements of immission in 2004 showed:

- The average daily value of CO_2 immission is the ELV scope (150μg/m^3)
- The average annual immission of SO_2 is in the ELV scope (50μg/m^3)
- The average monthly values of TPM immission is 73.91% higher than in the ELV (450mg/m^2/day)
- All data on the average annual TPM immission exceed ELV (200mg/m^2/day)

The largest quantity of **waste** generated in Kostolac is the ash, placed in the category of hazardous waste that could be used. So far, ash was not delivered to anyone. The ash from the boiler is collected in the dredge station where the hydraulic system transports it to the ash dump. The amount of ash is about two million tons per year (for all TEKO-A and TEKO-B blocks). Estimated amount of disposed ash is about twenty-five million tons. The ash is disposed in an open dump of 240Ha area.

Due to **Aeolian erosion** from the landfill, there are episodic air pollutions. Strong gusts of east wind caused the ash to be lifted from the landfill and blown off by the left bank of the Danube, while the western wind did the same throwing the ashes to Stari Kostolac. In order to minimize the impact of waste on the environment, they started with installation of new equipment for the transport of the ash (dense hydro blend) to the ash and slag disposal place.

Based on years of air quality monitoring in the environment of "Kostolac", we can conclude:

- the emissions of SO_2 in the ELV and SO_2 is a global and not a local problem,
- the particulate pollution is a consequence of wind erosion of ash on the one hand and increased particulate emissions in the flue gases on the other hand,
- the problem of particle pollution is often expressed at the time of the wind due to inadequate passive protection, which is usually without a water mirror. There are no sprinklers around the embankment of the cassettes A and C. This pollution is of local character and has priority in solving.

In order to improve the air quality: installation of equipment for continuous measurement of emissions in the flue gases was done (in B1, B2 and A2 blocks, SO_2, NOx, O_2 and dust are measured, and in block A1 only particulate matter) reduction of emissions/immission, reconstruction of electrostatic precipitators in line with EU standards (ELV = 50 mg/m^3 of particulate matter) in A1 and A2 blocks, while in the B1 and B2 a construction of the plant for flue gas desulphurization is in the progress, in line with EU standards (ELV = 400 mg/m^3 sulfur oxides) in Kostolac B, monitoring to increase the efficiency of power plants, the introduction of new technologies of transport and disposal of ash and slag (by mixing ash and water in the ratio 1:1), and the construction of a new ash dump pit "Cirikovac". The introduction of new technologies of ash transport and disposal, the negative impact on water pollution is minimized (surface and underground).

A PLANT FOR DESULPHURIZATION OF FLUE GASES

During the construction of thermal power plant in Kostolac, there were no legal provisions that stipulated measures to reduce emissions of sulfur oxides. Therefore, the current emissions of sulfur dioxide in flue gases exceed the maximum allowable values as defined in domestic and in the regulation of the European Union. Measured values of emissions of sulfur dioxide ranged between 5000-7000mg/m^3, with the specific emissions of 30 kg/MWh. In order to examine possible solutions for flue-gas desulphurization in power plants, a study was carried out, in which technical solutions to reduce SOx emissions from existing power plants were proposed and a preliminary proposal by the sequencing of desulphurization plants and the implementation schedule and the necessary investment funds. Based on the examination, as the optimal method, the wet flue-gas desulfurization process (FGD) was selected using limestone for SO_2 absorption, having as the final product of the absorption process commercial high quality gypsum. At the same time, the minimum investment criteria in relation to the reduction of emissions of sulfur oxides, "Kostolac B" was chosen as the first power plant in which construction of such facilities was planned.

Plant for flue-gas desulphurization consists of the following basic technological stages:

- Transport and storage of limestone
- Preparation and delivery of limestone suspension
- Flue-gas desulphurization
- Thickening of the gypsum suspension
- Transport of suspended gypsum or dry plaster to the disposal place

Process of flue gases desulphurization is shown in Figure 1.

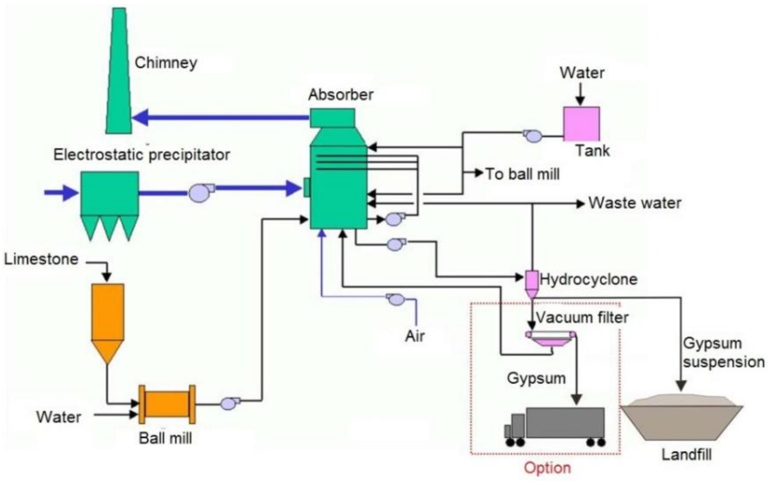

Figure 1. Process of flue-gas desulphurization

After passing through the electrostatic precipitators (whose limit values are 50 mg/m3), flue-gas fans and booster fans, flue-gas streams from each of the blocks of power plants into the absorber just above the level of liquid phase in the reaction pool. After entering the pool, flue-gas stream is moving in the direction upwards towards the top of the absorber, where it encounters fine droplets of recirculation suspension to absorb SO_2 from flue gas. The purified flue-gas then passes through a two-step droplet eliminator that removes droplets from the suspension and water, and then through the flue channel at the top of the absorber is channeled into a brand new chimney and released into the atmosphere.

The goal of the flue gases is to reduce SO_2 emissions by more than 94%, to achieve a concentration of SO_2 output to be lower than 400 mg/m^3 (6% O2, dry gas) under the heavy load of the block and while combustion of the coal of the worst quality. Characteristics of the flue gases at the entrance and the exit of the plant are shown in Figure 2.

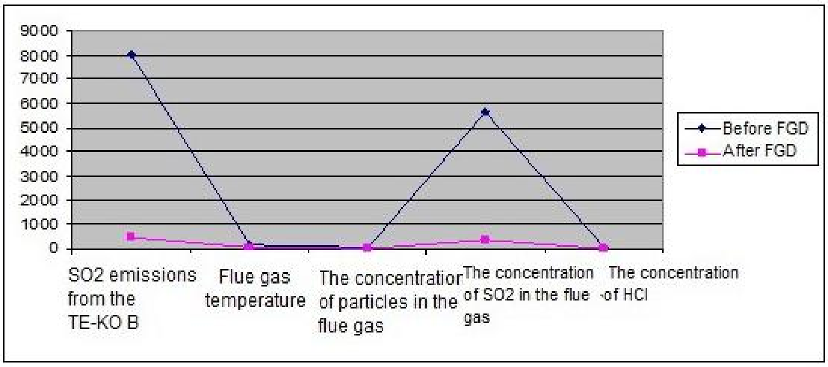

Figure 2. Graphic illustration of the flue-gas characteristics at the inlet and the outlet of the FGD facility

The main goal of building a plant for wet flue-gas desulfurization is to control and drastically reduce the amount of SO_2 emitted into the atmosphere. Therefore, the main contribution of the project to the air quality will undoubtedly be positive and will result in improving air quality in terms of concentration of sulfur oxides, which results in a number of positive effects on the environment by reducing the possibility of formation of the acid precipitation. The process of wet flue-gas desulphurization will achieve a positive impact by reducing the amount of emitted particulate matter and gaseous and acid components (HCl and HF). In order to display positive effects of the operation of FGD, the Table 2 gives a comparative overview of reducing the concentration of pollutants in flue gas, at the exit of the absorber.

Table 2: Comparative assessment of reduction of pollutants from flue-gas when desulphurization plant starts to work

SO_2	NOx	Suspended particles	HCl i HF	CO_2	CO
Reduction of 94,03%	No change	Reduction of 70%	Reduction of 90% - 96%	Increase of 1,6% - 1,7%	No change

Negative impact on ambient air quality will be realized in the form of increased emissions of particulate matter due to diffuse outs of the system of transportation, unloading, storage and handling of crushed limestone. If case it is not possible to find a purchaser for a produced plaster with moisture content up to 10%, gypsum storage will be made in the form of a suspension with 50% humidity. Gypsum will be transported to the landfill ("Drmno" open pit mine) by pipeline system. Due to thixotropic properties of gypsum, after a short period, the suspension hardens and forms a crust on the surface and therefore significant emissions of particulate matter from the landfill is not expect.

CONCLUSION

The biggest problems in the field of environmental protection are caused by air pollution, water pollution, loss of water resources and inadequate waste management practices. Air quality is caused by emissions of SO_2, NOx, CO, particulate matters originating from thermal power plants (due to use of coal and bad dust collection). Because of that, most of the projects realized in the field of environmental protection are directly aimed at controlling and reducing air pollution.

Taking into account the nature and its environment, following the proclaimed EU norms, in particular regulations concerning environmental protection, a number of priority activities and projects that significantly improve environmental protection has been completed or initiated.

In order to bring the concentration of sulfur oxides to a level of 400 mg/m^3, in accordance with the provisions of Directive 2001/80/EC at the "Kostolac B" plant, by 2015, installation of the plant for flue gas desulphurization was planned. As the optimal procedure, a wet flue gas desulphurization (FGD) was selected using limestone for SO_2 absorption; and the gypsum of commercial quality is the final by-product of the absorption process.

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FATIGUE CRACK GROWTH IN GLASS/EPOXY COMPOSITES

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ABSTRACT

Construction materials, traditionally used in process equipment, are today successfully replaced by composite materials. Composite materials have a wide range of applications thanks to their good properties under loading conditions, specific mechanisms of crack initiation and growth and capabilities for the accumulation of energy, and represent the greatest competitors to classical construction materials. Their advantages lie in their relatively small mass, good strength/mass and stiffness/mass balances, good static and dynamic properties, good resistance to corrosion and simplified fabrication and mounting time. The analysis of fatigue crack growth in composites, is important for evaluation of composite quality under service conditions. This paper presents the experimantal determination of C and n parametars from Paris equation, on glass/epoxy composites described below.

Key words: glass/epoxy composites, fatigue crack growth.

INTRODUCTION

The intensive development of polymer engineering, as well as the capabilities of polymers in combination with other materials to form new synthetic structures of improved mechanical properties, has led to a real expansion in the application of composite materials, which was followed by a continuous improvement of the technology of their manufacture.The analysis of fatigue crack growth in composites, is important for evaluation of composite quality under service conditions. This paper presents the experimantal determination of C and n parametars from Paris equation, on glass/epoxy composites described below. Analysis of results of da/dN behaviour was combined with SEM analysis, too.

EXPERIMENTAL PROCEDURE

The tested composite material is produced from glass-fiber cloth with the weave $0^0/90^0$ (specimen GE-1) and $\pm 45^0$ (specimen GE-2), and epoxy resin properties presented in Table 1.

Table 1. Properties of glass - fiber cloth

Volume content of glass, %	55-60
Specific surface weight, g/m^2	163
Layer thickness before composite production t_0, mm	0.18
Tensile strength R_m, MPa ($0^0/90^0$)	370
Shear strength τ_{12}, MPa ($\pm 45^0$)	79
Elasticity modulus E_1, GPa	21
Pressure strength R_c, 440 MPa	440

Hand made laminates contained 52 layers. Thus obtained laminates had been polymerized by pressing between two aluminium plates in order to prevent delamination. Subsize Charpy specimens (Fig. 1) had been made by a hard metal milling cutter, from small bars, extracted from panel samples. Each specimen is shaped and dimensioned according to the standard ASTM [1], with purpose to get a-N curves and to determine crack growth rate (da/dN) versus stress intensity factor (ΔK).

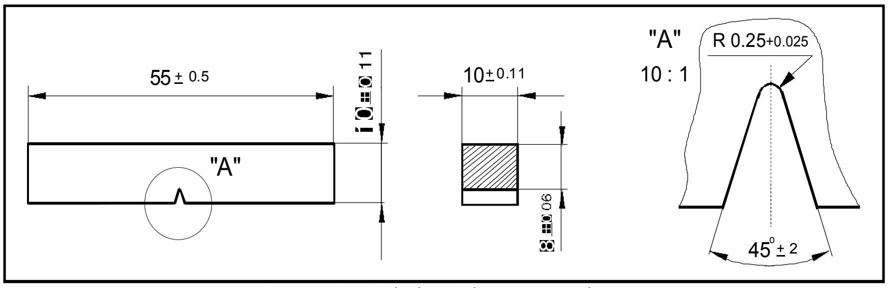

Figure 1. Subsize Charpy specimen

The tests were carried out on resonance high-frequency machine CRACKTRONIC under load control, in three point bending. The test machine can produce sinusoidal one-direction discontinuos moment within the range -70 to +70 Nm. The test is performed with the same stress ratio R=0.1 and with the dynamic moment M_d varying within the range of 12.7 to 4.4 Nm. The measurement accuracy was □0.05 Nm. Test machine is connected with the computer, printer and plotter, which enable automatic measurements. Machined specimens were instrumented with special foil (crack gauge) glued like a common strain gauge. The crack gauge, produced by the firma RUMUL type RMF A-5, used in tests, had the measuring length 5 mm. Crack growth was registred by a device with trade mark FRACTOMAT. The system for crack growth meassurements - fractomat is based on the electric resistance of the sticked foil. As fatigue crack grows under measuring foil, the measuring foil splits, following the fatigue crack tip, and ensures the change of the foil resistance, which varies linearly with the change in crack length.

During the experiments on a high-frequency machine the number of cycles per each 0.1 mm of fatigue crack growth was recorded automatically. On the basis of the recorded a-N diagrams (Fig. 2) [2] for the tested composites, was possible to calculate fatigue crack growth rate. This calculation was implemented by the computer, during the tests, using a program, provided together with the testing machine. As a significant amount of data was collected in the course of one specimen testing (about 50 measurments), it was usual to represent the relationship log da/dN=log(ΔK) in the graphic form (I

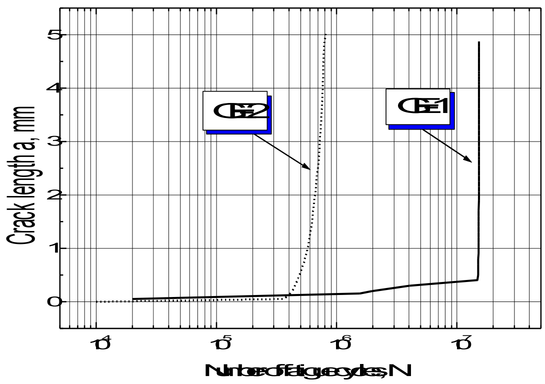

Figure 2. Experimentally derived dependance a-N for tested composite specimens

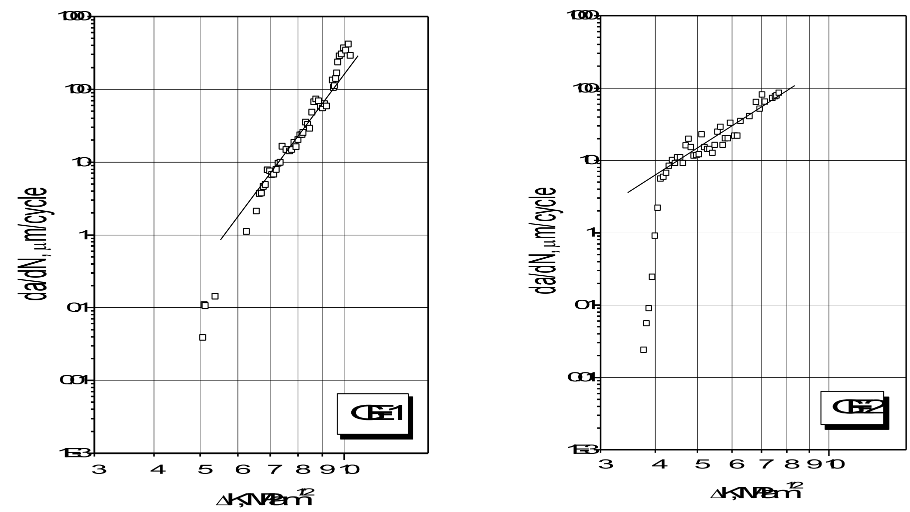

Figure 3. Graphic presentation of the dependance da/dN - ΔK for tested composite specimens

On the basis of experimental results and graphic presentation of the crack growth rate da/dN in dependence on stress intensity factor range ΔK, the coefficient C and the exponent n in Pariss equation (1) [3] could be calculated:

$$\frac{da}{dN} = C \cdot (\Delta K)^n \quad (\mu m/cycles) \qquad (1)$$

For tested specimens obtained C and n values are given in Table 2, together with the value of fatigue threshold:

Table 2. C and n values for tested specimens

Sample	Fatigue threshold ΔK_{th}, $MPa \cdot m^{1/2}$	C	n
GE-1	5.1	$6.14 \cdot 10^{-16}$	8.356
GE-2	3.7	$2.85 \cdot 10^{-11}$	3.873

DISCUSSION AND CONCLUSIONS

Higer value of fatigue threshold ΔK_{th} for GE-1 specimen can be explained by orientation of fibers. However, da/dN is higher in region II of Paris dependence for GE-2 compared with GE-1. The intreface between glass cloth and epoxy, as crucial parametar, was subjected to lower shear stress level in GE-1 compared to GE-2 specimen. Much higher shear stress on interface had been found in GE-2 specimen, which result with lower values of ΔK_{th}. The higher da/dN value for GE-2 compared with GE-1, can be explained by involving fretting factor between fibers and epoxy for GE-2 samoles. As result, heat generated due to fretting degradated characteristic of fibers and resin. Fretting was virtualy absent in GE-1 (in 90^0 direction, that is in notch direction) specimen and therefore fracture of fibers is pronounced in 0^0 orientation.

From above it can be concluded that fatigue crack growth was gradual in several stages [4, 5]. For GE-1 specimen stages of crack growth was:

1. When the main crack developed in notch direction and become stacionary, the initiation of subcritical cracks in lateral directions was pronounced in paralel layers.
2. After arresting of subcritical cracks growth due to local stresses on the main crack tip, the increasing of stress was pronounced in fibers ahead of crack.
3. After some number of cycles, fibers ahed crack tip cracked and main crack continued to grow for the diametar of cracked fibre; after cracking of fibre the growth of main crack become again stacionary.

Orientation of clothing, for GE-1, is an additional factor, decreaseing all the effect of above considered factors due to fretting between fibers and resin and between fiber and fiber. Characteristic fractographs, obtained on SEM, are presented in Fig. 4.

Simmilar mechanism of fatigue crack growth was revealed in GE-2 specimen. Base difference is found in the growth of cubcritical cracks in layers $+45^0$ i -45^0 with maximal shear stress. Deflection of crack path during test confirmed the statement that number of crack initation sites of fibers was greater compared with GE-1. SEM fractograph in Fig. 5 has shown that the crack of fibers was on 45^o direction.

The confirmation of performed analysis is found in references [6-9]. During the test, failure of resin was clearly visible by colour changes. Different colours can be explained with thermal effects acting during fatigue crack growth.

Figure 4. Fracture of fibers for GE-1 specimen (23,2 X)

Figure 5. Fracture of fibers for GE-2 specimen (126 X)

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RECYCLABLE POLYMER MATRIX COMPOSITES IN MANUFACTURING OF VEHICLES

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ABSTRACT

Recycling occurs for three reasons: altruistic reasons, economic imperatives, and legal consideration. Today, recycling is clearly the environmentally preferred method of solid waste management. Composite materials with recyclable polymer matrix are widely used in a automobile industry. In market economies recovery operations are judged by financial criteria. Thus, whether or not a discarded waste is exploited for the materials it contains depends, among other things, on the technical ease of recovery of a saleable secondary product. The aim of this paper is to explain reason, ecological, financial and technical, for using of recyclable polymer matrix composites in manufacturing of vehicles.

Key words: recycling, composite, polymer, automobile industry.

INTRODUCTION

Historically, waste management has been an engineering function [1]. The current and future waste management and environmental legislations require all engineering materials to be properly recovered and recycled, from end-of-life (EOL) products such as automobiles, wind turbines and aircrafts. Recycling will ultimately lead to resource and energy saving. Materials and processing technologies hold the key to the future success of polymer matrix composites in the automobile market [2].

The plastics industry has been able to expand into metals territory, meeting the automobile sector's chief requirements for mechanical properties, freedom from corrosion, speed of production, cost and a top-quality Class A finish. The future requirements list will have to include recyclability, especially in the European Union where the End of Life Vehicle Directive requires that cars made from 2015. will have to be 95% recyclable [3-5].

Recyclable polymer matrix composites are used in manufacturing of vehicles for financial and technical reasons. This materials offer advantages: their use can achieve significant weight savings relative to metals and, whether for this reason or for others, they may offer substantial lifetime energy savings.

Composite materials, as a special category of engineering materials have not yet been properly recycled (both for the matrix and for the reinforcement materials).

Thermoplastics are a rising star of automobile composites [4]. One telling advantage is that, unlike thermosets, they are more like traditional plastics in being serially recyclable. Because of their fundamental ability to be re-shaped upon heating, thermoplastic matrix composites can be recycled directly by re-melting and re-moulding high value materials. They can be melted down and re-moulded a number of times before their properties become too degraded for further use. This feature can survive addition of reinforcement and justifies claims of environmental acceptability. Automobile polyurethane (PU), polypropylene (PP) and polyamide (PA) thermoplastics, suitably reinforced, can be tough, durable, and highly resistant to chemicals and impacts. Because of that, polymer matrix composites clearly surpass all alternative materials in automobile industry.

RECYCLING TECHNOLOGIES FOR COMPOSITES

There are essentially four classes of recycling technique which apply to composite waste in general [1,3]:

- Primary recycling – conversion of waste into material having properties equivalent to those of the original material
- Secondary recycling - conversion of waste into material having properties inferior to those of the original material
- Tertiary recycling - conversion of waste into chemicals and fuel
- Quaternary recycling - conversion of waste into energy.

CHANGES IN THE MATERIALS USED IN VEHICLES

The automobile industry's use of structural composite materials began in the 1950s. Since those early days, it has been demonstrated that composites are lightweight, fatigue resistant and easily moulded to shape, a seemingly attractive alternative to metals. However, there has been no widespread switch from metals to composites in the automobile sector yet. This is because there are a number of technical issues relating to the use of composite materials that still need to be resolved including accurate material characterization, manufacturing and joining. Nowadays the polymer–matrix composites (PMC) are in competition with the existing metal components in the automobiles [4].

Changes in vehicle materials are made for a variety of reasons, including cost, absolute performance, lightness, (to improve fuel economy), and longevity. The magnitude of fuel savings over an estimated 174,000 km vehicle road life has been computed as 15-25 l/kg of weight saved. Though improved engineering design may achieve weight reductions, a point is reached where further improvements may be made only through the use of light materials. Considerable effort has therefore been devoted to substitution of steel and cast iron by lighter materials, such as aluminium, polymers and composites.

Polymer matrix composites are used in manufacturing for financial and technical reasons. In transport they can provide reductions in the first cost. Such cost reductions are not necessarily permanent, since technological improvements and shifts in the raw materials prices continually give one material a cost advantage relative to another. And, the main reason is that with primary recycling of composites we can convert waste into materials having properties equivalent to those of the original material (polymer matrix and reinforce) [4,6].

However, composites also offer other advantages: their use can achieve significant weight savings relative to metals and, whether for this reason or for others, they may offer substantial lifetime energy savings. It has been calculated that although manufacture of a given automobile fuel tank in HDPE matrix composite typically consumes 6% more energy than does a corresponding tank in steel, 68% of the total energy consumed in the production of the latter is associated with the conversion of sheet steel into tanks and so cannot be reclaimed through recycling processes. In the calculations it may be seen that, relative to the recycled steel fuel tank, the recycled polymer matrix composite tank can effect a 28.8% energy saving during manufacture, lifetime use, and recycling. There is, therefore, some advantage in reclaiming the plastic as material rather than burning it for energy recovery.

So far as recyclability in its widest sense is concerned the most important change has been the reduction in the amount of steel used. Of increasing significance now, however, is the disposal cost for the non-metallic residuals of vehicle and appliance dismantling and shredding operations; their low density makes them expensive to transport and landfill. This problem is likely to intensify.

The 1960 model composite car described by Dean and Sterner contained 0.9% polymers; in the model years 1972 and 1973 U.S.-built cars typically contained almost 5% polymers, largely in safety and comfort applications. By 1985 the plastics contents of automobiles produced in various countries were 8% (Japan), 9% (USA), and 10.5% (Federal Republic of Germany). By 1995 is risen to about 15%, and 2006. to 25%.

GREENING

Balancing the recycling challenge is a major opportunity for composites within an impending automobile revolution. Composites may soon face their greatest challenge, the recycling issue – and their biggest opportunity, the 'greening' of road transport. Experts accept there could be a problem. A researcher at Ford's Dunton researchcentre, UK, told Reinforced Plastics that a certain amount of 'rethink' was taking place in view of the European Unions's strict end of vehicle life requirements. He thought it would be ironic if we were pushed back towards metals for their inherent degradability.

Alan Foster, global product leader reinforcements for Owens Corning agrees that recycling is a challenge but thinks that the current major research focus around the world will deliver answers. Moreover recyclability should not be over-emphasized as safety and energy efficiency may be just as important. David Cripps of SP Systems points out that much depends on what is meant by recycling. If another use for reclaimed material outside the automobile sector is acceptable, then it is easier to manage the situation than if 'a piece of car has to be recycled to another piece of car.

Separation of phases (fibers from matrix) using fluidized beds, pyrolysis or other means may not be feasible or economically worthwhile, leaving grinding into small fragments the only viable option.

Thermoplastics are inherently more recyclable than thermosets but even these reach the end of the road, due to progressive degradation of properties. Nevertheless, with their menability to repeated thermoforming, they do go some way to addressing the issue. Thermoplastic recyclate can be added to new material in proportions that do not excessively reduce properties. The one step long fiber transfer moulding process devised by German company Ramaplan Anlagenbau supports this possibility by accommodating recycles of a number of thermoplastic types including GMT [7,8,9]..

High fractions of dense carbon or other fibers can reduce recyclability. Researchers at Queen Mary, University of London suggest that this can be avoided by using thermoplastic fibre to reinforce thermoplastic matrix. Thus a PP/PP, dubbed PURE, developed by the University in collaboration with the Advanced Materials Centre at Ford, Dunton, UK, is a material with similar properties to GRP which can be melted and remoulded as a single entity, without inhibition from fibre content. The PP fibers do not seriously degrade during thermal recycling and Ford's Alan Harrison believes it should prove possible to substitute them for glass in a range of items including body panels, under trays and bumper beams.

Most recyclable of all would be naturally derived fibers and resins, which are combustible, compostable, renewable and carbon dioxide neutral. These substances have the further advantages of being widely available, and very low in weight. This all explains why manufacturers around the world are experimenting with fibers from jute, hemp, kenaf, soy, cotton, hemp, flax, coir, kapok, coconut and bast; and resins based on soybean and corn. Mercedes Benz introduced jute-based door panels into its A-Class vehicles as long as eight years ago. The North American market alone for natural fibre composites is growing at some 50% annually, from a base of $150 million in 2000. A landmark agreement between Kafus Biocomposites and Ford supplier Visteon Automobile Systems should see natural fibre composites used for ,items such as in interior panels, linings and fittings.

Although a natural fibre/thermoset composite might only be half as strong as a glass composite, and even less stiff, this can sometimes suffice and is appropriate technology.

In resins, a notable initiative is that by Ashland Specialty Chemicals' Polymer Composites Division to combine grain derived organic systems with polyester. The company reports, for instance, performance equal to or better than current polyesters for a hybrid in which a quarter of the total resin was renewable.

FUTURE PERSPECTIVES

For the materials recyclability for automobiles, the bottleneck can be identified in the plastics and composite materials, and to a large extent this goes to the ASR. Without proper solutions to the recycling issue for the plastics and composite materials, more use of strong and light weight composites will be strongly limited [4-10]. All industrial development trends will give more incentives and raise higher demand for better and true materials recycling of composite materials. The first generation wind turbines are reaching their end of life. The turbine blades made of glass fiber reinforced plastics need immediate recycling. Materials recycling (at least for the glass fibbers) issue deserves great attention and immediate action from both governmental (legislation and incentives) and industrial parties (manufactures and users or owners).

Year 2015 is just 2 years ahead and we will not expect drastic changes in industrial operations. But the EU Directives for ELVs require 85% materials reuse and recycling or 95% reuse and recovery including a maximum 10% energy recovery, compared to 80% materials reuse and recycling since 2006. This implies that ASR which accounts for 25% of the car mass has to be recycled to a very large extent.

Whether the 20% composites within the plastics fraction are recoverable is questionable within 2 years. Looking into the aerospace industry, there are no legislations yet for composites recycling like the automobile sector of EU ELV Directive. The same is true for the EOL wind turbines. The technologies are waiting for the legislation and better economics of the recycling process. At the same time the technologies are going through further developments, in particular for the increased quality of the recycled products and cost reduction of the recycling operation. The increased accumulation of EOL wind turbines and increased use of composites in automobile and aeronautic industries will further draw attention from the society and government bodies to promote commercialization of the composite recycling process.

The situation for plastics and composites, and even in 5 years time there would be no dramatic change for the car parts made from the recycled plastics and rubbers. This will be greatly limited by the quality degradation of polymeric materials and composites, and hindered by the difficulty in general polymer recycling. However, there will be no doubt that new scrap of these types of materials could be used in making new car parts.

Even recycling from bumper to bumper could be possible if the quality of the EOL plastic bumpers is still sufficiently good so that it can sustain and serve another life of a new car. Therefore, mixed use with virgin polymers would be much more realistic.

In 2 years from now, there would be no big change of polymer matrix composite recycling technology, and any commercially recycled fibers in the near future will be most likely used in lower levels of non-structural applications with less critical quality requirements.

What will be the situation in 2030, 2050 and beyond? We have now many years to develop technology, infrastructure and legislation. Simply from resource availability point of view, it will force us to recycle and recover not only the valuable reinforcement materials (carbon and glass fibers and a like) but also increasingly scarcer organic polymer matrix materials. It will be hard to imagine if the EOL wind turbine blades are still buried or burnt in incinerators, and composites car parts are being mixed with general plastics and discarded as the rest stream of waste. By year 2030, the manufacturing process will become so efficient that much less manufacturing composites wastes will be generated. The product design can tolerate much more use of the recycled fibers. Legislation will promote contribution of all involved parties to the recycling efforts and cost so that the high recycling cost based on state of the art technology will be more than compensated by the market value of the recyclates. A much more healthy market tolerated by the manufacturing industry would be ready based on groundbreaking innovative design. A proper balance for the production and use between virgin and recycled constituents of composite materials would have been established.

The consequence of the success in the recycling of composite materials will be the direct benefits of increased use of this type of stronger and light weight materials in transport (automobile and aerospace) and other civil sectors. Looking into a much longer future, by year 2050 the fundamental contradiction between the heterogeneity and recyclability would become less critical, by using newly developed reinforcement materials which will have much more similarity with the matrix materials in their chemical nature. The use of non-remeltable thermoset matrix will be significantly replaced by thermoplastics.

Recycling technology will become much more mature to either separate the reinforcements from the matrix materials most likely based on clean chemical recycling technology such as super critical water, or recycle the (remeltable) matrix together with reinforcements. The high cost of composite recycling will be compensated by legislation for forbidding the landfill and incineration of composites waste and EOL products, and by increasing production cost of virgin composite constituents (reinforcement fibers and polymer matrix). With the constantly developed new expertise and knowledge and the joint efforts from all involved parties, we can turn many today's dreams in composite world to reality in the coming 30–40 years.

CONCLUSION

Recycling of engineering materials will contribute to the sustainability and sustainable development of industrial processes. To put automobile plastics recycling in perspective, we must consider the following:

- Automobile plastics have contributed to reducing the weight of automobiles by 500 to 750 pounds, depending on the vehicle. A rough rule of thumb is that a 10% reduction in weight improves gas mileage by about 6%. Thus, the use of plastics (about 257 lbs/vehicle) significantly improves mileage, reducing greenhouse gases.
- Over 85% of the energy consumed during the life of a vehicle occurs during its useful life (gas, oil, maintenance). So weight reduction brought about by using plastics significantly reduces the total energy consumption of a vehicle.
- Automobile plastics make up about 0.5% by weight of a landfill. Despite this low number, automobile and plastic companies are striving to reduce that amount.

To put things in perspective, the greatest values plastics bring to automobiles are their lightweight characteristics and their potential for part consolidation. Since about 85% of the energy consumed during a car's life occurs during its use phase, the lightweight plastics significantly improve gas mileage, reducing greenhouse gas emissions.

Cars of the future will be lighter, faster, and more fuel efficient, and this will require lightweight materials – a big opportunity for composites. It is hoped that future innovative research and development, and new breakthrough separation and recycling technologies for the composite materials recycling will be available and more easily recyclable composite materials will be developed for the industry.

Acknowledgements

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ANALYSIS AND RECYCLING OF MIXED PLASTIC WASTE FROM HOUSEHOLD WASTE

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ABSTRACT

Mixed plastics from household waste involves the medium/short life articles that are used in food, pharmaceutical, and detergent packaging, shopping, and others. There are mainly five different polymers that contribute to the total amount of plastic waste, however the composition can change depending on the regional habits and the seasons of a year and the mode of a waste collection. This work reports the recycling approach for the above mentioned group of plastic waste.

Key words: plastic waste, PE, PP, PS, PVC, PET, polyolefines, recycling.

INTRODUCTION

Mixed plastics from household waste involves the medium/short life articles that are used in food, pharmaceutical, and detergent packaging, shopping, and others. The majority of these articles are composed of thin protective films, sheeting for blisters, strapping, thermo-formed trays, as well as a variety of bottles for soft drinks, food and cosmetics.

There are mainly five different polymers that contribute to the total amount of plastic waste, and they are commodities (PE, PP, PS, PVC, PET) [1-3]. The plastic composition of the above mentioned mixture can change depending on the regional habits and the seasons of a year. Also the mode of a waste collection can influence its final composition. This paper reports the recycling approach for the above mentioned group of plastic waste.

EXPERIMENTS AND RESULTS

A study of this type of a plastic waste has been performed using samples that came from two different experimental collection systems, the first in plastic boxes (internal volume: 3 m^3), and the second in arranged plastic areas inside the dump. The two "city" samples showed two different compositions, as reported in Fig. 1. The polyolefin fraction (PP and PE) falls in the range of about fifty to fifty five percent, while large differences between the two samples are in the PET and PS percentages.

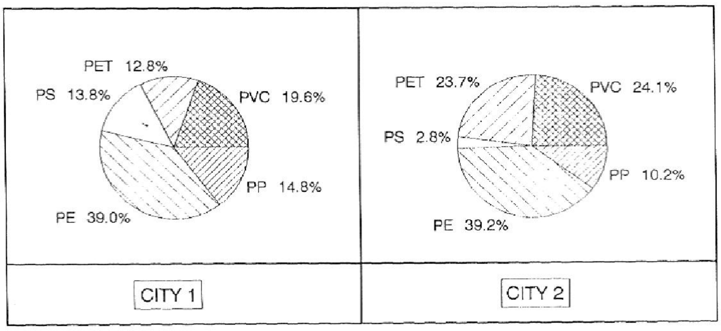

Figure 1. Mix composition

A direct solution to plastic disposal problems can be the reuse of a heterogeneous mixture of plastics, directly obtained from a separate urban collection. The processing behavior of the heterogeneous mixture has been preliminary investigated to establish the critical technological points and a more suitable machinery. In particular, injection molding and extrusion (single and twin screw) have been considered in this investigation. Afterwards, the mechanical properties evaluation has been performed to identify potential applications of plastic waste. As a result of this research step, it has been demonstrated that the heterogeneous mixture can be processed through extrusion or injection molding technologies using traditional machineries. In the case of extrusion, it has been found that the use of a twin counter-rotating screw extruder guarantees greater efficiency than a single screw extruder. In addition, a degassing unit on the extruder is advisable to remove the gas that is eventually generated by residual traces of organic materials following the washing step. Due to the presence of PVC resin, the melting temperature must be kept below 483 K and the barrel residence time must not exceed 6 min. Furthermore, the relatively high content, in the mixture, of semicrystalline polymers like PET, whose melting point is above the processing temperature, influences either the technological solution or the final properties of the manufactured product. Larger injection gates and mould channels must be used in order to avoid undesirable occlusions in the channels. A micro-grinding of the semicrystalline polymers seems to be the most suitable solution to produce thin wall articles with improved aesthetics and mechanical properties.

Nevertheless, because of the incompatibility of the various plastic materials, the mechanical properties of molded or extruded products are rather poor. Some mechanical properties of a molded sample have been measured and the results are reported in Table 1.

Table 1. Mechanical properties of heterogeneous mix

IZOD impact strength unnotched (KJ/m^2)	Tensile properties	
	Elastic modulus (MPa)	Elongation at break (%)
11.5	950	7

A sample of the heterogeneous plastic mixture derived from the city 2 collection, having the composition reported in Figure 1, have been evaluated through mechanical impact (IZOD) and tensile tests. According to the ASTM methods, several specimens have been molded, employing a traditional injection molding machine. The melt temperature during the plastic mixture processing was held at 463 K and the barrel residence time was about 3 minutes. The mechanical testing showed wide numerical distribution of the values, but a more important aspect was a very poor tensile or flexural strength. This means a strong limitation of applications, in particular in the case of thin walls and manufactured products that have to work under flexural or tensile stresses. Therefore, by adding to the mixture specific components, like other polymers from homogeneous recycling, fillers (talc), fibers or promoters that increase the compatibility, it is possible to improve the tenacity or stiffness, product aesthetics, and processability.

Table 2. Improvement of mechanical properties

Material		Formulations				
		1	2	3	4	5
Heterogenous mix		100	100	100	100	100
Talc			20			
Glass fiber				30		
SBS finaprene						10
LDPE from agricultural recycling					20	
Flexyral evaluation		Properties				
Strenght (Mpa)	at yield				16.5	19.0
	at break	20.5	16.5	24.5		
Elongation (%)	at yield				8.0	11.2
	at break	6.8	4.3	2		
Elastic modulus (Mpa)		950	1250	2800	700	820

Table 2 reports some mechanical property improvements obtained through an addition of several components. As shown, the glass fibers allow the product to obtain a very high stiffness, higher than the one with talc and far better than that of the original mixture, while the SBS and PE improve the tenacity. The final choice of a type and an amount of these components is based on their cost as well as their efficiency. Finally, specific "aid-processors" can be employed to increase the processability range of the heterogeneous mixture of plastics.

The philosophy of our research is to consider the heterogenous mixture as a new plastic base for different formulations to be correlated with application requirements. Starting from this concept, some formulations have been employed to produce several manufactured products for different application areas [4-6]. Fig. 2 shows some samples of extruded profiles that can be employed to build benches, garden tables, bicycle racks, fences, and playing facilities for parks.

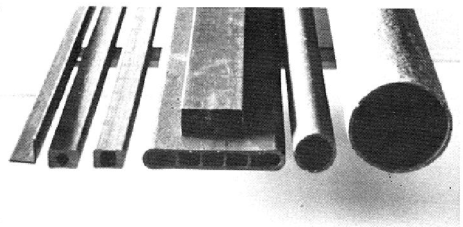

Figure 2. Extruded profile sample

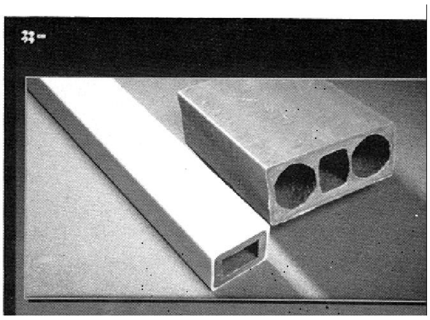

Figure 3. Coextruded samples

Coextrusion technology is the best way to improve the surface properties like puncture, impact and weather resistance, as well as the appearance. Samples obtained through coextrusion are shown in Fig. 3.

A wide spread solution, in terms of application and market volume, can be the recycling of single materials or homogeneous fractions obtained from a separation process of the mixture. In fact, the samples obtained from single homogeneous fractions show a general performance far greater than that of samples produced from mixed plastics. It has been recently worked on a procedure that separates four fractions of different materials. These are: polyolefins (PO), PS, PVC, and PET. As shown in Table 3, mechanical properties of polyolefin-based fraction are far better than those of the heterogeneous mixture.

Table 3. Mechanical properties of PO fraction/heterogeneous mix

Material	IZOD impact strenght		Tensile properties	
	Unnotched (KJ/m^2)	Notched (J/m)	Elastic modulus (MPa)	Elongation at break (%)
PO fraction	no break	80	450	108
Heterogenous mix	11.5	-	950	7

The improvement of tenacity is, in particular, evident when considering impact resistance. Samples subjected to impact tests show an increase in elongation at the breaking point from 7 percent to above 100 percent. As well as for polyolefins, the properties of recycled PVC fraction are comparable with those of a common virgin PVC, as shown in Table 4.

Table 4. Mechanical properties of PVC fraction/virgin PVC

Material	IZOD impact strength, notched (J/m)	Tensile properties, Elastic modulus (MPa)
PVC fractions	60	2810
Virgin PVC	40-90	3000

With regard to PET fraction, the potential applications are strongly dependent on its purity. Applications like films, fibers, or straps are not recommended when a high concentration of impurities are present. In this case, PET fraction can be employed for structural applications as an engineering polymer. To this aim an appropriate mixing process of PET with other components, like glass fibers, impact modifiers and/or nucleating systems must be developed.

However, the reuse of the PET fraction implies that the amount of residual PVC must be kept below 50 ppm to avoid undesirable polymer degradation. This degradation determines poor surface appearance and loss of mechanical properties of the manufactured products.

One interesting application for mixed plastics, because of their large market volume, is the production of injected tiles for paving. In order to demonstrate the feasibility of this application a large parking area has been built at CSI (Research Institute at Bollate, Italy) at employing specially designed molded tiles, Fig. 4. [7]

Figure 4. Parking area

CONCLUSION

Mixed plastics from household waste consists mainly of PE, PP, PS, PVC, PET, but its composition also vary based on the region and season, therefore there is no unique method for the recycling it. One of the methods that can be applied generally is presented in this paper. The philosophy of our research is to consider the heterogenous mixture as a new plastic base for different formulations to be correlated with application requirements. A wide spread solution, in terms of application and market volume, can be the recycling of single materials or homogeneous fractions obtained from a separation process of the mixture. The recycled polymers can be applied to build benches, garden tables, bicycle racks, fences, and playing facilities for parks. However the properties of the given recycled polymer has to be taken into consideration, by determining its mechanical properties. For example, the reuse of the PET fraction implies that the amount of residual PVC must be kept below 50 ppm to avoid undesirable polymer degradation.

Acknowledgements

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LONG-TERM OVERVIEW OF DEVELOPMENT THE MINE CEROVO WITH A PROPOSAL OF CONSTRUCTION THE DRAINAGE FACILITIES IN A FUNCTION OF WATER QUALITY AND ENVIRONMENTAL PROTECTION

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ABSTRACT

Production of copper ore in the mine Cerovo that operates within the Mining and Smelting Basin Bor Group creates the conditions for pollution the environmental factors: air, water and soil, as well as the regime change of surface and ground water.
This work gives an overview of long-term development the mine Cerovo with a proposal of way for preserving the water quality of area and proposal of facilities to be built for that purpose.

Based on the carried out analysis, it was determined that the new facilities must be built in order to undisturbed ore production in the mine Cerovo and in accordance with the principles of sustainable exploitation and environmental protection.

Key words: Mine Cerovo, drainage facilities, environmental protection.

INTRODUCTION

The mine Cerovo is situated within the Mining and Smelting Basin Bor Group (hereinafter referred to as RTB). It includes the copper deposits "Cerovo" and "Kraku Bugaresku - Cementacija." These deposits belong to the hydrothermally altered zone Mali Krivelj-Cerovo, and they are located about 2 km from the nearest village Mali Krivelj or ten kilometers northwest of Bor (Figure 1).

In accordance with the new strategic plan for development of copper production in the company RTB Bor, with the annual production capacity of 80.000 to 85.000 t, -a concept of further development the mine Cerovo is redefined. According to the mentioned development strategy, the required excavation of this site was 7.5 Mt per year[1], and the latest strategy of RTB Bor Group - 6.0 Mt.

At the locality Kraku Bugaresku, there is the open pit Cementacija 1, where the production was restarted after temporary suspension of works for a few years. In addition to the open pit, there is a plant for mineral processing with the entire infrastructure, and the ore is processed in this plant to the pulp that is hydraulically transported by pipeline to the Flotation Plant in Veliki Krivelj.

Figure 1. Situation of the complex Cerovo Kraku Bugaresku

The present (existing) processing capacity of ore of 2.5 Mt/year is also dictated by the excavation capacity.

The existing infrastructure will be operational in the future production.

CONCEPT OF DEVELOPMENT THE MINE CEROVO

Considering the research that has been done at this site and based on which the ore reserves are certified of ore deposits Kraku Bugaresku (C1, C2, C3, C4) and of Cerovo (the old name Cerovo Primary and Drenova), and further planned development of mining at this site is based on exploitation of these ore bodies. Required planned production from mining field will amount to 6.0 to 7.5 Mt. This includes, in addition to the ore mining at the open pit Cementacija 1, opening the open pits Cementacija 2 as well as the open pits on deposit Cerovo (Cerovo Primary and Drenova).

Operating dynamics of the existing and new open pits is defined in a function of continuous production and positive economic effects of such production. After the completion of mining at the existing open pit Cementacija 1, the focus of production will move at the open pit Cerovo - Cerovo Primary and Drenova.

Concept of further development the mine Cerovo was set using the modern software tools for optimization, strategic planning and design of open pits, Gemcom and

Whittle. This software defines the optimal boundaries of open pit based on certain techno-economic parameters and makes the calculation of masses [1].

Table 1 presents the calculation of masses for open pits Cementacija 1 and 2, Cerovo Primary and Drenova.

Table 1. Calculation of masses for open pits Cementacija 1 and 2, Cerovo Primary and Drenova

Elements	Cementacija 1 and 2	Cerovo Primary and Drenova	Total
Ore (t)	30,911,833	98,295,751	129,207,584
Waste rock (t)	22,151,493	100,769,987	122,921,480
Excavations (t)	53,063,326	199,065,738	252,129,064
Cu (t)	94,698	327,968	422,666
Ag (t)	37,191	106,517	143,708
Au (t)	2,771	16,414	19,185
Cu (%)	0.306	0.334	0.327
Ag (%)	1.203	1.084	1.112
Au (%)	0.090	0.167	0.148

The obtained waste rock in the mining process becomes at the open pits Kraku Bugaresku Cementacija 1 and 2 will be disposed on the existing landfill on the south of the open pit. The landfill is formed in the slope of hill Kraku Bugaresku and in the period from 1991 to 2002 nearly 22,000,000 t of waste rock was disposed. Now, only superelevation would be made of some parts.

From the open pits CerovoPrimary and Drenova, waste rock will be disposed in the newly formed landfill on the east side of the so-called "Landfill 1"and in the excavated area of the open pit Kraku Bugaresku Cementacija 2.

DRAINAGE FACILITIES IN A FUNCTION OF WATER QUALITY AND ENVIRONMENTAL PROTECTION

In order to realize development plans of the mine Cerovo, it is needed to meet a number of preconditions, certainly including the construction of drainage facilities, ensuring the preservation of water quality and required protection the entire area.

For further exploitation of this mine, construction of the following facilities is predicted: Water from the catchment area that form the Cerovo river on the north of open pit Cerovo in a part of its source area will be taken out through a tunnel (collector) in the river Valja Mare. The length of this tunnel is about 1200 m. Dimensions of this facility are present in Figure 2. Since the present course of the river runs through the middle contour of future open pit Cerovo, this way excludes any possibility of pollution of its water because they will not have any truck with mining activities. So, there is no deviation of the river flow next to the open pit or riverbed regulation otherwise, simply turning of the river is made before its entry in the open pit region, into the river Valja Mare. It should be noted that these two rivers are tributaries of the Krivelj Krivelj, which they form in the village Mali Krivelj, and it will thus protect the balance of the Krivelj River water.

For further exploitation of this mine, the construction of the following facilities is predicted:
By this way, a space is also free (i.e. a part of space) of the whole Cerove river valley for other mining activities with some limitations in terms of use the entire area of the valley.

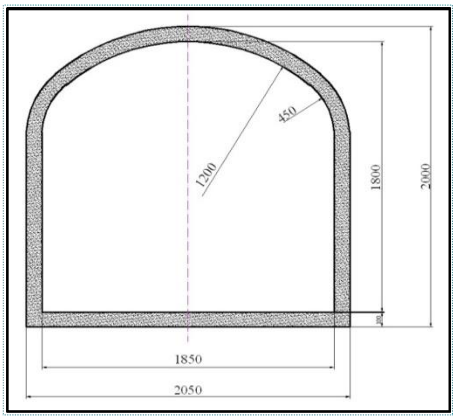

Figure 2. Cross-section of the tunnel with oversized dimensions

After completion of mining operations of excavation at the open pit Cementacija 2, within the preparation of the site for disposal into excavated space, it is necessary to install on the bottom of current Cerovo river, i.e. the valley bottom, the concrete pipes of suitable cross section which will transfer the pumped pump water from the open pit Cerovo to the accumulation, predicted below Cementacija 1 (Figure 3).

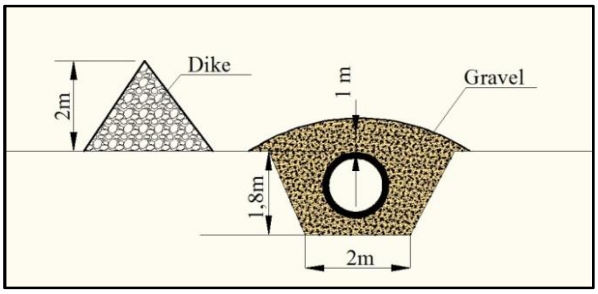

Figure 3. Concrete pipes at the bottom of the Cerovo river valley

In the valley of relocated Cerovo river, downstream from the open pit Cementcija 1, it is necessary to build a waste water treatment plant from open pits, and also water from tailing dumps, which gravitate toward the valley. At present, downstream of Cementacija 1, the Cerova river water are already polluted with alkaline solutions from open pit. As this river and watercourses downstream would not have experienced the fate of the Bor River, the construction of factory or plant for waste water treatment and bringing them to the cleanliness class of the second category is inevitable, or it could be said that a condition for any mining activities in this locality. The residents also represent such attitude who are very familiar with the problems in the basin of the

Bor River. Practically, without safe solution on protection of waterways the areas of Cerovo Kraku Bugaresku, any mining activities in this area cannot even begin.

CONCLUSION

In accordance with the new strategic plan for development of copper production in the company RTB Bor, a further development concept was defined for the mine Cerovo, which predicts in the first stage the resumption of production at the open pit Cementacija1 and opening the new open pit Cementacija 2. In the second phase, the exploitation of deposits Cerovo Primary and Drenova is planned.

In order to realize the development plans of the mine Cerovo, it is needed to meet a number of preconditions, including the construction of drainage facilities, ensuring the preservation of water quality and required of protection of the entire area.

Proposed and detailed technical-technological solution for drainage the open pit Cerovo - CPD, i.e. construction the tunnel from the site "Sources", i.e. formation the Cerovo river that flows over the deposit Cerovo and in the east of the open pits C1 and C2, to the river Valja Mare, in a length of 1364 m, will release the Cerovo river valley for location of waste rock landfill from the open pit Cerovo. In relation to the technical solutions that predicted the location of waste rock landfill in the valley of Bigar stream, the height of mass lifting is many times less as well as transport relations, what also reduces costs of technological phase of disposal.Another benefit, provided by this site, is that the water from catchment areas of tailing dump can be controlled carried to the site of future plant for waste water treatment. After treatment in the treatment plant, the water is discharged into the recipient and further downstream waterways; thereby permanently solve the impact of mining activities on the environment.

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OLD INTERNAL COMBUSTION ENGINE RADIATOR RECYCLING

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ABSTRACT

Old internal combustion engine radiators are mainly made of brass elements. Individual elements are joined by soldering, that is by soldering alloy. During recycling this soldering alloy is not recovered separately but is mixed with melted brass.

From the economic point of view this is not efficient since the soldering alloy is more expensive than the brass and is lost. In order to overcome this deficiency a rotating furnace was designed and constructed within the New smelter facility operating within the RTB Bor.

Once the soldering alloy is recovered the remaining brass elements are further recycled in a classical manner.

Key words: engine radiator, recycling.

INTRODUCTION

Latent economic crisis and the general shortage of raw materials resulted in much more engaged and careful approach to secondary raw materials recycling. Compared to previous procedures this primarily means full collection, in order to reduce environmental pollution, and further optimal treatment resulting in minimum environmental impact and maximum economic efficiency.

One example of appropriate treatment of secondary raw materials is the treatment applied in the New smelter facility in Bor (smelter in further text). The smelter treats old internal combustion engine radiators in such manner that the final products are soldering alloy and brass. For that purpose a rotating furnace for radiator cover treatment (furnace in further text) is designed and constructed. The soldering alloy is recovered during the first stage of the process and the second stage, utilizing additional equipment, recovers the remaining brass.

Having in mind the successful application of the technology and equipment this article presents the details with the intent to raise a debate on possible application of this technology for electronic waste, primarily motherboards, recycling.

Internal combustion engine radiators

Internal combustion engine radiators are heat exchangers used to transfer the excess heat energy of the engine to the air (Fig. 1)

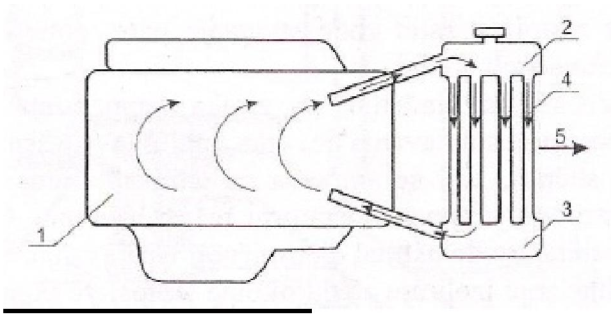

Figure 1. Cooling system of the internal combustion engine
1) engine, 2) upper radiator cover, 3) lower radiator cover, 4) pipe links, 5) vehicle travel direction

Old radiator models consist of upper and lower reservoir (cover) connected by small diameter ribbed pipes. The ribs between the pipes and the pipes present the radiator core and create a large surface needed for heat exchange (Fig. 2).

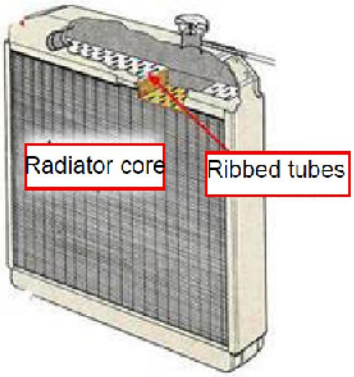

Figure 2. Internal combustion engine radiator

The problem of fast and tight joining of pipes and reservoirs is solved by pouring the melted soldering alloy over all joints simultaneously. As a result the joints are of good quality, require less time to make but also require more soldering alloy. Besides soldering pipes and reservoir walls the walls are also soldered to outside coatings.

The radiators do not require some special maintenance during usual engine use and become the secondary raw material mainly because the engine itself is no more used.

ROTATIONAL FURNACE FOR RADIATOR TREATMENT

The rotational furnace is installed within the facility of New smelter operating as a part of RTB Bor. The basic principle of furnace operation is the heating of the radiator parts to the melting point of soldering alloy which is in the range of 250 to 450 ºC and further to the temperature of 600ºC to allow the alloy to become liquid and flow into the sump mold. The furnace is heated by burner consuming propane-butane gas.

To avoid unnecessary energy consumption only parts of the radiators containing the soldering alloy are heated. Because of that the radiators must be preprocessedwhich considers mechanical cutting and removal of the pipes and ribs since those contain no soldering alloy.

The furnace is slightly inclined towards the discharge face. It is cylindrical in shape, double coated with the diameter of outside coating of 1230 mm (Fig. 3). The inner coat is perforated to allow the alloy to flow out into the space between the coats and then, due to the dip, towards the discharge face and into the molds to cool down to the final product (Fig. 4).

Figure 3. Rotational furnace

Figure 4. The final product

The inner coat is ribbed to ensure that radiator parts are lifted, turned and mixed during heating to allow the soldering alloy to drain.

The frontal, charging, face of the furnace is fixed to the coat and is equipped with the burner and the charging hatch. Discharge face is not fixed and can be fully opened and is also equipped with a charging hatch.

A suction hood is installed above the discharge face zone to ensure gaseous products of the process so they could be sent to purification system.

To enable rotation the furnace has two rims fixed to the outer side and the whole furnace is rested on four wheels out of which two are driven. The drive is electro-mechanical providing 0,833 min^{-1}. Drive components are electric motor, gear transmission and friction transmission.

The dip of the furnace is achieved by tilting the mount meaning that the furnace shape is cylindrical and not conical. The mount dimensions are 3,5 x 2 m.

RADIATOR RECYCLING

The radiators recycling preoceedure involves:

- The separation of the brass covers, iron elements and the core from the radiator;
- Cutting of the pipes and their separation from the reservoirs;
- Furnace is heated to 600 ºC using the burner;
- Once the furnace is heated the burner is shut down and the furnace is filled with brass covers to the half;
- When the furnace is charged, the burner is lit again and the drive is turned on to rotate the furnace.
- Melted soldering alloy flows towards the discharge face of the furnace where it is being poured, trough the outlets, into the molds;
- Recycling time depends on the charge quantity and preheating temperature;
- Once the entire soldering alloy is recovered the furnace is opened and the remaining brass parts are taken out and sent to further treatment.
- The soldering alloy is melted once more in the smaller inclined furnace for additional refinement and is finally formed into ingots.

COMMENT

The applied process of internal combustion engine radiators recycling provides efficient soldering alloy recovery. However, due to the discontinuous nature of the process and the lack of isolation on the furnace walls the fuel consumption is large leading to decrease in economic effects. Further improvements are not in plan since this type of radiators is being replaced by modern aluminum ones and old radiators will not be available as raw material.

Figure 5.Soldering alloy refinement pot

CONCLUSION

Rational procedures for secondary raw material recycling consider separate recovery of usable components leading to better economic effects with an imperative on minimizing environmental impact of the process itself. Such a treatment is successfully applied for internal combustion engine radiator treatment in the New smelter facility in Bor. The process is proven to be efficient and financially feasible. The technology and the procedure applied here and described in this article should be considered and tested for recycling of electronic waste, primarily in the form of computer motherboards.

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OPTIMIZATION OF THE PROCESS OF PRODUCTION OF CERAMICS FROM WASTE COAL ASH AND CLAY

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ABSTRACT

Industrial solid waste product generated by Macedonian coal fired power plants, namely fly ash were used in combination with local clay to develop composite ceramic materials. The clay was mixed with the fly ash in the range 10 to 90 wt%, hydraulically pressed and sintered at temperatures in region from 900 to 1100°C. The sinterability of fly ash and clay was investigated by following the physical and mechanical properties. The process of optimization was conducted of the main process parameters such ratio clay/fly ash, sintering temperature and heating rate and their interactions. As a response functions in the optimization process were bulk density and bending strength. The optimization was performed through application of 3D surface method and the obtained results are presented in the graphical and analytical form using "Statgraphics Centurion" software package.

Key words: fly ash, clay, optimization, composites, ceramics.

INTRODUCTION

Fly ash is an inorganic product produced as a result of the combustion process of thermal power plants. The total quantity of fly ash in Western Europe for 2009 was 34 million tons with tendency of growing up to 66 million tons [1].

Large volume utilization of fly ash is crucial, so many methods are developing to reduce the amount of waste. Uses in the construction industry [2], agriculture [3], replacement material in road construction [4], as mineral fillers [5] are the most important. The fly ash is a very fine –grained raw material containing valuable oxides such SiO_2, Al_2O_3, CaO, Fe_2O_3. The morphological characteristic and the chemical composition make this residue suitable for production of ceramics with the addition of the natural raw materials [6] or waste materials [7].

Fukumoto et al. [8] investigate the possibility to fabricate composite material using coal ash in the range of 0-30% and clay. Applying two different sintering methodologies by setting optimum condition they explained the role of reinforcement of fly ash and the binder effect of clay in the fly ash/clay composite material.

The aim of this paper is to optimize the process of production of dense ceramics compacts from fly ash and clay.

The process of optimization was performed of the process parameters such quantity of clay, sintering temperature and heating rate and their interactions on the physical and mechanical properties of ceramics.

MATERIALS AND METHODS

The fly ash used in this study was collected from the electro filter from thermal power plant "REK Bitola" located in the western part of Republic of Macedonia. The investigation was conducted on the fly ash fraction lower than 63μm. The clay sample, also fraction lower than 63μm, was obtained from local brick manufacturing plant.

The clay was mixed with the fly ash in the range from 10 to 90 wt%. The samples was hydraulically pressed at P= 45 MPa by Weber Pressen KIP 100 using PVA as binder.

Sintering of the compacted samples was realized in the chamber furnace in the air atmosphere at temperatures 900, 1000, 1050, 1100^{0}C using heating rate of 3 and 10^{0}C/min and isothermal treatment at the final temperature of 60 min.

Bulk density of the sintered samples was determined by water displacement method according to EN-993.

The bending strength was measured on the sintered samples (with the dimensions of 50 mm x 5 mm x 5 mm), which were subjected to a 3-point bending strength tester (Netzsch 401/3) with a 30 mm span and a 0.5 mm/min loading rate. Each individual test was performed for five samples of each composition and the average value is reported.

The optimization was conducted based on the influence of the main process parameters: quantity of clay, sintering temperature and heating rate and their interactions on the properties of obtained dense ceramic such density and bending strength. The optimization was performed through application of 3D surface model and results are presented in the graphical and analytical form. Software package "Statgraphics Centurion" was used for this purpose

.

RESULTS AND DISCUSSION

Optimization process 1: optimization response of bulk density as a function of clay content, sintering temperature and heating rate.

The process of optimization was conducted based on the influence of the main process parameters and their interactions on the property of obtained ceramics. The response function is presented in the following figures:

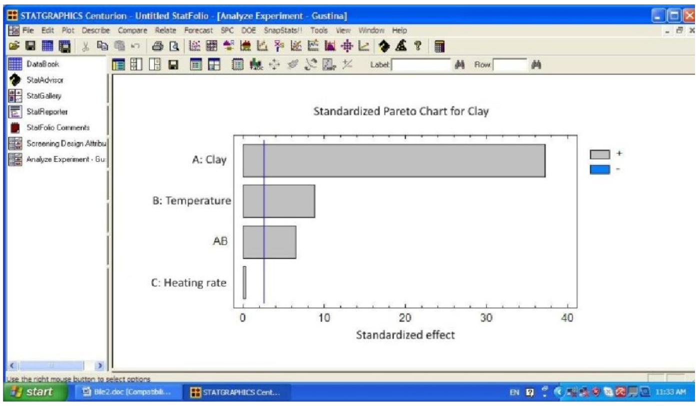

Figure 1. Statistic influence of the main process parameters and their interactions on the density of FA compacts

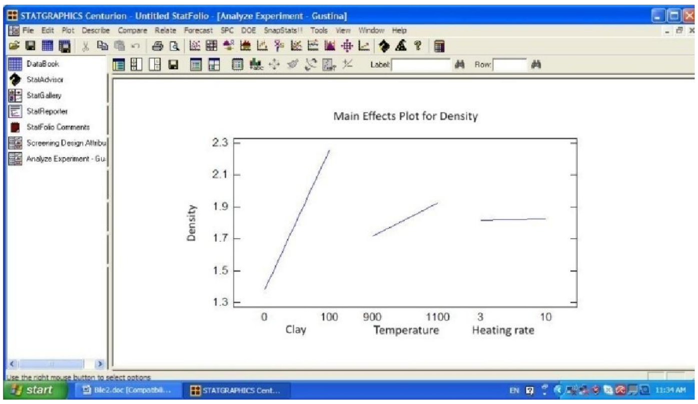

Figure 2. Diagram of main effects of process parameters on the density of the ceramic composites

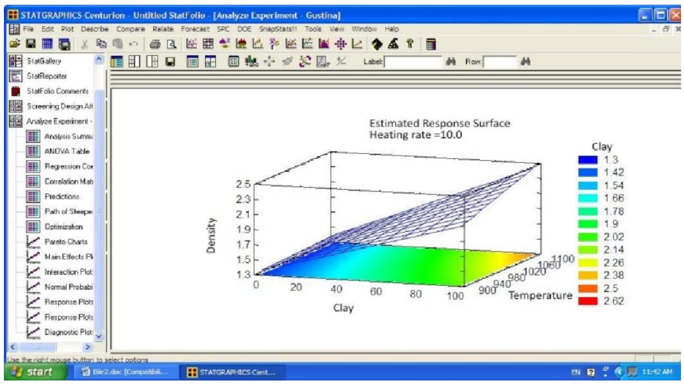

Figure 3. 3D optimization diagram of the main effects at constant value of heating rate (^{o}/min) and variable temperature (^{o}C) and clay (wt %)

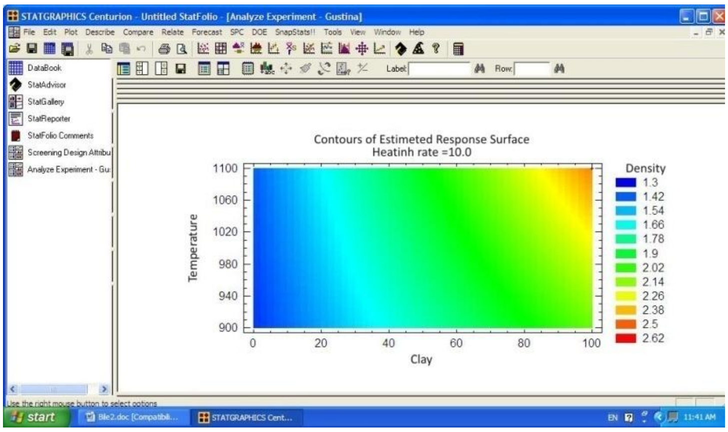

Figure 4. Optimization diagram of the main effects at constant value of heating rate (^{o}/min) and variable temperature (^{o}C) and clay (wt%)

According to the results of the process of optimization presented by the software package, a final model equation of the bulk density is:

Density= 1.10029-0.006475*Clay+0.000275*Temperature+0.00107143*Heating rate- +0.00001525*Clay*Temperature

In this case of optimization the response value of bulk density of the compacts was examined as a function of the process parameters – clay content, sintering temperature and heating rate. It is evident that bulk density of the compacts as the main process parameter that defines the densification of the ceramic body is directly dependent of the clay content. The results indicate that the density of the compacts increased as the clay content increased. The influence of the sintering temperature and heating rate on the bulk density of the composites is smaller compared to the clay content. From the surface area (3D) optimization diagram (Fig.3) and optimization diagram of the main effects (Fig.4) it is evidant that for constatnt heating rate of 10 ^{o}C/min there is a wide range of composites with densities higher than 2.15 g/cm^3 for the clay content between 50 to 90 wt%.

Optimization process 2: optimization response of bending strength as a function of clay content, sintering temperature and heating rate.

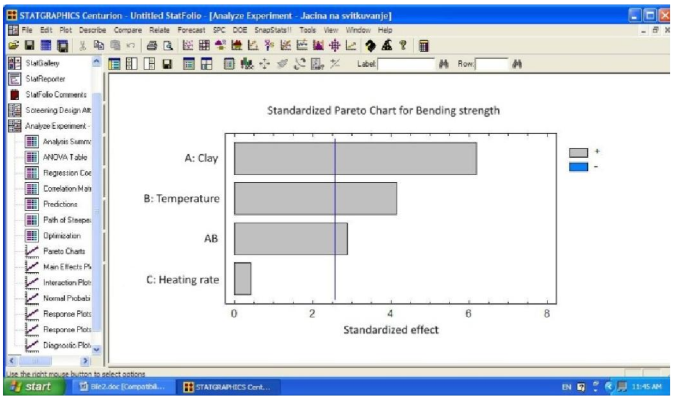

Figure 5. Statistic influence of the main process parameters and their interactions on the bending strength of the ceramic composites

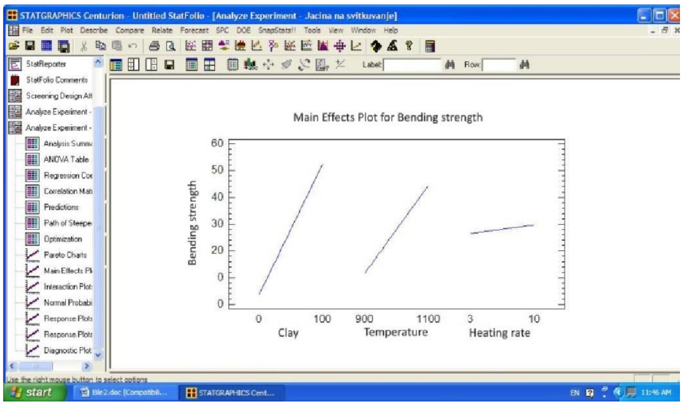

Figure 6. Diagram of main effects of process parameters on the bending strength of the ceramic composites

According to the results of the process of optimization presented by the software package, a final model equation of the bending strength dependence is:

Bending strength = - 49.2929-1.7875*Clay+0.05*Temperature+10.464286* Heating rate+0.002275*Clay*Temperature

In this case of optimization the response value of bending strength of the FA compacts was examined as a function of the process parameters – clay, sintering temperature and heating rate. By analyzing the Pareto chart (Fig.5), it is evident that bending strength of the compacts is directly dependent of the clay content. The influence of the heating rate on the mechanical properties is smaller compared to the other parameters. From the 3D optimization diagram (Fig.7) and optimization diagram of the main effects (Fig.8) it is evidant that optimal maximum for bending strength (78 MPa) was obtained at sintering temperature 1100^{o}C and clay content higher than 80 wt%. From the environmental point of view, the content of fly ash in the ceramics should be as high as possible, so from Fig. 7 and 8 can be concluded that starting from 60 wt% clay content and sintering temperature of 1020^{o}C can be considered as optimal area for ceramics production.

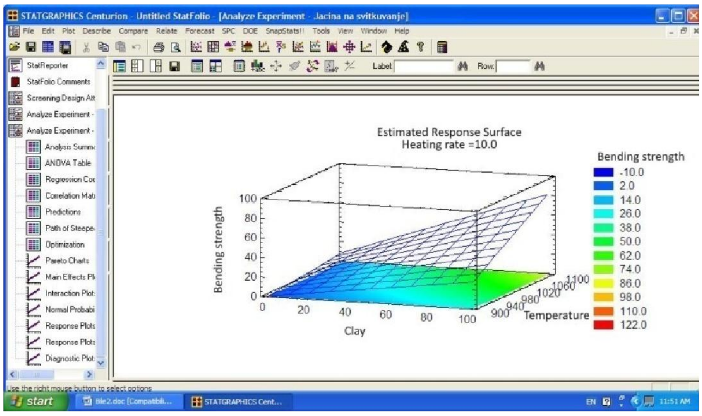

Figure 7. 3D optimization diagram of the main effects at constant heating rate (^{o}/min) and variable temperature (^{o}C) and clay (wt%)

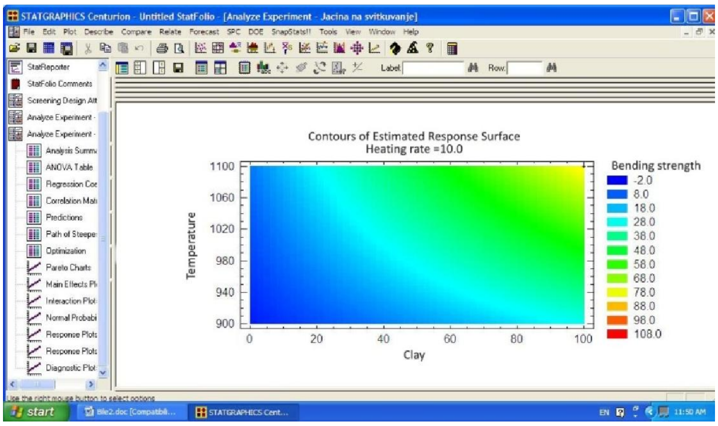

Figure 8. Optimization diagram of the main effects at constant heating rate (^{o}/min) and variable temperature (^{o}C) and clay (wt%)

CONCLUSION

In this investigation 3D optimization method has been successfully applied in order to determine the optimal operating areas for production dense ceramics based on fly ash and clay where temperature, heating rate and clay content were used as process parameters and response functions were density and bending strength.
The final model equation for density as a response function is:

Density = 1.10029-0.006475*Clay+0.000275*Temperature+0.00107143*Heating rate-+0.00001525*Clay*Temperature

The final model equation of the bending strength dependence is:

Bending strength = -49.2929-1.7875*Clay+0.05*Temperature+10.464286* Heating rate+0.002275*Clay*Temperature

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RECYCLING OLD CARS

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ABSTRACT

Dynamic growth the number of cars and other transport means, in all developed countries leads to further increase the number of vehicles that have reached End of Life. Because of diversity of material included in the composition of a car, procedure for recycling is very complex. Today the most important issue becomes the reduction of use and saving of raw materials on the one hand and reduction of waste material on the other side. Therefore, introduce of the recycling in the process of production vehicles are environmental directives. In this paper, we have discussed the general principles of recycling of motor vehicles, legal restrictions and procedures dismantling of these vehicles.

Key words: vehicles, recycling, legal restriction.

INTRODUCTION

The car industry belongs to that fields which are developing in accordance with the advanced society. Used cars, as all other bulky waste, present important and long-term available secondary raw materials. Processing of the waste cars is an activity which must be carried out on the organized basis and continually, as the car industry is the necessity of the advanced society and one of industrial branches which is going to be developed simultaneously with the development of civilized society. Nowadays, some 500 million of passenger cars run all over the world, and all predictions are in favor of the fact that in this century around 1.2 billion of passenger cars will be available if new markets expand by in today's rate [1-2]. It is expected that every product should be ecologically acceptable and, what is more, while still in the beginning phase of investigation, rely on new materials which meet these standards. During constructing, each part and each assembly must be visually marked so that it is easy to identify, and after being used, to separate it for the sake of easier introducing in the re-usage. By respecting global goals S+3E *(Raw materials + Energy + Ecology + Economy)* there comes the inspiration both for new technologies in crude oil treatment, additive production and continual optimization of technical, traffic, logistic and ecological qualities of vehicles and engines. It is quite clear that the car composition referring to its material is changing in terms of increased replacing metal components of vehicles by plastic materials and different alloys. Since the increasing problem in recycling are the plastic materials, especially polyvinylchloride, a definite number of manufactures replaces this type of material by various alloys, especially by aluminum alloys. Along the car industry development, there were launched many new technologies and new products. Automobiles of 21st century are automated, easy to drive, the construction is very simple and suitable for recycling, and the possibilities for cars to be recycled will be one of proofs for their quality. These problems occur in all parts of the world so that, in all countries, there will be a need for economic companies, which will deal with recycling of old automobiles. This problem will not get around our country so that a great number of people will be employed in this kind of industry.

LAW REGULATIONS RELATING TO RECYCLING OF OLD CARS IN EU

In order to define the appropriate relation to the waste made by vehicles at the end of their life service, the European Parliament in September 2000, accepted the Directive 2000/53/EC (End *of Life Vehicles* – ELV – Directive). The basic aim of this Directive is primarily to design measures for preventing the creation of wastes which come out from vehicles that are at the end of their life service – old cars.

Relevant legal limits, which deal with these problems, are:

- ELV Directive of European Unity (2000/53/EC).
- European Waste Catalogue *(EWC)*
- Hazardous Waste List *(HWL)* with some detailed supplements.

Future needs start from the investigation processes, development and the designation of the motor vehicle. Researchers and designers are required to set goals and assignments, which are often in conflict with todays generally, accepted attitudes and behavior (consuming society, wastefulness, lack of care for future generations, etc.). Some of the future requirements are: 100 % recyclable materials, low energetic intensity, high energetic and eco-efficiency, long service life, easy disassembling, payable recycling, a closed circle of material and energy, waste: re-usable source of material, sustained exploitation of natural resources, protecting and improving the human environment, etc, [2].

The current state of motor vehicles and the car industry is far away to satisfy the new concept of recycling, which is an urgent necessity for future prosperity. However, the vehicle development is moving towards the sustained vehicle and considerably improves the process of recycling old cars at the end of life service, which is shown in Table 1.

Table 1. Trend of the process of disassembling and recycling old cars up to 2050

Plant of motor vehicle (MV)	MV SUS on fossil fuels	MV SUS (natural gas, hydrogen)	Hybrid MV (ICE+electric drive)	Electric motor vehicle (on accumulator)	MV with fuel cell (hydrogen)
Structure of material in motor vehicle	Standard materials incorporated in current vehicles.	Standard materials with somewhat higher presence of light alloys. Increase of electronic materials.	Considerable presence of light alloys (Al, Mg), electric and electronic materials and composites.	Light alloys (Al, Mg), electric and electronic materials and composites.	Light alloys (Al, Mg), electric and electronic materials, composites and biological materials.
Requirements for new technologies for disassembling	Disassembling of air pad.	Disassembling of equipment for hydrogen.	Disassembling of batteries (Cd, Ni).	Disassembling of batteries (Cd, Ni; and others).	Disassembling fuel cells and biological components.
Requirements for new technologies for recycling	Recycling of plastic materials.	Recycling of electronic and plastic materials.	Recycling of batteries, composites and electronic and plastic materials.	Recycling of batteries, composites and plastic materials.	Recycling of fuel cells, composites and electronic and plastic materials and biological materials.
Year	**2010**	**2020**	**2030**	**2035**	**2050**

In the world, there is a concept known as 3R *(Reduce-Reuse-Recycle)* which completely defines the approach and principle of recycling, [2].

First R *(Reduce)* refers to waste reduction and it can be carried out through designing a car, which will have a longer life service followed by using as less as possible energy and raw material for its production and usage.

Second R *(Reuse)* refers to the re-usage of particular components and the whole assemblies of cars. It means that particular components and assemblies of vehicles can be used again as spare parts.

Third R *(Recycle)* refers to processing vehicles parts into materials they were made originally by and their new production from that way created material.

The world's tendencies show that we are increasingly coming to the concept 5R, which, besides these three ones, includes the procedures for material cleaning for the sake of easier recycling as well as the process of returning energy from the waste which occurs by processing waste vehicles – by grinding.

Old cars, after such procedures, are driven to special facilities which crush or grind these vehicles and which are called *Shredders*. The vehicle is being transported and compressed into the crushers where it is fractured and broken into pieces of several centimeters which makes easier the recycling of materials which enter the vehicles composition and returns almost 80 % of the material. After crushing and grinding of the vehicle, follows the split up and separation of the material mostly into metal and non-metal materials, and then the metal materials are sorted out into iron and alloyed elements. The remainder, around 20 % ASR *(Automobile Shredering Residue)* for the time being is damped on the waste dump, hoping that some new technology for recycling in future will reduce this part which has been dumped, Figure 1., [2-4].

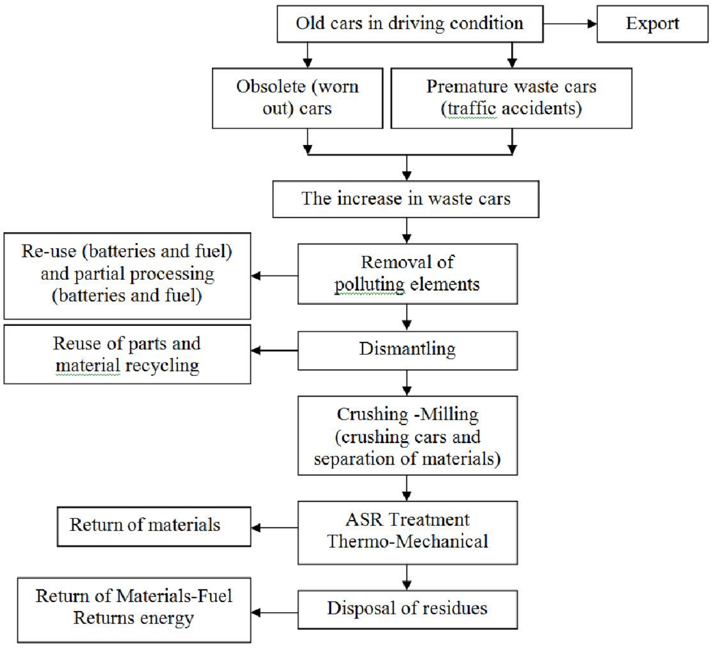

Figure 1. Algorithm of the procedure in processing old cars

LEGAL REGULATIONS IN SERBIA

In Serbia, the way of controlling motor vehicles at the end of their service life has not been systematically solved, although some 1.690.000 vehicles have been registered. The lack of integrated systematic approach to recycling old cars for Serbia means a considerable loss of resources (materials, energy, creation of new jobs), and on the other side, there are negative ecological consequences. Serbia's coming closer to the European Union imposed the need to take this problem more seriously as this has not been done so far. The relevant legal limits, which deal with these issues in our country, are:

- Law on environment protection ("Official Gazette RS", no. 66/91; 83/92; 53/93; 67/93; 48/94; 53/95 and 135/04),
- Law on treating waste matters ("Official Gazette RS", no. 25/96; 26/96 and 101/05),
- By-law on treating wastes which have got the property of dangerous materials ("Official Gazette RS", no. 12/95),
- By-law on criteria for determining locations and arrangement waste dumps for waste materials ("Official Gazette RS", no. 54/92),

- By-law on conditions and technique for classifying, packing and keeping secondary raw materials ("Official Gazette RS", no. 55/2001),
- By-law on documentation which is supplied by the request for issuing the permission for importing, exporting and transiting the waste ("Official Gazette SRJ", no. 69/99),
- Regulations on determining the list of projects, for which it is obligatory the estimation of effects and the list of projects for which it can be requested the effect estimation on environment ("Official Gazette RS", no. 114/08),
- Instruction book on conditions which must be fulfilled by the authorized operators for recycling waste vehicles (The Ministry for Envir. and Urban Planning – March 2009)

On the base of what is happening in EU, our country has designed one of the measures which was initiated by the Government of Republic of Serbia, and which refers to the model of replacement "old for new" and which will be carried out in such a way that the Government will subsidy the purchasing of a new car (for the time being only the car Punto) and all the citizens who recycle their old cars, will get a discount in the amount of 1000 € for buying a new one.

COMPOSITION OF MATERIALS IMPLEMENTED INTO OLD CARS

As there are numerous types of old cars and their technical equipment, and, the complexity of the structure of these old cars, it is very difficult to estimate what is the real composition of materials built in these vehicles. In Table 2., there are shown the data about the average content of particular materials built in passengers' cars produced in countries of western Europe during the period from 1965 to 2000, [5-7].

Table 2. Estimation of built- in materials into passengers'cars produced in the countries of Western Europe from 1980 to 2000

Material	Year of production, masses share in %		
	1980/85	1990/95	2000
Steel	55.1	53	45
Cast iron	14	12.5	10
Plastic masses	4.5	9	16
Non-magnetic materials	5.2	5.2	9
Rubber	3.9	5	5
Glass	4.5	4	4
Other	12.8	11.3	11

Steel and cast iron

Main parts of motor vehicles are made of metal. In passengers' cars, produced in Western Europe in 1993, the average mass of steel amounted to 513 kg and cast iron 104.5 kg. These materials, after being crushed in shredder facility, can be easily separated from other materials. For efficient usage of steel and cast iron from old vehicle in the steel industry, it is necessary from this machine to extract copper, chromium and nickel, which have negative influence on steel quality.

Plastic masses

Plastic masses are mostly used for arranging inside space of motor vehicles, for parts of bodies and for protection of electric cables. For producing parts of motor vehicles from plastic masses, some 20 to 30 different types of basis plastic masses are used in a combination with various fillers and mixtures.

Glass

Mass content of glass in old passengers' cars amounts to 40 kg or around 4 % by mass. Flat glass is only in exceptional cases recycled, that is, it is reused only if in it there is no foreign ingredient. In these cases, flat glass is reused for producing flat car glass.

Liquids

Liquids and lubricants in old passenger cars present useful materials, which can be very harmful for environment, which has got the treatment of a special waste.

Old oils

In old cars there are: motor oil, oil for power transition, oil in the hydraulic system which are not to be mixed while being recycled. Motor oil is separately collected due to the fact that it can be recycled again, that is, refined in a refinery.

Cooling liquids

Cooling liquids in motor vehicles can be treated by special a treatment, that is, decomposed into their constituent parts. In the first degree, water is separated, while in further degrees, heavy oil, oil and the corrosion residues are separated. With the purity of 99,5 %, glucose can be reused for producing liquids for cooling.

Other liquids

Other liquids cover oil in the braking system and battery's acid. In some types of motor vehicles, with the build-in system for cooling the inside space of the vehicle (air conditioner), there are the agents for cooling-type R-12, which are very harmful for human health and environment. These agents for cooling must in a special way, be collected and transported in special tanks to the plant for storing, [8].

RECYCLING PROCEDURES FOR OLD CARS

Recycling of old cars is carried out by the procedure of disassembling and mechanical procedures of treatment with a partial disassembly of definite parts or without any disassembling.

Recycling old cars by disassembling

The aim of disassembling old motor vehicles is to separate and to collect completely the useful materials and special wastes, which are in these vehicles. Disassembling of the old motor vehicles can be done by: manual, mechanical and automatic procedures (partially).

The most important processes in the procedure of disassembling old passenger cars, are: acceptance of a car, storing, disassembling it and packing. In Figure 2., it is given the pattern of procedure for disassembling old cars [7-12].

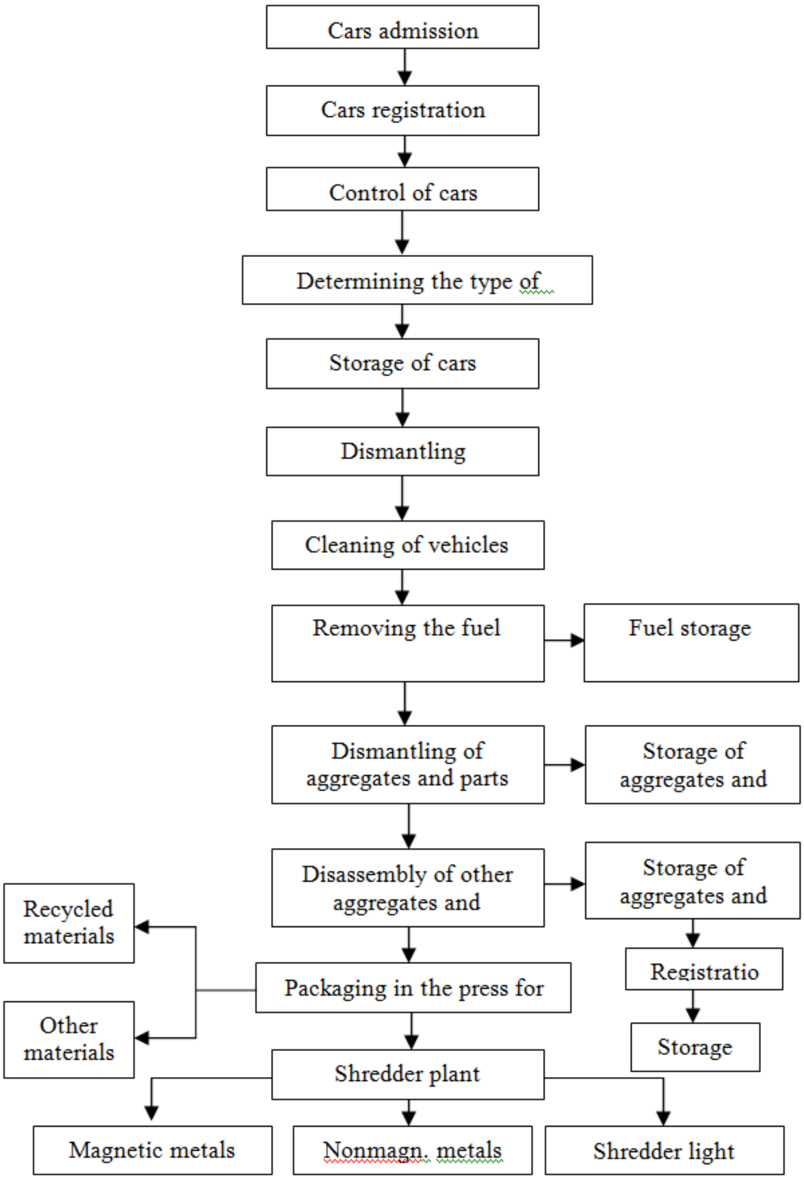

Figure 2. Disassembling process of old cars

RECYCLING OLD VEHICLES BY THE CRUSHING PROCESS (SHREDDER)

The range of reducing car waste is carried out by means of a cutter with the rotating hammers of Shredder machine. For the comminution of old passenger cars, metal sawdust and others, there have been used various models and types of Shredder machines, as it is shown in Figure 3. [11-12].

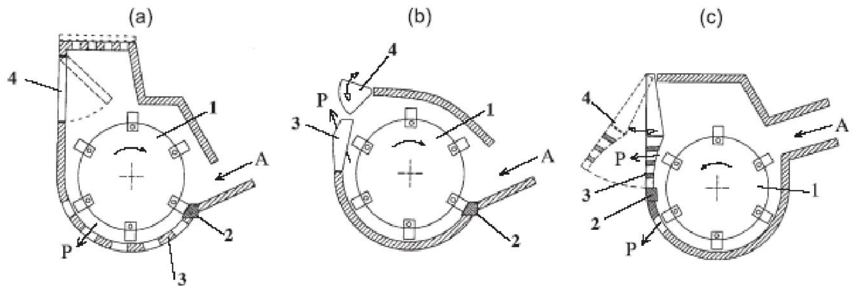

Figure 3. Shredder with rotating hammers for communition (crushing) old cars (1. rotor with rotating hammers for crushing old cars; 2. metal anvil, for accepting material; 3. discharging openings for crushed waste; 4. feed (inlet); 5. production of crushing)

In Figure 4., it is shown the principal flow sheet of the Shredder facility for recycling old passenger cars by the procedure of communition with an additional sorting out.

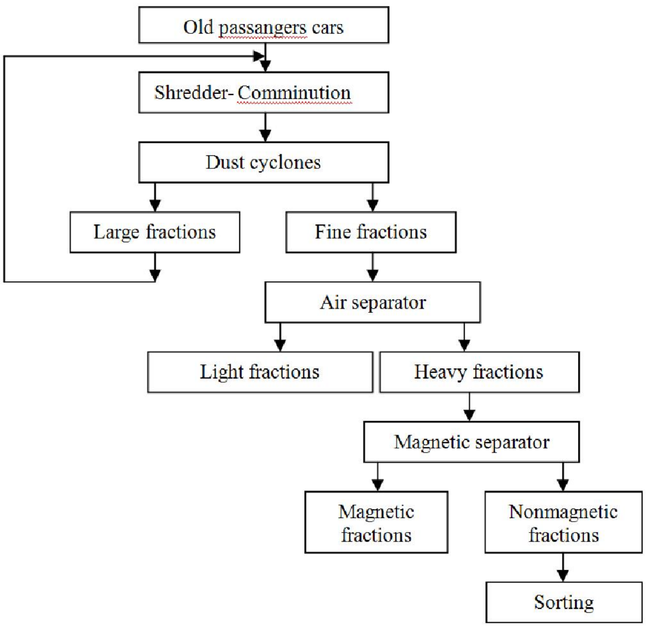

Figure 4. Principal flow sheet of Shredder facility for recycling old passenger cars

CONCLUSION

By applying recycling procedures for old cars at the end of service life, there could be expected positive effects. There are, first of all, the techno-economic, ecological and effects of developing a new industry (recycling old cars).

Techno-economic recycling of old cars at the end of service life in Serbia are reflected through:

- economic profitability of recycling old cars at the end of service life,
- increase of the level of energetic efficiency,
- development of recycling industry for old cars at the end of service life,
- reinstallation of recycled materials into new vehicles,
- usage of repaired parts, assemblies and machinery,
- sustained usage of natural resources (ores, energy),
- direct foreign investment,
- healthier human environment,
- ensuring the high-quality development of the local car industry as well as export,
- development of socially sustained cars (new recyclable materials, reducing waste to a minimum, the minimal influence of motor vehicles on human environment),
- development and application of new "green" technologies etc.

Ecological effects are reflected through the reduction of direct and indirect influence of motor vehicles at the end of service life on the human environment in Serbia. If it is taken into account the very incidental situation of used old cars on environment such as a great number of wild waste dumps, spilling fluids on the ground and into the water currents, heavy metals, plastics, rubber (tires) etc., then by applying the procedures of recycling there could be expected the following ecological effects:

- eliminating waste dumps and leaving and scattering old cars wherever and on any kind of spot
- proper handling fluids and their complete recycling,
- complete recycling of all metal materials (iron/steel, non-ferrous metals),
- maximum possible recycling other materials (plastics, rubber, glass etc.),
- storing the permanent waste to the already anticipated waste dump,
- improving the quality of environment in Serbia by eliminating old cars at the end of service life from the natural environment,
- sustained usage of natural resources for the sake of re-usage of already used materials.

Acknowledgements

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SUSTAINABLE TECHNOLOGY ANDNATURAL ENVIRONMENT

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ABSTRACT

Sustainable technology is usually connected with the design and analysis of complex,integrated management systems and sustainable development and it is a central target in environmental scienceand growth of global economies. The minimization of waste and reductions in material and energy inputs are the most importantenvironmental aims. Sustainable technological development and innovations do not automatically lead to totalreduction of environmental burden of industrial production. However, technological innovation is an importantfactor and seems to play a central role in the long-term initiation of cleaner production. Environmental improvement of companies strategy by application the idea of cleanerproduction linked with sustainable technologies leads to produce environmentally friendly products and leadsto increas the position of company on the market.

Key words: sustainable technology; sustainable development, environmental effects.

INTRODUCTION

The rapid increase of human activities since the industrialrevolution caused that huge quantities of resources and energyhave been consumed in relatively short time. That massconsumption and the large production has significant influenceson the earth's ecology, exhausting non-renewable resources andcausing some environmental problems by polluting the air, waterand soil [1-3].Nevertheless, there are a lot of possibilities to reduce theenvironmental burden of industrial production exist. For example;optimization of the environmental performance through goodhousekeeping, total quality management, application of end-ofpipetechniques, recycling of wastes, non-renewable productssubstitution or adaptation clean technological innovations [4].

The industrial engineering consumes of materials and is dependent on a continuous supply of them. Increasing population and living standards cause the consumption rate to grow - something it cannot do forever. Finding ways to use materials more efficiently is a prerequisite for a sustainable future.Recent global attention to the issues and challenges of sustainable development is forcing industries to conduct self-assessments to identify where they stand within the framework for sustainability, and more importantly, to identify opportunities, strategies and technologies that support achieving this goal. Design for environmental sustainability is the long-term view: that of adaptation to a lifestyle that meets present needs without compromising the needs of future generations.

The development of sustainable technology seems to be the main factor of company's strategy. Each companies, which want to reach the competitive position on the market and want to be environmental friendly should compile the strategy of technology.

The basic actions of preparation of technology's strategy contains a recognition of all using technologies in company and an identification of all components of technology, which are being with object of scientific investigations. Analyzing of all components of technology is very important. It helps in the selection of suitable techniques of production, which should guarantee established productivity, quality of realized processes and allows to manufacture ecological products.

Environmental context

In production industry the environmental questions are in the focus of attention. Several new strategies for incorporating these issues into design have been developed under designation eco-design or design for environment. The purpose of these strategies are to:

- minimise energy consumption,
- minimise use of material,
- exclude hazardous materials and substances,
- facilitate recycling.

Over the last decades, knowledge of complexity and extent of the environmental problems has increased. From being concentrated on local problems the focus has changed to global problems and resulted in a new viewpoint, sustainable development.The aim of this concept is to reach balance between resource use and environmental impact, so that the environment is able to withstand the burden within the ecological cycle. At the same time the resource distribution should be fair.

The extensive effect on the environment is connected to human activities and unrestrained exploitation of natural resources, which is illustrated in Figure 1.

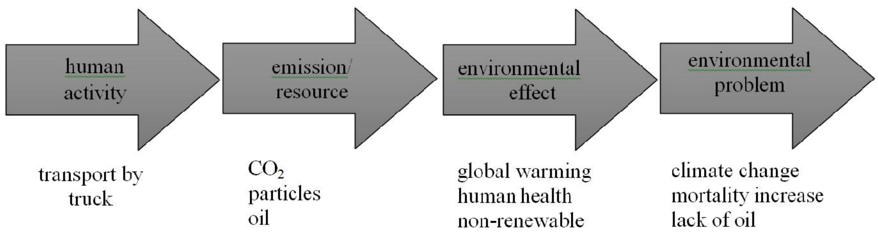

Figure 1. The chain of events resulting in environmental problems

Examples of such activities can be found through the whole life cycle of a product from raw material extraction, product manufacturing, use of the product to the waste disposal. Examples of emissions generated in transportation by trucks are carbon dioxide, CO_2, and particles, resulting in global warming anddeteriorating human health. Increasing use of resources as oil decreases non-renewable sources. The effects mentioned cause climate change and increased mortality. The increasing use of oil also may lead to shortage, due to insufficient supply.This exploitation has resulted in a high standard of living in the industrialised countries. With this high standard follows a high consumption of products leading to increased consumption of resources and energy[3].

CLEANER PRODUCTION AND SUSTAINABLE TECHNOLOGIES

In practice, a technology and realization of technologicalprocesses is in exact relationship from elements of working andnatural environments. Steering of technological processes can notbe realized without consideration of all settings in companyprocesses and external environment [5]. Because of the fact that the process technologies should becarried out from a cleaner production point of view, thedevelopment of sustainable technology should be based on thegeneral cleaner production aims. The technological process, which based on sustainable technology should tend to reducing orminimizing the amount of [5-6]:

- resources consumed;
- waste and emissions generated;
- the hazards of the waste and emissions generated (mainly by usage substitution of input materials);
- the risk of accident or malfunction.

The environmental consequences of the final phase of product life have many aspects or requirements which are summarized in the following guidelines:

- Toxicity - it means that avoiding toxic materials such as heavy metals and organometallic compounds is good because they in landfill, cause long term contamination of soil and groundwater.
- Potential of recycling - it means examination the using of materials that cannot be recycled, since recycling can save both material and energy and to minimize recycling of materials for which this is possible.
- Controlled combustion - when recycling is impractical the best way is to recover energy by controlled combustion.
- Biodegradability - it means the using of materials that are biodegradable or photo - degradable, although these are ineffectual in landfill because the anaerobic conditions within them inhibit rather than promote degradation.

Successful application of sustainable production in companies depends on property management, maintenance, adequate infrastructure and training of people. The transfer of sustainable production practices should be realized by:

- technological capacity (ability to adaptation clean technologies),

- training capacity (ability to training and education the ideas of cleaner production to various groups of people),
- institutional capacity (ability to network and co-operate among different stakeholders),
- government capacity (ability to prepare and implement policies in different policy fields).

Technological capacity is a one of the most important method to applicationthe idea of sustainable production. Environmental technology is usually connected with the design and analysis of complex, integrated management systems and sustainable development in the areas of:

- role of the design in the operations of environmental technology, control of integrated environmental systems,
- role of computer methods in the operation and control of environmental systems,
- education and training requirements to provide efficient operation and maintenance of complex environmental systems in range of clean technology.

The successful promotion of idea of sustainable production and environmentally sound technologies it is necessary to:

- built business strengths of company,
- connect the business and environmental advantages of sustainable technology,
- initiate long-term investments the technology transfer and development,
- exist government assistance and support mechanisms.

However, sustainable production and sustainable technologies will not be efficient without environmental management systems, which are the framework, set by top management of company.

CONCLUSION

The minimization of waste and emissions and reductions in material and energy inputs are the most important environmental aims. Sustainable technological development and innovations do not automatically lead to total reduction of environmental burden of industrial production. However, technological innovation is an important factor and seems to play a central role in the long-term initiation of sustainable production.

Sustainable technology is usually connected with the design and analysis of complex, integrated management systems and sustainable development and it is a central target in environmental science and growth of global economies.Design for environmental sustainability is the long-term view: that of adaptation to a lifestyle that meets present needs without compromising the needs of future generations.

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POTENTIALS OF MISCANTHUS GIGANTEUS PRODUCTION ON ASH LANDFILLS AND MULLOCK OF EPS

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ABSTRACT

Production and use of lignite in thermal power plants leads to significant pressure on the environment. JP Elektroprivreda Srbije has, through corporately responsible behaviour towards this issue, started and supported a large number of science, professional and performing projects. Within the project TR 31078 "Ekoremedijacija degradiranih prostora produkcijom agroenergetskih useva" (Ecoremediation of degraded areas through production of agroenergetic crops) there is a research done on the possibility of production of highly productive perennial grass Miscanthus giganteus on mullock landfill RB Kolubara and ash and slag landfill TENT B. Results of analysis of biomass development in two-year field experiment shows that it is biotechnically possible to produce up to 10t of technically dry biomass hectare/year on mullock. Total potential of production is possible to assess only with use of detailed data on mullock state on landfills.

Key words: bio-energetic crops, ekoremediation, perennial grass, biomass, reclamation.

INTRODUCTION

Environmental protection is mission and vision of "Electric Power Industry of Serbia". After many years in which the available money was invested only in the maintenance of production capacities, environmental protection became priority in the business policy of PE EPS.

In scope and complexity of projects, resources invested and achieved effects, EPS has become a leader in environmental protection in Serbia and the region. After the year 2000, PE EPS started the modernization of production capacities, which included the improvement of environmental protection. Solving those problems is of equal priority as the production of electricity. In according to priorities of the Development strategy of energetics of the Republic of Serbia the period from production and use of biomass is crucial for provision annually renewable national source of energy and especially for environmental quality conservation and improvement.

Integrated approach from the ecoremediation aspect is the imperative for production of energy crops both agricultural and forest ones.Comparing the production of energy crops on fertile and degraded soils through determination 10 parameters of plant growth should test the hypothesis that technologically significant production of Miscanthus giganteus is possible on mullock landfill RB Kolubara and ash and slag landfill TENT B.

MATERIAL AND METHODS

Field experiments were established in April 2011. Experimental fields were set on two locations:

1. Ash and slag landfill TENT B, Obrenovac
2. Mullock landfill Tamnava west field, RB Kolubara, Lazarevac

The experiment was set with 8 lots with an area of 100m2. Samples for analysis of biomass growth (10 parameters) were taken on from the areas of 1m2, three times per experimental lot, and results were shown as arithmetic averages of measures.

On the first location there were following experiment versions: planting density of 1 or 2 units per m2; the amount of fertilizer of 100 and 150 kg/haN:P:K=15:15:15; date of fertilizing in June or July. The combinations of all versions are given in 8 lots. The area is located near sprayer that is active when needed. The surface is made of ash and slag from TENT B without adding a layer of soil. The area is recultivated by sowing of reclamation grasses in 2010 directly on ashes.

On the other location there is field experiment with the same characteristics except the surface that was mullock that had been technically recultivated in 2010 and land treatment was done in 2011 just before planting. In this case irrigation was done when required from accumulation that is found nearby.

RESULTS AND DISCUSSION

Table 1 and 2 present results of Miscanthus biomass development on mullock RB Kolubara measured in July and October 2012. The first date was chosen in the moment of fastest growth and other in the moment of maximum biomass development. Presented results show that some examined parameters depend on treatment (height, tillering amount, number and length of leaves, leaf development) while other (leaf width, stem width) have significantly less variation in experiments versions. Versions of experiments: the first number is planting density (1 or 2 rhizomes per m^2); the second number is fertilisation (100 or 150 kg/ha); the third number is fertilisation date (May or June)

Table 1. Results of measures RB Kolubara May, June 2012

Lot No.	Version	Stem height (cm)	Leaf No. on stem	Length of green part of a leaf (cm)	Leaf width (cm)	Stem diameter (cm)	Green leaf No.	Dry leaf No.	Tillering amount
I	111	115	11,2	63,8	1,65	1,1	7	4,3	5,5
II	211	99,2	10,4	42,5	1,56	0,8	7,2	3,2	9
III	112	100,2	10,9	58,4	1,33	0,93	6,5	4,4	4,3
IV	212	86,6	11	27	1,3	0,7	7,4	3,6	6,1
V	121	101,8	10,3	34,5	1,55	0,85	6,5	3,8	5
VI	221	82,3	10,4	26,6	1,25	0,82	7,8	2,6	5,6
VII	122	88,7	10,5	32,2	1,24	0,83	7,5	3	5,2
VIII	222	97,6	11,8	57,3	1,24	0,78	7,2	4,4	3,8

Table 2. Results of measures RB Kolubara October 2012

Lot No.	Version	Stem height (cm)	Leaf No. on stem	Length of green part of a leaf (cm)	Leaf width	Stem diameter	Green leaf No.	Dry leaf No.	Tillering amount
I	111	157	12,8	17,2	1,5	0,9	8	4,7	5,8
II	211	189	12,5	13,8	2,0	1,1	9,2	6,1	9,3
III	112	151	13,0	16,1	1,3	0,76	8,6	4,2	9,4
IV	212	129	14,1	16,3	1,4	1,0	10,5	3,5	3,7
V	121	173	14,2	16,6	1,8	1,1	9,2	5,0	5,8
VI	221	173	14,2	24,8	1,8	1,0	9,8	4,4	6,4
VII	122	183	15,3	18,3	1,9	1,0	9,5	5,8	7,2
VIII	222	130	12,2	11,6	1,3	0,8	5,6	6,6	6,6

During vegetation there is a growth in stem height, but not a significant change in leaf number on a stem. On the other hand, during summer there is a drying of leaves especially through parameters: length of green part of the leaf.

The Table 3 shows results measures of the same parameters from the experiment on ash and slag landfill TENT B in July 2012. It is noticeable that development of biomass is significantly less than on mullock in RB Kolubara, the part of dry leaves is less, probably as a consequence of regular irrigation, and the amount of tillering is similar as in the previous experiment. Unfortunately, during summer there was a significant damage to plants on this location caused by animals so measuring in October was not possible.

Influence of planting density, dosage and period of fertilization could be discussed after detail statistic data processing. It could be expected that planting density did not significantly influence development of biomass in field experiments because plants were still relatively poorly developed considering that the measures were done in the second vegetative period. Data from the literature [1] and also our experience in previous experiments in Serbia support the assumption that the real perennial yields can be discussed only after the third vegetation [2]. This is caused by Miscanthus giganteus biology and reproduction method. The experiment is set by planting trimmings ofunderground stem – rhizomes in April of the first year of vegetation. As plants are in the stressful state (because of separation and replanting) the first vegetation starts in May of the following year. In that period plants have to develop root system and stems that are relatively small. Next year, in second vegetation period, vegetation starts when the weather conditions are appropriate (in Serbia it is beginning or middle of March). In this period the rood system is insufficiently developed and it is short, and rhizome has grown from 7-10cm to 50-100cm. This enables significantly more important tillering in the second vegetation. However, there are still no established stable relationships with the surface so in the third vegetation expected yield is approximately double the amount in comparison to the second year [3]. Fertilization, dosage and period in a topic of discussion between researches [3][4][5]. Publicised results are often contrasting. It appears that soil fertility is crucial for fertilization effect. In our case it is technogenic soil with no structure and with highly imbalanced biological components, in most cases sterile in the moment of creation. Because of this, expected answer on fertilization is omitted. The reason for this can be found in inability of the soil to keep the nutrients in the form available for plants, i.e. they are probably quickly rinsed.

Table 3. Results of measuring ash landfill TENT B July 2012

Lot No.	Version	Stem height (cm)	Leaf No. on stem	Length of green part of a leaf (cm)	Leaf width	Stem diameter	Green leaf No.	Dry leaf No.	Tillering amount
I	111	24	5	24,6	1,3	0,78	5	0	3,3
II	211	34	8	32,8	1,3	0,81	6	2	4,0
III	112	56	10	46,0	1,6	0,67	9	1	2,7
IV	212	37	8	28,4	1,5	0,68	8	0	5.2
V	121	86	9	40,4	1,7	0,80	9	0	4.8
VI	221	56	9	32,8	1,6	0,72	8	1	6,1
VII	122	48	10	46.5	1,9	0,66	9	1	5,4
VIII	222	67	8	34,0	1,6	0,74	6	2	5,2

Table shows yields of technologically dry biomass (15% of moisture) achieved in the second vegetation on the experimental field RB Kolubara that are compared to control lot located at Sadzak, Sremska Mitrovica municipality. Results are shown from field experiment with planting density of 2 rhizomes perm2, fith fertilization just before planting with 100 kg NPK/ha. The experiment uses seedlings from the same contigent, and planting was done in the same way in April 2010. Considering that result comparison was not correct due to distance of control location, results show the difference in dynamics of Miscanthus biomass development on experimental field with mullock as a surface and control field that leads to difference in yield. On the control location (humogley) yield is significantly higher in both observation periods. As Miscanthus biomass consists of shoots (stem and leaves) it is determined by the height of shoot, number of leaves and tillering from a single rhizome. As the number of leaves does not vary significantly through experiment versions, there is a comparison between stem height and a number of sprouts and it is shown that the number of sprouts is the deciding factor of Miscanthus biomass.

Miscanthus biomass is harvested early in the spring, in our conditions in February or in the beginning of March, because during winter drying of sprouts takes place as well as accumulation of nutrients in rhizomes. However, during winter there is also a loss of a part of dry biomass due to defoliation and stem tops loss [3][6][7]. For calculation of yields we will use a data from literature that we have proven through experiments [8] that the loss in biomass during winter 25% based on technologically dry mass (15% of moisture). That is how we get a yield of 4.73 T/ha on a control field and 2.85 T/ha on experimental field. In the third year of development, in March 2013, on a control field the yield was 16.52 T/ha. Experimental data for a field with mullock are not yet processed due to short period of time, but expected yield should be around 10 T/ha. These yields are as expected.

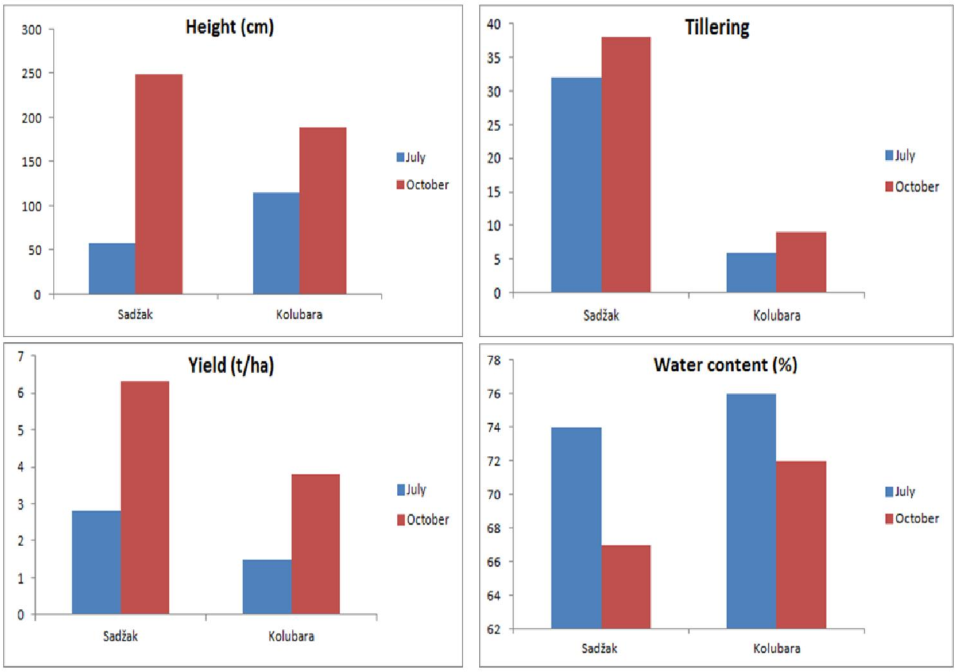

Figure 1. Yields of Miscanthus giganteus biomass at location RB Kolubara and control location Sadžak

CONCLUSIONS

By using techogenic soil created in production of electric energy for production of bioenergetic fuels ecosystem values are emphasized and some of ecosystem damages are compensated. It is not realistic to think that the damage to ecosystem will be fully compensated by any techniques of remediations, so this is not the goal of the project. Remediation of ash and mulloch landfills is a challenge not only for biotechnical sciences but also for fundamental sciences, because it is possible to systematically follow successions and influence them, from a practically sterile substrate. Achieving any kind of bioproduction in these conditions is a challenge and we have shown that this is possible, furthermore with a plant species that is new in our region.

The experiment on a ash landfill TENT B, even though there wasn't significant yield achieved, showed that Miscanthus giganteus can sustain extreme conditions and that there are animals that can feed on it which has not been publish anywhere yet.

The experiment of mullock landfill RB Kolubara showed that the realistic yields are around 10 T/ha/year which is the limit of rentability for fertile soil, but on a technogenic soil it is a remarkable result.

Based on the results, further research of processes of ecoremediation of technogenic soil of JP Elektroprivreda Srbije can be recommended, which includes integrated approach for improving degraded areas through processes of recultivation and bioproduction.

Acknowledgement

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STEELMAKING SLAGS AND SUSTAINABLE PRODUCTION

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ABSTRACT

Today about 1.5 billion ton steel is produced every year and the necessary by-product at steel production is slag. Slags can be divided into oxidizing – black slag and refining – white slag. The reusing i.e. recycling of slags has at least double effect; it increases ecology of steel production and also lowers the cost and increase competitivnes.

For the black slag the problem of usage is very good solved. If they are properly prepared it can be used as building material or as additional component of asphalt.

The recycling of refining – white slags is more complicated. If it is planed they will be stored at deposit they have to be stabilized. Another possibility is usage in the production of cement. The uneven content of some oxides is the reason that their worth is limited.

The third possibility is recycling in the EAF. White slags with high amount of CaO can be used as the supplement for the lime. For the steel grades with higher amount of sulphur this approach for solving white slag problematic is suitable. For usage in processes and steel grades which demand low sulphur content additional investigations must be conducted.

Key words: steelmaking slags, recycling, sulphur, sustainable development.

INTRODUCTION

World production of steel and pig iron continues to grow. In last ten years it has increased by half a billion tonnes and was one and a half billion the year 2012. During the production of pig iron and steelmaking slag is formed, which can be treated at the end of the process as by-products or secondary raw material. At the dump yard or in warehouses of secondary raw materials it can burden the environment. But with proper preparation it can be environmentally friendly and can be used as a secondary (synthetic) material. Dust and sludge from EAF can be for example used in production of zinc[1,2,3].

Figure 1. Wall built from the blocks of 19^{th} century blast furnace slag from Prevalje

Slags remaining after the production of pig iron have been for centuries considered as anby-product and have been used as building material. Liquid slag was used for the preparation of an insulating material. In Prevalje wall made from the blocks of 19^{th} century blast furnace slag is still standing (Figure 1). Ironworks Prevalje was in operation from 1833 until 1899 and was known for the manufacture of railway tracks.

When using steelmaking slags may occur problems due to their very different compositions. Slags can be divided into oxidizing and refining. Oxidizing slagsare produced in convertor – basic oxygen furnace (BOF) or in an electric arc furnace - EAF. This slag is used as a building material in the construction of roads or even as a supplement to the asphalt coating. Before using the pickling tests must be successfully carried on.

Refining slag, also called white slag, may be very different in composition. Their composition is dependent on the production program of the steel plant and secondary refining process.

Production of alloyed steels, i.e., stainless steels, hot and cold working tool steels, various constructional steels, etc.., follows the technological scheme of EAF-VLF (Vacuum Ladle Furnace). Slag may vary in basicity, and the vast majority contain di-and threecalcium silicate ($2CaO \cdot SiO_2$, $3CaO \cdot SiO_2$) and threecalciumaluminate ($3CaO \cdot Al_2O_3$). Because of di-calcium silicate slag disintegrate during cooling into a very fine powder. Dicalcium silicate can be stabilized by the addition of borax into the liquid slag[4]. Calcium oxide in refining slag can be used for formation of EAF slag[5].

With the addition of refining slag in EAF the specific consumption of lime has decreased by 8 to 10 kg/t of steel. Savings were at first sight not big but on an annual basis, this means about 800 t of lime lower consumption. With a reduced consumption of lime the emissions of carbon dioxide were reduced for 5 to 6 kg/t of steel. The savings are actually even bigger because the costs and energy consumption for the production and decomposition of limestone has to be also considered.

The process of recycling of refining slag is not as easy as it looks at first glance. Problems and the details connected with the production of high-quality alloy steels are shown in a longer period of time. These steels in most cases require very low content of sulphur, less than 0.01 mass %, or even below 0.005 mass %. Desulphurisation takes place during the secondary refining process and slag contains sulphur in the form of calcium sulphide.

INFLUENCE OF SULPHUR CONTENT IN THE REFINING LADLE SLAG ON RECYCLING PROCESS

The recycling of refining slag by forming the oxidizing slag has reduced consumption of lime, but at the same time it has also entered sulphur in the EAF, which is in the slag after desulphurisation melt previous batches. With the recycling of slag in steel melt it can be predicted that sulphur content in EAF will increase.

Figure 2 is a graphical representation of the sulphur contents in the EAF melts prior and after the addition of refining slag. In the graphic representation of a large number of batches shift in the sulphur content is visible.

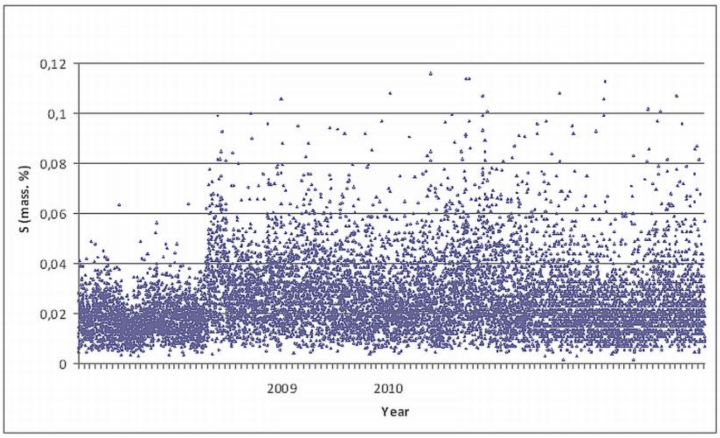

Figure 2. The sulphur content in the EAF melt before and after the addition of recycling slag

THE PHASE COMPOSITION OF THE REFINING SLAG

Refining slags from secondary steel melt refining process containing calcium oxide, which is added in the form of lime, deoxidation and alloy products such as Al_2O_3 and SiO_2, remains of refractory material - MgO, and to a lesser extent oxides of alloying elements. Part of aluminium oxide and magnesium oxide may result from additions of bauxite and dolomite. In Table 1 the composition of refining slag is presented.

Table 1. Composition of the refining slag

CaO	MgO	MnO	FeOx	SiO_2	Al_2O_3	TiO_2	Cr_2O_3
50.0 – 65.0	3.0 – 10.0	0.1 – 0.2	0.2 – 0.9	8.0 – 16.0	16.0 - 24.0	0.2	0,1

In Figure 3 is presented the XRD pattern of the refining slag. In addition to calcium silicates and calcium aluminates in the slag also contains periclase (MgO) and calcium sulphide (CaS - oldhamite). The sulphur content in the refining ladle slag is dependent on the degree of desulphurisation in the process of secondary metallurgy and the amount of slag.

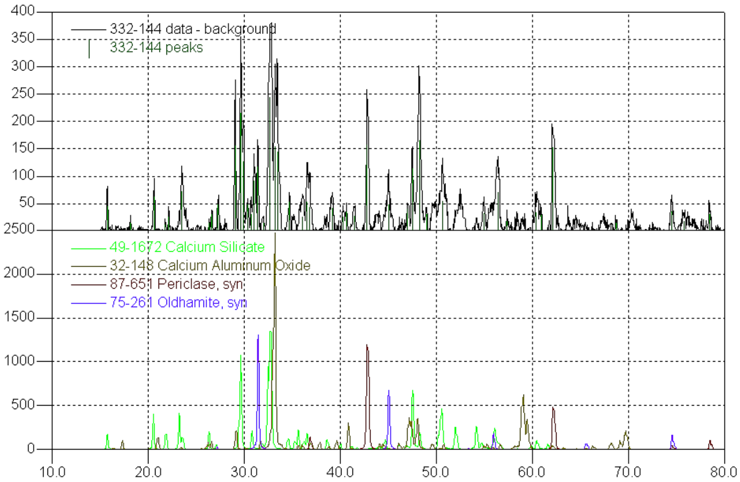

Figure 3. XRD pattern of the refining slag

For a metallurgical description of the refining slag composition the ternary systems such as $CaO-Al_2O_3-SiO_2$ with 5 or 10 mass % MgO can be used, depending on its content in the slag. In the ternary system $CaO-Al_2O_3$-SiO2 slags are in the area of di- and three-calcium silicate and three-calcium aluminate. Also the intersection of the system $CaO-MgO-SiO_2$ with plane representing different contents of Al_2O_3 can be used. For a more detailed description of the phase composition and metallurgical properties of slags the system C_2S-C_3A-CA (C - CaO; A - Al_2O_3; S - SiO_2) can be used[6].

THE SULPHUR CONTENT OF THE MELT

Figure 4 shows a comparison of the sulphur content in the slag produced with usage of recycling slag and the case when lime only was used. The sulphur content in the melt in the case when recycling refining slag was used is in an average about 100% higher than in batches when lime only is added to form a slag. Recycling of refining slags in EAF requires a change of technological rules for the production of certain types of steel.

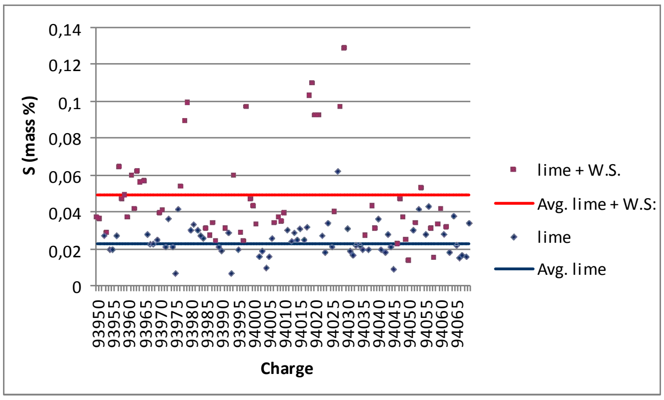

Figure 4. Effect of recycling slag on the sulphur content in the melt

However, for those steel grades in which very low sulphur contents are required for the formation of slag refining slags are not used. Amount of slag added into the EAF depends on the final content of sulphur in steel. The effect of the added amount of slag in the EAF to the sulphur content in the melt is a graphically presented in Figure 5.

Larger quantities of slag can be recycled in the production of steels with prescribed higher content of the sulphur, i.e. the machinability steel grades. Slag is so used as an alloying material for sulphur. To clarify the mechanisms of formation of sulphides, which affect the machinability of steel, further studies are required. In short we can say that the use of intermediate products and secondary raw materials require further research. The use of secondary raw materials, which reduces the ecological problems, should not at the same time affect the quality of the product, or increasing the cost of production. This must be considered, namely the reduced competitiveness against those who do not have these requirements or they do not stick is also an issue.

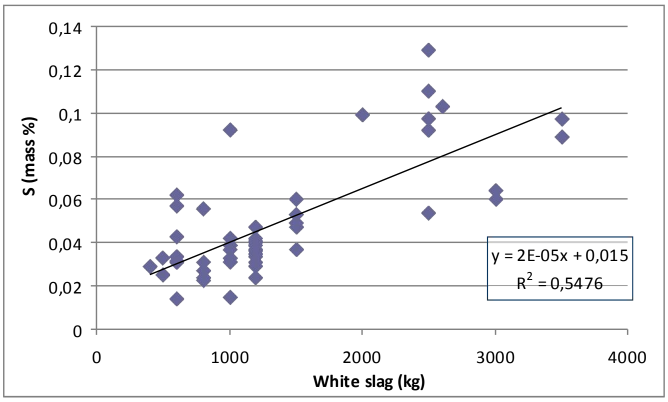

Figure 5. Influence of the refining slag on the sulphur content of the steel prior to secondary refining.

Due to the presence of calcium silicates and calcium aluminates the refining slag has hydraulic properties and would be suitable as a secondary raw material in cement industry. Because of the uneven levels of magnesium oxide and oxides of some alloying elements, which can be in a basic medium soluble in water, i.e. in the production of clinker, their worth is limited. In order to protect the environment the selective collection of slags from the production of various types of alloy steel should be applied.

The procedure described for the recycling of refining slag in EAF leads to the microstructural and phase changes in slag. In the oxidizing slag is di-calcium silicate, which is stabilized due to increased levels of iron oxide. Iron is in the slag mainly in the form of wustite as Fe^{2+}.

In Figure 6 is presented the microstructure of the refining slag which contains C_2S, C_3S, C_3A and C_2AS. During melting and oxidation of the charge in the EAF slag is formed, which can be presented in the ternary diagram CaO-(FeO+MnO)-SiO_2. In the oxidizing slag, the primary mineral phases are wustite and stabilized di-calcium silicate (Figure 7). Oxidizing slags are stable and suitable for building materials. From the Figures 6 and 7 it is clearly visible that refining and oxidizing slag have different microstructure.

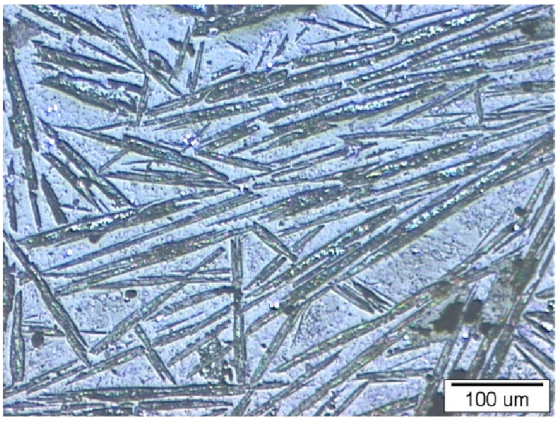

Figure 6. Microstructure of the refining slag with C_2S, C_3A and C_3A

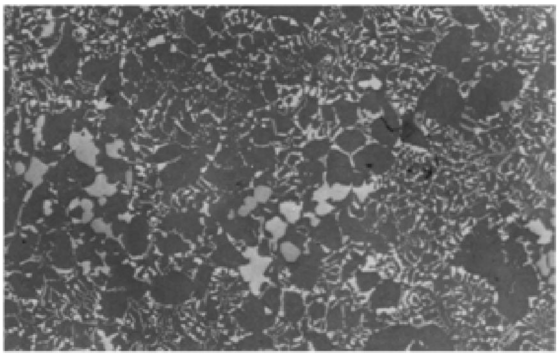

Figure 7. Microstructure of the oxidizing slag wustite-FeO, C_2AS and C_3A

CONCLUSIONS

Refining white slags contain after ladle treatment (ladle metallurgy) calcium oxide which is bonded into calcium silicates and calcium aluminates (C_2S, C_3S in C_3A). Di-calcium silicates disintegrate during cooling into fine dust and can cause environmental problems.

Calcium oxide from calcium silicates and calcium aluminates can be used for formation of EAF steelmaking slag. With treatment in EAF white refining slag transforms into oxidizing slag and stable after cooling. During melting in the EAF the composition and microstructure of slag change from the system $CaO-Al_2O_3-SiO_2$towards the system $CaO-FeO-Al_2O_3-SiO_2$As such it is suitable for building industry. With recycling of the white steelmaking slag the consumption of lime decreases for 8 to 10 kg/t of steel.

The sulphur from refining steelmaking slag is in EAF transmitted from slag into the melt. The amount of refining steelmaking slag is between 10 and 30 kg/t of steel and depends on the upper limit prescribed for particular steel grade. For machinability steels the amount can be as high as 40 kg/t.

The usage of secondary raw materials needs further research work because the quality of produced steels cannot be affected, particular the morphology of non-metal inclusions.

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QUALITY AND QUANTITY OF WASTEWATER UNDERGROUND MINE "OMAZICI" RMU "BANOVICI"

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ABSTRACT

Groundwater movement toward underground mining areas passing through the hollows and parts of the coal seam that affect change their composition. The change groundwater quality is also greatly affected by applied equipment and machinery. Such contaminated ground water is treated as wastewater and it discharges into nearby waterways.

Underground waste water polluting waterways, it's necessary to determine does the separation of pollutants substances in them constantly, does it depend on the flow of groundwater or be carried by some rules.

Key words: underground water, polluting substances, wastewater, watercourse.

INTRODUCTION

In underground coal mining is one of the inevitable occurrences are groundwater. Ground water on its way through the coal seam, the hollows or under the influence of machinery and equipment contaminated with various compounds and substances, and as the wastewater from the pit is pumped into open waterways. Working environment, people and equipment in the pit affect on groundwater changing usually temperature with them, smell, pH value, suspended solids content, the content of certain compounds, electrical and other. In this way, groundwater is changing and getting properties, respectively it considered of wastewater.

By 2011 there was no requirement for control the quality and quantity of wastewater from the pit included in open natural waterways. Knowing that such a wastewater, more or less, adversely affecting on the water in streams, as well as the need to adopt EU standards, a mine "Banovići" is imposed the need to control the quality and quantity of wastewater which discharged into the waterways.

Since they show significant differences in the amount of wastewater that is transferred from the pit into the streams during one year (depending on atmospheric conditions), in this paper will be determined which way changes in the amount of wastewater affects its quality, that there is any connection between wastewater and contents of contaminants in them.

QUANTITY OF WASTEWATER UNDERGROUND MINE "OMAZIĆI"

Volume of wastewater pits "Omazići" depends on the extraction of groundwater in the pit. Intensity extraction of groundwater in the mining areas is not constant and depends on several factors, of which the most important catchment size and intensity of rainfall, type of terrain (fields, forests, degraded land), the coefficient of permeability roof beds, surface accumulations, groundwater levels etc.

Banovići coal basin, and thus the area of the pit "Omazići" seems a valley in the hilly terrain in which the most striking Konjuh to 1328 meters above sea level. Elevation of the terrain above the pit moving 310-400 meters a pitch is in the form of mild hair partly covered with forest. In this area of temperate continental climate with average annual temperature of 10.2 (^{0}C). The average annual total precipitation is 899.3 (mm/m^2).

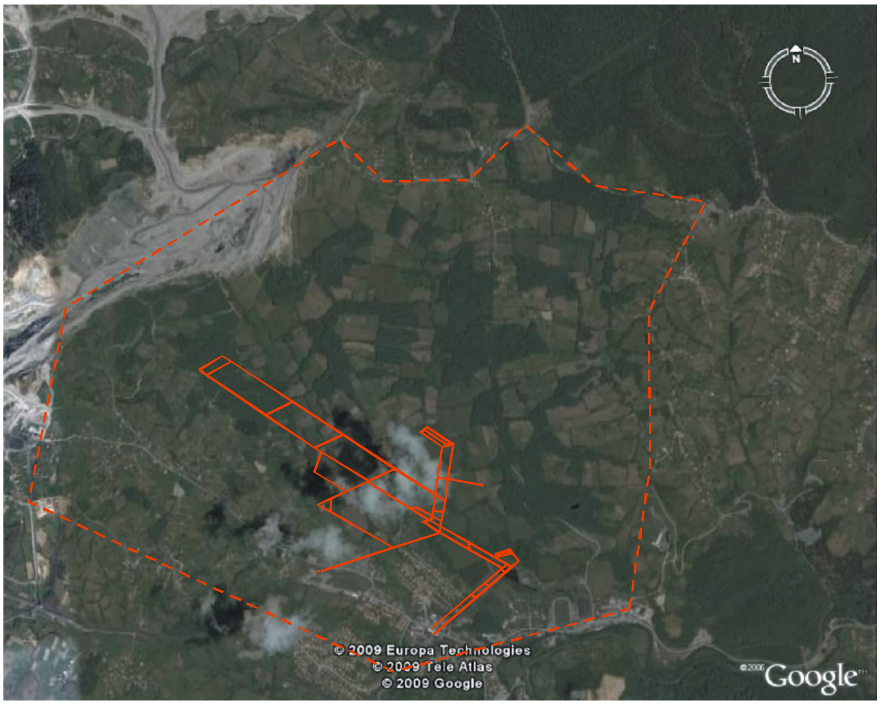

Figure 1. Catchment area and the terrain above the pit "Omazići" (Google)

Catchment area of the pit "Omazići" makes catchment area four streams: Slatina, Ostrožno, Brezički and Begov stream. The total catchment area is 6,107,750 (m^2), of which 20% is forest, and 5% is degraded land. The meadows and fields are the rest of it.

Intensity extraction of groundwater in the mine openings and places allocations

Measurement tributary water in mining areas pits "Omazići" performed regularly since 1991. year, and for this period of the existing data about the intensity of water tributaries of the mine workings. According to these data, the maximum inflow of groundwater in the mining room was 4256,6 (m^3/day) and measured the 03.06.2010. The minimum water inflow into mine openings was 460,8 (m^3/day) and measured 06.10.2012. This information is very important considering that all allocated underground water has pumped into the waterways as wastewater more or less contaminate them.

The most common places allocation of groundwater in mine openings are from the hollows, fault zones, exploration wells and synclinal zones. On the basis of the measurements showed that the amount of groundwater extracted from the hollows represents almost two thirds of total groundwater. This can easily be explained by the existence of a large number of cracks from the hollows to the ground surface caused due to the excavation of coal seam thickness of 15 (m). These cracks cause a drastic increase in inflow of groundwater into the pit at the time of heavy rains and rapid melting of snow.

WASTEWATER QUALITY MONITORING OF UNDERGROUND MINE "OMAZIĆI"

Quality control groundwater coal pit "Omazići" is done on the basis of the Regulation on conditions for discharge of wastewater into the natural recipients and a system of public sewers (SN FBiH No. 04/12). The Regulation defines limit values and test methods (Table 1). Wastewaters is performed during the technological process, on the control point immediately before to discharge wastewater into the waterways.

Table 1. The most important parameters are investigated wastewater

Parameter	Units	Method	Limit value
Temperature	^0C	JUS.H.Z1.106	30
Color	-	BAS EN ISO 7887	-
Smell	-	BAS EN 1622	-
pH value	pH units	BAS ISO 10523	6,5-9
Total suspended solids	mg/l	BAS EN872	35
Chemical oxygen consumption	mgO_2/l	BAS ISO 6060	125
Biologic oxygen consumption	mgO_2/l	BAS ISO 5815	25
Total nitrogen N	mg/l	computing	15
Total phosporus P	mg/l	BAS ISO 6878	2
Sulphates	mg/l	H.Z1.163	200
Total oils and fats	mg/l	JUS H.Z1.150	20

Sampling is by hand, samples are single. Time interval sampling and flow measurement is 60 minutes. The samples must be tested temperature, smell, color, content of dissolved oxygen, pH value, total suspended solids, alkalinity, electrical conductivity, evaporation residue, loss on ignition, total nitrogen and nitrogen compounds, total phosphorus, chlorides, sulfates, toxicity test (Toxicological biotest Daphnia magna Straus 48hE50), total oils and fats.

Sampling and testing perform independently ispection body once a month. According to the mentioned Regulation allowed the two samples during the year whose results deviate from standard values.

Sources of pollution of underground mine water

Sources of water pollution in underground mining areas may be different. They can be grouped into two basic groups: sources of pollution related for characteristics of the working environment and pollution sources related to technology work.

Working environment affects groundwater by changing their temperature, color, odor, increases solid particles in it, which would increase sulfur content is removed from the coal and other.

The technology works trough the use and the types of application equipment and machines for work. It can contaminate groundwater by increasing the nitrogen compounds (from explosives), through the emergence of oils and fats, to the appearance of various other compounds used in work proces (paint, glue, varnish), through solids particles and other.

Test results

Analysis of the samples of wastewater pits "Omazići" confirmed that all mandatory parameters did not identify in significant amounts. For this reason, it will be presented the results of tests for the parameters that have a significant values in samples of wastewater pits "Omazići."

Table 2. The test results of wastewater pits "Omazići"

Datum	Temperature (^0C)	pH value	Total suspended solids (mg/l)	Chemical oxygen consumption (mgO_2/l)	Biologic oxygen consumption (mgO_2/l)	Total nitrogen (mg/l)	Sulphates (mg/l)	Flow (m^3/dan)
07.12.2011	12	7,7	**61**	38	13	2,02	108	590
31.12.2011	11	7,6	2	20	5	1,82	81	705
07.02.2012	11	7,4	9	97	24	7,65	65	979
29.02.2012	8	7,7	8	19	5	3	103	892
31.05.2012	12	7,6	14,4	9	3	0,97	133,8	1190
26.06.2012	13	7,7	**86**	9	3	2,32	134	1195
31.07.2012	15	7,6	17	10	3	1,18	29,1	778
31.08.2012	19	7,7	6	12	3	2,58	26,2	775
11.10.2012	12	7,7	21,1	12	4	1,33	21,1	749
05.11.2012	15	7,4	18	19	5	2,81	24,7	490
07.12.2012	15	7,6	27	56	14	3,38	189	706
08.01.2013	10	7,5	26	45	12	3,4	178	691
31.01.2013	15	7,6	27	9	3	2,4	79,6	1728
07.03.2013	10	7,4	5	11	4	1,46	139	2736

The water temperature ranges in small limits, the pH value is in the normal range, chemical and biological oxygen consumption were under the limit values and the nitrogen content is relatively small.

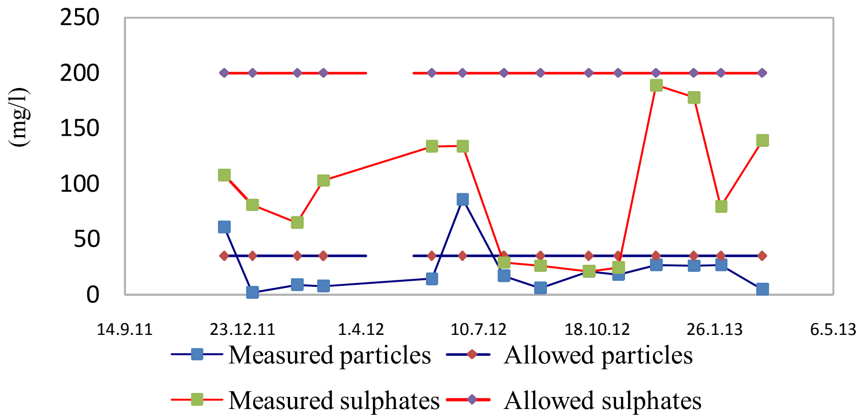

Figure 2. Sulfate content and suspended solids in wastewater samples

According to the data of Table 2 and in Figure 2 we see that two samples of wastewater was outside the permissible value and the contents total suspended solids (samples of 07.12.2011 and 26.06.2012.). Also, samples of mine wastewater sulfate content is very close to the limit value.

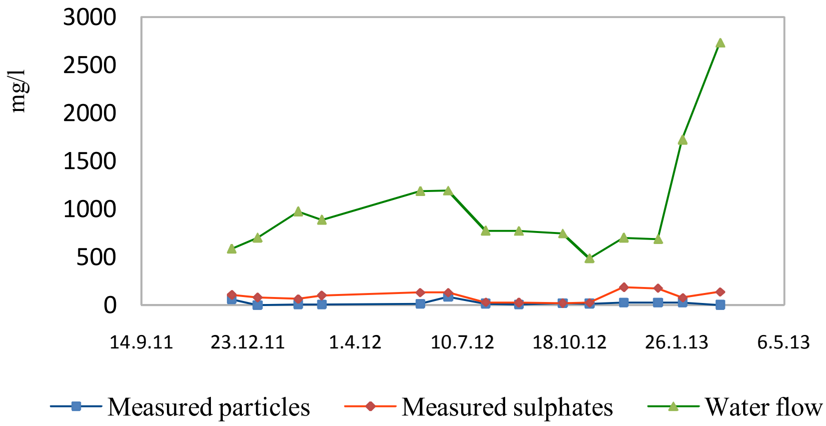

Figure 3. Two factorial diagram of the quantity and quality of wastewater

On the diagram from Figure 3, the relationship is represented by the amount of sewage and their quality in terms of sulphates and suspended particles. It is clear that there is no link between an increase in water inflow into the pit and the reduction of suspended solids and sulfates in them, extracting suspended particles and sulfates in groundwater volume (kg/day) is not constant.

CONCLUSION

Content of suspended particles in samples of wastewater ranges from very small values to those that exceed the limit value. The greatest amount of suspended particles in waterways was 102,77 (kg/day) (26.06.2012.), and the lowest is 1,41 (kg/day) (31.12.2012.). Of course, in those days were not the maximum or minimum tributary water in the pit.

According to the data from Table 2 of sulphate in some samples is higher and six times than others. However, if we consider the mass quantities that are released into waterways they range from 15 (kg/day) (11.10.2012.) up to 380,3 (kg/day) sulfate (07.03.2013.) and the variation is much more pronounced. Also, no we're not talking about minimum and maximum water tributaries in the pit.

Separation of pollutants into groundwater varies in a wide limits without certain rules.

Cause major changes in the quantities of pollutants in groundwater may also depend on the amount of water in the water pool and this requires further examination .

Although the mine is used considerable equipment and machines in wastewater samples did not determine content of fats and oils.

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ELECTROCOAGULATION IN WASTE WATER TREATMENT

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ABSTRACT

Chemical coagulation is commonly used in raw water and wastewater treatment plants for the destabilization of pollutants in order to be more easily removed by separation processes. The most commonly used coagulation chemicals are aluminium and iron metal salts. Electrocoagulation technology has also been used for the treatment of raw waters and wastewaters. With this technology, metal cations are produced on the electrodes by electrolysis and these cations form various hydroxides depending on the pH of water. Although electrocoagulation is effectively applied today, complexity of involved processes leads to the fact that many of them are not sufficiently explained switch may limit the further development of this method. The objective of the paper is to present the influence of various parameters on the efficiency of the process as practical aspects of this method.

Key words: Electrocoagulation, Coagulation, Wastewater, Electrolysis.

INTRODUCTION

The electrocoagulation process has been successfully used to:

- Remove of protein, fiber and fat from food processor waste streams (Food Industry).
- Recycle water, allowing closed loop systems (Various Industries).
- Remove metals and oil from wastewater (Metalworking, Metallurgy, and Oil Industry).
- Recondition antifreeze (i.e. AF regeneration) by removing oil, dirt, and metals (Automotive Industry).
- Recondition brine chiller or cooling towers water by removing bacteria, fat, etc.
- Pretreatment before membrane technologies like reverse osmosis.
- Precondition boiler makeup water by removing silica, hardness, TSS, etc.
- Recondition boiler blow down by removing dissolved solids eliminating the need for boiler chemical treatment.

- Remove BOD, TSS, TDS, FOG, etc., from wastewater before disposal to POTW, thus reducing or eliminating discharge surcharges.
- De-water sewage sludge and stabilize heavy metals in sewage, lowering freight and allowing sludge to be land applied (Sludge and Sewage treatment).
- Condition and polish drinking water (Portable Water and Water Supply Systems).
- Remove chlorine and bacteria before water discharge or reuse (e.g. after biodisc process).

It can be used like pretreatment or as the stage in treatment for various applications: Commercial Laundries, Distillation/Desalination of sea or brackish water, Emergency Potable water, Metal recovery from waste waters, in Mining, Process rinse and wash water, for Steam cleaners, Surface and Ground water cleanup, in Textile industry, Radioactive isotope removal and various pretreatment [1].

Pretreatment of Reverse Osmosis (RO) includes eventually perchlorate treatment (if it is used for desalination) but mainly different level of filtration, roughly with PP filters of 25 to 5μm followed with microfiltration. However, membrane fouling is often caused with silica and EC is widely used for its removal [2].

EC action is primary precipitation of complex metal ions or oxides with impurities, solid and colloidal directly and other indirectly. Other mechanisms are: emulsion breaking, halogen complexing, oxidation-reduction reactions, electrons donation into the water which reduce the polar effect of the water complex and the increase of electrons creates an osmotic pressure that destroys bacteria and viruses, induced pH toward neutral, etc.

EC is more efficient then sedimentation and chemical coagulation. For basic treatment of waste water comparison is shown in the table 1.

Table 1. Removal efficiency of pollutant for different methods

Indicator/Method	Electrocoagulation	Chemical Coagulation	Sedimentation
TSS	95 to 99%	80 to 90%	50 to 70%
BOD	50 to 98%	50 to 80%	25 to 40%
Bacteria	95 to 99.999%	80 to 90%	25 to 75%

Where: TSS – Total Suspended Solids and BOD – Biological Oxygen Demand

EC is very usable is metal recovery or removal and achieves concentrations of the order of ppb [3, 4] especially for Arsenic, Zinc, Chromium and Lead where less then 10ppm could be obtained with 99.99% removal. As discharge requirements become more stringent EC will become more essential. It is obvious that EC is often combined with other methods.

Principally scheme of commercial system with EC as part of it is shown on figure 1.

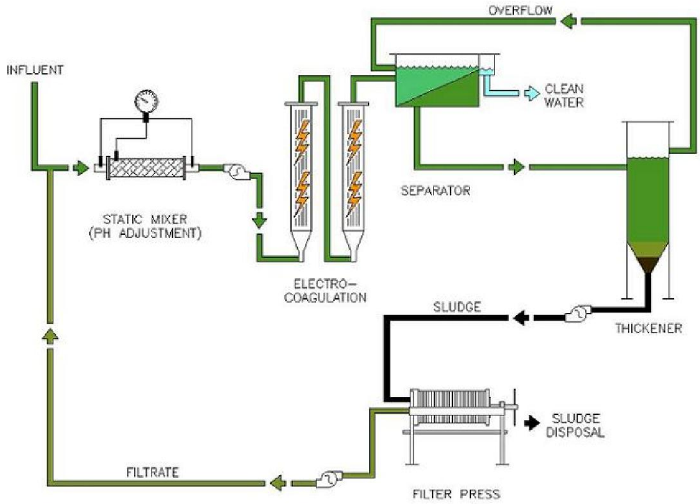

Figure 1. Schematic of Proposed Wastewater Treatment System [3]

Even when chemical coagulation can meet demands, operating cost for the EC is an order of magnitude smaller. For the commercial process, as example, with requirements to: reduce Ni from 25 to < 2.38mg/l and Cr from 210 to < 1.71mg/l with flow rate of 100 gpm ($22.7m^3h^{-1}$) operational costs are 14.18 and 1.69 $/1000gal. For the CC and EC respectively [1] and they are 8.4 times less for the EC.

INFLUENCE OF PROCESS PARAMETERS ON ELECTROCOAGULATION

The process is optimized by controlling reaction chamber materials (iron, aluminum, titanium, graphite, etc.), amperage, voltage, flow rate, and the pH of the water. The technology handles mixed waste streams (oil, metals, and bacteria), very effectively. Variables such as temperature and pressure have little effect on the process.

Effect of current density on EC efficiency

It is known that in EC the removal efficiency is proportional to the amount of hydrous oxides (coagulant) generated by the electrode in the solution. Increasing current intensity will increase removal efficiency during a time but will also increase the power required to achieve the removal efficiency. Current density increase efficiency of the process but only to a certain value above which efficiency decrease as shown on Figure 2. Impact of this variable is most obvious in removal of metals from waste water.

In metal plating effluent, 60% of TOC was removed after 150min. at $9mA/cm^2$. The same removal efficiency was obtained in 45 min. at 45 mA/cm^2, zinc was 90% removed with current densities higher than $9mA/cm^2$ with 25 min. of application (Kabdaşli, et al. 2009).

Removal efficiencies of 58.1, 88.6, 99.3 and 100% were achieved for arsenic (III) at current intensity values of 25, 50, 75 and 100A/m^2 respectively for 30min. of process; and 81.9, 99.2 and 100% of chromium (VI) removal efficiency was found with 25, 50 and 75A/m^2, respectively during 30min. (Thella, et al. 2008) [5].
The effect of current density on the reduction of COD, BOD and TDS and the removal of chromium gives similar results and are in accordance with previous.

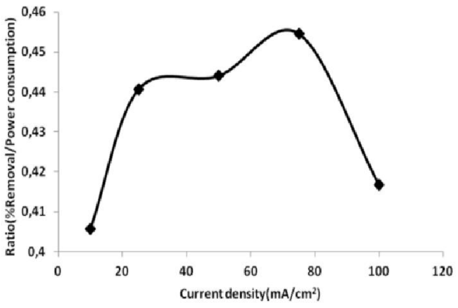

Figure 2. Effect of current density on removal efficiency [6]

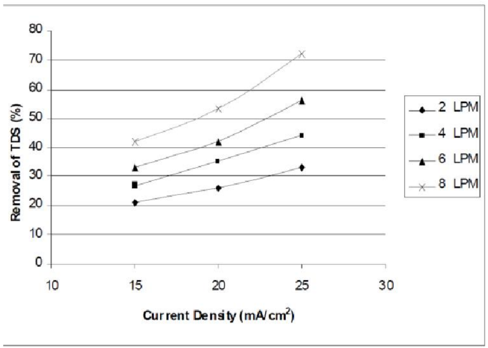

Figure 3. Effect of current density on Total dissolved solids removal [7]

Current Density directly increase efficiency as well as flow rate, what is given on figure 3. Flow rate is independent parameter and improves removal of pollutants.

The flow rate parameter is related to the operation time, which is the time that the wastewater stream is treated inside the EC reactor, and thus it is related to the amount of dissolved electrode metal and the EC performance efficiency.

Effect of initial pH value on EC efficiency

In contrast to chemical coagulation, EC treatment increases the pH of the solution when it is in an acidic, neutral or slightly alkaline region and decreases when it is highly alkaline. This change is affected by formation of aluminium and iron hydroxides. At highly acidic pH, at 2 or below, the alkalinity produced during the EC is not sufficient to increase the pH of the solution, whereas at pH=3 and higher initial pH values of pH rises during the treatment [8]. When initial pH is significantly alkaline (pH>9), pH decreases due to the formation of aluminate $[Al(OH)_4]^-$, which is an alkalinity consumer [9]. It seems that the pH change rate and final steady state pH depends on the concentration of anions in the solution. Thus, pH increases more in sulphate than in chloride solution [10] as sulphates can replace hydroxyl ions in the hydroxide precipitates and therefore less hydroxyl ions are bound to hydroxides.

Some authors have noted an imperceptible incidence over EC efficiency between pH ranges from 4 to 9, out of these limits, the efficiency varies, more or less, linearly with pH, probably due to the few coagulant produced in that outrange. A slight drop of COD removal of 60% was observed for pH<4 or pH>9 compared with 70%

COD removal at pHs 4–9, for suspended solids, a low efficiency of 40% at pH 3 compared with 90% at pH 5 [8].

For the different metals removal neutral initial pH in the range 6–8 was found optimal [5].

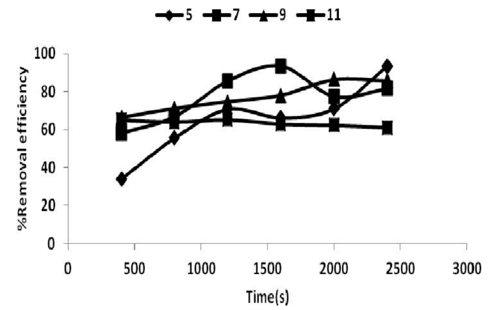

Figure 4. Removal efficiency vs. time at different solution pH [6]

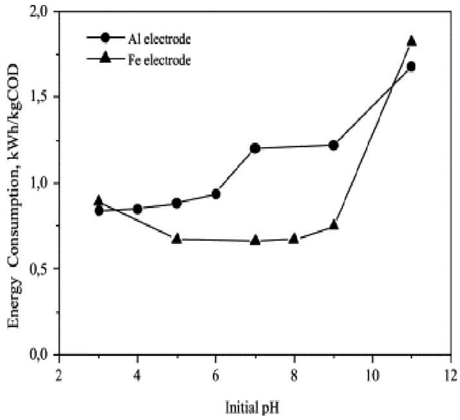

Figure 5. Influence of initial pH value on the energy consumption of the EC process [11]

Removal efficiency (RE) get maximum for different time, on figure 4., but the value of the maximum is higher for the pH=5 and pH=7, with still high RE for pH=9 and the lowest value for the pH=11. Specific consumption of energy is an view from other angle and it gives lowest values for pH between 5 and 9 for the Fe electrode and for pH 3 to 6 for the Al one, which can be ascribed to the fact that, increasing the solution pH can destroy the passive aluminum oxide layer that is formed at lower pH [6].

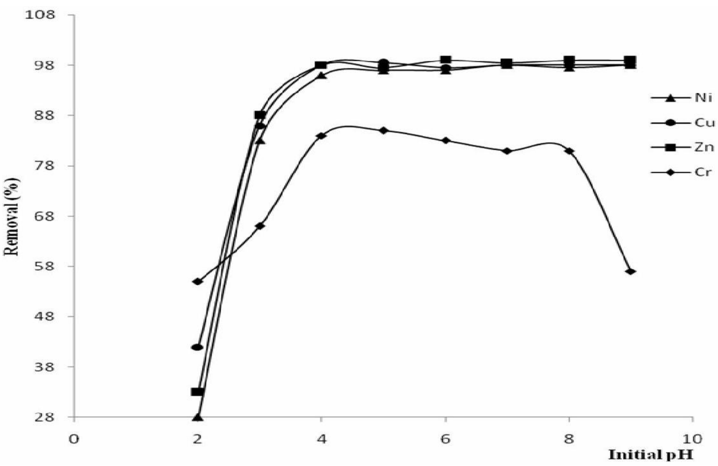

Figure 6. Removal efficiency for different metal ions as a function of initial pH value of wastewater [12]

Results shown in figure 6 gives removal efficiency for: Ni^{2+}, Cu^{2+}, Zn^{2+} and Cr^{6+} ions in initial concentration of 50 mg/l for each of them. Initial pH value range was from 2 to 9. Duration of EC process was 20 minutes on constant current density of 20 mA/cm^2. Removal efficiency was more than 97% for all metals except chromium where it was about 85%.

Effect of solution temperature

Figure 7. shows the effect of solution temperature on the electrocoagulation reactor performance. Test results show that removal of phosphate ion increases by increasing solution temperature up to 60°C. A further increase in the solution temperature was found to decrease the removal efficiency of phosphate ions [6].

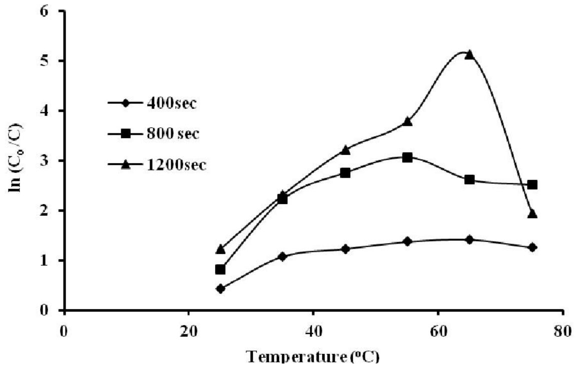

Figure 7. ln(C_0/C) vs. solution temperature at different electrocoagulation times [6]

These findings can be explained by the fact that increasing solution temperature can improve ions transfer from the anode and/or cathode surface to the solution bulk resulting from the decrease in solution viscosity and the consequent increase in the ions diffusivity according to Stocks equation. The decrease in phosphate removal efficiency occurring at solution temperatures above 60°C is explained by the fact that higher solution temperatures also enhance the aluminum anode and cathode passivation by the formation of protective aluminum oxide layers, which decreases Al^{3+} ions dissolution and consequently the electrocoagulation reactor performance.

Conductivity, Passivation and addition of NaCl

Sodium chloride is often added to increase the conductivity of the solution, wastewater. Besides increasing conductivity, sodium chloride reduces the and harmful effect of some anions that may be present in water, such as sulfates and bicarbonates. The presence of carbonates, bicarbonates or sulfates in the water can lead to precipitation of Ca^{2+} or Mg^{2+} ions in the form of insulating film on the surface of the anode and the electrode passivation. NaCl is usually added in concentration 1÷10mg/l eventually up to 100mg/l which is sufficient to achieve electrical conductivity more than 1mS/cm (Na_2SO4 is also used this purpose) and for depassivation of electrodes [4]. For the emulsions (oil removal) higher concentration of NaCl is used, up to 0.8%. Above 1% the most of emulsions are not stable [13]. Even higher concentration (up to 0.1M) of NaCl is used for the treatment of dyes from textile industry [5].

Electrical conductivity seems to affect more directly the voltage or the current intensity than the removal efficiency. Removal efficiency for oil and grease, COD and suspended solids, usually is not significantly affected by variation in conductivity, but in electrolysis voltage, the higher the conductivity, the lower the electrolysis voltage. With conductivity values from 1000 to 4000µS/cm, the voltage between electrodes decreased from 4 to 2V [9]; this feature of the conductivity is used to lower the power used in the treatment, and consequently, to lower the operation costs.

Passivity is caused by an impermeable oxide layer on the surface of the electrode, which protects the underlying metal from oxidation. The oxide is an electronic, but not an ionic, conductor. Passivation becomes an additional overpotential that is related to many factors, such as pH, conductivity and current density, but close to the anode, the pH is always acidic thus the passivation overpotential depends on the conductivity (k) and current density (i) [14].

CONCLUSION

Electrocoagulation method is the leading electrochemical technology for waste water treatment. It is single method for COD, BOD and TDS removal with efficiency 95-99% or often more. It could be singe method for removal of metal ions, even for very toxic such as: arsenic, lead and chromium, with limits for industrial wastewater discharges with less than 0.05ppm. This method is suitable to be combined with other wastewater treatment processes.

EC eliminates the long-term liability associated with metal hydroxides. The metal oxides dewater easier, creates less sludge volume, and is less expensive than chemical coagulation.

Acknowledgment

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PESTICIDES–ARGUMENTS PRO AND COUNTER

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ABSTRACT

The protection of plants and plant products from insects and weeds is mostly based on using chemical products. So far, this kind of protection has had significant advantages, but disadvantages as well. Namely, pesticides are produced in factories with standardized quality and production can be controlled by relatively safe methods. At this moment, Serbia is relying on importing these products, as the former factories are totally destroyed or they are simply out of function. Similarly, contemporary production methods of these products have come a long way so that domestic production is not worth its time, especially without large investments.

Key words: plant protection, pesticides, plant diseases.

INTRODUCTION

In the ex Yugoslavia, as well as the SRY, there was a wide range of pesticide offers for whose production some 220 active substances were used. The majority of the needed substances (concentrates) were imported, which represented a significant financial cost. The Kingdom of Yugoslavia in 1939 had 42 registered preparations, and in 1989 there were 650 preparations registered in SFRY. In SRY, there were some 250-300 registered preparations. This points to the possibility of eliminating a larger number of importing items by using local syntheses. Syntheses such as plant alkaloid, nicotine, and compounds based on copper, sulfur, barium polysulfides, and DNCO were used in Serbia at the end of the 40ties of the 20th century, at the same time as in developed countries, meaning that the application of science was based on good experiences and sound scientific knowledge. However, using this knowledge in today's conditions is debatable. This is due to a simple reason, incurred by the process of transition and reflecting on the possibility of financing research projects. The material aspect has slowed down the development of those projects which were directed toward new syntheses, and yet, on the other hand, an entire group of triazine compounds were made use of. These compounds represent the fundamental substances of herbicides used to keeping weeds in check, and are not poisonous, which will help contribute to the ecological protection of the environment. Responding, thus, to these possibilities, basic chemistry is a significant factor for developing new projects which will serve as a substitute of imported syntheses of domestic raw materials and intermediary products. This can also be one of the directions of developing processing in Bor, considering the possibilities offered by copper production. And, of course, the competitive advantage of Serbia on the European and world food market should also be taken into consideration.

A quantitative decreasing of pesticides production in the former Yugoslavia is the result of the adopted new syntheses which are used in smaller amounts, and thereby are more efficient.

In the world, some 40 companies deal with developmental research of pesticides. It has been assessed that the world production volume of pesticides is worth about 24 billion dollars (according to GIFAP).

Table 1. Pesticide production in the SFRY, SRY, SCG by years

	1985	1988	1990 (SRY)	1995 (SRY)	2004 (SCG)
Herbicides	19,235	2,509	4,539	2,681	1,850
Fungicides	6,827	6,661	7,303	1,986	943
Insecticides	22,959	15,482	4,780	2,341	1,100
Insecticide fertilizers	3,053	4,670	1,693	1,039	320
Various regulators	4,415	4,539	2,145	1,897	525
Other methods of plant protection	15,583	11,766	529	52	15

Source: PU for plant protection, Belgrade-Zemun, Statistical almanac by years, as well as author's research.

Note: the greatest problem in gathering data were the years after the forming of SCG, as the main data registers (institutions) were disbanded.

Only those countries whose GDP exceeds US$ 6,000 can carry out research work and pesticide production. In truth, developmental research is very expensive, as from 10-15000 tested products, five or six of them satisfy the demands which must be met to battle plant diseases, insects and weeds.

In the former Yugoslav proportions, the expenditure of pesticides had the following cyclical movements:

Table 2. The use of pesticides in SFRY, SRY, SCG by years in tons

1986	30,263
1988	27,073
1990	20,828
1995 (SRY)	7,833
2004 (SCG)	3,857

Source: PU Plant protection, Zemun, Statistics Bureau of Serbia, by years.

A declining in usage is a temporary matter, considering that formulations to the amounts of four-five kg/ha were used, which are old products. The new preparations were far more efficient and concentrated, so that they were used in dosages from 0.1-1 kg/ha.

On the other hand, the issue of soil pollution based on the application of pesticides is an open one. Namely, in local conditions, the previous average use was 4.5-5 kg/ha, and twofold that in the EU (around 10 kg/ha), which means that the information regarding the soil pollution comes from a misuse of these products. Thereby, based on the experiments which were carried out by large agricultural systems, strict attention should be paid to their being applied in conditions such as for example greenhouses. If attention is not paid to the private agricultural sector which owns a huge area of land (which will be even bigger by the ongoing process of privatization), there will be grave consequences, particularly if there is proof that some herbicides and fungicides are toxic. Scientific research is trying to resolve some problems linked with the development of biological insecticides in order to create a healthy way of protection via the pheromones which appear on the market. The newest achievements, created in this area, are carried out via genes which produce toxins and their incorporation into bacteria which is in the composition of soil, so that they in symbiosis with the root bestow the area of the root with insecticidal properties. With herbicides, the derivates of propionic acids are used successfully for suppressing weeds in sugarcane. In new preparations, the greatest attention is given to the level of toxicity and lower amounts of application.

Table 3. The structure of use of certain types of pesticides in economically developed countries in %

Region	Herbicides	Insecticides	Fungicides	Others	Total
USA	50.0	26.0	11.0	41.0	33.0
EU	20.5	14.5	40.0	35.0	24.0
Eastern Europe	8.5	7.0	12.5	7.0	9.0
Japan	9.5	12.5	16.0	2.5	11.5
Others	11.5	40.0	20.5	10.5	22.5

Source: GIFAP, IHTM-ITR, Belgrade.

In the area of treating soil and the environment with fungicides, orthopreparations have reached their peak and their further development cannot be counted upon. Benzanalides and dicarboximides are being development, as well as substances which should replace organic compounds in protecting seeds.

The economic potential of Serbian factories to produce these chemicals does not enable developmental research due to the prices, which are exceedingly high, but there is space for research based on their application, and the results of this research should then be processed in order for them to be accessible to both experts and others.

Also, our research shows that the development of syntheses of basic materials for producing chemicals for agriculture should go the following ways:

- Expanding the production of zinc-phosphates, which as a cheap rodenticide can be exported to developing countries;
- Appropriate research based on triazines and cyanuric chlorides, as the basic raw materials, either domestic or imported from Russia;
- The use of propazine which would be upgraded and transferred, as it is a favorite herbicide;
- Developing the production of aluminum phosphates or magnesium phosphates;
- The use of insecticides which serves to suppress "warehouse pests";
- Development the production of colloidal sulfur in the form of fluid paste which can be combined with other organic fungicides;

- Developing the production of Cu-8 hydroxyquinoline (seed protection, fungicide);
- Extending the range of dithiocarbamates;
- Developing the production of zinc salts for the needs of pesticide synthesis based on extending the capacities of zinc-sulphide production;
- Developing some compounds from the wide range of phosphorus esters (on the basis of phosphorus sulfides and dithiophosphates); developing the production of mercaptobenzothiazoles for fungicides; developing the production of fillers, solvents and emulgators which are sued in forming products for plant production.

We consider that eventually, the building of capacities for pesticide production should be located in those systems which deal with this or similar production, and the base materials which use the foundation of copper or phosphorus salts are to be found in those factories which have a high production of copper or phosphorous components (RTB Bor, now in the new manufacturing by IHP Prahovo, Zorka Šabac, et al.).

Regarding the application of herbicides, fungicides and insecticides, it is necessary to make them to be suitable and useful, depending on their purpose. This will be achieved if their use is directed and dosed responsibly and appropriately. Namely, Serbian factories which deal with manufacturing these preparations make it a practice to explain their use in various prospectuses, as well as their method and time of use, but on smaller packaging there are no instructions for proper dosing.

Trading with pesticides is regulated by law, but it is considered that factories should commit themselves to also render products in smaller packages measuring instruments (beakers and similar), in order to give potential consumers the possibility of an easier and more proper application. This can simply be done with liter or half-liter packaging by making a stopper so that it can be useful in a security as well as functional point of view.

Also, the containers can have an engraving which will indicate a certain volume indicator and the pesticide dosage used in the process of plant protection can be determined optically.

Pesticides are highly concentrated poisons (1-1.5 l/ha), so that an inappropriate application can significantly imperil the environment. The suggested method of controlling the application can significantly remove those dangers.

THE ECOLOGICAL ASPECT OF USING MINERAL FERTILIZERS

There were various problems in the prior application of fertilizers. It is considered that an uncontrolled use of pesticides, fertilizers and other substances can contribute to a significant extent to soil pollution, only for it to be absorbed by the human organism later on. The danger of this is corroborated by the stands which define the principles still valid in farming which were established at the Congress of Ecologists in the former Yugoslavia, and are still valid in Serbia. They are the following:

1. In using agro-ecosystems, a full ecologizing of the farming production should be carried out, in the sense of finding an optimal ecological-economic calculation.

2. In that sense, a system of controlling soil fertility and use is a scientific basis for a rational use of fertilizer (and other products) as well as for controlling ecological factors in plant production.

Both of these stands back up the necessity of using science and professionalism as a basis and a means of controlling the appropriate application of fertilizers and other chemical substances.

An uncontrolled usage and high dosage can lead to negative consequences. Prof. S. Manojlović and other experts who have dealt with this issue stress that, for example, an excessive dosage of nitrogen (both in the ammoniac and nitrate forms) leads to an accumulation of nitrates in the soil, which is reflected in an excessive intake of nitrogen on the part of grown corps, as well as accumulation in the tissues, which decreases the quality, as well as admixtures, and along with the appearing of dangerous nitrogen, there are problems in the technology of processing sugarcane, such as for example, the decreasing of the quality of the final product, a rapid decay of fruit, the impossibility of refrigerating, and similar.

There should, above all, be a strict control of nitrate contents in olericulture, primarily in glasshouses, as this is where the vegetables are exposed to so-called stress due to an insufficient control of applying products for plant protection, as well as their nutrition. One thing is for sure – an uncontrolled use of nitrogen, along with all its advantages, leads to the pollution of the oil and water, and via grown plants, it also has an impact on the health of people and animals from which meat and other products are obtained (proteins).

Similarly, when the use of nitrogen is in question, note should be taken of the effort which is made by science in the aim of replacing nitrogen with the so-called "biological" nitrogen. The point is in the fact that nitrogen is released from an open environment into the natural world via plants which have the ability, along with a symbiosis with microorganisms, to link and release into the biological cycle of plants the usually inaccessible molecular nitrogen. Then, with the help of genetic engineering, the appropriate genes are released into plants, but considering that that kind of research is just starting, practically speaking, the problems of deficit are not being resolved. Basically, leguminous plants take up small areas, and in the perspective in crop rotation, they cannot take up so much space in order for this to solve the problem of nitrogen in plant production.

The ecological aspect of environmental protection from an excessive amount of **phosphorus** is not as rigorous as it is with nitrogen, but it can be stressed that this can be the cause of a lowered dissolubility and accessibility of microelements, which leads to a disruption in adopting the nutritious contents and other substances. The same is valid for other macro-elements (potassium) in fertilizer and, generally speaking, its components.

Here we also wish to stress the conclusions of expert teams (Prof. I. Bikita and Prof. S.Manojlović) who carried out research of a long-term use of complex NPK fertilizers which contain phosphorus and also the exploring to what extent oil is polluted by elements from uranium series and cadmium. Their conclusion is the following: It can be noted that the statistically significant differences have not been determined in the concentration of activities of radio-nuclides of uranium series between the samples of soil of non-fertilized phosphorus (nor in other elements within a longer time period) and the soil samples which were fertilized by increasing doses of phosphorus. According to their assessment, these differences could not be assessed, as the radioactive activities introduced by fertilizers during a longer time period were relatively small, according to a natural radioactive soil in which all the trials with fertilizer were founded. Thus radioactivity, which is taken in by annual fertilization, according to orientation assessments, amounted to only one thousandth of the soil's natural radioactivity.

From the scientific and research point of view, it is very significant to establish the distribution course of cadmium (Cd) from phosphates originating from different bearings, which are chemically processed due to obtaining phosphorus compounds, that is, phosphorus fertilizers.

On other hand, the claim of Prof. Jordan Milivojević from the School of Agriculture in Belgrade has been given a lot of attention, in regarding the soil on which the domestic strategic fruit is grown – the **raspberry.** Namely, he says the following: 'The raspberry is a forest plant which man has cultivated and today it is grown on plantations. As such, in the purpose of achieving high yields, it demands fertile, aerated, permeable soil with pH value 6-7. Furthermore, a pH value of soil has the same significance as body temperature in humans. Namely, if the temperature is 36 degrees, and the pH value amounts to around 7, this means that a person is healthy, and that the soil is nourishing. Soil acidity under 3 pH is the borderline at which life and an increase of cultured plants. Where raspberries are concerned, this plant is fighting for its survival in that acidity, which is corroborated by the fact that a raspberry in optimal conditions would weight over 20 t per hectare, and in these conditions it has merely 2 tons."

Within the framework of the mentioned, it can be claimed that the essence of the problems in the entire process on knowing pedology and production possibility, is the proper application of fertilizer. For, the mentioned problem of "acidizing" the soil does not happen overnight. This is a longer time period of using mineral fertilizer which is not appropriate for the soil in which raspberries are grown. How this came about can be explained by the following: If raspberries do not bear fruit, the owner of the land, at the same time also the producer, can conclude that there is a lack of fertilizer. Then he increases the dose of fertilizer with the traditional combination of three fifteenth (NPK fertilizers). Thus, this is wrong and then the next year there is even less yield. When he turns to experts, it is too late, as a longer period is needed for the acidity to diminish (via the calcilization of the soil) and lead to the tolerance level or pH value which suits the demands of raspberries. It is an excessive dose of use of inappropriate fertilizer and in application standards which are far greater than what the soil demands, and thereby there is a demand for potassium which enables the plant to satisfy its needs with its root. Calcium is that factor which regulates the feeding of raspberries, activates life and work of the soil microflora, amending the soil structure and its aeration. In such negatively established relations between the micro and macro elements, molybdenum, sulfur and magnesium become even more inaccessible for the raspberry, and yet they have such an important role in developing and forming the raspberry yield, its resistance to drought and frost. Not to even mention, let us say, the possible use of pesticides or herbicides for destroying weeds and similar. All these are basic elements of knowing science and its participation in the processes of creating new products, or maintaining the existing ones, but on a completely different foundation. The demands of foreign buyers are rigorous when these elements are concerned, so what is recommended is the permanent training of those who are involved with the production of strategically ecological products.

Research, however, shows that long-term application of moderate doses of complex fertilizers does not increase significantly the contents of such accessible cadmium in the soil. During a long-term application of high doses of complex fertilizers, what is evident is the tendency of a slight increase of easily accessible cadmium in the soil, and thus there is the need of a permanent controlling of fertility and thus, fertilizer use imposes itself. Thereby, it is necessary to institutionalize the appropriate rules of behavior in the application of chemicals which enter into production, in order to create the possibilities for producing 'healthy food'. Moreover, it is also necessary to introduce a mandatory control system of soil fertility and the use of mineral fertilizers, pesticides and other matters (especially those which contain increased amounts of heavy metals) in organized production until it is privatized, as well as in the already existing individual production sector.

CHEMICAL ENGINEERING AND ECOLOGY

The basic task of economical engineering in the protection of the environment is to take out the substances from polluted sources which pollute and furthermore, to eliminate their damaging effects to the extent that cleansed materials can be released into the environment.

The condition of the environment in Serbia is problematic. Pollution is unevenly distributed and is clearly differentiated by regions. It is characteristic that the degree of peril grows exponentially and depends on the industrial development of the area. Connected with this, one of the parameters is the increase of the life standard and population. It should be also said that contemporary productive processes are getting older more and more quickly (physically, economically or technologically). Energy plants, metallurgy, basic chemistry and some branches of machine construction have the longest lifetime, and the pharmaceutical industry, manufacturing chemistry, computers and similar have the shortest (up to five years). The food industry, paper, wood and textile industries and similar, have a lifetime of some 10 years. Taking all this into consideration, in perhaps the year 2010, if we accept the strategy of eco-marketing, the entire industry should be restored, replaced or destroyed. This is an overly optimistic forecast, but if this is not done, then we can only confirm the fact that Serbia is, technologically speaking, lagging behind other European countries. Nevertheless, if the revitalization project is carried out with a smaller success rate but a certain predisposition for a final processing of basic products is created, the demands in regards to the protection of the environment (eco-marketing) can be met in almost all the elements. Connected with this, it must also be taken into consideration that without a basic production there is no superstructure, so that all the demands which come from the movement and the "marketing opposition" must face this kind of production and its existence. Thereby, the degree of the protection of the environment must be constantly improved and updated by the latest technical achievements. Having in mind this kind of set reconceptualized eco-marketing and its mix in regards to ecological demands, we can create the following framework of activities:

1. To produce such goods which with use will not pollute the environment; to stress the agro-economic features of the product; to extend the lifetime and use of products; to carry out the re-semantization of the product; to eliminate products which damage the environment; to use and process waste; to minimize energy use; to stimulate the use of alternative energy; to build ecological packaging; and to re-cultivate soil and deposits;
2. To form distributive centers in areas which do not damage the environment; to adapt distribution and manipulation to exogenic demands (maintain security measures in delaying and distributing the transporting of radionuclide waste).
3. To calculate in advance regarding price policy, in the sales price of products to neutralize the damaging effects on the environment during and after use; to determine the most optimal sales prices of those products which do not cause pollution; to stimulate by lower prices the purchase of the products caused by recycling; to stimulate with lower prices the purchasing of ecological equipment and products for ecological protections; to stimulate with taxes and other measures the use of alternative energy;
4. With the help of promoting awareness, direct, stimulate and train consumers not to use products which are harmful for the environment and, what is most important, educate all the consumer segments in developing awareness on the needs of protection and promotion of the environment.

In effect, the intensifying of the process of development and application of new technologies can be carried out by taking up different measures and activities on the level of the economy and the level of companies.

The most important directions of activities can be carried out along with the following actions: by increasing the participation of the state in the financing of scientific research with the task to produce two basic results – a higher level of theoretical knowledge and new technologies (in the industrially developed countries of the 80ties of the last century, the relative participation of the state in financing scientific research increased from 30 to 40 percent, while the participation of the industry decreased from 60 to 50 percent from the total profit, that is, from the increase of the government in the participation for financing research from budgetary means; by increasing the total investment in scientific research (today, developed countries invest into scientific research two to three percent of the BDP, while it was 0.91 percent in the SCG, in order for that percentage to increase to a sufficient 2-3 percent of the BDP in the most recent measures of the government of the Republic of Serbia; by a more efficient selection of future directions and priority development programs (an economic system, as a rule, cannot successfully develop and conquer new technologies in all domains); by determining a more efficient plan for conquering new technologies (in a given moment, not all technologies are equally ready for a successful conquering and application); by directing the development of small and medium-sized companies in priority directions of development, not only on the part of the state but also on the part of key companies which have the role of leaders in developing new technologies, by organizing a successful application of results of that research and in the application of modern methods and techniques of strategic planning, engineering, marketing and managing development as a whole; by a spilling over of the free part of capital from old and used technologies to new ones.

Practically speaking, the accepting of this initiative in the sense of re-conceptualizing marketing as a social process and setting certain ecological demands as well as a subsystem of eco-marketing will enable the meeting of basic criteria of environmental protection, under the condition that the normative (legal) acts are carried out. The earlier conclusion that Serbia does not have a strategy of environmental protection or is just starting to set one up is assures us that this endeavor should be started and realized as soon as possible.

OTHER PREPARATIONS ARE NECESSARY FOR THE PRODUCTION OF ORGANIC FOOD

The allowed means in the aim of protecting plants, suppressing diseases, pests and weeds in organic production are the following:

- Botanical pesticides;
- Soaps;
- Oils;
- Propolis;

There are also other methods used - pheromones, bacterial and viral preparations, mechanical methods, powdered clay, water in which insects were soaked, tree bark preparations.

Propolis **–** It has an antibacterial and antifungicide effect and it is used as an insecticide (many Italian and German eco-fruit growers and winegrowers use it).

Table 4. The effect of propolis against diseases and parasites in fruit growing.

Table 4. The effect of propolis against diseases and parasites in fruit

Fruit	**Diseases or parasites**	**Usage**
Citrus	Mold fruits	Before or immediately after harvest
	Scale hosts	Coat attacked branches
Olive	The olive fruit fly	Destruction of fly's eggs
	Scale hosts	Coat branches with propolis oil
Peach	Leaf curl pathogen	The appearance of symptoms
Vine	Grey mold	The appearance of symptoms

- Mineral basis; Water solutions
- Alcoholic solutions
- Hydro-alcoholic solutions
- Water-alcoholic solution mixed with colloidal sulfur
- Propolis oil

Mostly used for protecting the majority of cultures is a mixture of water and alcoholic solution with added egg white and soy lecithin 0.125-0.2% with colloidal sulfur 0.25-0.3%. The treatment is carried out every 10 days at sunset, as a fungicide and insecticide.

Various – The ashes of insects and other animals – prior to application, it is recommended to use a mixture of a water-alcoholic solution with added egg white and soy lecithin 0.125-0.2% with colloidal sulfur 0.25-0.3%. The treatment is carried out every 10 days at sunset, as a fungicide and insecticide.

Various – The ashes of insects and other animals – prior to application, the recommendation is to mix the ashes with sand. There is a greater effect in preventing the appearing of weeds or parasites. Also, water in which insects were soaked, water in which the bark of some trees (oak, walnut, apple, and others) was soaked is also used. Here it is most important to take bark with various lichens and such, as it concerns an antagonism with disease instigators. The bacterial and viral preparations in the fight against insects are based on the sensitivity of insects regarding metabolic products such as for example mz. Bacillus thuringiensis, Helicoverpa armigera Hb, Hyponomeuta malinellus, Plutella xylostella, etc. Application: treating plants with spores, and crystals at the time of larvae appearing.

After entering the digestive tract, they cause larvae paralysis which prevents further nutrition, resulting in death. There are divided opinions about applying the preparations on the basis of viruses.

In organic production, in the fight against weeds, there are three main factors at play:

1. Prevention (a decreasing of the amount of weeds by applying numerous prevention measures);
2. Direct measures;
3. The time of making a decision about the application of measures by introducing information technologies in the battle against weeds.

1. Prevention - Preventative measures are an important factor in an efficient fight against weeds observed during a long time period. In the aim of integrating various measures and procedures of suppressing weeds, it is necessary to pay adequate attention to preventive procedures. They must disable the restoring of seeds reserved and other reproductive organs of weeds and their spreading in farming. Thus, all the measures which help to prevent weeds in the fields are used.

2. Direct measures – these measures are the following:

- Mechanical;
- Chemical;
- Physical;
- Biological.

Table 5. Basic characteristics of organic food production treatment (Personal research (doc.dr Zorka Jugović; prof.dr Božidar Mihajlović and team).

Material	Basic use	When they are applied	How they are applied
Compost	Fertilizes the soil, increases fertility, suppresses weed, heats soil	During planting and year round	Cover the plant once or twice.
Mown grass	Fertilizes the soil with nitrogen and organic matters	During planting and year round	Some 1-4 cm around the plant.
Litter	Fertilizes the soil, suppresses weed, regulates soil temperature	During planting and as a winter cover	In a 3 cm layer.
Newspapers	Suppresses weeds, retains humidity	During planting	Fasten with soil or organic mulch.
Pine tree needles	Suppresses weeds, is effective against fungal diseases	During planting and as a winter cover	In a 2-4 cm layer, is not used for plants which do not like acidic soil.
Straw	Fertilizes the soil, suppresses weeds, cools down the soil	During planting and as a summer cover	In an 8 cm layer around the plant, but not touching it. The best is oats straw.
Scrapings, wood chips and chopped bark	Suppresses weeds, cools down the soil and retains water	During planting and year round	It is best to compost it prior to use, and it is used in 1-2 cm layers.

CONCLUSION

This sort of re-conceptualized eco-marketing mix, in regards to ecological demands, can be put into the following framework of activities:

1. To produce the kind of goods which will not after use pollute the environment; to stress the agro-economic features of products; to the extend the lifetime and use of product; to carry out the re-semantization of the products; to eliminate the products which damage the environment; to use and process waste; to minimize the use of energy; to stimulate the use of alternative energy; to create ecological packaging; and to re-cultivate the soil and deposits;
2. To form distributive centers in areas which do not disrupt the natural habitat; to adapt the distribution and manipulation to ecological and exogenic demands (establish security measures for delaying and distribution of transporting radionuclide waste).
3. In price policy, to calculate in advance, to use the products which neutralize the damaging effects for the environment after use; to establish the sales prices of those products which do not pollute the environment; to stimulate the purchasing of products which are a result of recycling by setting lower prices; to stimulate the purchasing of ecological equipment and means of ecological

protection by setting lower prices; with tax relief measures, to stimulate the use of alternative energy;

4. By using promotions, to inform, direct, stimulate and educate consumers not to use products which are damaging for the environment and, what is the most important, to educate all consumer segments in developing awareness regarding the need for the protection and promotion of the environment.
5. To calculate the economic viability of building the Factory for producing the 'bluestone' in Bor. This would be an important ecological-economic endeavor, as the bluestone is used in winegrowing, fruit growing and similar cultures, for the production of ecological wine and other ecological products which make up the protection of both plants and man's habitat.

Concurrent with this, the intensifying of the process of development and application of new technology can be carried out by taking up different measures and activities on the level of the economy and companies.

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INTERACTION OF HYDRAULIC STRUCTURES AND LARGE WESTERN LANDFILL OF OPEN MINE "BOGUTOVO SELO" IN UGLJEVIK

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ABSTRACT

Opening of open mines, exploitation of the ore and tailings management are often followed by complex water management and hydro technical problems. Protection of open mines and tailing ponds from surface and ground water is very complex and significantly contribute to forming of price of a final product - ore. Therefore, this work studied condition of existing hydro-technical objects and their operational safety, impacts analysis or interaction of built and planned hydro-technical objects and objects of mine and power plant Ugljevik, including the possibility of construction of planned hydro-technical objects in new exploitation conditions.

Key words: open mine, tailing pond, hydro-technical objects, protection from water, dam, closing-drainage tunnel.

INTRODUCTION

Hydro-technical object often need to be realized prior to the removal and storage of tailings, at the same time when the ore exploitation conducts and finally, after the ore exploitation and storage of tailings. In other words, open mines and landfills need to be protected from great water in every moment. This is the case for the open mine (OM) Ugljevik. At its beginning, on the east side of the mine, the riverbed of Ugljevik river and Mićić stream are moved and regulated in order to protect mine from flooding. On the west side of the open mine, in valley of the river Mezgrajica, the storage of tailings was planned. In order to achieve this during the preparation phase, there was an attempt to move and lift up the riverbed of the river Mezgraja on the right side of the valley. It was planned to make the space for storage of tailings on this place. However, due to landslides on the site Crveni potok, this option was delayed. Therefore, the Large western open mine (LWO) of Bogutovo village mine was formed in the valley of Mezgraja river, upstream of power plant Ugljevik with previous construction of dam at the upstream side of tailing pond and tunnel below the pond.
Following hydro-technical objects were constructed before the storage of tailings:

- Earth dam Ugljevik,
- Closing chamber and sliding shutters,
- Drainage tunnel beneath the dam and landfill with length of 4,4 km.

Objects which are not constructed to date:

- Channel on the collection point for drainage of high water which may overflow the dam,
- Quickflow at the downstream end of the landfill,
- Regulations of the Mezgrajica river downstream of the quickflow.

Observations (auscultations) of drain tunnels were made with some interruptions, while auscultations of the dam were not made at all. Built objects are exploited during last 26 years, so certain visible damages occurred.
The work was made according to study results [1].

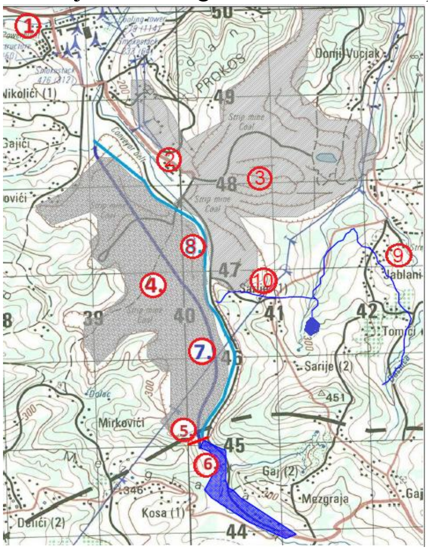
AVAILABLE SURFACES

Available geodesic, hydrological, geo-mechanical, geological, mining and other media, as well as existing studies and project documents were used for purpose of this work [2,4]. These documents are related to the open mine Ugljevik and Large western landfill. Also, these documents are in possession of Mine.

CONSTRUCTED HYDRO-TECHNICAL OBJECTS IN LARGE WESTERN LANDFILL

The Mezgraja dam

Dispositional position of the Mezgraja dam and other earlier constructed hydro-technical objects in Large western landfill is presented in the Figure 1.



LEGEND:
1. POWER PLANT
2. UGLJEVIK MINE
3. OPEN MINE
4. LARGE WESTERN OPEN MINE
5. MEZGRAJA DAM
6. MEZGRAJA RESERVOIR
7. TUNNEL BENEATH THE OPEN MINE
8. CHANNEL ON THE OPEN MINE (SUGGESTED ROUTE
9. PROPOSAL FOR REGULATION OF UGLJEVIČKA RIVER
10. MOVING OF WATER FROM MIĆIĆA STREAM INTO CHANNEL ON THE OPEN MINE

Figure 1. Overview position of LWO „Bogutovo selo"

The Mezgraja dam is located in the canyon section of the Mezgraja river which is 6 km away from the confluence of the river Janja, or from the power plant Ugljevik. The river valley is widened downstream of the dam, which provides the storage of large amount of tailings(Figure 2).

Considering that the dam height is larger than 10 m, this dam belongs to the group of high dams, according to existing regulations. These dams need regular auscultations according to the auscultations project.

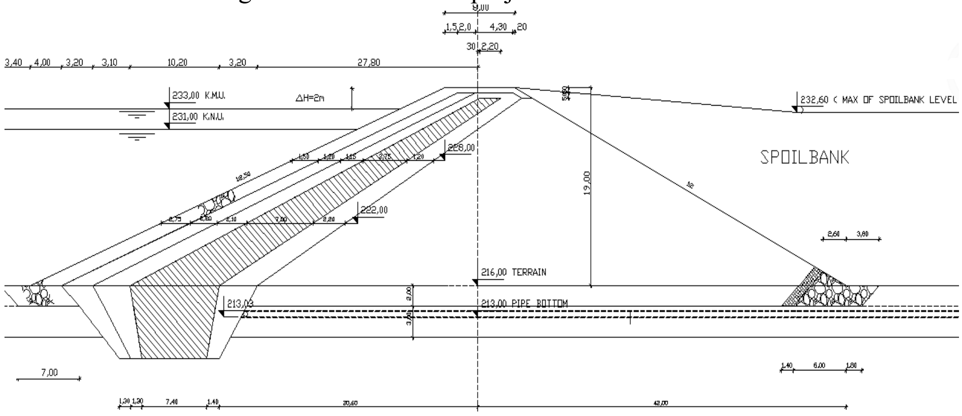


Figure 2. Normal profile of the dam

Selected ground materials from the open mine Ugljevik were used for the construction of the dam. According to the kind of building material, this dam belongs to the group of earth dams.

There is a drainage system beneath the dam and reverse wells are placed downstream of the dam.

Using field survey in the vicinity of the dam and reservoir, and visual inspection of the accessible surface of the dam, it was found that there are no visible landslides, damage, displacement and deformations of the dam.

The valley profile of the Mezgraja, where the dam is built, provides the elevation of the dam in morphological and geological sense. This can be done in order to achieve the largest volume of the landfill downstream of the dam. However, the elevation of the dam would increase the height of the maximum gradient in the reservoir and the length of the reservoir. This would sink the network on the end of current accumulation and open mine which is placed south of the reservoir. Therefore, it is not rational to consider the elevation of the dam while additional landfills should be provided on other and safer locations.

The dam overflow

There is frontal gradient with trapezoidal cross-section at the dam crest. For earth dams, the overflow over the downstream side of the dam is not allowed because of possible erosion of the downstream slope and dam stability. Lateral gradients are made in practice. In this case, the water flows in collection concrete channel and quickflow which are made in indigenous soil at the one side of the river valley. However, this option is excluded for the case of the Mezgrajica dam for two reasons. First, the construction of the lateral gradient would significantly decrease the volume of the landfill and second, the storage of tailings should be made on the right side of the valley, in order to provide conditions for landfill channel forming. This channel should be used for the evacuation of large water which overflows the dam.

Overflow construction on the dam and the connection with the channel are not completed. The crest of the dam includes tubular part with circular cross-section, diameter of 1000 mm, which is not enough. In the area of water entrance into the tubular part, some minor damages are visible at the upstream side of the dam, which is the result of turbulent flow when water enters the tube during the overflow.

According to this, the gradient for the flow is not completed and it needs an urgent construction.

Bottom outlet (drainage tunnel beneath the landfill)

Prior the construction of the dam, the reinforced concrete bottom outlet is built. This outlet is continued with drainage tunnel beneath the landfill (Figure 3). During the dam construction, the bottom outlet was used for the water evacuation during the construction. After the dam is built, this outlet is extended along the Mezgraja river valley to the end of the landfill on the downstream side. Total length of the drainage tunnel beneath the landfill is approximately 4, 4 km.

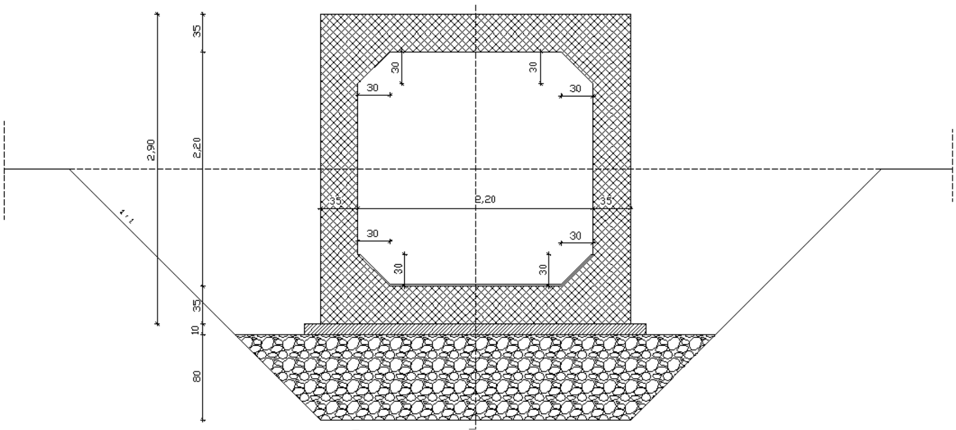


Figure 3. Drainage tunnel

The tunnel is built during the period 1984– 1986. At the same time, the building of the dam started, including the storage of the tailings on the LWO.

Zero tunnel vision was made in May 1985 using the special program for auscultation. Observations were made with certain delays, while the last observation was conducted in October 2011. Several last auscultations indicated on visible damages on concrete and reinforcement on the entire length (subsidence of 1066 mm at the section with maximum height of the landfill).

Beside the large load, great subsidence and tunnel damaging can be result of the soil composition on the position where the tunnel is founded, including the permanent presence of water. Water causes corrosion of concrete and reinforcement.

Closing chamber

Closing chamber is reinforced concrete construction with slide shutters which are used for regulation of flow from the reservoir. According to main project, the closing chamber is divided into three equal parts (shafts). Two upstream chambers include two slide shutters while the third chamber has downstream stairs with back protection.

All steel elements are corroded and their capacity is questionable. Axes and shutter spindles are deformed. Concrete notches for shutters are also damaged. Therefore, the function of shutters is unsecure and even impossible. During the visual observation, both shutters were rolled down but because of the bad sealing, the water excelled beneath them (Figures 4 and 5).

Figure 4. Corrosion of slide shutter

Figure 5. Excelling beneath the slide shutter

PLANNED HYDRO-TECHNICAL OBJECTS IN LARGE WESTERN LANDFILL

Projected channel in landfill, quickflow and regulation of Mezgrajica river bed

Projected channel in landfill is open and in shape of double trapezoid (Figure 6). Clear view of normal profile provides the transportation of ten-thousand-years large water ($Q_{1/10\ 000}$ = 210 m^3/s). Also, this is the flow for which the gradient over dam is dimensioned so in case of eventual collapse of draining tunnel beneath the landfill the evacuation of catastrophic large water over the dam gradient and channel in landfill is provided.

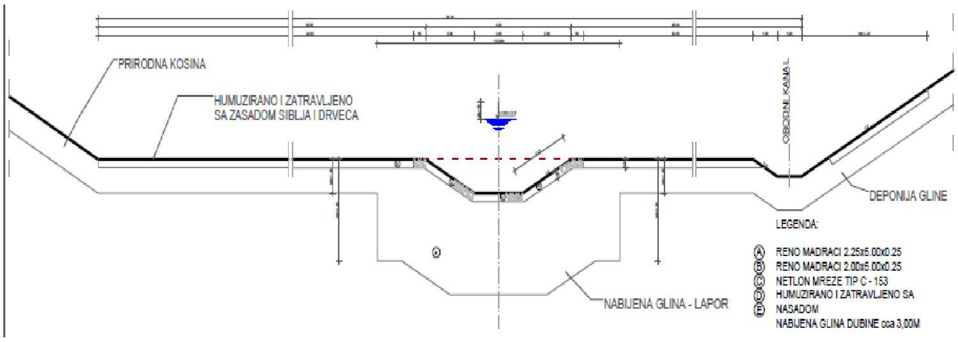


Figure 6. Normal profile of the channel in the landfill

In meanwhile, the landfill was filled with uncoated gully with irregular geometric elements and insufficient throughput which is not maintained – the riverbed is not cleared, trees and other plants are not cut down, which also decreases the throughput of the riverbed. Bottleneck includes two tubular outputs on sections for trailing transportation. Elevations of bottom tubes on outputs are much higher than the channel bottom so large water upstream of these outputs causes back pressure and certain water accumulation, which can create the saturation of the landfill and its instability.

Due to a need for larger landfill, it is needed to analyze the possibility of construction of closed channel in the landfill in the area of Crveni potok, or from the cross-section of the channel with path LWO – Land mine, to the dam gradient. Building of closed reinforced concrete rectangle channel in the landfill could provide additional volume of landfill for 17.000.000 m^3 of solid mass.

The analysis (according to [3]) of hydraulically morphological characteristics for two rectangular normal profiles and one circle profile was conducted. In static aspect, the most inappropriate is rectangular cross-section which has largest lengths while the circle profile is considered as the best. The basic issue is that the closed collector would be founded on unconsolidated landfill with lower physically – mechanical characteristics in comparison with indigenous soil. Furthermore, in these conditions, it is needed to analyze forming of relieving layer according to Protođakonov, which can be used for decreasing of pressure on closed and covered collector and dimensions of concrete basis. After analysis, the construction of a circular reinforced concrete profile that has significant advantages over static rectangular and semi-circular profile is proposed.

River Ugljevik and Mićića stream

Considering their dispositional position, this water streams were not always directly connected with Large western landfill, so their first regulation was conducted according to natural riverbed. After the widening of the mine, these streams were moved. Because of irregular maintaining of natural and regulated riverbed, larger amounts of water infiltrated or overflowed into open mine. This water was returned by pumping (discharge pipe) into river Ugljevik which increased the use of power and production of coal. Additional problems in maintaining occurred due to landslides in this area.

CONCLUSION

During reconnaissance of terrain nearby dam and reservoir and visual observation of available dam surfaces, it is concluded that there are no visible landslides, damages, movements or deformations on the dam and in the area of reservoir.

No auscultations of the dam according to the existing auscultations project have been conducted yet although it was an obligation regarding legal regulations for high dams. Dam auscultations need to be conducted as soon as possible at least twice a year during the next period in order to define the object behaviour and deviations from project dimensions.

The radical reconstruction of closing chamber, slide shutters and their operation is needed in order to achieve maximum safety during operation and accumulation. All this is needed to obtain optimal use of water from the reservoir in order to fulfil needs of Mine/Rudnik. Also, in order to provide reconstruction work at the drainage tunnel, reconstruction works for closing chamber and slide shutters are prior needed.

The construction of circle reinforced concrete profile is suggested. This profile has significant static benefits over rectangular and semicircular profiles. Since the disposed tailings is consolidated in channel area, dimensioning of closed circle reinforced concrete profile for one-hundred large water is suggested in order to obtain significant savings. The construction of such profile would provide additional volume of the mine which could be approximately 17.000.000 m^3 of solid mass.

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PREPARATION AND THERMAL CHARACTERIZATION OF CHITOSAN/BENTONITE COMPOSITES FOR WASTEWATER TREATMENT

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ABSTRACT

Chitosan composites were prepared by bentonite particles addition using solution technique. The morphology of obtained beads was studied by scanning electron microscopy (SEM). The glass transition temperature (*T*g) was determined using differential scanning calorimetry (DSC). Thermal stability and decomposition of composites was investigated by thermogravimetry coupled with DSC (TG-DSC). It was found that clay particles improve the adsorption properties of deflocculated chitosan. It was estimated that the four stages mechanism of chitosan/bentonite thermal degradation are influenced by clay content and the molarity of used base for beads precipitation.

Key words: chitosan/bentonite composites, hybrid material, adsorption, thermal decomposition.

INTRODUCTION

As a result of human activities from households, industry and agriculture water is being polluted. Substances that pollute water beside petroleum, minerals, sewage treatment sludge or persistent organic pollutants produced by the incineration of waste, are synthetic substances produced by chemistry (heavy metals, dyes, fertilizers, pesticides, etc.) [1]. There are defined regulations that determine limits of the pollutant content. It is necessary to treat water or wastewater by decontamination processes in order to reach those limits. In the praxis exist variety of such processes: coagulation, precipitation, extraction, evaporation, adsorption on activated carbon, ion-exchange, oxidation and advanced oxidation, incineration, electroflotation, electrochemical treatment, biodegradation and membrane filtration [2–7]. For technological and particularly financial reasons, most of those processes cannot be used in industry. Process line for treatment of industrial wastewater has to be designed according to the quality aspects that have to be achieved [8–10]. Natural adsorbents like peat, banana pith, rice hull and chitosan proved to be cost effective and efficient for removal of multitude of impurities. Chitosan is a polycationic, biodegradable, non-toxic and high molecular weight linear copolymer of N-acetyl glucosamine and glucosamine. In acidic conditions, it is soluble and positively charged. Therefore, it can be used for eco-friendly coagulation and flocculation [11]. Chitosan is obtained by the deacetylation of chitin which is the second abundant natural polymer, after cellulose. It is found in the shells of shellfish, e.g. crabs and shrimps. Therefore, it can be collected as a waste product of the crab industry. It is already used as an efficient coagulant or flocculent for a multitude of suspended solids in different food and fish processing industries [12-15], and for water suspensions that contain mineral colloids . Because of its very good adsorption capacity for dyes and metal ions, its use in environmental biotechnology is growing [16–18]. Protonation of the amine group of chitosan, high content of –OH groups and high molecular weight of chitosan cause variety of mechanisms such as electrostatic attraction, sorption, chelating capacity and bridging that are responsible for coagulation and flocculation properties of chitosan. The influence of each mechanism depends on the pH of the suspension. In this applicative research the chitosan/bentonite hybrid materials for the adsorption of color dyes and heavy metals from polluted water were prepared. It was assesse how the preparation process influences the obtained composite beads morphology, as well as the thermal properties

MATERIALS AND SAMPLE PREPARATION

Before use, the bentonite clay (obtained from MTA, Ankara, Turkey) was treated in a following way: first it was dried at 110 °C for 2 h and modified after sieved through 200 μm sieve. Then, 1g of bentonite distilled in 100 ml water was suspended at room temperature. In order to enhance clay adsorption properties, the surfactant, cetyltrimethyl ammonium bromide (CTAB) was used to form the network together with chitosan. Solution of CTBA (1 wt. %) was prepared in hot water and it was added dropwise into bentonite suspension. Obtained mixture was stirred for 24 h at 25 °C. After filtration, bentonite was washed three times before it was dried in vacuum and crushed into fine powder. Chitosan was suspended in water at 121 °C for 25 minutes, and homogeneous solution was prepared by addition of acetic acid and stirring for 48 h. Different types of chitosan/bentonite nanobeads (Table 1) were prepared using the following procedure: 50 ml of distilled water was used for modified clay swelling, than the clay was added to 50 ml chitosan solution and, in the last step, stirred at 60 °C for 12 h. Droplets of chitosan formed beads which are left in the solution for another 12 h. After filtration, obtained beads were washed using deionized water and they were stored in distilled water. Diameter of obtained beads was around 2.5-3 mm.

METHODS

Scanning electron microscopy

The porous structure and morphology of chitosan/bentonite biocomposites were studied by scanning electron microscope JEOL JSM-6460 at magnifications from 10^3 to $2x10^6$ at 25 kV.

Thermogravimetry coupled with differential scanning calorimetry

The investigation of thermal decomposition of chitosan/bentonite beads was carried out by simultaneous TG/DSC experiments using TA Instruments SDT Q600. The measurements were performed employing open alumina crucible and a corresponding empty referent crucible. All experiments were done in the temperature range from ambient temperature to 390 ºC in flowing nitrogen atmosphere (100 cm^3/min) with a heating rate of 20 ºC/min. Sample masses was about 2.5 mg.

Differential scanning calorimetry

The investigation of thermal properties of chitosan/bentonite composites was performed by differential scanning calorimeter DSC Q20 TA Instruments. The instrument was calibrated using an indium standard. The samples mass was about 2.5 mg. All measurements were performed under the nitrogen atmosphere, at the purge gas flow rate of 50 cm^3/min. The experiments were done from 30 °C to 200 °C, with a heating rate of 10 °C/min.

RESULTS AND DISCUSSION

The beads structure with intercalated bentonite silicate layers is shown in Fig. 1. On the basis of SEM results, it can be concluded that the porous structure of prepared biopolymer hybrids depends on the preparation procedure (concentration of used NaOH solution, Table 1).

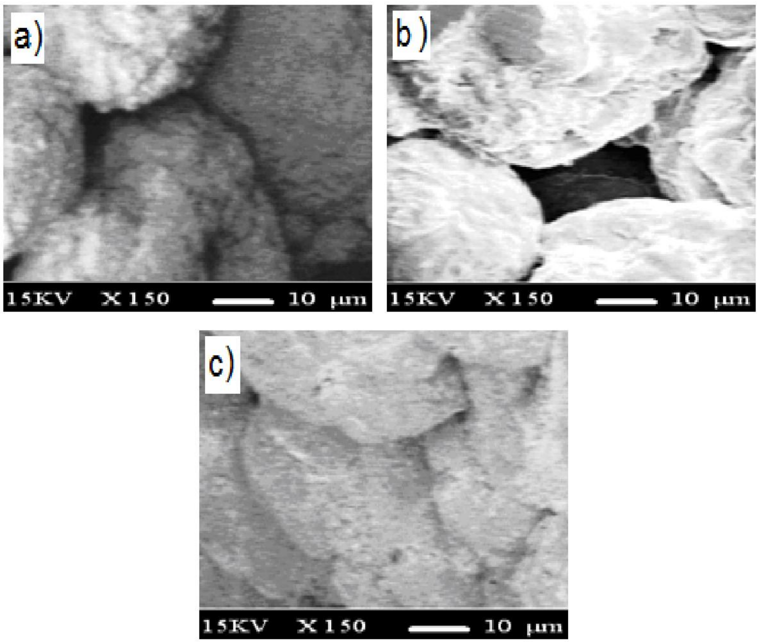

Figure 1. SEM micrographs of: a) sample A, b) sample B and c) sample C.

Table 1. The code and description of chitosan/bentonite beads (volume of chitosan/bentonite solution, weight content of chitosan/bentonite powder, volume of NaOH solution and molarity of NaOH solution)

Sample code	Chitosan/clay solution, ml	Chitosan/clay powder, wt. %	NaOH, ml	NaOH, mol
Sample A	3	6	10	1
Sample B	5	4	10	1
Sample C	3	6	10	5
Sample D	2	5	10	5

TG and DTG thermograms of obtained chitosan/bentonite composites are displayed in Figs 2 and 3. On the basis of thermogravimetric results, it can be noticed that all samples are stable up to 70 °C. Up to 390 °C, registered weight loss for all samples was in the range from 30-40 %.

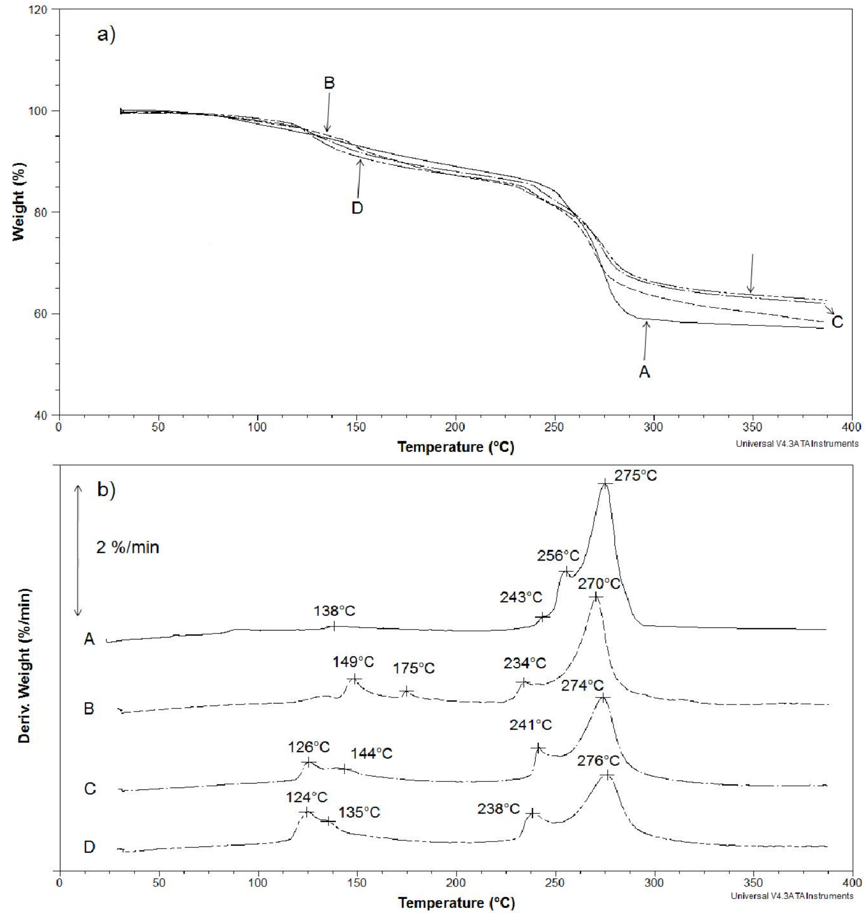

Figure 2. a) TG and b) DTG thermograms of obtained chitosan/bentonite beads.

According to TG results, it can be seen that degradation mechanism of chitosan/clay composites depends on the preparation procedure. In order to obtain detail information about degradation stages, as an example, simultaneously TG/DTG and DSC curves for sample A (prepared in low base concentration, 6 wt. % of chitosan/clay powder) are shown in Fig. 4.

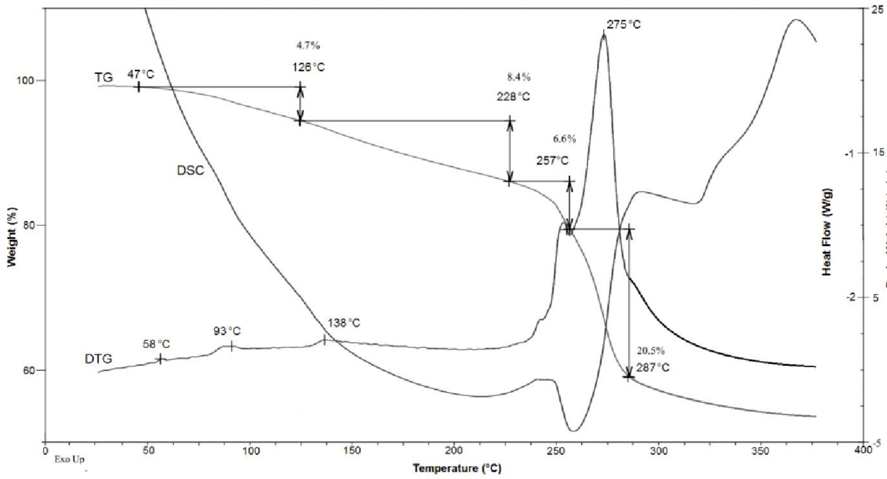

Figure 4. Simultaneously TG/DTG and DSC curves of chitosan/bentonite bead (sample A).

The decomposition of investigated samples is complex and consists of several (four) steps (see temperatures of each degradation maximum in fig. 3). Up to 126 °C, a small step (as shoulder) in TG can be seen, which may be assigned to water loss of about 4.7 %. The decomposition peaks positioned between 220 °C and 260 °C are attributed to the decomposition of pyranose ring structure. The last degradation stage peak, with the biggest weight loss of about 20 % (with DTG maximum above 270 °C) is the highest and could be connected with the decomposition of side chains. The influence of base concentration on decomposition can be determined by comparison of DTG curves of samples with the same chitosan/clay powder, but different NaOH content (samples A and C in fig. 3). The biggest influence of NaOH concentration is detected in the last decomposition stage, which peak area (as well as weight lost) was higher for the sample A (lower molarity of NaOH solution).

DSC curves of obtained chitosan/bentonite nanocomposites are shown in Fig. 5.

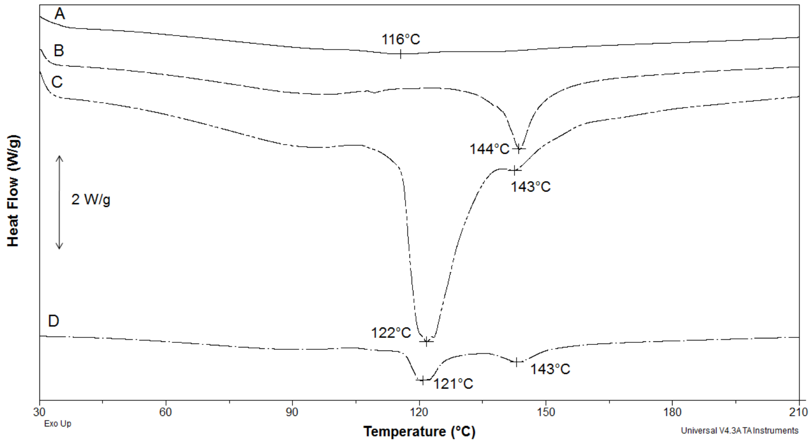

Figure 5. DSC curves of prepared chitosan/bentonite composites.

From fig. 5, it can be seen that the enthalpy of endothermic peak assigned to adsorbed water evaporation (detected above 100 °C) depends on the bentonite content and molarity of NaOH solution. The highest enthalpy value (75.2 J/g) was determined for the sample with highest chitosan/clay powder content and NaOH concentration, which might be explained by physical barrier of effect of bentonite silicate layers. On the other hand, DSC curves of the samples with low NaOH molarity (samples A and B) do not exhibit described endothermic change. The glass transition temperature was found to be independent on the preparation procedure, and for all chitosan/bentonite beads was registered at about 143 °C.

CONCLUSIONS

In this applicative research, with a proper preparation procedure of hybrids materials based on chitosan and bentonite were successfully obtained. The concentration of base used for composites precipitation was found to be significant for the final structure of beads. It was shown that the preparation procedure of beads affects their morphology and thermal behavior. The adsorbed water evaporation was influenced by bentonite addition, due to a physical barrier effect of the silicate layers. The clay presence improves adsorption properties of deflocculated chitosan, which is desired for the application of obtained biopolymers in heavy metals and colored wastewater treatment. Thermal stability and four step decomposition mechanism of chitosan/bentonite composites are influenced by clay content.

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FRESHWATER SNAILS IN THE BELGRADE REGION

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ABSTRACT

The aim of this paper is to present preliminary results of investigation of the Belgrade freshwater snails. The sampling was conducted at 31 sites, in the Summer of 2012. Snails were found at 18 localities. During the investigation relatively high diversity consisting of 13 gastropod taxa, belonging to 8 families, was found. The majority of them were adapted to moderate organic pollution and phytal and pelal microhabitats. The dominant species were eurivalent *Physella acuta* and *Valvata piscinalis*, both adapted to high organic load. Performed Correspondence analysis reveals five macrohabitat types. However, as limited set of data was used, further investigations are needed.

Key words: Freshwater gastropods,, fauna composition, macrohabitat types, Corespondence Analysis, Belgrade.

INTRODUCTION

The Belgrade region is the largest and the most populated urban area in Serbia, and one of the biggest in Southeastern Europe. About 1.7 million residents [1] live on 3223 km² of metropolitan area (ca 530 inhabitants per km²). In other words on 3.6% of Serbia's territory is accommodated about 25% of the country's population.

The city is located at the confluence of two large European rivers, the Danube and the Sava. Many smaller streams, the left and the right tributaries of the Sava and the Danube make the very unevenly developed hydrographic network. The terrain south of the large rivers is hilly, while north of them stretches the flat Pannonian Plain.

Densely populated area features a wide range of anthropogenic impacts. The most important are hydromorphological pressures (regulation and chanellization, bank reinforcement and embankments, sediment/sand extraction), organic and nutrient pollution (communal and urban wastewaters, agricultural drainages) and industrial and toxic pollution (industrial wastewaters, medical waste). All waterflows are under intensive hydromorphological pressures, besides channels on the north are under heavy organic\nutrients pollution (agricultural land drainage), while the south Belgrade flows are under intensive communal, industrial and toxic pollution. Finally, the Sava and the Danube are the main overall colectors.

In addition to running waters, artificially created lakes are present. Among them the famous Ada Ciganlija is the biggest. Besides, there are acumulations near Avala Mountain (the Pariguz, the Bela Reka and the Duboki Potok). The acumulations are threatened by communal waste, especially Pariguz (Resnik suburban area)

The Institute of Public Health Belgrade controls quality of Belgrade surface waters. The estimation of the water quality based on benthic macroinvertebrate communities is part of monitoring. However, besides large rivers Danube and Sava, there are no published data regarding whether benthos macroinvertebrates, or snails in particular.

Snails are integral component of benthos community, characteristic for large lowland rivers in the region [2; 3, 4; 5]. Besides, as low mobile whole aquatic organisms, they are good indicators of water and habitat quality.

MATERIAL AND METHODS

In June and September 2012, as part of regular monitoring of surface water quality in Belgrade region, conducted by the Institute of Public Health Belgrade, a 38 benthic macroinvertebrate samples was taken. Semi-quantitative sampling was done by combining hand net (25x25 cm, 500 µm mesh size) and Van Veen dredge/grab (270 cm²). Where it was possible (hand net sampling) a multi-habitat sampling procedure [6] has been applied. Samples from acumulations consist from one profundal part (by using dredge/grab) and one littoral part (by using hand net), while the rest of samples was taken mostly by hand-net. The samples were preserved by using 4% formaldehyde solution and further processed in the laboratory. The Gastropoda were found to be present in 18 samples,and were identified to the species level.

Composition of the gastropod fauna is provided in table 1. The supposed classification of monitoring sites into five groups/types according to overall (geomorphological, hydromorphological characteristics and dominant anthropogenic pollution) characteristics is given, and tested by multivariate ordination of data matrix. Correspondence Analysis (CA, [7]) was performed on 18-by-13 samples-by-taxa data matrix. To ensure consistency of data flora standardization was used [8]. Obtained ordination biplot, consisting of points representing samples and squares representing taxa, showed their multidimensional corelations. The callculation was done by the FLORA software (ver 6.0.: [8])

Table 1 - Composition of gastropod fauna of the Belgrade region

	Dun. Bat	Sa. Mak	Kol. Ob	Kol. Cel	Zel	Top	Bar	Belj	Ralj	Gal	Sib	Viz	Bela Rek	Parig	Dub. Pot	Ada1	Ada2	Ada3
	type 1		type 2		type 3					type 4			type 5					
Bythinia tentaculata	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Esperiana acicularis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34	2	2
Esperiana esperi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Gyraulus laevis	0	0	0	0	0	0	0	0	43	0	0	0	0	0	0	0	0	0
Gyraulus sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Holandriana holandrii	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Litoglyphus naticoides	4	0	0	20	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Physa fontinalis	0	0	0	0	0	0	0	0	0	0	0	0	1	1	6	0	0	0
Physella (Physa) acuta	0	2	76	0	2	9	118	0	11	0	3	0	0	0	0	0	0	0
Radix auricularia	0	0	0	0	2	0	1	0	8	0	1	0	0	0	21	0	0	0
Theodoxus fluviatilis	15	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata piscinalis	0	0	0	0	1	0	1	5	425	52	0	0	0	0	0	14	0	0
Valvata sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0

LEGEND:

Dun. Bat	Dunav, Batajnica
Sa. Mak	Sava, Makiš
Kol. Ob	Kolubara, Obrenovac
Kol. Cel	Kolubara, Ćelije
Zel	Železnička reka
Top	Topčiderski potok
Bar	Barajevska reka
Belj	Beljanica
Ralj	Ralja
Gal	Galovica
Sib	Sibnica
Viz	Vizelj
BelaRek	Bela reka
Parig	Pariguz
Dub.Pot	Duboki potok
Ada1	children's pool
Ada2	Well 12-1
Ada3	Well 14-1

RESULTS AND DISCUSSION

During investigation relatively rich community with 13 gastropod taxa belongig to eight families was found. Such high overall diversity, considering detorated habitats and intensive anthropogenic impacts, could be related to different types of macrohabitats and microhabitats.

Considering percentage participation *V. piscinalis* with 56% (87% at the Beljanica locality) and *P. acuta* with 25% (98% at the Topciderska River) were found to be dominant members of gastropod community.

With regard to frequency of occurrence *P. acuta* (F=0.39) and *V. piscinalis* (F=0.33) were also the most important species. On the other hand, many species were present in one sample/sampling sites (rare species), namely, *Bythinia tentaculata* (Vizelj), *Gyraulus laevis* (Beljanica), *Gyraulus* sp. (Galovica), *Holandriana holandrii* (Kolubara Celije), *Valvata* sp, *Esperiana esperi* and *Esperiana acicularis* (Ada samples). However, knowing that abundant occurrence and high frequency of occurrence are confirmed for some of these species, for example: *E. acicularis* and *E. esperi* in Danube and Sava Rivers [9, 10], future investigations should reveal more about this inconsistency.

The majority of identified taxa was adapted to moderate and/or considerable organic load (beta and alpha mesosaprobs) according to AQEM database [11]. Among them *P.acuta* as alpha-mesosaprob tolerates high organic pollution (poly-saprobic conditions). It should be mentioned that some taxa, the most notably *V.piscinalis*, *E. acicularis* and *E. esperi*, due to either a lack of data or wide ecological tolerance, could not be assessed. Therefore it is important to continue data collection.

Regarding microhabitats preferences, phytophylous and pelophylous taxa were dominant. Among them *G. laevis* and *P. fontinalis* are phytophylous, while *V.piscinalis* is pelophylous *par excellence*. [11]

Performed Corespondence analysis reveals (figure 2) separation of five main groups of samples/sites. The first group consists of Danube (Dan_Bat) and Kolubara (Kol_Cel) samples, with characteristic taxa *L. naticoides*, *Theodoxus fluviatilis* and *H. holandrii*. The second group is composed from Ada samples (Ada_1, Ada_2 and Ada_3) defined by taxa *Valvata* sp., *E. acicularis* and *E. esperi*. The third group are the Beljanica (Bel), the Barajevska River (Bar) and the Ralja (Ral), with taxa *V. piscinalis* and *G. laevis*. The fourth group, located in centre of biplot, consists of acumulations near Avala (Dub_Pot, Par and Bel_rek) and Vizelj (Viz) samples, along with species *B. tentaculata, Radix auricularia and P. fontinalis*. Finally, the fifth group consists of Sava (Sav_Mak), Kolubara (Kol_Obr), Topčiderska (Top) and Železnička (Zel) rivers samples. Species *P. acuta* determines this group. Samples Galovica (Gal) with *Gyraulus* sp. and Sibnica (Sib) are intermediary located. Hence, CA modifies supposed tipology of sampling sites, revealing faunistical/ecological differences. Thus, the first group consists of the upstream samples (near the edge of the Belgrade Region) which are least contaminated, where oligo to beta mesosaprob taxa (*T.fluviatilis* and *H.holandrii*) were found. The Ada is separated as the second type, due to presence of *Esperiana* species, which are found in potamon type of rivers [3, 9, 10]. *Gyraulus laevis* and especially *V.piscinalis* are species with wide environmental tolerance, rapid growth and high fecundity,so well adapted to variable conditions of small often polluted and occasionally dry streams, as those from the third group. The fourth group is influenced with communal and agricultural waste, with limno- to rheophylous species adapted to organic pollution (*B. tentaculata* and *R. auricularia).* Species *P. acuta* tolerant to high organic load, and with wide ecological preferences determines the final group consisting of the Sava river and lower parts of its tributaries, which are under intensive hydromorphological pressures. Remaining sites (Gal and Sib), considering their characteristics, gravitate toward the fourth group. However it should be emphasized that for more accurate analyze, to determine and to test differences in faunal composition, detailed investigation is needed.

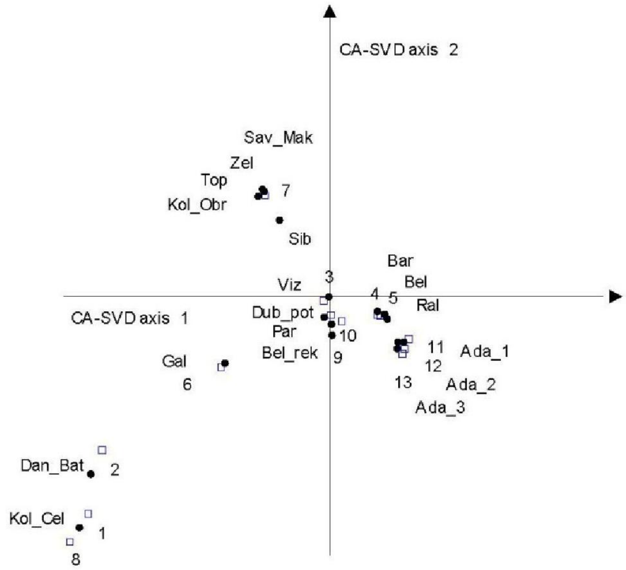

Figure 1. CA biplot performed on matrix of 18 samples x 13 taxa. The species names are numbered as follows: 1 - *Litoglyphus naticoides*, 2 - *Theodoxus fluviatilis*, 3 - *Bythinia tentaculata*, 4 - *Valvata piscinalis*, 5 - *Gyraulus laevis*, 6 - *Gyraulus* sp., 7 - *Physella acuta*, 8 - *Holandriana holandrii*, 9 - *Radix auricularia*, 10 - *Physa fontinalis*, 11 - *Esperiana esperi*, 12 - *Esperiana acicularis* and 13 - *Valvata* sp

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ZEOLITES FROM SLANCI AS A RAW MATERIAL FOR USE IN RECULTIVATION OF SOIL, AGRICULTURE AND OTHER APPLICATION

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ABSTRACT

The recent researches in Slanci area carried out during 2002 gave several new data about geological structure of wider surroundings (Djokovic et al., 2002). According to the research of composition and quality of zeolitic tuffs of wide area from the Slanci geological formation, the best-evaluated localities are the Tapino brdo and Zapis.

The most recent researches (2002, 2003-Institute for Technology of Nuclear and Other Raw Mineral Materials-ITNMS) determined appearance of tuffs on the Tapino brdo crop out. Mineralogical, chemical and crystallographic investigations confirmed that these tuffs are zeolitized. In this paper are represented results of the newest prospects.

Key words: Slanci, zeolitic tuff, clinoptilolite-heulandite group.

INTRODUCTION

Zeolites are group of natural and artificial inorganic compounds, which have specific physicochemical properties appropriate for industrial application. These minerals make specific group of alumosilicates within tectosilicates because of their origin, chemical compositions, structural characteristics and application. Clinoptilolite-heulandite mineral series (HEU type zeolite framework) represents economically the main group of natural zeolites. Application fields are numerous: in ecosystems (organic sulphur disposal from industrial oils, air purification from SO_2, CO_2, caesium and strontium disposal from soils contaminated with nuclear waste, in agriculture, farriery.

Their physical properties are: gray-white to yellow colour with limonite skins which fill-up cracks and fractures. Mineralogical composition of the zeolitic tuffs are: QUARTZ, FELDSPARS, MICA, HEU-TYPE ZEOLITES, LIMONITE, CLAY MINERALS, VOCANIC GLASS, ZIRCON, APATITE, RUTILE

GEOLOGICAL CHARACTERISTICS OF THE EXPLORATION AREA

Miocene and Quarternary sediments are represented on the Tapino brdo and Zapis localities.

Miocene layers have been discovered on the higher parts of heights of Tapino brdo and Zapis. They are represented with Lower Miocene lacustral and Badenian marine sediments. Lacustral sediments rise on the surface right beneath the peak heights. They are represented with gray and greenish gray claystones, intercalations of sandstones and tuff and tuffite layers. Recent Miocene sediments are represented with layers of Badenian age (mostly conglomerates, marly and sandy limestones), which are situated on the very top of heights of Tapino brdo and Zapis.

RESULTS OF THE RECENT RESEARCH

Wide area of the Beogradski Dunavski kljuc ("Belgrade Danube key") was studied in order to obtain geological map of Belgrade 1:25000 (Laskarev et al., 1931). The most recent research was carried out during 2002 within the project of obtaining geological map of the "Belgrade Danube key" (Djokovic t al. 2002). Within the scope of this investigation presence of tuffs on the Tapino brdo locality were noticed. According to mineralogical and crystallographic research these layers are considered as zeolitic tuffs of the very good quality (Radosavljevic et al., 2003). Intensive exploration of these tuffs began in 2004 (ITNMS) on the Tapino brdo locality and the results of these explorations are shown in this paper.

Geological operations

Geological operations embraced processing of up-to-date results, mineral prospecting, mapping and sampling of exploration digs and drill holes (five drill holes collectively 110 m), interpretation and guiding of further exploration operations.

On the basis of accomplished exploration operations and analyses of obtained results, can be concluded that zeolitic tuff layers are some 2.5 m thick (from 1 to 3.9 m), inclination angle amounts to some 20^{o} to the north-northeast (Figure 1).

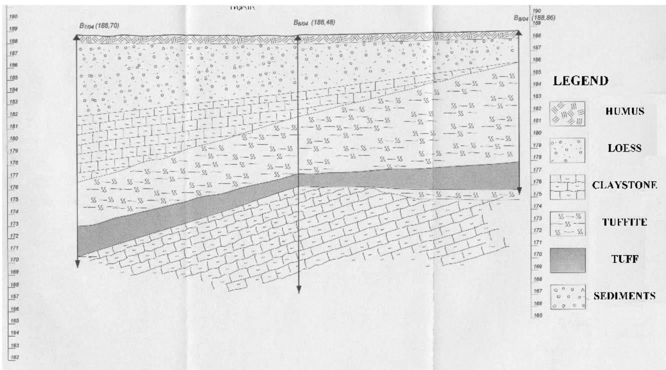

Figure 1. Geological profile B-B´

Laboratory examinations

Complete laboratory examinations were done at the Institute for Nuclear and Other Mineral Raw Materials (ITNMS) in Belgrade.

Mineralogical and petrographical analyses

Zeolitic tuffs samples were examined macroscopically (under the stereomicroscope), microscopically (in transmitted light), and by X-ray powder diffraction (XRPD) method. Macroscopically, these samples are white-gray to yellowish, sometimes significantly coated with limonite, without distinctly visible minerals. Mineral composition is: *QUARTZ, FELDSPARS, MICAS, ZEOLITE MINERALS, LIMONITE-GOETHITE, CLAY MINERALS, ZIRCON, RUTILE, VOLCANIC GLASS, PLANT FOSSILS.* XRPD analyses yielded following mineral composition: ***zeolite minerals from the clinoptilolite-heulandite group***, *quartz, plagioclases, amorphous material*.

Chemical analyses

On the basis of complete silicate (SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, MgO, K_2O, Na_2O, heating loss-H.L.) and heavy metal analyses (Pb, Zn, Cd, Cr, Ni, Sb, Cu, Mn) the obtained chemical composition of investigated samples is presented in Tables 1 and 2.

Table 1. Silicate analysis of samples from the Slanci deposit (in %).

Sample		Oxides								
Mark	ype	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	TiO_2	Na_2O	K_2O	H.L.
B_1-P_5	Zeolitic tuff	69.28	12.76	1.18	2.80	0.484	0.333	0.972	1.04	11.07
B_6-P_6	Zeolitic tuff	68.00	12.28	1.14	3.85	0.726	0.250	0.554	1.05	12.08
B_7-P_7	Zeolitic tuff	69.32	13.23	1.07	2.45	0.448	0.167	0.904	1.07	11.24
B_8-P_8	Zeolitic tuff	68.62	12.70	1.29	3.50	0.501	0.190	0.338	1.08	11.73
B_1-P_9	Tuffite	25.78	6.14	2.47	21.03	12.45	0.300	0.392	0.94	30.47

Table 2. Heavy metal content of samples from the Slanci deposit (in ppm)

Sample		Heavy metals							
Mark	Type	Cd	Cr	Ni	Pb	Sb	Cu	Zn	Mn
B_1-P_5	Zeolitic tuff	1	10	35	45	30	12	33	35
B_6-P_6	Zeolitic tuff	1.5	13	40	40	25	11	34	49
B_7-P_7	Zeolitic tuff	1	11	25	45	25	11	31	22
B_8-P_8	Zeolitic tuff	2	12	40	45	25	9	22	42

Based on the laboratory results, ore-bearing zeolite tuff layer is a useful raw material and fulfills criteria for different products for the further technological processing.

Physicochemical investigations

Moisture content, specific volume, DTA and TG analysis, acid stability, and cation exchange capacity (KKI) were done within physicochemical characterisation.
All zeolites contain different univalent, divalent or trivalent cations in the positions of offline cations. The type and content of exchangeable cations in the starting clinoptilolite tuff from the deposit Slanci is shown in Table 3. Because the following minerals do not have capacity of cation changes, all removable inorganic cations, shown in this table, belonging to the mineral clinoptilolite / heulandite. The total capacity of cationic change is defined as the sum of exchangeable cations content

Table. 3. Content of exchangeable cations in zeolitic tuff from the „Slanci" deposit

Ca^{2+} $MmolM^{+}/100g$	*Mg^{2+} $MmolM^{+}/100g$*	*Na^{+} $MmolM^{+}/100g$*	*K^{+} $MmolM^{+}/100g$*	*CEC $MmolM^{+}/100g$*
145	3,0	4,1	8,0	160

Based on the results of chemical analysis, and results of the capacity of of cation changes we determined the values for the ratio of Si / Al, as well as the related divalent and univalent cations and that is presented in Table 4.

Table. 4. Si/Al ratio, $Na^{+}/Na^{+}+K^{+}$, and $Ca^{2+}/Ca^{2+}+Mg^{2+}$ ratio.

Si/Al	*3,89*
$Na^{+}/Na^{+}+K^{+}$	0,27
$Ca^{2+}/Ca^{2+}+Mg^{2+}$	0,87

Atomic ratio of Si / Al present in the zeolite tuff Slanci is 3.89 and the ratio of divalent cations is higher than the univalent cations. As noted, clinoptilolite and heulandite were selected on the basis of atomic relations Si / Al, the atomic ratio of clinoptilolite Si / Al is higher than 4, while for heulandite this relationship is less than 4 (Mason and Sand, 1960). Thus we can conclude that in analyzed samples of zeolite tuff "Slanci," present is the mineral hejlandite with dominant calcium cations.

Technological examinations and areas of application the zeolitic tuffs

Zeolitic tuff sample was taken from the dig R-1 (approximately 4 m^3) in order to obtain incremented laboratory investigations. There results confirmed exceptional quality of this raw mineral material, approved by previous research.
Earlier years of technological and industrial testing zeolite tuff same or similar quality by experts from ITNMS shown that it can successfully applied in various fields of agriculture and the economy. In general:

- micronized tuffs are added to the concentrated food for cattle and poultry, and thereby reduce the impact of toxic substances that are present in an intensive diet of cattle,

- production the organic-mineral fertilizers on the pig farms,by absorption of ammonia from air and water by zeolite tuff and tuff subsequent disposal of such fields from the release of ammonia and enrich the soil with nitrogen,
- since Zeolite tuffs have the ability to absorb and release water, can be applied to the soil gravel composition with greater permeability, to prevent rapid drying of soil and leaching (treatment) also useful substances from the same,
- for recultivation of degraded land -example is coal tailings from the mine Štavalj near Sjenica, from the experts from ITNMS, a successfully rehabilitated using zeolite tuff
- for wastewater treatment plant, by production of micronized materials and resin-based zeolitic tuffs,
- production equipment for filtration and resources to environmental conditions,according the patent of scientists from ITNMS Institute from Belgrade,
- special applications in the paper industry which is using fine abrasives and many other application areas.

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CONCLUSION

Zeolitic tuff explorations near village Slanci were performed on the exploration area, which consists of Tapino brdo and Zapis heights.

Administratively, the exploration area belongs to the Palilula municipality, city of Belgrade. Exploration was performed on a surface of some 1.6 km^2, during which basic geological and geomorphologic characteristics were being introduced. Geological operations embraced processing of up-to-date results, mineral prospecting, mapping and sampling of exploration digs and drill holes (five drill holes collectively 110 m), interpretation and guiding of further exploration operations.

Basic lithological members of examined part of terrain are loess, marly claystones, zeolitic tuffs, tuffites, and carbonate-clay material in the base.
Macroscopically, these samples are white-gray to yellowish, sometimes significantly coated with limonite, without distinctly visible minerals. Mineral composition is: *QUARTZ, FELDSPARS, MICAS, ZEOLITE MINERALS, LIMONITE-GOETHITE, CLAY MINERALS, ZIRCON, RUTILE, VOLCANIC GLASS, PLANT FOSSILS.*

According to the obtained laboratory results the zeolitic tuff from the Slanci, deposit has very good quality. It fulfils demands for industrial application in agriculture, stock farming, and environmental protection.

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ROOT STRENGTH PROPERTIES IN SLOPE STABILITTY BASED ON ROOT THEORY

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ABSTRACT

Slope instability is one of the serious geological hazards to most environmentally regions. Significance numbers of failure are reported on residual soil slope and more than 2/3 of slopes movements are shallow sliding with less than 1m depth. Earth slope could be stabilized using reinforcement techniques and bioengineering techniques seem suitable for preventing shallow slope failures. Vegetation plays important roles for slope stability by providing immediate shear strength enhancement and modifying the saturated soil water regime. This paper contains a discussion on root reinforcement theories as a geotechnical engineering background for utilizing bio-engineering on the slope stability, with an emphasis on effects of roots on strength and suction of soil. The article also describes the recent experimental results on the strength properties of live pole roots.

Key words: Slope stability, soil-bioengineering, root reinforcement, soil suction, root strength.

INTRODUCTION

Successful management of roots as reinforcement systems requires understanding of Life Science related issues by engineers. Soil-bioengineering has been mostly been used in controlling erosion, but it has also been shown to be successful in stabilization of slopes against shallow failures. The lateral resistance of the poles has contributed to the shearing resistance along the slip surface because the root systems can contribute an additional component to the shearing resistance.

Soil-bioengineering has mostly been used in controlling erosion, but it has also been shown to be successful in stabilization of shallow slope failures. A recent development is the use of live poles array, with a length up to 2 m, to stabilize shallow slips on road embankments. The lateral resistance of the poles has contributed to the shearing resistance along the slip surface and increasing of the safety factor. Unlike piles, however, root systems of established poles can contribute an additional component to the shearing resistance.

This article aims to introduce geotechnical engineering background into the basics of bio- engineering on the slope stability, with an emphasis on roots, as well as a review on the related soil mechanics and the recent experimental results on the strength properties of live pole roots. Furthermore a discussion about the effect of root on soil suction is evoked.

ROOT REINFORCEMENT THEORY

Root reinforcement theory has basically been developed along two avenues. The first method originated from the efforts to quantify the effects of deforestation and precipitation on the slope stability, and entailed a description of root-soil interaction within a shear band through force equilibrium. The formulations were proposed by (Waldron 1977). Subsequent advances to these approaches mainly comprised refinements (for instance) in the form of explicit definitions of reinforcement element orientation (Gray & Ohashi, 1983), improved description of load transfer from soil to reinforcement elements and the effect of sand granulometery. These advances were, however, increasingly based on fibre reinforced soil behaviour with root reinforcement.

The second avenue, along which root reinforcement theory was developed, owed its origin to the description of the behaviour of composite materials. This method considers the macroscopic properties of composites, with the distinct characteristics of fibres and matrix having been homogenised or averaged. Within this context of fibre reinforcement, root reinforcement is clearly identified as a specific case. A very limited number of attempts still exist at description of fibre reinforced soil using this method. Among other, (De Buhan *et al.* 1989) addressed uni-axially reinforced soil, while (Di Prisco & 1993) attempted to describe continuous filament and isotropic fibre reinforced soil.

In this regard, also soil suction, as a possible major contributor to shallow slope stability is noticeable. Therefore, efforts to improve the quantification of the effect and mechanism of roots as soil stabiliser are required and should fully integrate the contribution of the whole root array, and include more of the possible effects of soil suction.

SOIL SUCTION AND VEGETATION

Unsaturated soils or soils with negative pore-water pressures can occur essentially in any geological deposit. In soil cover with vegetation, as the soil water moves into the roots and through plants, negative pressure or suction is applied by roots to soil through a decrease of the soil water potential. Plants and soil both influence this process which is interactive.

VEGETATION SYSTEM AND PROPERTIES

Vegetation can influence the stability of slope when the roots act as reinforcement to the soil. Their contribution is dependent on the plant material used, the method of installation and their properties. In soil-bioengineering, vegetation is installed artificially to improve stability and a wide range of vegetation is utilized for the stabilization of slope.

The geometry of the installed vegetation and its root system is often determined by the type of plants being used as well as the method of installation. Generally, the properties of roots which are needed for the computation of soil-root interaction include the geometry of root and the strength properties. However, while data are available for a number of species, these are limited to the sites from which the data were obtained. Hence, extrapolation of the data from one site to another involves uncertainties and is only sufficient for approximate calculations in a number of cases and should therefore be verified by in situ tests, whenever possible.

Soil bioengineering systems

Plants protect the surfaces of slope from the direct impact of raindrops, help trap waterborne sediment, reduce the velocity of surface runoff and strengthen the soil by the binding action of their roots. Similarly, vegetation has been indicated to have the tendency to reduce the moisture content of soil through interception of rain and transpiration. These usually increase the stability of slope; however, they also increase infiltration through root penetration, and may in some circumstances (such as where there is heavy surface runoff) decrease stability (Bayfield *et al*., 1992).

Vegetation used in stabilizing slope ranges from grasses to shrubs and trees. Grasses are the most widely used vegetation on slopes as their roots concentrate usually in the top 30 to 50 centimeters of soils, but they can also penetrate down to about one meter. Shrubs and trees, on the other hand, provide deeper slope reinforcement, with roots which penetrate down to three meters and more, but are mainly concentrated in the top one to two meters.

Vegetation may be established using a conventional seeding or live planting. Specialized methods have been developed to establish vegetation on slopes. In these methods, un-rooted cuttings, which are cut from live plants, are used, imbedded and arranged in the ground, in special patterns and configurations. These embedded cuttings take root, become established on the slope and act as barriers to earth movement, soil reinforcement, moisture wicks and hydraulic drains (Huat *et al*., 2008).

Two commonly used systems are extended to sufficient depth to serve as reinforcement in shallow slides. Brush layers consist of live branches which are placed in trenches or between layers of compacted fill (Figure 1).

Live stakes or live poles are stems cut from live trees and installed vertically or in a direction perpendicular to the slope (Wu, 2007). Live poles (Steele *et al*., 2004) consisting of willow stems, with diameter of 4-10cm and length of about 2m, were used to stabilize shallow slides (Figure 2).

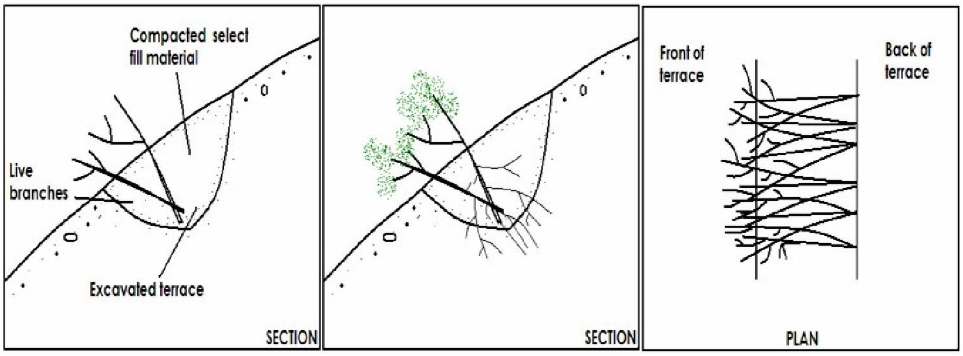

Figure 1. Schematic diagram of brush layering (Huat et al., 2008)

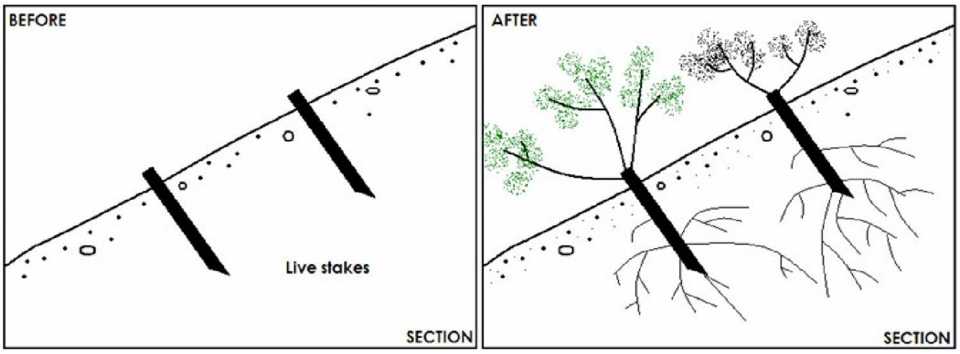

Figure 2. Schematic diagram of Live Pole (Huat et al., 2008)

The growth of roots from the cuttings used in soil bioengineering systems can be expected to be different from that of the natural seedlings. Data from (Steele *et al.* 2004) show that roots can grow from live poles at a depth up to 1.4 m.

Root geometry

In the comprehensive sense, root geometry denotes all the properties which are necessary to define the positions and dimensions of the roots in the system (Wu, 2007). The major parts of the root system are shown in (Figure 3) below.

The root crown or root stock includes the bases of the lateral roots and the concentration of small roots beneath the root crown. It may be spherical or heart-shaped. Plate-shaped root systems are composed mainly of lateral roots. The diameter of lateral roots decreases rapidly with the distance from the root crown. The relationship between the dimensions of different components of a root system has also been studied. The mass which contains most of lateral roots is sometimes called the root mat.

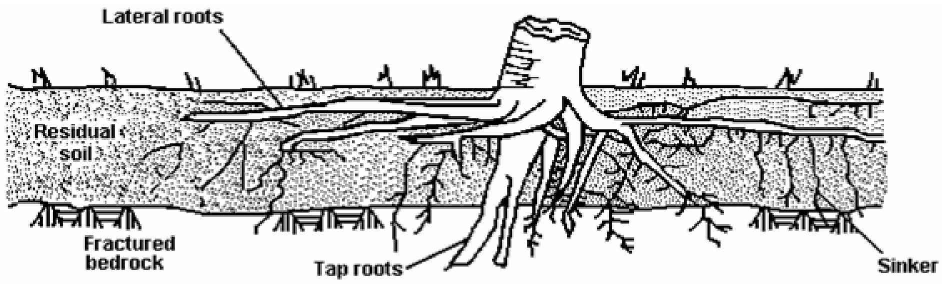

Figure 3. Root mat of a tree (Huat et al., 2008)

More detailed correlations between different dimensions of a root system can be developed and used in computer simulations so as to generate a distribution of root diameters at various distances from the stem (e.g. Wu & Watson, 1998). In the meantime, a more practical approach involves the use of available data on the root density and distribution of root diameters in some of the simplified computationsThe maximum depth of roots of grass and forbs in the temperate zones is usually less than 0.5 m.

CONCLUSIONS

Based on the provided evaluation of the earlier efforts, it can be concluded that vegetations have been effectively employed as acting elements for the stability of slope in different regions of the world. This is mainly due to their physiological behaviour and mechanical properties. However, many studies conducted on the geotechnical behaviour of live poles, particularly in the tropical regions, are obviously still lagging behind in terms of considerations of their other performances, while the subject of the soil-root interaction still needs further research to be done in any climatic condition.

Apart from slope appearance and ecological improvement, vegetation is reported to have both beneficial and adverse effects on slope stability (Greenway, 1987). However, fundamental studies on the effects of vegetation, under the theoretical framework of unsaturated soil mechanics, are still lacking (Ng & Menzies, 2007). Thus, studies on the reinforcement potential of common tree and shrub species planted or naturally occurring on man-made slopes are usually needed.

Bioengineering techniques can potentially provide immediate mechanical shear strength for slope rehabilitation and long-term beneficial effects. These techniques involve the use of willow live woody stem cuttings at shallow depths as brush layers in a near horizontal orientation and as wattles or fascines along the contour. These are arguably the leading techniques used in bioengineering slope stabilization (Schiechtl & Stern, 1996; Gray & Barker, 2004). The use of live pole arrays to stabilize slopes has received increasing attention; for instance, draft design and installation guides have been produced in the UK for the Highways Agency (Barker, 2006). However, the use of live poles in weathered soils in the tropical and sub-tropical areas has not been reported.

Both laboratory and field tests on roots of live poles have been carried out by a number of researchers. Among other, (Bransby *et al.* 2006) carried pull-out and shear tests on vegetation reinforcement. Similarly, (Wu and Watson 1998) conducted in situ shear tests of soil blocks with roots. Large shear box tests have also been done to measure the interface strength of a soil with a structural element (Huat *et al.*, 2005; Faisal & Normaniza, 2007; Mafian, 2009). All such experiences can be utilized and the equipment can be modified to test poles and roots.

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RIVER SAVA AS A CORRIDOR OF SPREADING INVASIVE PLANT SPECIES

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ABSTRACT

This paper provides an overview of some research and literature data of presence and distribution of invasive plant species along the Sava River in Serbia, Bosnia and Herzegovina, Croatia and Slovenia, with a special focus on protected areas (nature monuments and areas protected under the Ramsar Convention). It is noted that in all localities species *Amorpha fruticosa, Aster lanceolatus, Acer negundo, Ailanthus altissima, Ambrosia artemisiifolia* are presence. These species are highly presence on the sites of Ada Ciganlija, "Obrenovački zabran", "Bojčinska šuma", Zasavica and Bardača, tending to spread further and therefore may be a serious problem for the floodplain of the Sava River. Establishment of authority for monitoring and controlling presence and spreading of invasive plant species on international level is fundamental as well as mutual co-operation and exchange of information.

Key words: river Sava, invasive plant species, Ramsar sites, nature protection.

INTRODUCTION

Invasive plant species (neophytes) are most often spread by suppressing native species, primarily occupy urban areas forming a stable population, and then continue spreading on suburban and rural areas. Invasive species can become dominant and threaten the survival of the natural flora as well as undermine the ecological stability of ecosystem (Skočajić et al, 2008). It is also the increasing number of invasive plant species that damaging human health (Vrbničanin and Malidža, 2008).

Since the anthropogenic factor is one of those responsible for introduction of invasive species, urban, suburban and rural communities are centers of which further expansion begins. Cities and towns are commonly situated by major water flows and river flows which are important corridors of invasive species spreading (Obratov-Petković et al, 2009, Vrbničanin et al, 2004). The Sava River is a part of the Southern Invasive Corridor linking the Black Sea to the North Sea through the Danube-Rhine-Main, including the Main-Danube Canal and the main tributaries of the Danube River (www.savacommission.org). Because of the environmental and cultural values of wetlands, near the Sava river Basin are six areas protected under the Ramsar

Convention: Bardača (BiH), "Lonjsko polje" and "Crna mlaka" (Croatia), "Obedska bara" and Zasavica (Serbia) and "Cerkniško jezero" (Slovenia) (www.savacommission.org).

This paper provides an overview of some research and literature data of invasive plant species along the Sava River in Serbia, Bosnia and Herzegovina, Croatia and Slovenia, with the special review on the areas protected under the Ramsar Convention. Among the areas that are in the vicinity of the river flow Sava (or the river made a significant impact on them) the follow are discussed: Ada Ciganlija, "Obrenovački zabran", "Bojčinska šuma", "Obedska bara" and Zasavica. Sites "Obedska bara" and "Zasavica" were selected because of the importance that they have in the preservation of biodiversity (areas protected under the Ramsar Convention). Sites "Bojčinska šuma", "Obrenovački zabran" and Ada Ciganlija were selected because of their important urban recreational function. In Bosnia and Herzegovina it will be given special review to the area "Bardača", in Croatia, it is Nature Park "Lonjsko polje", and in Slovenia it is "Cerkniško jezero".

The Sava River Basin is the largest basin of South East Europe, with a total area of approximately 97,713.20 km ^{2}, and is one of the most important sub-basins in the catchment area of the river Danube with a share of 12%. Most of the catchment is covered by forest and semi-natural areas (54.71%) and agricultural areas (42,36%) (www.savacommission.org). All 207km course through Serbia has prospects to obtain the status of an international waterway, and also connect five states (www.beograd.rs). The Sava River is designated as one of the key European area for its natural values of the Pan-European strategy of biological and landscape diversity of the Council of Europe. Basin Sava contains the largest complex of alluvial wetlands and lowland forest which are important for biodiversity conservation. In Serbia, the ecological network of the Sava River Basin has nine separate areas: "Veliko ratno ostrvo", "Crni Lug", "Bojčinska šuma", "Obedska bara", "Trskovača", "Orlača", "Zasavica" confluence of the Drina and "Bosutsko-Morovićke šume" (Mijović et al, 2012).

Schedule of plant communities is determined by the type of soil and flood regime of the river basin (Stevanović et al, 2010, Obratov-Petković et al, 2009, Radulović et al, 2008, Letić et al, 2008, Tucovic et al, 2004). Along the basin is hydrophilic vegetation, and most communities that occur in the plains are *Salicetum albae, Alno-Quercetum roboris, Fraxino angustifoliae-Quercetum roboris.* In addition to those, In Slovenia, in the Dinaric area, communities *Abieti-Fagetum dinaricum* are occurring, while in the lowland region are associations *Querco roborri-Carpinetum, Fraxino-Ulmetum effusae*, *Genisto elatae-Quercetum roboris.*

PRESENCE OF INVASIVE PLANT SPECIES IN PROTECTED AREAS OF THE SAVA RIVER IN SERBIA

Ada Ciganlija

In the Belgrade, 4km from the confluence of the Sava and Danube, is a very popular sport and recreational area of Ada Ciganlija. Ada with Ada Međica, Sava Lake and part of Makiš field covers an area of 800 hectares (www.adaciganlija.rs). Area of 21.25 hectares of Ada is protected (www.adaciganlija.rs).

According to Stevanovic et al., (2010) on Ada was found a total of 96 plant species, of which 18 species are invasive and potentially invasive: *Aster lanceolatus, Acer negundo, Ailanthus altissima, Polygonum aviculare, Eleusine indica, Artemisia vulgaris, Ambrosia artemisiifolia, Xanthium strumarium* var. *italicum, Bidens frondosa, Helminthia echioides, Echinocystis lobata, Urtica dioica, Rubus caesius, Stenactis annua, Erigeron canadensis, Asclepias syriaca* and *Amorpha fruticosa.* Species *Stenactis annua* is most common in the studied areas, followed by *Aster lanceolatus*. On the third place are species *Acer negundo* and *Amorpha fruticosa* followed by *Rubus caesius, Ailanthus altissima*, *Urtica dioica* and *Polygonum aviculare*. The largest number of recorded invasive species is belonging to the family *Asteraceae*. Similar results were obtained by Obratov-Petkovic et al., (2009). According to their research, *Aster lanceolatus* was the dominant species at the three studied sites on Ada Ciganlija with the surface of 100 m².

Radulovic et al., (2008) indicated special importance of species *Amorpha fruticosa* on Ada Ciganlija area. According to their research, this species is highly present on this area and appears from flooded areas up to higher elevations at the forest line. However, the same authors stand out that *Amorpha fruticosa* isn't present or appears very rarely on the places where remains of wetland vegetation community *Magnocaricion* are present. One of the potential mechanism that may explain this fact is allelopathy. Detection of mechanisms that inhibit the spread of *Amorpha fruticosa* populations in habitats belonging or used to belong to the community *Magnocaricion* would be of great importance for control the spreading of this invasive species.

Invasive species *Reynoutria japonica* is very present along the stream of the Topčider River that flows into the Sava river near Ada Ciganlija. This species covers approximately 11 000 m² area along the river flow. This species can resist very low temperatures, as well as all soil types, and different pH values and salinity. In addition, when one appears, *Reynoutria japonica* continues to spread very easily and quickly. Therefore, it is very important to have detailed information of its spreading, biological, ecological and physiological characteristics of this but also of other invasive plant species to prevent further spreading and gain control. (Djukić et al., 2009)

Obrenovački zabran Nature monument

„Obrenovački zabran" is located about 2 km southwest of Belgrade suburban part with a total area under the protection of 47ha. The picnic part of the forest are made of coppice forest ash and oak (*Fraxino angustifoliae- Quercetum roboris*) and artificially established stands of red oak (*Quercus rubra*), while along the coast occurs forest of white willow and poplar (*Populeto-Salicetum*) (www.beograd.bgmap.com). *Ambrosia artemisiifolia* is a widespread invasive species on the Obrenovac territory. Based on data from floristic research this species is recorded at 1 034 sites in municipality Obrenovac with total area of over 655 hectares (Stankovic-Kalezić et al., 2009). However, ash from thermal power stations "Nikola Tesla" creates a cumulative effect on Obrenovac area, and along with pollen concentrations caused by flowering weeds, especially *Ambrosia artemisiifolia*, pose a risk to the health of citizens, and the most vulnerable are allergic people. Municipality of Obrenovac established a plan of measures and activities for prevention of this invasive species (www.obrenovac.rs).

Stevanovic et al., (2010) have reported of *Amorpha fruticosa* as highly invasive woody species on the Obrenovacki zabran area. The same authors have recorded 53 species in forest picnic area where 10 are invasive: *Aster lanceolatus, Polygonum aviculare, Helminthia echioides, Echinocystis lobata, Urtica dioica, Rubus caesius, Stenactis annua, Erigeron canadensis, Asclepias syriaca* and *Amorpha fruticosa*. Along the existing trim track *Urtica dioica* and *Aster lanceolatus* were distinguished by the highest values of the measured parameters (number and cover). The largest number of recorded invasive plant species on the sites belongs to the family *Asteraceae*.

Bojčinska šuma Nature monument

"Bojčinska šuma" are located in the lower Srem, in the municipality Surčin, between the villages of Boljevci, Progar and Ašanja and covers an area of 670 hectares. (www.beograd.bgmap.rs). Petrović et al. (2013) conducted field research on the flora and vegetation of "Bojčinska šuma" from 2009 to 2011 years and recorded a total of 185 plant species. Among them 31 species were invasive, 9 woody plant species and 22 herbaceous plant species (Petrović et al. 2013). Jurišić et al., (2011) state that on Bojcinska forest number of the neophyte extremely high and occupies an important place. According to research by Stevanović et al., (2010) in "Bojčinska šuma" following invasive species were recorded: *Aster lanceolatus, Urtica dioica, Rubus caesius, Stenactis annua, Xanthium strumarium* var. *italicum, Fragaria indica, Erigeron canadensis, Artemisia vulgaris, Polygonum aviculare, Ambrosia artemisiifolia, Amorpha fruticosa,* and also the species *Acer negundo*. The most dominant species are *Aster lanceolatus, Urtica dioica* and *Stenactis annua*. The largest number of invasive plant species recorded in this area belongs to the family *Asteraceae* (8 species), then the families *Rosaceae* and *Fabaceae* (3 species each) (Petrović et al. 2013). This authors also noted that the species *Amorpha fruticosa* forms thick complex in sunlit clearing areas.

Protected natural resource "Obedska bara"

"Obedska bara" was protected area since the Austro-Hungarian court, from year 1874. Due to its outstanding natural values, "Obedska bara" is on the list of wetlands of the Ramsar Convention from 1977 as the first in Serbia. Since1989 "Obedska bara" is a zone of extreme importance for birds in Europe (www.obedskabara.rs). "Obedska bara" is located on the left bank of the river Sava providing an arc between Obrež and Kupinovo, under the department of loess terrace. Forest vegetation build community of elm and oak (*Carpino betuli Quercetum roboris*) in drier habitats, communities of oak and elm with ash (*Ulmet-Fraxinetum*) in areas of long-lasting flood waters, the port community of ash in the lowest depressions where water is retained longer part of the year, and the community of poplar and willow occurred in areas deforested forests of oak.

In the area of "Obedska bara" prevalent hydrophilic vegetation type of *Fraxino angustifoliae Quercetum roboris*, while soils are fluvisol, humofluvisols and marshy black soil (Letić et al., 2008). A narrow strip of forest residues overgrown by invasive plant species *Echinocystis lobata*, which needs to be removed because of its wide spreading especially in wetland habitats. Meadows forming of invasive species, especially *Amorpha fruticosa*, even after their removal is present in about 30% of the total area of meadows. Removing *Amorpha fruticosa* should be conducted periodically to prevent it from spreading, in the young vegetative stage.

Protected natural resource "Zasavica"

Special Nature Reserve, is located in the Mačva, 10km from Sremska Mitrovica. The protection zone covers an area of 1150 ha. Special Nature Reserve, was placed under the protection from 1997 as a natural resource of great significant for the Republic (www.zasavica.rs). In Zasavica are over 700 species of plants. In this area is a large number of endangered plant species, some are listed in the Red Book of Flora of Serbia. Some endangered plant species found in the Red Book of Flora of Serbia are very sensitive to changes in environmental conditions and are in the process of disappearing or have already disappeared from the area (Vuk et al., 2003). Zasavica is Ramsar site, an area of international importance for plants (IPA), an area of international importance for birds (IBA), and the most important area for butterflies (Prime Butterfly Area).

In Zasavica a numerous of invasive species were recording tending to spread further. The most widespread invasive species in this area are: *Fraxinus pennsylvanica, Acer negundo, Amorpha fruticosa, Echinocystis, Aster lanceolatus, Erigeron annuus, Asclepias syriaca* (www.zasavica.rs).

Species *Amorpha fruticosa* is represented by 550 individuals in Zasavica. Among this species with a significant number of species *Acer negundo*, (95 individuals) and *Ailanthus altissima* (120 individuals) are also represent (Čavlović et al., 2011). The impacts of climate change may affect dissapearing of plants such as *Mentha aquatica, Rumex hydrolapathum*, *Iris pseudacorius*, and they could be replace by invasive plant species such as *Sorghum halepense* and *Lythum salicaria* (Čavlović et al., 2012). Bartula et al., (2011) proposed the concept of management and protection of different types of habitats in Zasavica.

PRESENCE OF INVASIVE PLANT SPECIES IN PROTECTED AREAS OF THE SAVA IN BOSNIA AND HERCEGOVINA

Ramsar site "Bardača"

Baradača occupies an area of 3500 ha. It is located on the left coast of the river Vrbas and along the Sava River, about 30 km northeast of Banja Luka. From 2007 Bardača wetland declared as a Ramsar wetland of international importance. On Bardaca area as well as in Bosnia and Herzegovina the most notably are the following invasive species: *Asclepias siriaca, Helianthus tuberosus, Solidago gigantea, Ambrosia artemisifolia, Tagetes minuta, Amorpha fruticosa, Robinia pseudacacia, Phytolaca americana, Reynoutria japonica, Ailanthus altissima, Impatiens glandulifera*. Most of these species inhabits coastal belts of plain rivers, forest clearings and similar habitats. Species *Asclepias syriaca, Helianthus tuberosus* and *Amorpha fruticosa* particular cause negative impacts on habitats of hygrophile forests consust of willow, alder and poplar in Bosnia and Herzegovina, particularly widespread in Posavina. Hydrophilic ecosystem Bardača today are under a high degree of threat from invasive species. (www.fmoit.gov.ba)

PRESENCE OF INVASIVE PLANT SPECIES IN PROTECTED AREAS OF THE SAVA IN CROATIA

Ramsar site "Lonjsko polje"

Nature Park "Lonjsko polje" extends on the municipalities of Sisak, Novska, Jasenovac, Kutine, Lipovljani, Velika Ludina, Popovača, and partly on the area of Brod-Posavina County. Area Nature Park is about 510 km ² and is one of the largest non-regulated floodplains remaining in Europe. Nature Park is protected by the Ramsar Convention (Španjol et al., 2011, www.pp-lonjsko-polje.hr). In the area of the "Lonjsko polje" 17 invasive alien species were recorded: *Amaranthus retroflexus, Ambrosia artemisifolia, Amorpha fruticosa, Artemisa verlotiorum, Asclepias syriaca, Bidens frondosa, Chamomila suaveolens, Conysa canadensis, Datura stramomium, Echinocystis lobata*, *Erigeon annuus, Galinsonga parviflora, Juncus tenuis, Lepidium virginicum, Solidago canadensis, Solidago gigantea, Xanthium strumarium.*_Borišić (2008) reported that by the number of invasive species in Croatia the most common family is *Asteraceae*. Species *Amorpha fruticosa* is very aggressive in a large number of habitats and in some counties such as Sisak, Slavonski Brod-Posavina presence a large problem. Nature Park Lonjsko polje and landscapes of tourist attractive sites are almost completely covered with this invasive species (http://awsassets.panda.org/downloads/prijedlogzaizradunacionalnestrategijeostranimin vazivnimvrstamauhrvatskoj.pdf).

PRESENCE OF INVASIVE PLANT SPECIES IN PROTECTED AREAS OF THE SAVA IN SLOVENIA

Ramsar site "Cerkniško jezero"

Area "Cerknisko jezero" is 29km² large. In year 2002 this area is declared as a protected area and included in the European ecological network of protected areas Natura 2000 sites. From year 2006 lake was declared as a Ramsar site. Also, "Cerkniško jezero" has a special importance for birds (IBA) (www.ec.europa.eu /environment/life/project).

Vegetation that occur in the Posavina and "Cerkinško jezero" are: *Salicetum albae*, *Fraxino-Ulmetum effusae*, *Genisto elatae-Quercetum roboris, Carpinetosum betuli.* Slovenia has recorded 21 invasive plant species. Those are mostly species that are most prevalent in Europe, such as: *Acer negundo*, *Ailanthus altissima*, *Elodea canadensis*, *Helianthus tuberosus* , *Reynoutria japonica*, *Solidago* species. *Amorpha fruticosa* is a species that occurs in moist habitats, rapidly expands and covers a large area in a short period of time and it spreading on many sites of Cerkniško jezero area.

DISCUSSION

Comparing the literature data related to different areas along the Sava river in Serbia, Bosnia and Herzegovina, Croatia and Slovenia, it can be concluded that in all four countries and in all localities the following invasive species are present: *Acer negundo, Ailanthus altissima, Ambrosia artemisiifolia, Asclepias syriaca, Echinocystis* *lobata, Solidago gigantea.* Species *Amorpha fruticosa*, due to its rapid and uncontrolled spreading, is one of the main problems in protected areas of the Sava River. Species *Ambrosia artemisiifolia* is also very prevalent along the Sava and, because of its allergenic activity can have a negative impact on human health, which is particularly important considering the sport and recreational use of the areas.

In Serbia, in researched locations invasive species are widespread as well as in neighboring countries, tending to threat biodiversity. Some of most commun and widespread species are: *Acer negundo, Ailanthus altissima, Helianthus tuberosus, Reynoutria japonica, Aster lanceolatus, Urtica dioica, Stenactis annua. Aster lanceolatus, Amorpha fruticosa* and *Ambrosia artemisiifolia* are the most invasive species in selected areas of the Sava in Serbia.

The largest number of invasive plant species recorded in the "Bojčinska šuma" belongs to the family *Asteraceae* (8 species), then the families *Rosaceae* and *Fabaceae* (3 species) (Petrović et al. 2013). Similar results were obtained by Stevanović et al (2010). According to research by Stevanović et al., (2010) at sites Ada Ciganlia, "Obrenovački Zabran" and "Bojčinska šuma" by recorded invasive plant species the most common family is *Asteraceae* (8 species), then family *Rosaceae* (2 species), while other families were represented by one plant species. Stavretović et al. (2010) reported that in the grass areas of residential areas of Belgrade the largest number of recorded invasive species belonging to the family *Asteraceae,* as well as on the grass areas around roads. Also, Borišić (2008) reported that the majority of invasive species belong to the family *Asteraceae*.

Monitoring and controlling of invasive species is a basis for developing strategy for planning measures to repress unwanted species, protect native vegetation and especially health of users on recreational areas. Establishment of authority for monitoring and controlling presence and spreading of invasive plant species on cities, national and international level is fundamental as well as mutual co-operation and exchange of information, particularly in regions with similar ecosystems. (Petrović and Stavretović, 2011)

CONCLUSION

Based on the above data it can be concluded that in the study sites, along the Sava river invasive species are present in large numbers. *Aster lanceolatus* is a species that grows mainly in pioneer communities. According to the above literature, this species is one of the most dominant invasive species along the Sava river in Serbia. In addition to this invasive species *Amorpha fruticosa*, is very present in the wetlands next to river. In all these localities this species is widespread with the tendency of rapid further spreading. In all the countries through which the river Sava flows *Amorpha fruticosa* is one of the most common and the most invasive species in the Sava valley. At all sites species *Ambrosia artemisiifolia* was observed. It is a problem in all the countries of the former Yugoslavia, taking in floodplains along the rivers, and agricultural land. The majority of invasive plant species in the study sites belonging to the family *Asteraceae.*

Considering the extensive distribution, rapidly spreading invasive species and their negative impact on biodiversity requires further monitoring and research in this areas, as well as the implementation of established strategies for control of these species in all republics.

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THE MANAGEMENT OF CONTAMINATED SITES AND SOIL REMEDIATION IN SERBIA

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ABSTACT

Impacts from human activities are affecting environmental and human security. Soil degradation due to soil contamination, is a serious problem in Serbia. Degradation of soil quality affects 25 percent of all potentially arable land in the world. Authors use methodology appropriate for social science and present in the paper background of soil contamination problem, legislative part of soil contamination, management of contaminated sites and reason for choose of phytoremediation techniques as a flexible, cost-effective, and technically sound approach for restoration of contaminated sites. Results show the urgent need for strengthening ,,soil remediation industry,, in Serbia and use some recent research activities in application of holistic approach of remediation of contamination sites. Conclusion remarks highlight a chance for creating similar database in plant response to abiotic stress and opportunities arising from business interaction with the natural environment.

Key words: soil degradation, management, contamination, plant, ecological risk.

INTRODUCTION

Soil is a non-renewable natural resource which performs crucial ecological, social and economic functions. Soils are being increasingly degraded across the European Union, as well as in the Republic of Serbia. Different environmental European policies are contributing to soil protection, but they are not sufficient to ensure an adequate level of protection for soil in Europe. The current state is Serbia could be recognized numerous similarities with those in Europe regarding the soil pollution.The most important adopted documents are a Soil Thematic Strategy [1] and a proposal for a Soil Framework Directive[2]. The Soil Framework Directive is still in the process of adoption.

The data about state of soil are presented only regarding contamination of soil as one of the major issue in its process of sustainable management. Due to more than two hundred years of industrialization, Europe has a problem of contamination of soil due to the use and presence of dangerous substances in many production processes. It has been estimated that 3.5 million sites may be potentially contaminated, with 0.5 million sites being really contaminated and needing remediation. Several studies demonstrate significant annual costs to society in the ranges of €2.4 – 17.3 billion [3].

Serbia on a path of seeking full membership in EU made considerable progress in the context of environmental protection, especially in the area of harmonization of national legislation with that of the EU [4].

In the Republic of Serbia it has been detected 375 contaminated sites, and realization of the management of contaminated sites is performed in the following way: Done remediation– 5,7%; detailed research – 0,5% and identification of sites/preliminary research – 93,8% [5].

The main objective of this paper is to highlight the issue of management of contaminated sites and the process of their remediation.This paper describes some legislative, scientific, and technological aspects of soil contamination and remediation in relation contaminated sites in Serbia.

LEGISLATIVE ASPECTS OF SOIL PROTECTION IN THE REPUBLIC OF SERBIA

Increasing public concern about the deleterious effects of contaminated soil on environmental and human health has led to legislative actions aimed at controlling and regulating the emission of potential pollutants into the soil. Identification of sources of soil pollution, and quantifying the pollution effects start to be an important issue for all interested parties. In recent years environmental legislation in the Republic of Serbia has had to deal with the problem of contaminated or polluted soils and their remediation is partially developed [6].

The strategic objectives of sustainable land use are given in the National Strategy for Sustainable Development of the Republic of Serbia [7]. The objectives of the Strategy include:

1. harmonization of legislative acts related to land use and soil protection with Eu-legislation;
2. prevention of further soil loss, especially due to industry, mining, energy, communication and other activities, and conservation and enhancement of soil quality;
3. prevention of soil degradation and changes of land use and development and management of agricultural soil.

Serbia does not have adequate administrative capacities for the enforcement of existing laws and by-laws in the area of soil protection. The Government of the Republic of Serbia adopted a Regulation on the program for the systematic monitoring of soil quality, soil degradation risk assessment indicators and methodology for the development of remediation programs [8].

The adoption of this Regulation had an aim to ensure the soil protection based on prevention of degradation through identification of risk area for soil degradation.

The establishment of systematic soil monitoring in the Republic of Serbia has its legislative basis in numerous laws and sub lows and is harmonized with the objectives set in the national strategies.

The national soil monitoring network is established to monitor soil quality in the Republic of Serbia on sites which are of special interest for the Republic of Serbia, where soil contamination has occurred or is likely to occur. The local soil monitoring network is established to monitor soil quality at the level of the Autonomous Province and local government. The local network consists of supplementary sites, that are established in accordance with its needs, on the basis of measurements or evaluation procedures, and for which there are no data available for evaluating the level of contamination. The National List of Indicators represent a set of soil indicators used for systematization of the information about soil condition, land use changes, and factors of soil degradation.

In Serbia public perceptions and political considerations still play a key role in the decision-making process in relation to soil remediation. The need for soil remediation depends primarily on the nature of the contaminant and the land use. Some efforts are planned and done in a certain scope, like monitoring of soil quality, monitoring soil degradation risk assessment indicators and implementing programs for the remediation of the consequences of soil contamination and degradation, whether natural or human-induced but there can be much more improvement.

MANAGEMENT OF CONTAMINATED SITES IN SERBIA

The management of contaminated sites in Serbia is closely connect with the question is there any kind of soil remediation industry in Serbia? In current economic crises the state of Serbian economy is very fragile. For a more comprehensive view on Serbian performances considering business crisis, there is a necessity to have in mind unfavorable basic economic indicators [9]. In numerous areas the need for international help in providing of material resources is recognized, especially in the area of approximation of adopted environmental legislative [10]. This is very important in the area of soil sustainable management to highlight economic feasibility of an extensive soil remediation. For this reason the need is rising for developed of soil remediation industry at national level.

The public welfare concern over the hazards of soil contamination has led to legislative action aimed at controlling contamination. The implementation activities are so far from objectives, and are evaluated as insufficient in numerous official reports and scientific researches, due to many objective and subjective reasons.Currently the remediation process of contaminated sites is mainly sporadic. There are lot of plans and public announcement about investment in rehabilitation process of contaminated sites, in the energy sector especially like in Electric Power Industry of Serbia and NIS Gazprom Neft, and etc. Another problem in these activities is that most of their program and plans are set in organizations as a part of social responsible strategies in Serbia [11].

State does not have any power to control those intentions and follow the objectives which they proclaimed in the area of environmental protection and in the sustainable soil management.In Serbia there are 20% of total land areas which are recognized as officially contaminated sites. All of those sites contain one or more pollutants. Industry which contributes to the soil pollution is on the first place: petrochemical industry, the chemical industry and industry of metal production [12].

Management of contaminated sites is tiered process starting with a preliminary survey searching, assessment of the contamination level, confirmation of environmental impacts and finally implementation of remedial and after care measures. The inventory of contaminated sites is an integral part of the environmental protection information system administered by the Serbian Environmental Protection Agency. In Serbia there is insufficient action in the efforts to improve soil remediation and with it connected remediation technologies that are currently used. The new findings on pollutant effects on environmental and human health have led to the continual development of remediation technologies in the science. Once a soil has to be remediation the key issue is 'which is the most appropriate technology to be used?' Serbia adopted a Strategy of scientific and technological development of Serbia for the period 2010-2015 included the urgent need for expanded scientific research in numerous interdisciplinary area (soil protection is one of them). Therefore there is a need for acceptance of the positive experience from developed countries.

The Republic of Serbia does not have a soil monitoring system in place at national level. The lack of systematic soil monitoring, harmonized methods for soil sample and analyzes affects the overview of the soil status in certain areas of the Republic and impedes comparison of results from previous years.

Existing soil monitoring program in the Republic of Serbia are presented through complex research conducted in certain parts of the country by scientific and specialized organizations, and the results of this research is integrated into the annual reports of the Environmental Protection Agency. Currents situation is not satisfactory because some of the most important documents still do not exists. Serbia does not have any Priority remediation lists, neither documents similar to the US National Contingency Plan (NCP). In the USA there are nine criteria which are: the overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implement-ability; cost; state acceptance and community acceptance.

Also in the process of remediation some unreasonable decisions could be made because there is no clear definition on which way the best technology will be chosen in the process of remediation of any contaminated site. For example in the United Kingdom, three criteria which influence the choice of remediation techniques are considered (Beckett and Carney 1993):cost-effectiveness;speed of reclamation and flexibility.

INNOVATIVE APPROACH IN THE PHYTOREMEDIATION PROCESS OF CONTAMINATED SITES

Remediation of contaminated site is every action which reduces the risk to human health or to the environment by treating the source of the contamination. Hard decision for policy makers is to have a sense to choose which technology is the most applicable for some site. Some criteria limit the use of technologies such as bioremediation and phytoremediation in comparison with well-established engineering technologies. Despite the common community approach that these technologies are more effective, bio and phytoremediation are better accepted, even though they require more time in gaining results. The choice of appropriate vegetation for phytoremediation requires plant screening for stress tolerance. During this process it is important to make distinctions between two types of abiotic factors: conditions and resources. The degree to which each abiotic factor is present or absent and high or low profoundly affects the ability of plant to survive. We shall find that this difference in response to environmental factors determines which plant may or may not occupy a given contaminated site or a particular area within a site.

Since decontamination process represent a synchronization of different scientific areas, it is necessary to understand it by applyinga holistic approach. The recent findings in the area of molecular biology have greatly influenced the knowledge on phytoremediation.It is interesting to mention opportunity to use and even in future to develop maybe data base like PASmiR. PASmiR is a literature-curated database for miRNA molecular regulation in plant response to abiotic stress.

Table 1. Eleven abiotic stress classes generated by manual curation

Abiotic stress	Abiotic stress type
Abscisicacud (ABA)	Hormone
Auxin	
Ethylene	
Gibberellic acid (GA)	
Cadmium (Cd)	Heavy metal
Manganese (Mn)	
Mercury (Hg)	
Compression	Mechanical damage
Cropping	
Tension	
Topping	
Wounding	
Carbon (C) deficiency	Nutrient defficiency
Nitrogen (N) deficiency	
Phosphorus (P) deficiency	
Sulphur (S) deficiency	
Hypoxia	Oxygenous stress
Ozone	
High light	Radiation
Radiation	
Ultraviolet B (UV-B)	
High osmotic	Saline, alkaline
High alkali	
High salt	
Heat	Temperature stress
Low temperature	
Aluminum (Al) excess	Trace element
Copper (Cu) deficiency	
Copper (Cu) excess	
Ferrum (Fe) deficiency	
Drought (water deficit, dehydration)	Drought, waterlogging
Waterlogging (submergence)	
Arsenite treatment	Unclassified
Glyphosate	
Sucrose	

In the past decade, the regulatory mechanisms of miRNAs involved in plant stress responses have garnered increasing attention. During abiotic stress to plants, such as drought, salinity, wounding, and high temperature, miRNAs act at the post transcriptional level in gene regulatory networks associated with stress adaptation and tolerance. More recently, a set of conserved and non-conserved miRNAs from various species regulating plant response to heavy metal exposure, have been identified. These findings indicated that certain stress conditions stimulate specific plant species to produce miRNAs involved in species-specific regulatory processes that vary highly between different species.

This web-accessible database was developed to provide detailed, searchable descriptions of miRNA molecular regulation in different plant abiotic stresses. PASmiR currently includes data from approximately 200 published studies, representing 1038 regulatory relationships between 682 miRNAs and 35 abiotic stresses in 33 plant species. Thus, PASmiR will aid in rapid and complete exploration of the complex network of miRNA regulatory mechanisms involved in plant abiotic stress responses, serving as a valuable resource for future research [13].

CONCLUSION

Soil contamination has negative effects on human health, natural ecosystems and climate change, as well as on Serbian economy. Remediation of contaminated sites in Serbia as well as sustainable soil management is a hard task for all interested parties. Results from this paper show the urgent need for establishment of soil remediation market in Serbia because it almost does not exist. Among various remediation techniques authors present phytoremediation and with it connected holistic approach. Native plants are locally adapted, aesthetically pleasing, beneficial to wildlife, require little maintenance, and can become self-sustaining [14].

In the future this issue will be significant due to the actual project of constructing of South East Stream on the Serbian territory. The paper presented opportunity to use some web-database like the PASmiR. Serbia has to create and adopt in future the National remediation strategy, thinking about getting additional value of land. The issue of finance could be solved following positive practice from European countries. The famous quote of Albert Einstein has to be recognized in the all future activities regarding soil decontamination: "We can't solve problems by using the same kind of thinking we used when we created them."

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SOLUTIONS FOR REMEDIATION OF THE LANDFILL IN ŽABARI

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ABSTRACT

Human activities generate waste materials that are often discarded because they are considered useless. The safe and reliable disposal of municipal solid waste and solid waste residues is an important component of integrated waste management. There are many illegal dumps cover the whole Republic of Serbia. Inadequate waste management is one of the biggest environmental problems in Serbia. Collected waste is usually disposed in landfill which is located in the municipalities. Landfill in municipality Žabari is problem which represents a risk to environment and public health. Project provides remediation of this landfill to minimize pollution. Meanwhile, chosen municipal dump location and transfer stations are in Cerovica.

Key words: environment, pollution, landfill, remediation.

INTRODUCTION

Waste management problems in Serbia are remarkable, and the solving of this problem has led to a critical situation in most of the region. Therefore solving waste management problems, especially municipal and hazardous is the absolute priority. Inadequate waste management threatens the environment, human health, and adversely affects on the appearance of environment and life activities. In most cities of Serbia there are uncontrolled dumps, usually located outside the settlement, but some of them are an integral part of the city. This dumps are dangerous because pollute all environment elements.

The term sanitary landfill was used to denote a landfill in which the waste placed in the landfill was covered at the end each day's operation. After closing and isolating illegal dumps, it's necessary design and build new ecological sanitary landfills in accordance with the basic principles of modern design and construction. Planning and building of sanitary landfills is only a part of a complex process of waste management, which includes treatment of waste since its formation, through amount minimization, selection, recycling, collection, transportation, disposal to landfill and recultivation. [1,2]

Necessary activities of rehabilitation and recultivation of Žabari dampsite in order to clasify it as a proper sanitary landfill which does not degrade the environment are presented in this work. These activities are anticipated by the contract Žabari Municipal Assembly and the Agency for consulting and management in ecology "ENVI tech." The Agency has also done a site selection study of a regional landfill for the municipalities of Žabari, Petrovac, Kučevo, Žagubica and Malo Crniće.

WASTE DISPOSAL

Waste generation is the result of the overall activities of each state, and is directly related to the national economy. Waste is generated in households, industry, governance and administrative institutions, and in all facilities and at all places where men lives and works. Communal waste origin, depends on the living standards, lifestyle, social surroundings, consumption and other parameters typical for broader community. According to the place of origin, solid waste materials are divided into: communal, industrial and agricultural. Quality and quantity of communal waste depend on many factors: location and source of its origin, population density, nutrition and standard of population, type of business activity, economic conditions, time of year, collection technology, type of vehicles and waste transport. According to the degree of risk to humans and the environment, waste is divided into harmless, inert and hazardous waste. [1,2,3]

Landfill management incorporates the planning, design, operation, environmental monitoring, closure, and post closure control of landfills. Waste generated in Žabari is collected in a landfill at the location about 3 km away from center the city. The nearest industrial facilities, cold storage and a mill, are located about 2 km from the dump location. Since the late eighties waste disposal is performed on this location. Area of the plateau is about 0,7 ha. Height of garbage layers is about 0,5 m, with periodic cones height of about 2,0 m. Žabari municipality has about 13,000 inhabitants and organized system of collection does not exist, as there is no communal company. For these reasons, it can not be reliably measured the daily waste amount which is transported to the dump. Besides the municipal waste originating from households, in a landfill are uncontrollably delays other wastes of different origin, including waste from slaughter of livestock. Primary waste disposal is not accompanied by any other activities to protect the wider area, and garbage is disposed without any kind of treatment. In a landfill there are no infrastructure facilities or mechanization. The dump is not fenced, so the shipment of garbage is uncontrolled.

Landfill directly influences the environment. At the existing landfill garbage is dissipates unplanned. In this state landfill is unsustainable and represents a real "ecological bomb" and potential latent source of infection for Žabari city. Thanks to the efforts of local government significant progress has been made. Agency "tech ENVI" took over the obligation to make investment and technical documentation in order to access the rehabilitation and recultivation activities of degraded area and facilitating conditions for sanitary correct waste disposal until the construction of regional waste management system.

The works provided by this project along with taking all necessary measures and environmental requirements, will enable that existing municipal solid waste landfill

Žabari to rank as proper sanitary landfills which do not impair the quality or the environment degradation and will fully serves its purpose to building a regional system waste management. The fact that the municipal assembly Žabari concluded a concession agreement with a foreign partner to collecting recyclable materials from municipal waste in their areas was taken into account in the designing of future measures at the landfill.

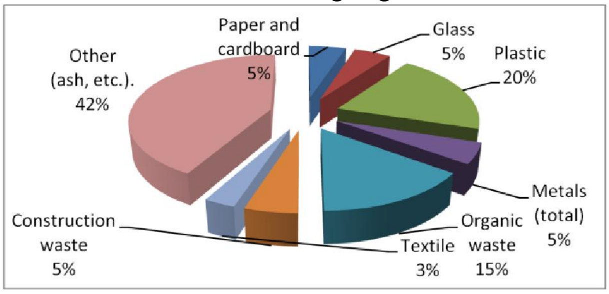

Figure 1. Morphological composition of waste for Žabari municipality

The disposal of the collected waste is a problem mainly because lack of knowledge and awareness. Waste disposal according to previous method was not performed in an organized deposition, compaction and control sanitary landfill covering. This landfill has all the features of disordered dumps (Fig.2). About 30% of degraded waste areas are burned and the two largest areas are a mixture of ruins and waste. Waste burning is done by waste collectors. This method of waste disposal and treatment has harmful effects on the environment in close surrounding because the irrigation canal is located in dump proximity (Fig.3).

Figure 2. The current dump

Figure 3. The current irrigation canal

Waste which is collected and deposited into landfill site is mostly inert and mainly represents municipal waste that has not the characteristics of hazardous waste.

Žabari has a moderate continental climate which is characterized by warm summers and cold winters. The average value of air temperature is +11.0 ° C. The average annual amount of precipitation is 758 mm. The average relative humidity is 76.7%. The predominant wind directions are east-southeast and west-northwest.

Waste dump of town Žabari is located in the basin of the river Velika Morava. Distance from landfill sites to Velika Morava river flow is about 5 km. In the vicinity of landfill, at 300 m is the melioration system channel. Analyzing topography, available hydrological data base it was concluded that the existing landfill has not influenced by high water Velika Morava river. Derived channel network draining the whole area and has function of maintaining the groundwater levels below the critical dimensions.

USING OF LANDFILL UNTIL ITS CLOSURE

According to Regulations on the criteria for determine location and arrangement of landfill waste ("Sl. glasnik RS", No. 54/92), the location landfill must fulfill following requirements [4,5]:

1. Distance between compact type settlements must be at least 1.5 km or less than 400 m if there is an artificial shelter or shelter from the geomorphologic formations. This condition is fulfilled, because existing landfill is located at a distance of 3 km from Žabari center.
2. Outside settlements dumps can not be located at a distance shorter than 0.5 km from individual houses. This condition is fulfilled.
3. Landfill can not be located on land in the narrow zone of water sources sanitary protection for drinking water. This condition is fulfilled.
4. Landfill can not be located at a distance shorter than 0.5 km from the river, lakes, and reservoirs in their alluvium. This condition is fulfilled, because the landfill is located about 5 km from the river Velika Morava.
5. Landfill can not be located at a distance shorter than 1.5 km from cultural monuments or protected natural resource. This condition is fulfilled.
6. Landfill can not be located at a distance shorter than 0.5 km from railway and bus stations, stocks of flammable materials and the military facility. The requirement is fully met.
7. Landfill can not be located at a distance shorter than 2 km from a health facility for stationary treatment, natural healing, and food industry. The condition is fulfilled.
8. Landfill can not be located within a radius of 3.2 km from the airport reference point (ARP) and 13 km along the jet runway and in the radius of 1.2 km for the other planes. This condition is also fulfilled.
9. Landfill can not be located on land which highest seasonal level of groundwater is 2 m from the bottom of landfill and in grounds with greater permeability than $1x10^{-7}$ cm/s. Since the landfill is located on a layer of quaternary age lake sediments, sand and gravel, which is covered by dusty clay sands, filtration coefficient is higher than allowed, this requirement is not met.
10. Landfill can not be located above built-in installation for artificial irrigation, and other underground infrastructure, above the tunnel, underpass, shelters. The condition is fulfilled.
11. Landfill can not be located at a distance shorter than 0.1 km from gas pipelines, oil pipelines, power transmission line. This condition is fulfilled.
12. Other objects in terms of fencing, lighting, related facilities, systems for accepting rainfall water, water from the dump body and used process waters, then in terms of prescribed waste disposal technologies, recultivation, environmental protection and monitoring of environmental impact, doesn't exists.

RECOVERY OF DUMP

Waste dump in Žabari was formed on relatively flat terrain, which over time became a location for spontaneous waste disposal. Lack of organization reflected in the fact that the garbage is dispersed in a relatively large area, mostly along the approach road while only single bigger proportion of land degraded completely. This field configuration allows disposal methods with formation of landfills in a single layer, height 2.00 m, with appreciation required protection measures of the surrounding area.

Planned remediation technologies include decorating area for receiving waste which spread over surrounding area, with the opening of large enough area for new depositing waste in a limited future. It is necessary to primarily perform land leveling for waste reception and then laying waterproofing foil (HDPE film thickness d=2 mm) on which is spread a layer of inert material with a thickness of 30-50 cm above which waste is disposed. This measure is necessary due to the geological and geomechanical characteristics of the terrain and high water permeability. On the placed foil are laying drainage pipe, then the waste disposal is performed will the waste is transferring from environment to the landscaped area.

Area is regulated in stages with defined work at every stage:

- The first stage represents development of area for receiving the daily generated waste and arriving at the site. At this stage it is envisaged location arrangement, bringing the dump to so-called "zero" state, equipping the necessary buildings and exploitation of the first cassette.
- The second stage occurs when entire surrounding waste is stored at the landfill and secured with all the technical elements of protection. This stage includes waste disposal (up to the complete filling of dump volume), landfill closure, covering with foil and inert material and recultivation area occupied by the first stage.

Recovery of landfill must be carried out as planned, while adhering to following rules: disposal begins at the lowest elevation; the cells are formed so that the daily working area is as small as possible; the cell is immediately filled up to final height; the cell is covered with inert material at the end of the day; all wastes which it is brought to the dump must be spread evenly and compacted to the required density; never leaves a bald cells for tomorrow; the slope of the working area is 1:3; adherence to the plan of filling the landfill is strictly; equipment is used according to manufacturer's instructions within the possibilities; equipment to locate in the zone of activity; ensure machinery to move only with the working head.

WASTE DISPOSAL

Waste disposal is done by "surface" cell type mode delay. Slopes leveling are done before a new waste disposal to communal waste dump, so their decline is 1:3. Then should waste disposal begin. Dimensions of cells work zone are determined depending on the volume of unloaded waste, topography, number and type of vehicles that operate on the landfill. In this case, one vehicle and single machine is used so the cell size depends exclusively on the amount of drive in waste. Thickness of drive waste which is spread evenly should not be thicker than 0.2 to 0.4 m. The projected height of the cell that satisfies the landfill capacity should not exceed a height of 2.0 m. Depending on the flow of waste to the location, dimensions of the cells will be formed by the authorized person who will operate the dump. Cell dimensions are formed in parallel rows to the dump working forehead, in accordance with the filling plan for cassettes. The cassette will be closed after one year of dump operation. At the dump location is necessary to predict the location where will be placed three-month reserve of inert material for daily waste cover.

Only permitted disposal on the dump is waste with no qualitative and quantitative properties that would endanger the environment and human health. At the dump may be deposited: communal waste, inert industrial waste, waste from public areas, waste from non-industrial company and administrative structures (institutions, schools), ash, agricultural and construction waste. At the dump should not be disposed: the remains of dead animals, industrial waste that is not biologically and chemically neutral, industrial waste that can be used as secondary materials, machine and motor oils, waste from health facilities, radioactive, biochemical and chemical waste, batteries and classical batteries, tires, flammable substances and explosive materials, fecal matter.

After bringing waste in the working area, waste is spreads by bulldozer and flattened to layers 0.2-0.4 m, and compacted using a multiple bulldozer moving over spreaded waste. On formed waste layer is applied a new layer and spreading and compaction operations are repeated during the day. For waste flattening and compaction at Žabari waste dump crawler tractor with a bulldozer and ripper device, and a truck with a trailer load to 10 t is enough.

Communal company in Žabari did not existed. Communal company in Žabari did not existed, so it was necessary to form it as soon as possible or to conclude a contract with another communal company from nearby towns which would collected and transported the waste to the landfill.

FACILITIES AT THE LANDFILL

In the admission and dispatch area are located entrance gates, reception desk, wheel washing ramp and facility for storing secondary materials. Admission and dispatch area is arranged in compacted poured materials (gravel, stone debris).

System for evacuation and treatment of leachate consists of drainage pipes, concrete reinforced dual chamber precipitator and tanks for receiving precipitator water. For leachate water evacuation, drainage system is projected**.**

System for evacuation of atmospheric waters is circumferential grooves that are built to protect against penetration of atmospheric waters into the dump body and receiving waters which are flowing from the dump.

System for drainage of landfill gas makes biothorn system projected to controlled removal of dump gas in order to prevent damage to crops, property and people injuring due to possible gas explosion. In the case of Žabari municipal dumps is planned passive way of draining gas from the landfill body - through degassing wells which caused evacuation of gases from the dump body. Degassing wells form a whole which consists of wells foundation and perforated PVC pipe.

MEASURES FOR DUMP RECULTIVATION

Upon completion of the filling all cassettes or at the time of joining the municipal Žabari to the future regional waste management system, landfill final layer should be form by covering the entire dump with 20 cm thick inert material with a slope for decline (from the center to the edge in a slope of 0.5%). Through the placed layer is placed waterproof foil or clay material (technical recultivation).

Because of the environment of the landfill Žabari, in accordance with modern technical solutions, the final layer covering is projected with waterproof PE film thickness of 2 mm. Over foil is embankment soil layer thickness from 50 to 100 cm for planting plants (biological recultivation). While filling up the layer for recultivation must be taken to extend the bio thorns that would always be above the top of the landfill. Closing (laying the foil and recultivation of the landfill) should be approached six months after filling the entire space allocated for waste disposal at this location, or six months after filing and sanitary control filling up the last cassettes in order to allow time for settling of waste disposed waste.

CONCLUSION

Waste disposal, collection transportation and disposition are one of the main problems in Republic of Serbia. Landfills are make in places that have been close to the settlements and in areas where did not perform any technological measures for waste disposal, contrary to the rules. Numerous landfills are not formed by the technical and hygiene regulations. We are facing a very difficult task in rehabilitation, re-cultivation and expansion of already existing, until they build a new regional type sanitary landfill of communal solid waste.

Performing all works provided by this project, including all necessary measures and environmental protection requirements, the existing Žabari landfill will be classified in proper sanitary dump that does not undermine the quality and does not degrade the environment. Municipality Žabari plans to make communal landfill and transfer station in the place Cerovica.

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PROTECTION SURROUNDING WATERCOURSES MINE DUBRAVE USING SANITARY WASTEWATER TREATMENT

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ABSTRACT

This paper presents methodology, as well as part of the practical results of applied technology for sewage and wastewater in the mining circle and workshop-mounting plateau of open pit mine "Dubrave". The goal is to define the input variable (load) given through the quantities of wastewater that it is necessary handle with appropriate technological process in the so-called BIO-DISK installation. Wastewater treatment is carried out in order to protect the surrounding streams and reduce pollution in the immediate vicinity of the open pit. This paper presents a brief (concise) description of the plant BIO-DISK.

Key words: open pit mine, wastewater, treatmant of wastewater, environmental, alluvion.

INTRODUCTION

In the process of opening, development and operation of the mine, as well as supporting the construction of mining facilities and other essential infrastructure, the environment, the existing natural watercourse, river basins, as well as underground water flows are being significantly affected in terms of contamination with materials of organic and inorganic origin. To realize the projected annual production of surface pits engage numerous basic and auxiliary equipment and machinery, as well as a relatively large number of workers of various professions. All this leads to an increase in "load" and direct pollutions of man's environment [1,2,3,4,5].

With a view to meeting the regulations defined by the legislation and the need to achieve progress towards the protection of the environment started with the construction of a unique system of drainage and of treating waste and contaminated (polluted) water in the open pit Dubrave. After treatment of wastewater in the plant suitable production processes, achieved satisfactory water quality parameters, which allow her casting and release into the surrounding receptors (watercourses), without the risk of contamination[2,3,4,7].

MATERIALS AND METHODS

Sanitized (clean) water for the purposes of the administration building with a bathroom, a restaurant, etc. provides urban water supply in the capacity of Q=2.0 l/s. In the mining industry circle, the so-called "external water supply system" is derived independently from the municipal water supply. It is designed to meet the needs of industrial and process water and protection against fire. Industrial water is obtained from deep wells constructed in the crater pit with a capacity of $Q=80\ m^3/h$.

All rainwater are accepted and taken away to the recipient (stream Velakovica). Precipitation waters are accepted through the so-called "roof outlets". With intensive traffic on surface, wastewater and rainwater are previously processed in the separator of petroleum products, and then discharged into the network relatively clean rainwater or directly into the watercourse [6].

Wastewaters generated in the industrial circuit and the open pit, were filtrated by the device type BIO-DISK (Figure 1). After treatment in the above mentioned device, the water is discharged into the stream Velakovica by collector. Precipitation waters do not lead to the BIO-DISK device.

Figure 1. BIO-DISK plant for wastewater treatment at the mine Dubrave

Load that is projected BIO-DISK, device for wastewater treatment:

1. Maximum number of workers in the first shift is 600 workers with distribution kitchen capacity of 600 meals
2. Not provided the additional load on the device,
3. For kitchen wastewater is scheduled appropriate separator oil and grease, so as not to be disturbed the process of biodegradation in BIO-DISK device,
4. Configuration of the field conditional installation pumping station in front of BIO-DISK device,
5. Industrial waste water can not drain to the BIO-DISK device,

6. Recipient of purified fluid is Velakovica stream,
7. After the biological treatment, the liquid will have the following parameters:

- $BPK_5 < 20$ mg O_2/l
- Suspended solids < 20 mg/l

The device BIO-DISK 420 ES is a compact device made of steel plates and profiles, and covered with a lid made of polyester laminate. The complete unit is placed in a reinforced concrete tank.

The components of the device BIO-DISC are: reservoir, semi-circular groove within which the biological process takes place, rotor, drive system and cover. Reservoir contains primary and secondary sedimentation tank. Precipitators are separated by partition while allowing accommodation semicircular grooves so-called bio-zone. The rotor consists of a steel shaft (shaft) to which are attached to the frame by means of disks made of polyethylene mesh. It is fixed by means of two-line semi-tuned roller bearings and positioned so that approximately 40% of discs are constantly immersed in the liquid, while 60 per cent were in contact with air. Rotor drive provides a relatively small electric power P=0.75 kW. The rotor drive is achieved by double worm gear and chain transmission. Speed is 0.48 turns/min. These are also all moving parts of the machine, thus the possibility of failure is minimized.

DISCUSSION

Purification process using a device, with rotating biological discs, requires primary separation precipitating particulate materials. Primary settling tank or cesspool was placed under the bio-zone and that separates approximately 50-70 per cent of suspended solids and 30-50 per cent of input BPK_5 load. Afterwards, the liquid passes through two flooded holes in the bio-zone, where the starting biological process. Therefore, in the primary sedimentation tank, beside larger particles specifically heavier than water, separated the particles lighter than water, forming a surface crust. The discs used as solid support for the growth of micro-organisms are placed to the spacing of 16-19 mm, in order to prevent bridging.

After a few days of normal operation, active biological fouling caught on disks in thickness of 2-4 mm. Biological fouling is updated slowly turning disc and alternate passing through waste water and air. When the disc emerges from wastewater fond film composed of living organisms takes oxygen from the surrounding air. When the film becomes too thick, due to friction in passing through the waste water, come to the shear surface layers of the film and its decay in the primary sedimentation tanks.

In order to ensure the best possible contact between the microorganisms and liquid bio-zone is divided into five sections separated by dams with weirs. With such designed envelope performance of faraway "zigzag" stream of liquid. Consequently, disks are divided into five packages. Five mutually separated degrees of biological treatment causes, the biodiversity of adapting environmental conditions in a given instance.

The first two sections were cut in the bottom. Therefore, particles of active sludge, which are due to friction with the surrounding fluid flung out of the first two disc package, sinking into the primary settling tank. The next three sections of bio-zone, particles that were fallen from the disc are retained in suspension using of special blades that cause turbulent fluid movement near the gutter. Because of this precipitation occurs only in the secondary sedimentation tank. Clarified suspension run out gravity from wastewater treatment plants. Sludge pumping is done 2-3 times a year, and is done using a water truck with a built-in pump or using regulated sewage pumps.

CONCLUSION

BIO-DISC is a modern compact device for complete purification of sewage water in small community of people. Can be placed above ground or buried in the ground. However, due to the very favorable aesthetic appearance fits easily in the environment and are commonly placed above ground.

The device is constructed so that the lattice and tanks for balancing of flow are not required. Raw sewage water is fed through a pipe directly into BIO-DISK, is being treated in the unit and can directly engage in waterways, sea or devices for tertiary treatment. The flow of water through the entire system is gravity. The quality of treated water is within the boundaries of BPK_5 <20 mg / l and suspended solids <20 mg / l, if the load is within the prescribed limits. Maintaining the unit is very easy and inexpensive. BIO-DISC requires extracting sludge from 2 to more than 3 times a year. Consumption of electricity is minimal, which makes driving charges on the unit is very cheap.

By this technological solution is partially solved the problem of environmental pollution by waste water on the open pit mine Dubrave. Further investment in more advanced systems of waste water treatment besides raising awareness about the need to protect the environment, directly contributes to a better and healthier life of the human population.

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IMPACT OF ACID RAIN ON THE ENVIRONMENT

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ABSTRACT

Due to the natural and anthropogenic factors of the environment is in increasing danger. In the air there was a phenomenon of smog, acid rain, the greenhouse phenomenon and creating holes in the ozone layer. The aim of this paper is to highlight the problem of environmental pollution and acid rain show ways to solve this problem.

Key words: acid rain, environment, solution.

INTRODUCTION

Contamination of land by rainfall comes into the soil from the contaminated atmosphere. Many industries intensively dischargepollution into the environm ent. The most intense emissions of pollution are in chemical industry, oil refining, steelworks and ironworks, galvanizing plants, battery manufacture, stone processing, paper industry and pulp industry, power plants operating by coal and fuel oil, coke industry, cement factories. Industry creates pollution in the normal mode, and numerous cases of accidental discharges of pollution are recorded with local severe consequences, fig.1.

The largest amount of pollution releases into atmosphere, a small part comes directly into the soil or groundwater. Air pollution ends before or after with rainfall in the land. It could come from local and remote sources. The biggest polluters of land are acids, particularly sulfur compounds. When obtaining sulfuric acid, nearly whole sulfur (IV) oxide, which is obtained by oxidation of elemental sulfur or ore melting can be converted into sulfuric acid. If the process is not completely efficient, then the emission of SO_2 is higher in the atmosphere. Sulfur compounds acidify land which affect the buffer capacity of the soil. Greater resistance to acidification have the land rich in calcium. Acidification has as a result a change in pH, leaching of nutrients and interfere with the growth of plants due to the release of toxic compounds of aluminum and certain heavy metals. In addition to acid, heavy metals, lead, arsenic, cadmium, and less zinc are entered in the land. Modern industry is characterized by giant factory plants, especially in steel, automotive, oil and gas and heavy chemical industry, which synthesize vast tonnage of certain toxic substances. Industrial pollution can contaminate land caused by atmospheric layers.

Figure 1.. Discharge of polluted gases in the atmosphere

Primary pollutants during the production of phosphoric acid are gaseous fluoride (HF and SiF_4). They generate from natural raw materials, which usually contain 3.5 to 4% of fluorine in the rock. Phosphatic fertilizers are divided into two groups. The first group are superphosphates, and the other is a plain ammonium phosphate. Superphosphate is a name comes from high content of phosphorus in the fertilizer. Primary pollutants during the manufacture of superphosphate are dust, HF and SiF_4. The rocks, which are used for the production of fertilizers have high phosphorus content, and may also contain heavy metals, lead, mercury and mildly radioactive, because in nature uranium has a high affinity for phosphates. Constant fertilizing of farmland makes uranium content steadily increasing in them.

During the production of paint, 1 to 2% of solvent is lost getting into the atmosphere. Soap production having no hazardous organic substances in the course of this process significantly pollute the environment, besides the pollution that comes from the unbearable odour. During the production of detergents, there is fine dust and gases enriched with organic vapors. Benzene, toluene and other compounds can be found in traces, descended from organic matters added to the detergents dissolving at temperature from 300 to 400ºC during drying the detergents.

During the production of chlorine Cl_2, H_2, CO_2, CO and mercury vapours are released.

During the production of explosives follows can reach in the environment: toluene, sulfuric and nitric acids, via waste water or in the form of vapor during drying. Especially sulfide solution with nitrotoluene isomers must be filtered by this mixture to avoid contamination of natural waters. This mixture is usually concentrated, and then burned.

During the combustion of coal SO_2 emission occurs, which directly depends on the quality of coal, respectively sulfur content in coal. Almost all sulfur is converted into SO_2 and comes into the atmosphere. CO emission depends on the quality of the combustion chamber in which coal burns. When oxygen supply is a better, CO emission is reduced. NO_x emission depends on the temperature of coal combustion, as higher the combustion temperature as the creation of nitrogen oxides is higher. During coal combustion dust emission ocurrs, and in the large plants flue gases and many harmful elements present in coal: Hg, As, Mn, Ni, Cd emit too.

IMPACT OF ACID RAIN ON THE ENVIRONMENT

Primarily emitted gaseous oxides of nitrogen and sulfur, after a series of gas-phase and heterogeneous reactions can, dissolving in water clouds, make the precipitation of pH value lower than 5.6. This value is obtained by dissolving carbon dioxide in fresh water, along with hydrogen and bicarbonate ions. All precipitation with a pH value lower than the specified commonly called acid rain. When the acid oxides of sulphur and nitrogen finally find themselves in contact with water in the cloud, wherein quickly dissolved and react by increasing the concentration of hydrogen ions, which lead to a reduction in pH. This dissolution in the cloud water is one of the most effective ways to remove pollutants from the atmosphere. The speed of this process depends on many factors, particularly the type and concentration of pollutants, as well as size and temperature of drops in the cloud. Another process that also leads to the reaction between acidic substances and the precipitation is a process of ablution under the cloud. Although through this process the raindrops are enriched with acidic substances, the time for their mutual reaction is relatively short, and it is of less importance for creation of acid rain, but it is very important to rinse particles from the atmosphere. However, if the intensity and duration of rain longer, then the rinse under the clouds may contribute significantly to the deposition. In the case of sulfur dioxide, which dissolves easily in water giving sulphite and bisulfitne ions, the concentration under the clouds falls below half after two hours of heavy rain. The evaporation rate of nitrogen dioxide is lower due to its lower solubility in water. At larger distances from the source most of wet deposition of sulfur dioxide comes for rinse under the cloud. Closer to the source, where the concentrations are higher, primary processes important for the deposition take place in the cloud. Of total deposition of acidic substances in Europe, 60% to 70% of sulfates and 30% to 40% nitrate come to the surface by acid rain.

While sulfates and nitrates are the main sources of acid rain falling on the land, as long as chloride ions are basis of acidity for precipitation above the sea surface. When air currents bring clouds from sea to land, it can be shown that the dominant ions in aqueous sediment are chlorine and sodium ions. The most important single source of alkalinity in the atmosphere resulting from human activity is ammonia. In large quantities it is produced by waste material burning, especially plastics, as well as oil refinery operations, but the farther largest source of ammonia is the use of chemical fertilizers. The highest concentrations of ammonia in precipitation are in the time of intensive agriculture, in spring and autumn. In regions with intensive agriculture ammonia emission can exceed the emission of acid gases. This is well confirmed by the increase in pH values of precipitation, which in some agricultural areas may reach values above 8. Due to the reduced solubility of sulfur dioxide and the oxidation rate at lower pH values, it is considered that the lower limit of rain water acidity around pH 3.4. However, suspension of acid droplets and mist may have lower pH (below 2.8). This is particularly evident at higher altitudes because the lower atmospheric pressure and the changed conditions of evaporation for small droplets, can lead to an increase in the concentration of acid in them. Such intensely acid mist at high altitudes can significantly damage the forest vegetation.

THE EFFECTS OF ACID PRECIPITATION DEPOSIT

Polluting substances come on aquatic and terrestrial areas due to wet and dry deposition. Speed of dry deposition depends mainly on the nature of the receiving surface (vegetation or sole land). In the case of wet deposition the nature of the receiving surface does not play a significant role, but the concentration of dissolved gases in the water of the clouds and their concentration in the air are important. Acid rain and increase in acidity of freshwater systems are subject to increased interest in the last twenty years. However, the problem is not new, since the decline of fish populations in some Scandinavian lakes is recorded in the twenties of this century. Some examinations in Scottish lake sediments have shown that the gradual acidification started in the middle of the last century. However, it is certain that the acceleration of this process is related to the period of a few decades ago.

The acidity of the land is increased by acid rains leading to increased mobility and rinsing some nutrient cations. Forest vegetation significantly involves in acidic substances depositing not only direct but also by surface adsorption. Later this rain washes the adsorbed substances from leaves and branches of trees to the base tree whichby certain substances in the increased concentration enter in the forest land. This is especially the case with the sulphate whose input can reach tens of g/m^2 per year in certain types of forest land. However, the measurements performed over a short period of time (less than 10 years) suggest that, in the affected regions, sulfur intake and the amount to be detected in the torrential waters nearly the same. While this amount of sulfur retained balances with its input, in the case of nitrate rinsing out is much greater, so less than 30% of entered nitrogen stores in the soil. This is probably the reason for the considerable areas of poor land in the regions exposed to acid rain saturated by sulphates, but contain very little of nitrogen components. Due to the reduced solubility and oxidation rate of sulfur dioxide at lower pH values, it is considered the lower limit of acid rain water around pH 3.4. However, suspension of acid droplets and mist may have a lower pH values (below 2.8). This is particularly evident at higher altitudes because the decrease in atmospheric pressure and the changed conditions of evaporation of small droplets, can lead to an increase in the concentration of acid in them. Such strongly acid mist at high altitudes can significantly damage the forest vegetation in the equatorial zone, where warm air masses rise over the tropics. This rising stops after tropopause because the temperature begins to increase with height. Here polluting substances may remain for a long time before they are moved to the north (or south) and then for cooling the air with which they move, back again into the troposphere. This is essentially the only mechanism by which polluting atmospheric substances are transferred between the hemispheres. Carrying the emitted gaseous polluting substances, there may be episodes of highly acidic precipitation, often a thousand or more kilometers from the polluters. Such conditions are often encountered over the northeast United States and Northern Europe.

The increase in concentration of acid anions in the land enlarge the level of exchange between H^+ ions and alkali cations of potassium, magnesium and calcium, which later leads to their faster rinsing. The most sensitive land to the acid rains is that one does not contain limestone, sandy, with a pH value of about 6 and a low content of colloidal material, through which water easily percolirate. On the other hand, a lot of land containing different buffer systems that resist change in pH. In acid soils (pH 2.8 to 5) in a series of ion exchange reactions may change the mobility of aluminum. If acidity is increased there are more protons than the available quantity of divalent cations of calcium and magnesium, so trivalent cations like aluminum are used for substitation with protons. This process causes the release of aluminum from the land and its transfer to the soluble form.

If the land is more acidic (pH less than 3.8), and iron becomes more mobile and can be partially rinsed out of the land. All these cations, or their compounds, followed by the torrents, melted snow and similar processes come to watercourses and lakes. As a result of ion exchange, at the increased content of H^+ ions, the base cations are released, which then usually binded with sulfate and in this form rinsed out of the land. The mobility of metal ions generally increases with increasing of the soil acidity, especially where there is a low content of organic matter (humus). The usual core component in the atmosphere is ammonia, which in the form of ammonium ion dissolved in rain droplets or aerosol particles can be deposited on water surfaces and in land. The main effect of the additional deposition of ammonium ions is the increase in the land capacity to neutralize the acidity. Otherwise, acidification the land has an additional effect - to prevent ammonia goes from the soil through denitrification process, because this gas can not be released from the ammonium ion if the land pH is lower than 8.

THE ACIDITY IN RIVERS AND LAKES

The pH range between 5.7 and 5.2 marks the boundary between life and death for many organisms in fresh water. In the waters containing sufficiently bicarbonate ions there is significant buffering capacity for resisting change in pH; and in such waters pH is above 5.4. In the waters where there is no bicarbonate, as a consequence of acid rain efects, pH can have much lower values, fig.2. Many studies have shown significant changes in the acidity of freshwaters in Scandinavia and eastern parts of North America. The tests of ice in the northern polar regions show that there is a gradual decrease in pH of 0.007 units per year for the last thirty years. The measurements show the greatest impact in spring, which coincides with the movement of polluted air in the polar regions. As there is no similar change in the area of Antarctica it is clear that this increase in acidity should be attributed to the effect of industrial activity in the Northern hemisphere, which is inhabited by 90% of the population of our planet.

The only way to reduce acid deposition is to control the emission. However, even it gets significant reduction, the recovery process would take a long time, although it still depends on ability of the environment to neutralize acidity. Some lakes in Canada have recovered relatively quickly, within a few years. It is estimated that the emission reduction would be required by 90%, so at some point in time, the current acidic surface water to be back into its original state. To maintain the present, already bad condition, the emission reduction of 30% is needed.

Figure2. Effect of acid rain on lakes

IMPACT OF ACID RAIN ON PLANTS AND ANIMALS

In addition to the above mentioned metal cations rinsing from the land, the immediate consequence of acidic atmospheric precipitation on vegetation is not easily determined. The acid precipitation will contribute to further damage if the vegetation is already threatened by the influence of other factors. The degree of direct damage to leaves of acid rain depends on numerous factors. Thus, the contact time of acid droplets or film on the surface of leaves and drops of acid concentration determining the degree of damage. Factors such as temperature, humidity, wettability and morphology of leaf, the wind presence and alike affect the contact time, and thus to the degree of damage. The contact time between the vegetation and the acidic substance is greater in situations where fog and low clouds are present than when normal rainfalls appear. This additional inclusion of moisture from the atmosphere is known as a hidden precipitation. The measurements carried out under the conditions of hidden precipitation show that the concentration of ions as H^+, $SO_4^{2-}$and NO^{3-} 2 to 4 times higher in fog and cloud water than in rainwater. However, the damage to the leaves under natural conditions, the same as that in the controlled experiments can not be attributed with certainty to the direct effects of acid rain. Truly, some defects are observed, particularly in coniferous trees, in the areas that have been more exposed to the effects of acid precipitation. However, it seem that the immediate effects of wet, acidic deposition on leaves and needles are not the primary explanation for the decline of forest complexes. According to the widely accepted opinion, nutrient cation rinsing is one of the main reason for decline of forests. Nearly 10% of the forests in Germany is in the process of degradation due to the effects of acid rain, and out of about 3.4 million hectares of Austrian forests covering 44% of the national territory, consisting of coniferous, oak and beech trees are affected approximately 600,000 acres. The extent of real disaster reaches the national situation in Poland, where 400,000 is affected, as in the Czech Republic and Slovakia, where 500,000 hectares of forest are affected. The consequences are evident in our woods, somewhere the effects of acid rain manifest in milder cases, while in some areas the process of drying leaves and trees is present.

The most serious effects of acid rain are on freshwater systems. Many studies have shown that the presence of aluminum is critical parameter, and its level of toxicity depends on the level of acidity. The examinations on metal toxicity have shown that aluminum rinsed out of the land and sediments is highly toxic at pH 5.5, and its toxicity is reduced at lower and higher pH values. The concentrations of free aluminum greater than 30 $\mu g/dm^3$ can be toxic to wildlife, especially at low concentrations of calcium. The examinations on the mechanism of aluminum effects have shown that its hydroxide is adsorbed on the gills of fish and interacting with sodium and calcium disrupts the normal osmotic pressure in cells. The main cause of the fish extinction in acidic waters of the loss of ions from the cell fluid, primarily sodium, which may not be fast enough recovered.

As for lakes, the biggest damage have been found in Sweden and Norway. Out of around 5000 examined lakes in southern Norway, the fish stock has been destroyed in 1750 lakes, whilst 950 is dangerously at risk. In the southern and central part of Sweden the loss of fish stocks has been noted in 2500 lakes, and serious signs of losses in even 6500.

Aluminum and heavy metals (lead, cadmium, mercury) released by acidification are concentrated in fish and invertebrates that birds eat, so getting into the food chain. Due to leaching of calcium from the land the concentration of this metal is reduced in the leaves caterpillars eat. This leads to the accumulation of aluminum and heavy metals and the impoverishment of calcium in the diet of birds, which results in poor calcification of their eggs. The result may be a decline in the population of certain bird species, as it has already been observed in some affected areas.

CONCLUSION

The main responsibility for the damage caused by acid rains is of power plants, smoke from the households and exhaust gases of traffic. The damages caused by acid rains usually occur quite far from the actual harmful sources. The tests show that sulfuric and carbon acid have the greatest responsibility for the acidity of rain.

The reduction on acid rain emissions is achieved by:

- the control and reduction in emissions of oxides of sulfur and nitrogen,
- adding limestone to the lake and surface accumulations,
- removing sulfur from the fuel before use,
- installation the devices to reduce emissions of SO_2, NO_x, CO_2 at existing power plants,
- washing the coal before combustion,
- installation the automotive catalysts.

Approach to this problem should be individual. Anyone can make a small contribution to reducing greenhouse gas emissions into the atmosphere just consolidating power in the following way:

- turn off the heaters, lights and other electrical appliances when not needed,
- use electrical appliances that are energy efficient,
- use public transportation whenever possible,
- always be well informed how you can help to reduce greenhouse gas emissions and so on.

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DIFFUSION OF WIND ENERGY, PUBLIC ATTITUDES AND NIMBI EFFECT AN ITALIAN CASE STUDY

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ABSTRACT

There is a new challenge to face in the coming decades, the development of an efficient, safe, sustainable energy system which reduces the environmental impact. The development and diffusion of renewable energy technologies is more than important, it is crucial for humankind, as Georgescu Roegen emphasized it in the 70s (Georgescu 1976). The transition from fossil to renewable energy is not as easy, there are many obstacles ahead. Renewable energies are well developed in recent years but are still resistant. This study reporting a brief history of the development of wind energy and the current state of the art, and after, analyzes the causes of slow development of wind energy. The study compares different cases in the literature of installation of wind power in various countries, considering the behavior of people and institutions. Finally, it examines a new case of failure of a participatory process for building a wind farm in Apulia, Italy.

Key words: wind energy, NIMBY, sustainability, environment and climate, energy efficiency.

INTRODUCTION

A crucial challenge to address the present economic and environmental crises is to develop energy systems which are efficient, safe, sustainable, and with low global and local environmental impacts. The use of renewable sources helps lowering carbon emissions, energy costs and decoupling energy prices from oil ones (GWEC 2011). The EC energy policy adopted in 2007 prescribes to get, by 2020, a reduction of greenhouse gas emissions by 20%, and improvement in energy efficiency of 20%, and an increase in renewable energy share of 20% (EC 2007) (Eurostat 2012). Wind power could give an important contribution to overall sustainability not only due to its very low emissions, but also since it does not produces toxic waste and does not use water. Wind energy has unevenly developed in different countries despite a rather widespread support for it. In some instances concrete plans are being blocked (Nimby forum 2011). The main cause of failure of these projects is attributed to the Nimby (Not in my backyard) syndrome. There are, however, other and more relevant barriers, i.e., institutional factors, democracy deficits in the planning system, and lack of qualified support for developing of wind power. In this paper we will look at seven countries (the United States, Nederland, UK, Germany, Sweden, Spain, and Italy) by comparing six case studies reported in the literature with a new one which is about the failure of a participatory process for the construction of a wind farm in South Italy (Apulia Region).

MATERIALS AND METHODS

The first windmills were built in 200 BC in Persia. Later on they played an important role in the Netherlands, in Mediterranean regions, and in the 19 century they were built in the US. The interest in wind energy increased during the 1970s oil crisis (Kaldellis 2011). In recent years, wind energy technology has been developed in almost all countries. China has the biggest installed capacity, with 62733 MW followed by the U.S. (46919 MW) and Germany (29060 MW) (see fig.A 1). The situation by continents at year-end 2011 is summarized by figure A.2 (GWEC 2011).

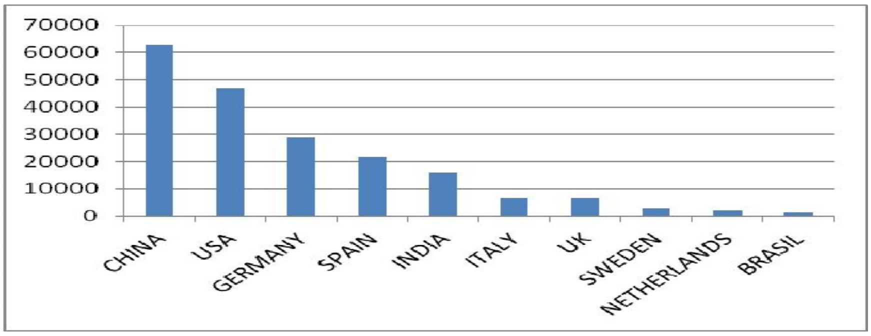

Figure A 1. Distribution of Wind Power Capacity (MW) in Major Markets (2011)

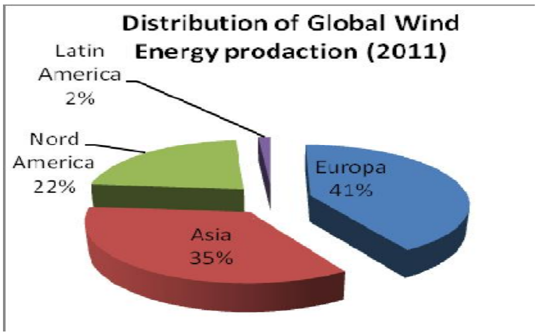

Figure A 2. Distribution of global Wind Energy production(2011)

Public attitudes of wind energy, local obstacles

In recent years, major development of wind power has occurred in Germany and Spain. In Germany several laws supported wind power and the involvement of the population, especially by encouraging cooperative investments. The ownership of wind power has led to a higher level of local acceptance (Fabian 2011). In the UK, Netherlands, and Sweden there has been some resistance which can be attributed to institutional factors, in particular to a top down approach, and to the lack of location policy (Wolsink 1999, Christopher 2010). In Sweden and in the Netherlands there has been opposition from environmental groups which stimulated a negative attitude from the population (Patrik 2007, Christophe, 2009). Since one of the main obstacle to the development of wind farms in the countries analyzed here is the visual impact, the process of choosing the appropriate site for wind power is very relevant. In Sweden, the legal protection against activities with visual/environmental impact is strong and investors are discouraged by the long time required for getting permissions. Local administrations have great decision power, also against national energy planning (Patrik 2007). The lack of discussion/participation in the choice of the sites, and in planning processes more in general, is a common feature of most countries, so that it is not appropriate to speak of "nymby" syndrome, which implicitly requires awareness of the projects. In Spain there has been a good development of wind power, despite the large number of authorities involved and the lack of coordination between them resulting in a long waits for the permits (De Rio 2011). The U.S. population is in favor of the wind power because this technology is supported at the political level. The resistance of local population is born because of the visual impact and loss of value of the land/houses that are located within the area chosen for the construction of the wind farm. Some studies have shown that if people living near wind turbines they get used to them and the level of acceptance increases, that is, the presence of a wind farm is more accepted than the prospect of it. Also the value of land and houses has been seen to lower when the park is under design and construction, but tends to rise when the farm has been built (Klick 2010).

Italian case study

The observatory nimby forum (Nimby Forum 2011) has observed an increasing opposition to new infrastructures. In southern Italy, Puglia region has invested heavily in renewable energy, especially wind power. However in recent years the number of legal disputes have increased, involving municipalities, the regional government and business investors. The case we report here is about a conflict between the company Wind ERG, the Region of Puglia and the town of Conversano, the site chosen for a wind park. We examined legislation, press releases and newspaper articles, and archives used for officials involved in the process. We also interviewed key actors such as civil servants at the regional and municipal levels, entrepreneurs and investors of the project, political associations, environmental groups and local population. The project was submitted February 2, 2007 by ECE-ERG CESA WIND SpA. The park was planned in area of Conversano, a small city (25.000 inhabitants) situated in a rural area called "Murge Castellana". The project involved the construction of 28 towers on an area of 10 km2, an investment of 88 million Euros with a run of about 2080 hours per year. From a legal standpoint, the production of energy in Italy is a matter of law concurrent State/Region. The Puglia regional government regulates the matter through specific regional laws in which plans to install wind turbines are approved also by inter-municipal panel of local authorities. In this case a first positive opinion was expressed by the municipality of Conversano, the population was involved in a series of meetings, and local media gave a good coverage of the debate. The environmental groups highlighted several positive issues, the arrangement of the blades out of the corridors migration and spawning, the positive impact on the development of local jobs and the improvement of 'energy sourcing, and the low environmental impact of wind energy. The political opposition strongly opposed the project, mainly for the sake of discrediting the mayor and his council. The council was unable to appropriately defend his choice so that the initial favor of the population converted into disagreement. In 2008 the same municipal council withdrew the authorization. The company appealed to the administrative appeal tribunal. The appeal was rejected in June 2011 since, according to the court, *"interventions and associated works would result in a transformation of the structural, historical, and natural landscape of the area. The site of interest is also a strip of land that fits into the landscape of the Valle d'Itria, characterizing the portion of the Murgia territory of South-East where the architectural elements, trulli, farms, stone walls, must be safeguarded and enhanced*.

RESULTS AND DISCUSSION

Opposition from the local population is often labeled as a Nimby, "not in my backyard", that is, people do not want a plant in their territory but would not object if it is installed elsewhere. The reason for this opposition is the usual free-riding argument Actually, much local opposition arises from a distribution of advantages and disadvantages that heavily penalize the local population or from authoritarian and non-participatory methods by which the projects are approved (Martin 2009). Local oppositions can be classified according to a broad spectrum of categories, such as those shown in Table A 1.

Table A1. Various forms of local opposition (Wolsink 1989)

A	Positive attitude towards the project, but opposition to the construction at any point in its neighbour hood	NIMBY Non in my backyard
B	Negative attitude against a given technology	NIABY Non in any Backyard
C	Positive attitude towards the project becomes negative during the decision process	
D	Opposition to specific aspects of the projects and request to meet certain conditions	

Wind farms have a broad social support in the countries analyzed here, around 70%. Specific attitudes toward a given project is very variable (Henley 1998). There are several local actors: institutions, political parties, environmental groups, companies investing in the project. The kind of opposition that will be made depends on the ability of various actors to convey their beliefs about the construction of the project, where institutions have a strong power. In meetings with the stakeholders, the population can easily move opposition from type A and B to C and D. The case study reported here showed a shift from no opposition or NIMBY to C type. This confirms that the development of resistance to wind energy is mainly due to institutional mechanisms(Lake 1993). To avoid deterioration of support from the public, the institutions should make a fair and appropriate steps to raise awareness and involvement and also make an appropriate regional energy planning (Luloff 1998). The involvement of the population should be given from the beginning of the planning phase and continue also once the plant is in operation (Pendel 1999). Our result is consistent with several studies by Wolsink, (e.g. 1999) who which analyzes public acceptance using a multivariate technique on a set of interviews(see figure A.4).The relationships between positive and negative impacts and the general attitude of the initial population and the local resistance which is formed later are analyzed. Wolsink has revealed that only two major factors determine the general attitude of the initial population, the negative visual impact and the positive impact of getting clean energy. There is no direct relationship with: the impact due to noise, the problems of wildlife (ANNOY), with syndrome Nimby let alone with the effectiveness of institutions. While on the resistance developed by the population at the local level as a result, all impacts have direct relation, it is noted therefore that the only impact that has a double importance is that visual that interacts both in the first phase of attitude in the second of resistance to project (Wolsink 1999).These evaluations emphasize again that the Nimby syndrome has a limited role, and has fundamental importance of visual impact assessment and therefore the choice of sites.

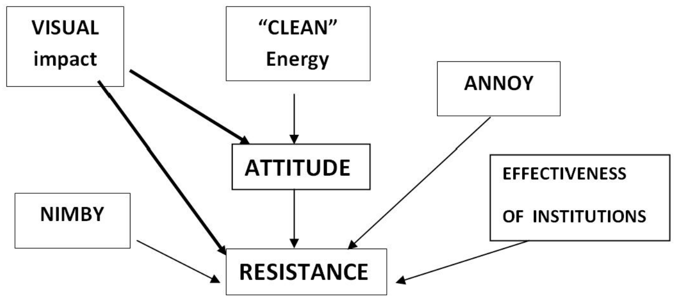

Figure A.4. Direct and indirect impact of arguments and motives on resistance to wind turbine projects

The literature survey and our case suggest adding the picture the behavior of the institutions as a key variable able to influence actual attitudes opposition, especially through participatory planning rather than a top-down decision-making approach, information/education of the population, planning skills.

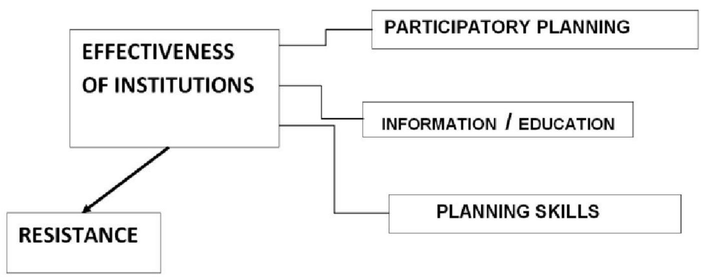

Figure A 5. Extrapolation scheme in Figure 4 A, addition of new variables significant

CONCLUSIONS

From an environmental point of view, wind energy is a good option. From an economic point of view it must be noted that in recent years the global crisis has led many countries to raise tariffs for renewable energies to create barriers to trade, thus jeopardizing the ability of the wind industry to develop, and dramatically reduce the level of international technology transfer (GWEC 2010). In our opinion, the main obstacle to its development, however, is given by inadequacies of the institutions, particularly the lack of collaborative planning which implies that project cannot be easily changed if the public consultation occurs at the end of the planning phase (Thayer 1988). The resistance of the population emerges when there is no or little knowledge of wind energy. Financial participation of the citizens in the projects increases the level of acceptance (Fabian 2011). In Italy the main obstacles to wind power are the political exploitation of projects for electoral purposes, the absence/low quality of information, the conflicts between the various levels of governments, a lack of planning skills. To sum up an institutional capital (Hearley 1998), consisting of knowledge resources, relational resources and mobilization capacity, is needed for the development and diffusion of wind energy.

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COAL BURNING PROCESSES AND ITS ENVIRONMENTAL IMPACT AT HEATING PLANT „TOPLANA“ LAZAREVAC

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ABSTRACT

In this paper we presented environmental impact analysis of coal burning in the heating plant. During this process, products appear that can endanger environment (flue gases, ash and slag).

„Toplana“ is the thermal energy facility that operates within the PD RB „Kolubara“, branch „Prerada“. Capacity of heating plant is 2x60 MW and it's used for production of heat that is requisted for operating technological process of manufacturing facilities, heating and industrial circles of Lazarevac.

Key words: coal burning, heating plant, environment.

SHORT REVIEW OF COAL GEOLOGY IN KOLUBARA COAL BASIN

Low quality coals, as Kolubara Coals are, content a high ash amounts (20–30%), and in combusting processes in thermo energetic boilers produce huge ash and slag masses which posses some quantities of toxic and harmful compounds. The most abandoned chemical elements in coals are C and H, but also in significant quantities there are also S, Ca, Mg, heavy metals (Cu, Zn, Pb, Ni, Cr, Hg, As). The contents and quantities of micro and macro elements and chemical compounds determine with laboratory assaying.

Analyzing the total sulfur (in coals in deposit) horizontal distribution on rest parts of most important ore field ‘’D’’ deposit (figure 1), and on ore field ‘’B+C’’ deposit (figure 2), we can notice that we have the low sulfur coals in rest parts of this two deposits. On coalfield ‘’D’’ average total sulfur content reach barely 0.5%; and on ‘’B+C’’ coalfield reach 0.6%. In both cases, those low sulfur coal is undoubtedly environmental friendly and technological acceptable as a solid mineral fuel in thermo energetic facilities of Serbia.

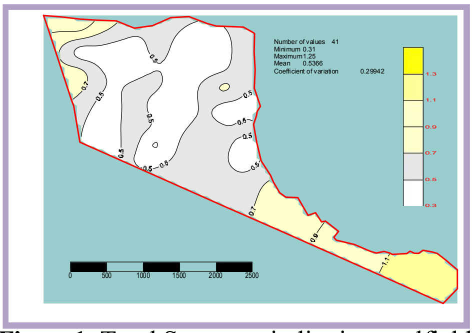

Figure1. Total S content in lignite, coalfield ''D'', after 2011.

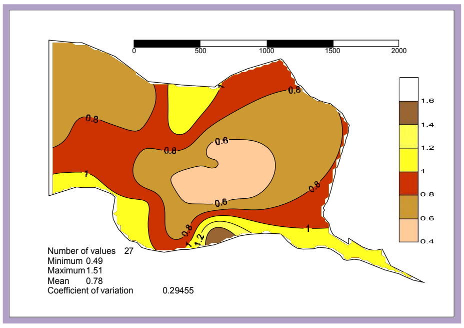

Figure2. Total S content in lignite, coalfield "B+C", after 2011.

In table1 is shown the results (technical and elementary analyse; heating value) of coal which is solid fuel in heating plant boilers.

Based on more then 2.300 complete laboratory coal analyses and 1.500 ash analyses we can conclude about the contents and character of distribution of total, combustible and resistant sulfur on 11 exploration-exploitation coalfields in Kolubara Coal Basin. With total lignite masses of 3B t and average total sulfur grade of 0,53% and combustible 0,28% conclude that in all Kolubara Coal Mines deposits been deposited 15,5M t of total, respectively 8,1M t of combustible sulfur. Average C-fix ammounts reach 14,7%, average coke value is 30,6%. Looking from that aspect, these coals such as they are, they are "usable" for in termoenergetic and heating plants and comparing with other Serbian, European and world coals cuold be environmental friendly, as it can be acceptable.

KOLUBARA HEATING PLANT "TOPLANA" – BRANCH " COAL PROCESSING"

Heating plant is thermo energetic object, with 2x60 MW heating capacity, designed for thermal heat production. The last one is aimed for techology processes in coal processing plant, then for the factory facilities and nearby agriculture production heating, and last but not the least for heating the Lazarevac town. The feedwater for steam boliers is delivered from the chemical water processing plant, with water clarifing, decarbonising and demineralising processes. Capacity of chemical water processing plant reach 3x60 m^3/h. Flue gasses are purified on electric filter unit before they are leaving the 80 m high chimney. The electric filter ash and biolers slag are hydropneumatic transporting to the ash disposal.

Heating plant "Toplana" is constitute of :

- Boilers unit;
- Chemical water processing plant (HPV);
- Heating substation of remote heating the town Lazarevac (TPS);
- Solid and liquid fuel delivery system;
- Slag and ash hydraulic transport installation.

The average annual coal consumption reach 220K t. Noncombustible matters in coal (ash and slag) vary in range between 11 and 15% together, which depend of supplied coal quality.

SHORT REVIEW OF COAL COMBUSTION TECHNOLOGY AND ADVERSE IMPACTS ANALYZE

DELIVERING AND COMBUSTION PROCESSING THE COAL

The coal is delivering from Wet and Dry separation plants using conveyor belts transportation and stock at coal bunkers. Combustion coal treating is performing separately for each boiler using ventilation rotation mills. Pulverized coal, which is now a solid fuel, is –30+0 mm particle size.

COAL COMBUSTION PROCESS

The boiler firebox provides very good coal combustion without oil fuel adding, even when the boilers are running under the techology minimum. At the bottom of firebox is boiler grate for reheating the noncombusted coal particles, and beneath that is wet slag remover. From the firebox summit the heated gasses are deducting and together with one part of heated and other part of cold air introduce in recilkulating chanells in mills for coal drying. Fresh air is consuming from the attic of plant and with industrial fan systems insert in air reheating unit. Heat air distribute in heat recirkulation chanells, burners for solid fuel combustion and on boiler grate for recombusting.

Two industrial flue gasses fans sucks gasses form boiler and after the electric filter passing purifeid gasses through the chmney are going out. On each of chimney chanells are one electric filter with static adjuster for compulsive hauling substanation in chanell of flow.

COAL COMBUSTION PRODUCTS WHICH IMPACTS ON ENVIRONMENT

In coal combustion processes in thermo energetic plants as a combustion nusproducts there are:

- *Suspended flaying particles,*
- *Fuel gasses,*
- *Ash,*
- *Slag.*

Important potentially dangers for air represent suspended particles (coal dust) which emission values in some natural conditions could reach up then limit values required for urbanized areas. Disperse phase genesis (flaying dust) in air in small or high amount related with all phases of coal processing of raw coal.

Thermo energetic fuel gasses beyond the essential compounds also contain a numbered chemical compounds bad for environment. This compounds change the atmosphere conditions. The very first adverse effects on environment originate from SO_2 and NO_x compounds. The CO_2 increasing in air impact on long lasting climatic changes (greenhouse effect).

In table 1 are shown the results (technical and elementary analyse and heating value) of coal analyses as fuel in heating plant "Toplana".

Table 1. Techical and elementary analyse of delivered coal for may and november 2011. year

Content (%)	May 2011 With deliverd moisture	May 2011 With analytic moisture	May 2011 Without moisture	May 2011 Without ash and miosture	November 2011 With deliverd moisture	November 2011 With analytic moisture	November 2011 Without moisture	November 2011 Without ash and miosture
TECHNICAL ANALYSE								
Moisture	50,45	8,25			51,30	11,52		
Ash	7,81	14,47	15,77		9,69	17,60	19,89	
Sulfur total	0,53	0,99	1,08		0,69	1,26	1,42	
Sulfur in ash	0,10	0,19	0,21		0,24	0,43	0,49	
Sulfur combustible	0,43	0,80	0,87	1,04	0,46	0,83	0,94	1,17
Coke	26,21	48,53	52,89	44,07	26,62	48,36	54,66	43,40
c-fix	18,39	34,06	37,12	44,07	19,93	30,76	34,76	43,40
Volatile	23,34	43,22	47,11	55,93	22,08	40,12	45,34	56,60
Combustible	41,74	77,28	84,23	100,00	39,01	70,88	80,11	100,00
HEATING VALUE (KJ/kg)								
Upper	11199	20737	22602	26834	10775	19576	22125	27619
Lower	9542	19627	21593	25643	9127	18462	21165	26420
ELEMENTARY ANALYSE – content (%)								
Carbon total	27,51	50,93	55,51	65,90	26,45	48,06	54,32	67,81
Hydrogen	2,41	4,47	4,87	5,78	2,27	4,12	4,66	5,82
Sulfur combustible	0,43	0,80	0,87	1,04	0,46	0,83	0,94	1,17
Nytrogen and oxygen	11,39	21,08	22,98	27,28	9,83	17,86	20,19	25,20

In table 2 are the results of mass concentrations of dusted materials and fuel gasses measured in May 2011, when only one boiler is running. In table 3 the results are from November 2011, when both boilers are under running.

Table 2. Mass concentrations of total dusty matters and fuel gasses, may 2011., one boiler is under running

SAMPLE TYPE	NUMBER OF ASSAYING	CONCENTRATION, (mg/m³)	AVERAGE VALUE	GVE
Dust matters total	1	156,0 ± 7,6		100
	2	116,5 ± 5,7		
	3	164,0 ± 8,0		
Average value		145,6 ± 7,1		
Carbonmonoxide, CO	1	802,7 ± 16,1	897,2 ± 17,9	250
	2	623,7 ± 12,7		
	3	1265,3 ± 25,3		
Nytrooxides, NO_x (svedeno na NO_2)	1	549,9 ± 11,0	538,8 ± 10,8	800
	2	526,6 ± 10,5		
	3	539,8 ± 10,8		
Sulfurdioxide, SO_2	1	1659,1 ± 33,2	1613,7 ± 32,3	1450
	2	1596,5 ± 31,9		
	3	1585,5 ± 31,7		

Table 3. Mass concentrations of total dusty matters and fuel gasses, november 2011., both boilers are under running

SAMPLE TYPE	NUMBER OF ASSAYING	CONCENTRATION, (mg/m³)	AVERAGE VALUE	GVE
BOILER 1				
Dust matters total	1	85,1 ± 7,2		100
	2	92,1 ± 7,6		
	3	97,2 ± 8,1		
Average value		**91,4 ± 7,6**		
Carbonmonoxide, CO	1	168,2 ± 3,4	220,0 ± 4,4	250
	2	227,4 ± 4,5		
	3	264,5 ± 5,3		
Nytrooxides, NO_x (svedeno na NO_2)	1	243,4 ± 4,9	240,4 ± 4,8	800
	2	231,9 ± 4,6		
	3	246,0 ± 4,9		
Sulfurdioxide, SO_2	1	1794,5 ± 35,9	1631,1 ±32,6	1450
	2	1407,7 ± 28,2		
	3	1691,2 ± 33,8		
BOILER 2				
Dust matters total	1	142,7 ± 15,8		100
	2	130,3 ± 12,3		
	3	134,8 ± 12,4		
Average value		**135,9 ± 13,5**		
Carbonmonoxide, CO	1	339,1 ± 6,8	472,1 ± 9,4	250
	2	597,5 ± 12,0		
	3	479,7 ± 9,6		
Nytrooxides, NO_x (svedeno na NO_2)	1	399,7 ± 8,0	394,7 ± 7,9	800
	2	412,0 ± 8,2		
	3	372,4 ± 7,4		
Sulfurdioxide, SO_2	1	2315,4 ± 46,3	2156,1 ± 43,1	1450
	2	2259,8 ± 45,2		
	3	1893,1 ± 37,9		

As table 2 show, during the boiler 1 running total dusty matters for three measuring exceed the upper emission value (GVE); also as carbon monoxide and sulphur dioxide. At the very same time, the nitrogen oxides for all three measuring are acceptable and stay below GVE.

As table 3 show (november 2011., both boilers are under running) we can notice that the boiler 1 stay in allowed values of emission for all parameters, except the concentration of sulfur dioxide. For the boiler 2, only the nitrogen oxides are under GVE limits; all of the rest parameters are higher then it is allowed.

According to facts that the ''Toplana'' heating plant is older then 20 years, its SO_2, CO and solid particles emission exceeds allowed values. High emission values of SO_2 are characteristic of the existing combusting technologies, which running without the desulphurization unit installation. Unexpected high CO emissions are consequences of boilers running out of defined route, and particle emission is consequence of irregular electric filter work.

DISPOSAL OF ASH AND SLAG, CHEMICAL COMPOSITION

As it mentioned before, next to fuel gasses during coal combustion generate huge masses of ash and slag. Combusting the lignite in boilers remains the slag. When fuel gasses pass the electric filters in chimney columns, remains the ash. After the boiler grate for reheating, slag drop into the crusher with 5t/h capacities. After crushing, the slag is going to slag pool. Mixture of slag and industrial water from slag pool is going to pipeline using the dredge pumps. Electric filters ash is going to reception ash bunker with volume of $5m^3$, and from there in containers for fluidization. After the containers are full, the ash in fluidized condition is transporting to pipeline. Ash and slag with hydraulic 6 km pipeline transportation drive on the ash dump.

Tables 4.and 5. Macro and micro elements contents in ash and slag, Medosevac ash dump, March 2012. year

Elements	ash
Macro (%)	
SiO_2	45,48
Al_2O_3	18,82
CaO	8,03
MgO	2,30
Fe_2O_3	8,85
S	0,50
K_2O	1,09
Na_2O	0,20
TiO_2	0,67
P_2O_5	0,037
Fe	6,20
V_2O_5	0,027
P	0,016
SO_3	1,25
SO_4^{-2}	1,50
ZnO	0,027

Elements	ash
Micro (ppm)	
Th	38
U	12
Zn	220
Cu	174
Co	24
Cr	171
Ni	147
Pb	210
B	439
Sr	293
Ba	570
Mn	859
V	169
Be	1
Cd	>10
As	204
Se	>1
Hg	0,7

Beside macro and micro elements assaying, the heating plant departmants measure moisture values and pH of solid phase. All abowe perfomed assayings are repeated monthly, in special occasions more complicated assaying are perfomed on each three monts.

CONCLUSION

The average annual coal consumption reach 220K t. Noncombustible matters in coal (ash and slag) vary in range between 11 and 15% together, which depend of supplied coal quality.

Looking at coal at deposits, we can conclude that this is low sulfur lignite (probably with lowest sulfur grade in Europe). Average total sulfur content hardly reaches 0.53%, with 50% combustible. In addition, beyond that statement, even this geological parameters show that the lignite is ''environmental friendly'' the old technologies in combustion processes and after that in heating plant produce slightly environmental pollution, just nearby upper limits of allowed emissions. According to that, it is necessary modernization of boilers, chimneys, and other heating plant units. The aim of that modernization is to find, designed and performed new types of units for better working and environmental conditions.

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ENVIRONMENTAL IMPACTS OF COAL DRYING, CLASSIFYING AND STORAGE IN COAL PROCESSING PLANT ''KOLUBARA-PRERADA''

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ABSTRACT

Analyze of possible environmental influence of drying, classifying and store of coal in branch "Coal processing plant - Prerada". Coal processing is an integral part of complex exploitation in "Kolubara" coal mine. Branch "Prerada" represent industrial facilities for coal washing, drying, sorting and storage. These activities may cause environmental changes in the various forms of pollution and their causes. This paper describes the possible impacts of specific technologies of coal drying, classifying and storage as well as consideration of ways and methods that can mitigate the above impacts, or reduce it to levels that are acceptable. It is necessary to comprehensively evaluate and define all possible influences and factors that lead to successful solutions in the field of environmental protection and improvement.

Key words: Coal processing, pollution, environmental protection and improvement.

INTRODUCTION

Geografic settings

Mining basin ''Kolubara" branch ''Prerada–Vreoci'' seat in central part of Kolubara Coal Mines basin. The coal processing facilities are seated nearby the ''D'' open pit. Also, in the same industrial zone, nearby is seat ''Xella'' brick factory and ''Kolubara-Metal'' facilities; 6 km north are thermo enegetic plant ''Kolubara-A'' and ''Universal'' conveyor belt factory. It could be said, that industrial zone and nearest setllements are under environmental ''deep impact'' of all jointed industrial activities. At neiboroughood there are also magistral road Ibarska magistrala, international railroad Belgrade-Bar and industrial rail track. Kolubara river is seat 1,7 km west of these facilities; in peripheral parts of industrial zone are two smaller rivers Turija and Pestan.

Short review of processing plant ''Prerada'' units

Processing plant is designed for processing and refining of raw coal delivered from open pits ''D'' and ''B''. Delivred coal is used for thermo enregetic plants supply, industrial and broad consumption. As a parts of processing plant, there are :

1. Coal refining,
   - Wet separation
   - Dryer and screening plant
   - Heating plant
   - Maintenance unit.
2. Dry separation,
3. Railway transportation,
4. Head Office.

The main analuze in this paper is on ''Prerada'' industrial units :
- Screening plant,
- Old Dryer unit,
- New Dryer unit.

During the technological processes of drying, classifying, and storing the coal dust, fuel gasses, diesel gasses, waste industrial water, sanitary water, used oil, municipal waste, worn spare parts… are harmful substances. Technological characteristics of drying, classifying and storing the coal, significantly impact on air pollution (dust and gasses), waters (waste industrial waters), as well as oversize noise emission in nearby industrial units.

POLLUTION

Air pollution

Air pollution depends of range of factors:
- Geological characteristics of raw coal,
- Climatic and meteorological conditions,
- Coal processing technologies,
- Efficiency of prevention dust emission.

Significant potential danger for air represents suspended dust particles (coal dust) which emission values could reach higher then the regulations allow in urban areas. Generating the disperse phase (hovering dust) in air is linked more or less for all the phases of technological processes in coal processing plant.

Typical sources of air pollution with suspended particles are:
- Dotted (all loading places of Dryer and Screening plant),
- Linear (conveyors),
- Aerial (areas nearby Dryer unit).

Measured substances from Dryer are 410 g/h H_2S; 108 g/h SO_2; 23 g/h NO_X; 38 g/h phenol; 1,82kg/h solid particles... In units of New and Old Dryer and Screening plant, where technological process of drying, classifying and storing the coal is taking place, it is possible to perform few procedures for preventing the dust emission with particle size bellow 10μm from worktops (all loading places, charging and discharging of autoclaves and bunkers, conveyors, track loading places and railway wagoons, resonant screens, transporters ...) and other specific places in industrial zone.

Coal drying process by ''Fleischer'' procedure is well known as a producer of huge masses of waste industrial waters, gasses and dust which is generate in different phases of this procedure. Secure processing, on environment and employee and other citizens health, could be reached only with implementation of complete protection prescribed for these industrial units. With drying system reconstruction and wet system dedusting, the pollution parameters should result in normal limits according to legislation rules. Unsatisfactory state of environment confirms also results of measuring the area around the Dryer units (Mining Institute Belgrade, Report of measuring emission of harmful substances, 2003) in table1.

Table1. Mass flow of harmful substances from firebox (results 2003. year)

Harmful matters	**Average concentration mg/m³**	**Average gass flow m³/h**	**Average emission during one firebox is under running, kg/h**	**Average emission, all firebox in run, kg/h**
SO_2	1.75	18756	0.0328	1.131
NOx	0.11	18756	0.0021	0.008
Phenol	0.124	18756	0.0023	0.0092
Dust	66.82	18756	1.2530	5.01

Analyzing the measured values of harmful matters and them comparison with maximal allowed, it could be state that measured values of all matters are in allowed limits, except the dust. Dusty matters emission during measuring time oversize the allowed limits for 33.64%. *Conclusion – performed safeguards malfunctioned.*

For dust emission prevention on the same sourcess it is possible to enforce the wet system of dedusting. The main unit for dust removal and brid steams from vacumed gas is centrifugal water separtor. This device is cyklon type unit in which particles separation from gasses is perform under centrifugal force influence and underpreasure produced by industial fan.

Dusty air vacumed at the sources of pollution is drain with master pipeline in conic part of centrifugal wet separator. With two spray nozzles under presure is adding the new portions of industrial fresh water, in quantities which can vary. Wasuot hepls other three spray nozzles for recycled industrial water. Conic part of separator is ending with valve with counterwieght which regulate contaminated water discharging into the resrvoir for sludge precipitator. Clarified discarged water with recirculation pump and spray nozzles is again going back at the centrifugal water separator. Densified sludge is going through the pipeline valve in sludge pump and then in pipeline goping to concrete precipitator pools.

Additional prevention measures of dust linked to conveyor transportation consist of numbered measures, where conveyor speed optimisation lead. In few conditions, where it is possible, suggestion is to roof cover the conveyors and dust collectors ussing. Also, it is necessary high attitude among conveyors on minimum and cleaning the ribbon in direction opposite of transportation. Duriug loading and discharging of coal and waste from bunkers, it is necessary to decrease the height between trucks and bunkers.

As additional protection, in short time of toxic exposing, must mandatory use the personal protective equipment (dust respirators, protective mask).

Watter pollution

Coal processing technologies produce a large ammounts of waste industrial waters and harmfull matters emission which pollute surface and underground waters.

Waste waters generate in next producing units :

- Wet separation,
- Dryer,
- Heating plant,
- Sanitary wastewaters.

Recipient of these waters is river Kolubara. Waste waters from Wet separation unit and heating plant are loaded with suspended matters, until the waste waters of Dryer unit beside suspended matters posses oragnic matters and phenols.

All previous testings shows that the coal in raw conditions does not posses the toxic or harmfull characteristics, it could be said thet the coal is in inert state. Phenol generate during processing or combusting processes, when the coal is under high preassure or temperature. Phenol appearance is registered specially in neiboroughood of processing plant units, with increasing the distance phenol dissapear.

The existing legislation it is not defined the emmision effluent quallity, only the request is linked for recipient waters doesnt disrupt class of water downstream of discharging place. It means that purified industrial water must to satisfy II class of waters (river Kolubara in natural conditions upstream of Kolubara Coal Mines). Based on results of physical-chemical and microbiological measurments so surface and waste waters on specified measuring points and existing legislation, the level of pollutin evaluate. Those analyse performed ''MOL Belgrade'' laboratory in 2009. year.

Process wastewaters from Wet separation characterized high turbidity and visible waste matters. According to suspend matters content and five days biochemical oxygene consumption those waters belong to IV group of waters, by the serbian regulations. The parametres values such as chemical oxygene consumption, permanganate consumption i BPK 5 chemical compound shows that this waters were burdened with organic substancess in all phases of sampling. To phenol matters contents in IV sampling phase, this waters belong to IV class of waters according to harmful matters in waters rulebook. Arsenic concentration in all sampling cyclusses are lower then rulebook limits for the II group of waters.

Process wastewaters from dryer unit also are characterized with high turbidity and visible waste matters. According to high suspend matters content and five days biochemical oxygene consumption those waters belong to IV group of waters, by the serbian regulations. The parametres values such as chemical oxygene consumption, permanganate consumption i BPK 5 chemical compound shows that this waters were burdened with organic substancess in all phases of sampling. In all sampling phases phenol matters and arsenic content were out of category, also ammonium-ion content was out of range in III and IV sampling cycles.

Process wastewaters from water chemical treatment unit characterized high specific conductivity in I, II and III sampling cycle as ionic species presence. In I, II and IV sampling cycle pH value is base; then in III is acid. In III cycle Fe matters also define this water out of category.

Purified waste waters at place of confluence in Kolubara River is high turbidity. Waters are fully loaded with organic matters, but significant lower then before purification. According to BPK5 content these waters seat at IV class at III and IV cycle of sampling, and III class in II sampling cycle. In III and IV sampling cycle ammonium-ion define them into III/IV class, as well as Fe content in II and IV sampling cycle. Arsenic concentration in II, III and IV sampling cycle exceeds MDK limits for III/IV water classes (out of class). Phenol matters concentration satisfies MDK for III/IV class of waters in IV sampling cycle and it is significant lower then before purification. In I cycle sampling failed, because waste water discharge miss.

Conclusion – performed waste water purification in chemical treatment unit satisfied. Suspended matters values at discharged waste waters are significant lower then before purification. Also, organic matters values decrease in discharged purified waters. Phenol concentration also decreases.

Kolubara River upstream from place of confluence of purified waste waters according to suspended matters values belong to III category of waters. Concentration of other matters seat upstream waters in II category. Downstream it is III category of waters. Water posses traces of arsenic, but in concentration lower then MDK for II category of waters allow.

Downstream from the place of confluence values of phenol, Fe, ammonium-ion and five days biochemical oxygen consumption doesn't rise and there are no significant changes in water quality.

Noise and vibration pollution

The noise sources analyze in dryer unit and screening plant there are identified next potential noise sources:

- Mining equipment (resonant screens, autoclaves, vibrating feeders…),
- Transport machines (conveyors, trucks…),
- Utility machines (forklifts, trucks).

The noise spreading from generating place depends of few factors:

- Noise source type: stationary or mobile gear,
- Noise production lasting,
- Reception position,
- Présence of noise barrier,
- And other factors, such as meteorological (direction and wind velocity, air humidity), soil absorption …

Evaluation of the noise influence criteria are defined with Serbian legislation: Regulation of noise indicators, limited values, methods for evaluating noise indicators, disturbing and harmful noise effects in environment *("Sl. glasnik RS", br. 75/2010)*.

Adverse vibration impacts objectively exists in selected phases of minig gear work, and it is strongly related for nearest neighboroughood of working machines. Noise production ''IN SITU'' shall impact only on the employees. These is why it is necessary to perform employee personal protection measures.

In order to ensure employee and other citizens protection of overloaded noise it is necessarry to perform planned measures of protection:

- Control of noise level in mine, processing plants and sorrounding setlements,
- Noise reduction at specified units and equipment,
- Acoustic protection using phisycal barriers or fences,
- And personal employee protection implementation.

Minig gera used in open pit exploitation and coal processing represent a significant noise source, which can be reduced with manufacturer consultation. Mentioned measures are relate to exhausted gases, modifyung the exhausted branches and exhaust pipe, acoustic isolation of metal parts of gear, fencing the machines...

Employee education is very important in context of employess informabillity and needs for noise reduction. Also, it is necessary employee trainning in gear maintenance and regular working conditions.

CONCLUSION

Environmental protection in coal processing facilities represent one of important soccial problem. It is necessary to monitoring the environmental pollutants and environmental protection monitoring. Beside that, it is recomended to start health protection monitoring of employess and other civilians. On analyzed area should be performed measures for decreasing the negative impacts on environment. Based on positive home and forecountries expiriences as a speccial long lasting environmental programs should start:

- Defining the drying and screening dynamic, taking care that the emmision of harmful matters shouldn't reach legislation limits,
- Prevention of dust emmision at same suorceses using wet dedusting methods; and additionally performing a fews maesures related for transportation, reloading, charging... Also it is necessary to detect and monitor selected places which are defined as dust, noise and waste waters producers.
- Aplied environmental monitoring according to SRPS-ISO 14.001 standard, and provide public informing in environmental meaning.
- In environmental problems close participation of company representatives and surrounding population.
- In next steps, to install new more environmental functional equipment and provide more efficient maintance of existing gear.

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INDIRECT UTILIZATION OF 30 kW COMPRESSOR WASTE HEAT ENERGYFOR TECHNICAL WATER HEATING

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ABSTRACT

In this paper it is given adescription of the operation of 30 kW compressor installation with indirect utilization of waste heat energy for technical water heating. It is given the technological scheme of the installation for indirect utilization of waste heat energy with all components and indicated operation parameters.Operating parameters of primary and secondary fluid at mixing points are determined analytically using heat balance equations. Also, it is given the description and schematic display of heat recovery system operation which is a component of the compressor aggregate.

Key words: indirect utilization of waste heat energy, technological scheme, heat balance equation, compressor aggregate.

INTRODUCTION

The utilization of waste heat produced during the operation of industrial facilities is not significant only from the aspect of ecology but also from the aspect of economy of the facility operation. As it is known from thermodynamics, during the air compression in compressors it occurs the increase of air temperature i.e. only a minor part of compressor driving energy is consumed for the increase of air pressure, while a most of it is wasted on air heating. In order to use this waste heat certain compressor manufacturers have developed the energy recovery system. By means of this system the heat is transferred from compressor lubricating oil to water in heat exchanger of type oil/water which is a component of compressor aggregate. At direct systems water is directly heated and used afterwards for different technological purposes as technical water, while at indirect systemschemically treated water with or without suitable additives (for example against freezing) is usually heated in this heat exchanger, and afterwards technical water is heated in another heat exchanger of type water/water. At installation which is the topic of this consideration it will be considered the possibility of waste heat utilization of 30 kW stable screw compressor with air cooling and oil lubrication which was designed for compressed air production for air atomizing of water at an installation for wet dust extraction, where the water temperature would be increased by waste heat for the purpose of preventionof water freezing in winter operation regime.

TECHNICAL DESCRIPTION OF THE INSTALLATION FOR INDIRECT UTILIZATION OF 30 KW COMPRESSOR WASTE HEAT ENERGY FOR TECHNICAL WATER HEATING

Installation for utilization of 30 kW compressor waste heat energy for technical water heating refers to the compressor with technical characteristics given in table 1:

Table 1.

Compressor aggregate	
Manufacturer	Atlas Copco
Type	$GA30^{+}$ 8
Power	30 kW
Maximum working pressure	8 bar
Capacity FAD (1 bar; 20^{o}C)	5,6 m^{3}/min
Noise level	65 db
Dimensions (length x width x height)	1395x865x1625 mm
Mass of aggregate	780 kg

According to catalogue data of the manufacturer available heat recovery of this compressor amounts 22,5 kW, while the heat exchange is done in oil/water heat exchanger with water flow of 32 l/min and relation of inlet and outlet water temperature of 50/60 ºC.

Method of installation operation is given on technological scheme (figure 1.).

In primary circulation circuit the heated water from oil/water heat exchanger which is a component of the compressor aggregate is brought to the vertical boiler by means of thermostatically regulated circulation pump with technical characteristics given at table 2. In primary circulation circuit chemically treated water circulates in order to prevent the sedimentation of scale and to prevent the corrosion of installation elements.In vertical boiler technical water from the second circulation circuit is heated from 10 ºC to 45 ºC at flow of 9,18 l/min. This heating of technical water is obtained on account of cooling of demineralised water from the primary circulation circuit in vertical boiler from 60 ºCto 26 ºC at flow of 9,42 l/min.Primary and secondary fluid parameters are dictated by catalogue data of boiler manufacturer which technical characteristics are given at table 3. In order to enable both heat exchangers to function with designed parameters a bypass connection is installedbetween the pump discharge connection and return pipeline of primary circulation circuit from the heat exchanger water/water i.e. vertical boiler, enabling the rising of demineralised water temperature at the inlet of heat exchanger oil/water from 26 ºC to 50 ºC.Installation operation parameters at characteristic points are given on technological scheme (figure 1.).

Table 2.

Water pump	
Manufacturer	WILO
Type	TOP-Z 25/6 3~ PN 10
Power	0,21 kW
Speed	2550 rpm
Head at operating point	5,1 m
Flow at operating point	1,92 m^{3}/h
Nominal pressure	PN10
Mass	3,5 kg

The primary circulation circuit is made of steel pipes with diameter DN 25 and it is equipped with all necessary armature including ball valves, drain and filling valves, air release valves, strainers, check valves and safety valves.For temperature and pressure measurement corresponding gauges are installed in suitable points, while flow regulation is obtained by automatic flow control valves. Thermal dilatation of fluid in primary circulation circuit is enabled by installing the membrane expansion vessel with volume of 5 l.

No.		1	2	3	4	5	6	7	8	9	10
Fluid		DEMI water	DEMI water	DEMI water	DEMI water	DEMI water	technical water	technical water	technical water	technical water	technical water
Temperature	°C	60	60	60	26	50	10	45	10	10	21,5
Volumetric flow	l/min	32	22,58	9,42	9,42	32	9,18	9,18	27,97	18,79	27,97

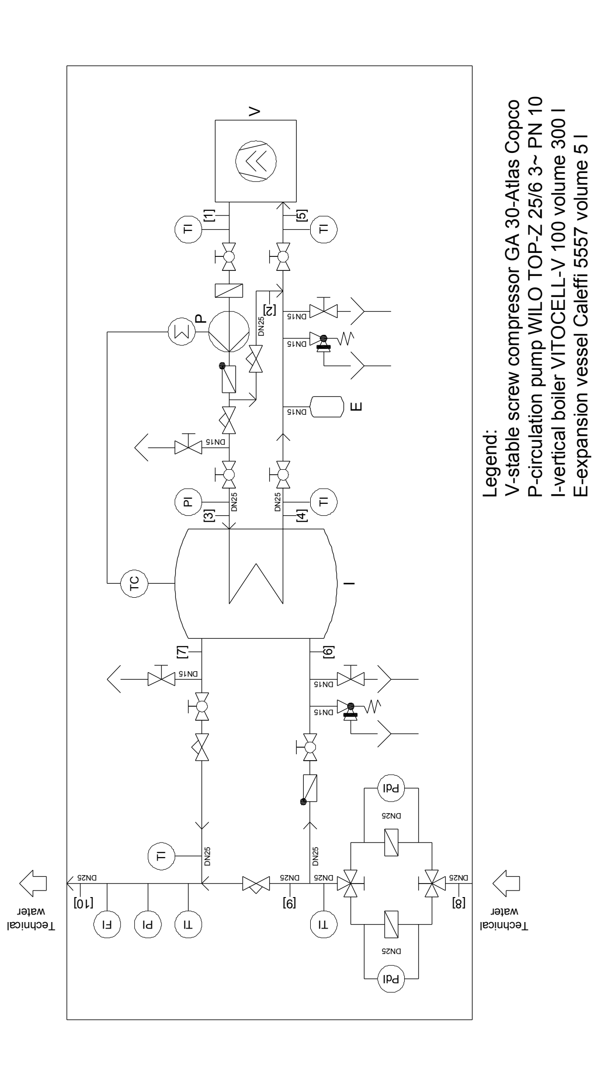

Figure 1. Technological scheme of installation for indirect utilization of compressor waste heat

Tabela 3.

Vertical boiler	
Manufacturer	VIESSMANN
Type	VITOCELL-V 100
Power	23 kW
Volume	300 l
Inlet heating water temperature (primary circuit)	60 ºC
Inlet technical water temperature (secondary circuit)	10 ºC
Outlet technical water temperature(secondary circuit)	45 ºC
Nominal pressure in primary circuit	PN 25
Nominal pressure in secondary circuit	PN 10
Dimensions (length x width x height)	633x705x1746 mm
Connections	1″
Masswith thermal insulation	151 kg

The secondary circulation circuit is made of steel pipes with diameterDN 25 and it is equipped with all necessary armature including ball valves, drain valve, air release valve, strainers, check valve and safety valve.For temperature measurement a thermometer is installed at the boiler outlet, while flow regulation of technical water is obtained by automatic flow control valves whereby it is enabled that the boiler operates in according with designed operation parameters.

Only one part of the total amount of technical water entering the installation inlets the secondary circulation circuit and after it`s heating in the vertical boiler it is mixed with the residual quantity of technical water which preserves the initial temperature. Mixing relation is regulated by automatic flow regulator in bypass connection.In such a way at the outlet of the installation it is obtained technical water with temperature of 21,5 ºC at flow of 27,97 l/min. For the removal of impurities from technical water, at the inlet of installation, operating and stand by strainers are predicted whose contamination level is regulated by differential pressure regulators, so thatone filter is always in function while the other is regenerated.For measurement of temperature, pressure and flow the corresponding gauges are installed in suitable pointsof the installation.

Whole installation is placed in ground object along with the compressor aggregate. At figure 2. it is given the scheme of heat recovery installation functioning which is a component of the compressor aggregate according to [1].

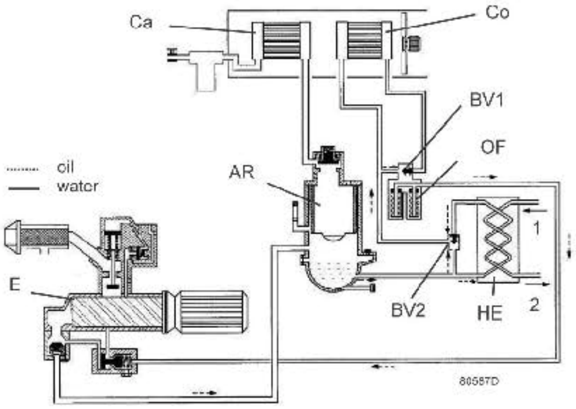

Figure 2. Scheme of heat recovery installation of the compressor aggregate

Heat recovery installation consists of following components: E-compressor element; AR-oil separator reservoir; Ca-oil after-cooler; Co-oil cooler; OF-oil filter; HE-heat exchanger oil/water (ER unit); BV1-thermostatic bypass valve in oil filter case; BV2-thermostatic bypass valve of ER unit; 1-water inlet; 2-water outlet.

At the start of compressor from cold bypass valve BV2 shuts off the oil supply from the heat exchanger HE, while bypass valve BV1 shuts off the oil supply to the oil cooler Co, in order to prevent oil cooling and enabling oil heating as soon as possible. The oil circulates from the compressor E, through the oil separator reservoir AR and through the oil filter OF back to the compressor E.

During the operation of compressor as soon as the oil temperature reaches the set point bypass valve BV2 starts to open enabling oil flow through the heat exchanger HE. At the temperature 15 ºC above the set point all the oil passes through the heat exchanger HE. The heat exchange at the heat exchanger HE and heat recovery are maximal. The oil flows from the heat exchanger HE, through the oil filter OF, compressor E and separator AR back to the compressor. Bypass valve BV1 bypasses the oil cooler Co as long as the oil temperature is below its previously set point.

CALCULATION

Calculation of water parameters in installation for wet dust extraction has for its purpose the determination of water parameters at mixing points in primary and secondary circulation circuits. In primary circulation circuit water with state 2 (see fig. 1) and state 4 are mixed to get water with state 5. In secondary circulation circuit water with state 7 and water with state 9 are mixed to get water with state 10.

Water parameters after mixing are obtained by using material and heat balance equations.

Material balance equations for mixing in primary and secondary circulation circuits are as follows:

$$\dot{V}_5 = \dot{V}_2 + \dot{V}_4 = 32\left[\frac{l}{min}\right], \dot{V}_{10} = \dot{V}_7 + \dot{V}_9 = 27{,}97\left[\frac{l}{min}\right]$$

where is $\dot{V}_i\left[\frac{l}{min}\right]$–volumetric water flow at corresponding points in installation

For adiabatic mixing at constant pressure we apply formula according to [2]:

$$\dot{m}_M \cdot h_M = \dot{m}_1 \cdot h_1 + \dot{m}_2 \cdot h_2$$

where is $\dot{m}_M\left[\frac{kg}{s}\right]$–mass water flow after mixing; $\dot{m}_i\left[\frac{kg}{s}\right]$–mass flow of component i; $h_M\left[\frac{J}{kg}\right]$ –specific water enthalpy after mixing and $h_i\left[\frac{J}{kg}\right]$ –specific enthalpy of component i

Using formulas for enthalpy and mass flow

$$h = c \cdot t, \dot{m} = \rho \cdot \dot{V}$$

where is $c = 4200\left[\frac{J}{kg \cdot K}\right]$ – specific thermal capacity of water; $t[°\mathrm{C}]$ - water temperature and $\rho = 1000\left[\frac{kg}{m^3}\right]$–water density, we get formulas for calculation water temperatures after mixing in primary and secondary circulation circuits:

$$t_5 = \frac{\dot{V}_2 \cdot t_2 + \dot{V}_4 \cdot t_4}{\dot{V}_5} = 50[°\mathrm{C}], t_{10} = \frac{\dot{V}_7 \cdot t_7 + \dot{V}_9 \cdot t_9}{\dot{V}_{10}} = 21{,}5[°\mathrm{C}]$$

DISCUSSION

The amount of technical water which inlets the installation is dictated by the necessary capacity for technological process[3]. Quantity of technical water which is brought to the vertical boiler is dictated by designed operation parameters of this heat exchanger. Since these two amounts of water can be rarely identical in practice, which is the case here, the quantity of water which is heated in this heat exchanger has to be mixed with the residual water quantity which is not subject to heating.That is the reason for mixing at the secondary circulation circuit. Selection of vertical boiler with operating regime 10/45 ºC enables one more convenience, that is during the operation periods of installation when it is not necessary to utilize all available compressor waste heat energy for technical water heating (for example at high ambient air temperature) it is possible to utilize heated water for other technical purposes.Also, this may be the case during summer regime of installation operation.In this work it was considered the case where the whole available compressor waste heat energy is used only for technical water heating for technological purposes i.e. for prevention of the freezing of water for damping in wet dust extraction installation [4]. Mixing in primary circulation circuit is also dictated by designed operation parameters of heat exchanger oil/water and on the other hand heat exchanger water/water i.e. vertical boiler. Calculation shows that the temperature after mixing at the inlet of heat exchanger oil/water corresponds to designed operation parameters of this heat exchanger. Selection of indirect operation of installation is dictated by the quality of technical water which often does not meet the requirements regarding quality in order to enable reliable operation of heat exchanger oil/water.

CONCLUSION

Installation for indirect utilization of compressor waste heat energy, shown here, is a basic solution which does not deplete all possibilities for the utilization of this energy which appears as a by-product during the operation of compressor and which is not utilized at the most of the existing compressors or it is only partially utilized. Regardless certain technical problems which appear during the indirect utilization of this energy,like the adjustment of the operation of heat exchangers and adjustment with technology demands which solutions have been given in this work, the application of these systems has a good prospect.

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HYDROPOWER POTENTIAL OF SERBIA

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ABSTRACT

The term renewable energy sources (RES) includes the sources of energy that are found in nature and are reproduced in whole or in part. Using these sources contributes to more efficient usage of own energy production potential, reduction of "greenhouse gases", reducing the import of fossil fuels, as well as the development of local industries and creating new jobs. Hydropower can be obtained in hydropower plants, which represent the alternative sources of energy, and have no significant adverse impact on the environment. The key advantage of hydropower plants is reducing or complete elimination of harmful gas emissions. Hydropower potential of Serbia is not exploited enough because the construction of hydropower plants is very expensive and demanding process that must be well-planned.

Key words: environment, renewable energy, hydropower.

INTRODUCTION

Renewable energy sources (RES) include the sources of energy that are found in nature and are reproduced in whole or in part, this especially refers to energy streams, wind energy, solar energy, biomass, geothermal energy, etc. (Fig. 1) [1].

Using these sources contributes to more efficient usage of own energy production potential, reduction of "greenhouse gases", reducing the import of fossil fuels, as well as the development of local industries and creating new jobs. Water is essential source of life on Earth. Apart from using it for drinking and various human needs, water can be used to generate electricity - hydropower. Hydropower can be obtained in hydropower plants which, in addition to the hydro-solar, wind and geothermal power, are an alternative energy source .

The key advantage of hydropower plants is reducing or complete elimination of harmful gas emissions. In the process of obtaining electricity harmful gas emission is completely eliminated. Disadvantages of hydropower plants in Serbia and in the world are those that we cannot always obtain the amount of energy we want, because the speed of flowing water is not always the same. Hydropower potential of Serbia is not exploited enough because the construction of hydropower plants is very expensive and demanding process that must be well-planned.

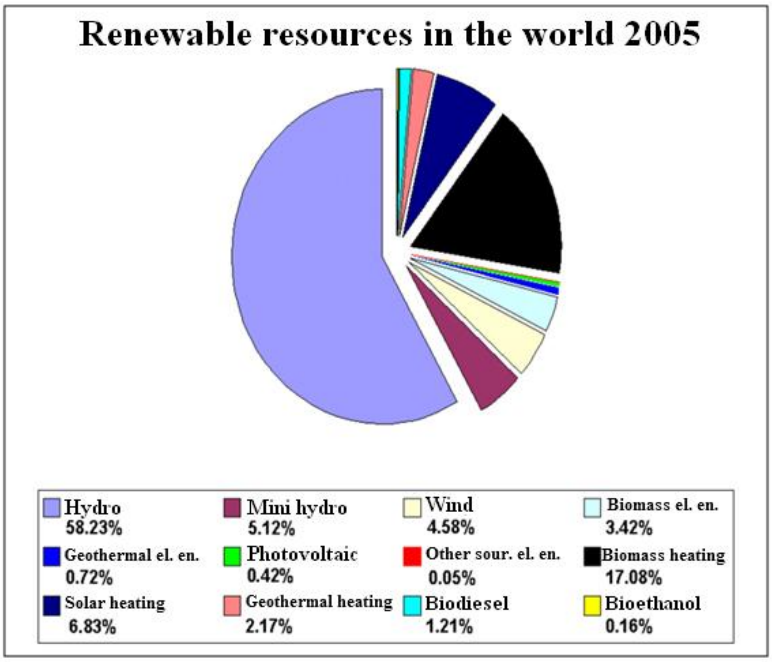

Figure 1. Renewable energy sources

WATER AS A SOURCE OF ENERGY

Water, odorless and tasteless liquid, is present everywhere: in the oceans, seas, rivers, lakes, clouds of gas, frozen in glaciers and large underground pools beneath the limestone rocks. Water is constantly used by the living world.

Water energy (hydropower) is the most important renewable energy source, and also the only one that is competitive to fossil fuels and nuclear energy. In the last 30 years hydro power production is tripled, but the share of hydropower increased by only 50%. During the same period in nuclear power plants production is increased by nearly one hundred times. This happens due to the limitations in the use of hydropower. Hydropower cannot be used anywhere as it requires plenty of fast flowing water in sufficient amounts during the year, because electricity can not be stored cheaply. To offset the impact of water level fluctuations dams and reservoirs are being built, which increase the cost of power plant (Fig. 2), and this also increases the level of ground water in the vicinity of reservoirs. Underground water levels affect wildlife so, hydropower is not completely harmless to the environment. The big problem regarding the accumulation of water is the protection from earthquakes [2].

Figure 2. Hydropower plant "Bajina Basta", Perucac

According to its nature, water is divided into atmospheric, surface and groundwater. Water is circulating in nature and it's constantly going through the cycles of exploitation, use, discharging after its use and return to the cycle in the form to atmospheric or running water. Going through the cycles the water is changing, filling with harmful substances and pollutants of biological, chemical or radiological origin. Primary objectives of this century are to save the remaining clean water and reduce pollution in the process of exploitation.

WATERS OF SERBIA

Surface waters are located on the Serbian border and mountain areas, in the south-western and central part of the country in the basins of these rivers: Drina ,Rzav and Studenica river; in the south of the country in the basins of the Beli Drim river and the river Lepenac from Sara and Ptokletije mountains; from Stara Planina in eastern Serbia, in the basins of these rivers :Vlasina, Nisava, Timok and Mlava river. With the construction of accumulation system (reservoirs) surface water can be stored at the time of the great floods and then it can be used according to the plan during the summer droughts, so this way we can prevent damage from flooding and sediment [3].

Groundwaters are located in alluvial (alluvium) river valley aquifers in Serbia, as well as in primary aquifer complex of Vojvodina - about 44 m^3/s (65%). The total potential of natural groundwater is about 67 m^3 / s (100%). Until now, most groundwater were mostly used as drinking water of the highest quality. From alluvial aquifers we have about 13 m^3/s crust sources, 4.2 m^3/s and Neogene formations 3.9 m^3/s, which make a total of about 23m^3 /s. Groundwater are renewing slowly and represent highly sensitive natural resources, and that is why we need to take complex measures to protect them from pollution in a significant area, as well as over-pumping. Republic Hydrometeorological Institute of Serbia will monitor groundwater quality at 63 stations within the 10 areas. There are not enough reliable sources of quality groundwater for supplying total population.

HYDROELECTRIC POWER PLANTS (HPP) IN SERBIA

Hydropower plant or hydro-electric plant regards to the electrical plant for the production of electricity powered by water. This type of power plant is being built in places where there is enough liquid water in terms of quantity and height differences. Hydroelectric power is proportional to the amount of water and the height difference. Therefore, we chose the streams with a large flow of water or mountain streams with smaller flow but with large falls.

One kWh produced in the hydroelectric plants is cheaper than in the thermal power plant (steam power station) and has less negative impact on the environment, so they are popular as a source of hydroelectric power for the country. However, the amount of produced energy depends on the amount of water flow and varies during the year, so this is the greatest lack of these plants in addition to the fact that reservoirs take up vast areas of, most likely, fertile land [3,4].

According to the water quantity and method of construction there are different types: reservoir, reversible and (run-off) river hydroelectric power plants.

Based on their size hydroelectric power plants are divided into: large (delivering over 100 MW of large power networks), medium (10 - 100 MW of energy), small (0.5 to 10 MW of energy), mini (100-500 kW), micro (5-100 kW), and pico (from several hundreds of watts up to 5 kW) hydroelectric power.

The goal of hydroelectric power plant is to convert hydro energy potential of water volume (flowing due to the height difference) into electricity so, the power of the plant is proportional to the flow and fall.

Hydroelectric power plants in Serbia produce approximately 9,930 GWh per year, which is about 25.5% of the total annual electricity production. Its installed capacity is 2831 MW, which makes 34% of the total installed power interaction potential for electricity generation.

The first hydropower plant (HPP) in Serbia, was started on 2 August 1900 (using a Tesla polyphase current system) -electrical power station-"Under the city" in Uzice on the Djetinja river. It was stopped in 1970. , then re-launched in 2000 and it is still working today. The second hydropower plant was started on the Vucjanka river in Vucje in 1903 and it still works. Djordje Stanojevic is responsible for these two and many other hydropower plants built in Serbia before the First World War. HPP "St. Petka" on the Nisava river was made in 1908. and the other one,"Gamzigrad" was built on the Black Timok near Zajecar in 1909. Both of these HPP are still working. After World War II the first HPP "Sokolovica" was made on the Timok river in Čokonjara, in 1948. First HPP on the Drina river was "Zvornik", opened in 1955. Our biggest HPP "Iron Gate I" (Djerdap I), (Fig. 3) was started working in August 1970. All generators started running at full power on 16 May in 1972. Last significant HPP "Pirot" in Visoko was launched in 1990. Since then there were no significant investments in new hydropower facilities [3].

Figure 3. Hydroelectric power plants "Iron Gate I"(left) and "Iron Gate II"(right)

HYDRO POWER POTENTIAL OF SERBIA

Gross potential from the waters which flow through river streams in Serbia is 27.2 TWh / year. Table 1 shows the approximate value of the gross potential of the rivers [3, 5].

Table 1. Gross hydropower potential of rivers in Serbia

RIVER	GROSS POTENTIAL (GWh/год)	RIVER	GROSS POTENTIAL (GWh/год)	RIVER	GROSS POTENTIAL (GWh/год)
Dunav	10.000	Vlasina	265	Jerma	74
Dunav	5.678	V. Rzav	202	Raska	66
Lim	1.584	Temstica	200	Veternica	54
Beli Drim	1.230	Ivanjicka Moravica	199	Jablanica	53
V. Morava	1.090	Pek	199	Vrla	52
Ibar	998	Studenica	152	Aleksinacka Moravica	48
Uvac	937	Crni Timok	151	Djetinja	48
J. Morava	797	Kolubara	142	Josanica	48
Z. Morava	767	Lepenac	134	Jadar	43
Sava	464	Rasina	134	Skrapež	30
Nišava	430	Mlava	131	Kamenica	26
Toplica	278	Resava	80	Pusta Reka	23
Timok	274	Svrljiski Timok	77	Crnica	16

From all of this, technically exploitable potential is 19.8 TWh / year. By now, 10.3 TWh / year of that potential have already been utilized. A part of the unused 9.5 TWh / year is economically valuable.

There are plans for the utilization of remaining hydro potential. More than 50 locations with predicted potential of more than 10 MW have been selected and more than 850 locations where it is possible to install approximately 450 MW (small power plants with the range of 100 kW to 10 MW). Among the biggest potential hydropower we need to mention HPP Novi Sad, which could benefit around 1.1 TWh / year on the Danube.

Hydroelectric power plants on the upper Drina and Lim represent a significant potential, this means there are many possibilities and each of them can be realized only through cooperation of Serbia, Montenegro and the Serbian Republic, and that is why there are problems regarding planning and the final solution. The Drina river in its middle course has the potential of 1.5 TWh / year and in the lower course another 1.4 TWh / year of unused energy.

On the Velika Morava river with 6 or 7 cascades we could use 830 GWh / year. According to one of the options the construction of 7 cascades is predicted, establishing waterway from Stalać to the eustary of the Danube, while utilizing the power of about 270 MW.

Not all dams are planned for hydropower plants, but are made for regional water supply systems (V Rzav Lepenac, Rasina, Studenica).

Serbia has 856 identified places where it is possible to build small hydro electrical station up to 10 MW. At these locations, technically, up to 450 MW can be used which means that the annual production of electricity would be 1600 GWh. Currently, there are 31 small hydro power plants on the streams, and Electric Power Industry of Serbia planned to take a loan for the construction of 26 new small hydro power plants. Electric Power Industry of Serbia owns a certain number of small hydro power plants, some of them are revitalized and there is a plan to build some new ones. One of them is HPP "Prvonek" on the Banska River near Vranje. Production of electricity per year will be 2.5 to 3 million kWh. Compared to some of the big HPP benefits of small HPP are: almost no shortcomings; there are no electricity distribution expenses; there is no negative impact on the ecosystem; inexpensive maintenance.

The construction and functioning of hydroelectric facilities greatly **influence the regime of surface and ground water.** Upstream of the dam the reservoir is formed with water level which is above the water level before construction. Apart from the natural flow, the change in water level in the river is affected by the functioning regime of the hydroelectric power plant as well. Downstream of the facility, the water level changes and it depends on the type of reservoir. In hydroelectric power plants of canal type there are drastic changes due to the fact that there is everyday biological minimal flow in the riverbed and during the floods there is the entire flow. It is possible to predict the impact of hydroelectric power plant on the regime of surface water, while for the groundwater it is much more difficult. Changes of groundwater regime depend on: the natural groundwater regime; the change in the regime of surface water; the type of construction.

In the vicinity of reservoirs, underground water level is rising, during some time it is reduced, but artificially, it can hardly get back to earlier levels. Downstream of the dam the groundwater level is getting lower. All this things are influence the water supply systems and drinking water quality. Hydroelectric power plants, "Iron Gate I" and "Iron Gate II" (picture 2) greatly changed the regime and water quality of the Danube: flow is weaker and the variations are large; there is less oxygen; there is more phosphorus, ammonia and salt. Pollution from pesticides and fertilizers are huge and there are also radioactive substances. Due to the excessive water pollution and changes in water regimes, many organisms disappear.

Microclimate space is disturbed by the construction of water reservoirs. There are changes in the air temperature and increasing humidity. Also, there are major changes in the ground vegetation and fauna. Many animals and insects are sunk, and many were forced to change their inhabitations.

Since they do not use fuel, hydroelectric power plants have a positive impact on nature. Price of produced energy does not depend on hikes of oil prices, gas or other fuels. Hydroelectric power plants are made for longer operating life than the steam power plants. Reservoirs that occur upstream of the dam have a positive impact on the ability to control the flood waves, irrigation, water supply, fisheries, tourism development and water sports.

In addition to these, there are also negative impacts on the environment. When the reservoir is made on the lowland rivers, the flow upstream slows down and the level of groundwater is increasing. Microclimate in Big Lake changes in one small area by increased humidity. Mountain rivers that make canyons and gorges are suitable for making the reservoirs (accumulation) of great fall and hydropower potential, but they are completely flooding and changing the eco-system. A lot of river sediment is collected in the reservoirs, which contains organic material that eventually starts to crumble and that leads to the occurrence of methane, a gas which is far more dangerous than carbon dioxide in terms of greenhouse gas emissions [5].

CONCLUSION

Renewable energy sources are faster restored than spent, so according to that those stocks cannot be exhausted. Renewable and sustainable resources are also called alternative because they offer an alternative to the usage of conventional fuels.

Water is in Serbia must be used more than once, rationally and efficiently. It must be respected and kept as something of the highest value. Sources of ground and surface water should be protected, which has not been done so far.

The total hydropower potential in Serbia is estimated at about 31,000 GWh per year. Most of this potential (about 62%) has already been used because the construction of larger production capacities is economically justified. The rest of hydropower is usable by building smaller facilities especially if you count the mini and micro power plants. Preparation and construction of hydropower plants is a long process, and the investing ability of private investors will not grow rapidly, so it is expected that in the next ten years half the maximum potential of small rivers to be realized.

One kWh produced in the hydroelectric power plant is cheaper than the on produced in steam power plant and has less negative impact on the environment. Side effects of hydropower on the environment include: changes in the mode of sediment in the accumulation impact zone and the downstream; activation of current and potential landslides; changes in the groundwater regime in the coastal areas; flooding of fertile soil; microclimate changes; the negative impact on biodiversity; changes in seismic activity. These side effects of hydroelectric power plants can be prevented by their proper use, maintenance and renewal.

It is necessary to update the Water Management of Serbia and adopt new laws with which the new investment cycle will be harmonized and implemented according to the priorities and systems. Concession for the construction of hydroelectric power plants should be given with caution, according to the new Water Law, Energy Law and the Law on Concessions, in accordance to the relevant EU regulations.

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MINERAL MAGNESIUM IN SOILS AND NUTRITION POPULATION OF VOJVODINA, SERBIAN REGION AND ITS IMPORTANCE FOR HEALTH

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ABSTRACT

Although people consume minerals for thousands of years, modern science has only recently revealed their importance for human health. Magnesium is one of the most essential elements to human health and can only be found in the soil. The recommended daily intake of magnesium is 250 to 300 mg / day.

In Vojvodina out research solonetz soil solodic soil and the presence of various minerals. Investigations were carried out at a depth of 0 to 168 cm. Magnesium values ranged from 0.25 to 66.95 Eqv. milli moles / l. The highest concentration of magnesium 66.95 Eqv. milli moles / l. at a depth of 63 to 83 cm.

It is necessary analyse foods from these soils and determine whether the soils are rich in magnesium.

Key words: magnesium, land, food, health.

INTRODUCTION

Minerals in nature make the composition of the human body and participate in the structure of bones, teeth, muscles, blood and nerves. They are vital to our overall mental and physical well-being. Taking frequent in digestion, muscle reaction, hormone production, energy production, protect cell walls (over 300 different enzymatic reactions). (4) If the body runs out of one or more of these essential nutrients, there may be various symptoms. (1,3)

Although people consume minerals for thousands of years, modern science is just beginning to understand their significance for human health. Human physiology is unable to produce minerals as it produces some vitamins. Iron, magnesium and other minerals can be found in the country. Plants absorb them directly from the country and we get them through the food chain. (2)

The recommended daily intake of magnesium-RDA (Recommended Dietary Allowance) is 300 to 420 mg / day in the treatment of stress and tension, muscle cramps, constipation, protection of the heart and blood vessels, 350 mg / day. (5) Magnesium is a mineral whom we may have a deficit in the body. From there, even more important this element. Minerals are opposed to vitamins resistant - remain in food after frying, steaming but not "indestructible." During cooking to lose 38-67% of freezing up to 38%, and refining to 99% magnesium. One of the most common reasons for a lack of magnesium is inadequate and poor quality diet (diet athletes). Since the trigger of numerous enzymes, chronic deficit leads to exhaustion. That's why it has most of the body parts that are metabolically active (brain, heart, liver, kidneys). The body quickly regenerates saturation of magnesium.

Because of its role in soft tissues and nerves, leading to a lack of megnesium specific phenomenon- "Restless Legs Syndrome" - improperly controlled nerve and muscle impulses. Other symptoms include mood swings, confusion, muscle weakness, cramps, loss of appetite, insomnia. Women who suffer from abdominal cramps and PMS syndrome, established a low level of magnesium. According to enlargement of the same concentration, drastically reduced these problems.

During the past fifty years is the emergence of widespread impoverishment of the soil, and introduced the trend of breeding land, and not for the purpose of breeding and grain necessary minerals. The best sources of magnesium include nuts, almonds, raisins, sesame seeds, green vegetables (due to chlorophyll, whose core is the magnesium). (4)

The Vojvodina (91%), predominantly dominated by different subtypes of humus soil, černozem, as a production the most superior. By their fertility are among the best in Europe. The analysis of 89.825 samples of soil, within the system of control of fertility, it can be concluded that the soils of neutral and alkaline. In this land, magnesium is one of the most exhausted minerals. Modern food production on soils with artificial potassium and nitrogen fertilizer depletes the country you begin to decrease the amount of magnesium. This is also the reason why there is less magnesium in foods and in the drinking water. In addition, modern processing of sugar, grain and salt from food extracts more than 80% of magnesium and other oligo-elements.

GOAL

Of this paper is to highlight the importance of minerals in the soil to human health or to the fact that the quality and content of the soil is crucial for the presence of this element in food and drinking water.

METHOD

In Vojvodina, the soils are of different character. It is most common mold, but there are slatina land, which is more interesting for special culture. An example is given composition of the soil type and solonetz solodic soil as soil type halomorphic. Such land changes its character depending on the groundwater. Research related to the presence of magnesium in the soil types in different parts of Vojvodina refer to the place, the horizon, Depth of land in cm, where the samples were taken, soil pH, total amount of salt in the water saturation percentage fall in conductivity ECmScm (-1) and magnesium cations and anions hydrocarbons and chloride in equivalent milli moles / liter of water saturated soil extract.

In this paper we have used data obtained in the laboratory of the Faculty of Agriculture in Novi Sad (Miljkovic 1963). Analysed solenetz very pronounced sulphate, expressed solenetz sulfate-chloride, low-osolođeni and regradirani solenetz sulfate and soil type in places, Karlovic, and Nikinci Petrovčić.

RESULTS AND DISCUSSION

Were analyzed Solonetz, a very strong-sulphate at depths from 0 to 146 cm soil horizons defined by A, ABCs, B1cs, B2cs, B3, BCCA and černozem. The pH value of the soil ranged from 5.85 to 8.75 approximately 8.26, and the percentage of total salts from 0.03 to 1.08, averaging 0.42%. Electrical conductivity ranged from 0.56 to 9.19 $ECmScm^{-1}$, an average of 4.27 $ECmScm^{-1}$. Solonetz of quality, based on the analysis of saturated water extract, magnesium values measured ranged from 0.25 to 3.41, averaging 1.11 ekv.mili mol / l $HCO3^{-}$ hydrocarbons from 2.00 to 7.27 , average 4.97 ekv.mili mole / l chloride Cl^{-} of 0.52 to 1.62 on average ekv.mili 1.05 mol / l (Table and Figure 1).

Table 1. Chemical properties solonetz very strong lack of sulfate-Karlovčić

Level	Depth (cm)	Water saturated paste		Analysis of saturated water extract			
				Electrical conductivity $ECmScm^{-1}$	Equ. Milli mol/l		
					Cation	Anions	
		pH	In total of salt %		Mg2+	$HCO3^{-}$	Cl^{-}
A	0-9	5,85	0,03	0,56	0,36	2,00	0,57
ABcs	9-29	7,75	0,42	6,43	2,35	5,01	1,62
B1cs	29-53	8,65	1,08	9,19	3,41	4,01	1,41
B2cs	53-73	8,90	0,64	5,90	0,74	4,71	1,14
B3	73-81	9,00	0,40	3,88	0,25	5,76	0,52
BCca	81-110	8,95	0,23	2,49	0,25	6,02	0,63
CG	110-146	8,75	0,15	1,47	0,38	7,27	1,47

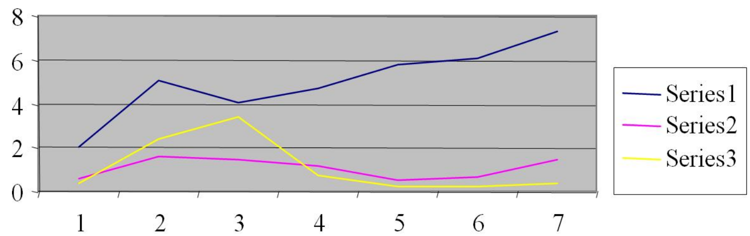

Figure 1. The values of magnesium (series 3), chloride (series 2) and hydrocarbons (series 1) with respect to the horizon depth is too strong-sulfated solonetz Karlovčić

At a depth of 0 to 130 his horizons A, AB, B1, B2, Bca, solonetz expressed sulphate-chloride, pH values do not differ much from 6 to 8.60, average 7.61, and the percentage of total salts ranges from 0 , 03 to 0.24 average of 0.156 and electrical conductivity of 0.87 to 3.61 average of 2.49. Under these conditions, the measured values of magnesium ranged from 0.26 to 1.74 ekv.mili average of 1.05 mol / l hydrocarbons from 1.50 to 4.26 ekv.mili average of 2.60 mole / l of chloride of 3 51 do23, 95 equ.milli/l average of 16.52equ.milli mol / l. High levels of chloride in relation to other types of Solonetz, make this land chloride. (Table and Figure 2).

Table 2. Chemical properties solonetz expressed-sulfite-chloride in Nikinci

Level	Depth (cm)	Water saturated paste		Analysis of saturated water extract			
				Electrical conductivity ECmScm^{-1}	Equ. Milli mol/l		
					Katjon	Anjoni	
		pH	In total of salt %		Mg2+	HCO3^{-}	Cl^{-}
A	0-19	6,00	0,03	0,87	1,74	1,50	3,51
AB	19-39	7,25	0,11	1,62	1,12	2,63	9,63
B1	39-59	7,95	0,19	3,08	0,26	1,75	22,42
B2	59-110	8,25	0,24	3,61	1,14	2,88	23,95
BCca	110-130	8,60	0,21	3,28	1,00	4,26	23,12

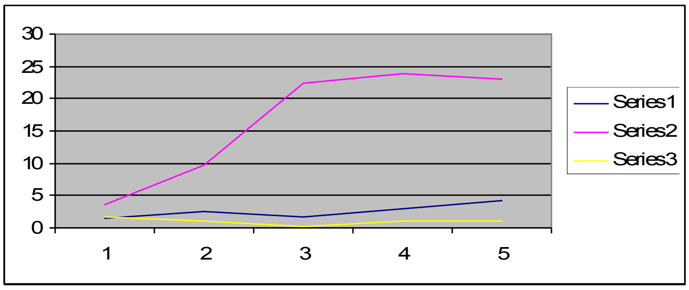

Figure 2. The values of magnesium (series 3), chloride (series 2) and hydrocarbons (series 1) with respect to the depth of the horizon expressed in sulphate-chloride solonetz in Nikinci

The weak properties solonetz soil solodic soil-sulphate in horizons A / E, B1, B2cs, B3cs and B / C at depths of 0 to 103 m, the soil pH ranged STO 5.20 to 8.00 and 7.04 average overall percentage of salt from 0.03 to 0.97 average of 0.43. Electrical conductivity ranged from 0.34 to 11.02 average of 5.46. Magnesium values ranged from 0.49 to 66.95 average 23.84; hydrocarbons from 0.50 up to 2, 25 averaged 1.38 and chloride from 0.10 to 0.35 average of 0.27 (Table and Figure 3). It is extremely poor chlorides, but rich in magnesium soil.

Table 3. Chemical properties solonetz soil solodic soil-sulphate in Petrovići

Level	Depth (cm)	Water saturated paste		Analysis of saturated water extract			
				Electrical conductivity ECmScm^{-1}	Equ. Milli mol/l		
					Cation	Anions	
		pH	In total of salt %		Mg2+	HCO3^{-}	Cl^{-}
A/E	0-15	5,20	0,03	0,34	0,49	0,50	0,37
B1	15-35	6,60	0,17	2,31	4,17	1,25	0,10
B2cs	35-63	7,70	0,55	7,16	27,25	1,50	0,22
B3cs	63-83	7,70	0,97	11,02	66,95	1,38	0,34
B/C	83-103	8,00	0,45	6,47	20,32	2,25	0,33

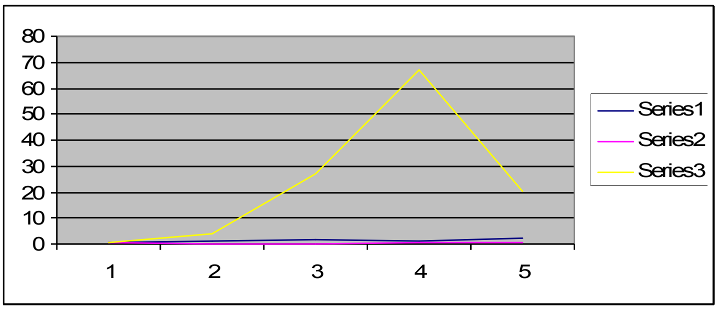

Figure 3. The values of magnesium (series 3), chloride (series 2) and hydrocarbons (series 1) with respect to the depth of the horizon and weak properties solonetz soil solodic soil-sulphate in Petrovići

We note that magnesium dominates properties solonetz soil solodic soil-sulphate at a depth of 63 to 83 m. This is important to know and the aquifers. In chloride Solonetz small values of magnesium, chloride and most of it at a depth of 19 to 59 m. The sulfuric Solonetz expressed at a depth of 30 m, the parallel development of concentrations of magnesium chloride and hydrocarbons, in order to then go in depth, increasing the value of magnesium, and chloride and carbonate are reduced. In other words, the more depth, more cations and anions less. (Figures 1,2 and 3)

CONCLUSION

Knowing the composition of the soil and the presence of magnesium in it, and a special culture in which the highest magnesium installed and it has the most, can be targeted to this population supplementation plans scarce mineral and timely prevent health disorders that are a result of his lack of presence, a huge daily intake of people .

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CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS – A POTENTIAL HAZARD FROM SOME FOODSTUFFS

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ABSTRACT

Polycyclic aromatic hydrocarbons, PAHs, are organic pollutants widely spread in the living environment. Many of these semi-volatile, hydrophobic organic compounds have mutagenic and carcinogenic characteristics which make them important pollutants despite the fact that they are present at very low concentrations in the environment, much lower than other persistent organic pollutants. Their bioaccumulation in biota may represent a specific risk to human health. The consumption of edible plants, or animals, existing near pollution sources is very risky for people, as it plays an important role in the dietary exposure to PAHs. In particular the threat comes from charring meat or barbecuing food over a charcoal, wood, or other type of fire because these conditions of food preparing, greatly increase the concentration of PAHs in foodstuffs.

Key words: PAHs, foodstuffs, health risk, toxicity, cancer.

POLYCYCLIC AROMATIC HYDROCARBONS: UBIQUITOUS PERSISTENT ORGANIC POLLUTANTS

Polycyclic Aromatic Hydrocarbons (PAHs) are a class of several hundred diverse compounds usually containing two to seven fused benzene rings. They belong to a special group of ever-present contaminants known as Persistent Organic Pollutants (POPs), which are subjected to long-range atmospheric transport (LRAT) and most can be photo-oxidized and degraded to simpler substances [1]. As a consequence of their persistence and ability to re-volatilize, PAHs may transport from source regions even to the polar region, and many studies confirmed significant concentrations of PAHs in the Arctic soil, and organisms as well [2].

PAHs form as a result of incomplete combustion of organic compounds. They can originate from biogenic or anthropogenic sources, but the primary sources of PAHs in the atmosphere are the incomplete combustion of fuel and wood for residential heating and engine exhausts. Other important anthropogenic sources are: industrial processes, coal tar, coal tar pitch, coke tars or coke oven emissions, bitumen, mineral oils, cigarette and tobacco smoke, tar and smoke condensates, photocopier toners. The main natural sources of PAHs are volcanic eruptions and forest fires [3-9].

Once emitted to the atmosphere, PAHs may partition from atmosphere to water, soil and vegetation [4]. Soil is considered as one of the major sinks of PAHs and PAH concentrations ranging from 1 μg/kg to over 300 g/kg [10, 11]. PAH concentrations in water tend to be low due to their weak solubility; the weak solubility leads to accumulation in sediments and aquatic organisms [11-13]. Plants can absorb PAHs from the environment trough the roots, or through the leaves [11]. The hydrophobic character and low biodegradability of PAHs cause accumulation not only in plants, but also in all organisms through food chains [14].

The 16 PAHs are included in the list of priority pollutants in EU, and also in the USA: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, benzo(a)pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene,indeno (1,2,3-cd) pyrene, benzo (g,h,i) perylene, dibenzo (a,h) anthracene, pyrene [15, 16].

TOXICITY OF POLYCYCLIC AROMATIC HYDROCARBONS FROM FOODSTUFFS

For the majority of human population, PAH exposure through air, water, soil, and food sources occurs on a usual base. Routes of exposure include inhalation, ingestion, and dermal contact in both: occupational and non-occupational settings. Some exposures may include more than one route simultaneously, affecting the total absorbed dose. After exposure, PAHs are distributed through the body and are found in almost all organs. The organs rich in adipose tissue act as depots from which material is slowly released. Elevated levels are found in the gastrointestinal tract irrespective of the route of administration.

All non-workplace sources of exposure such as diet, smoking, and burning of coal and wood are important routes of potential human exposure to PAHs. In non-occupational settings, up to 70% of PAH exposure for a non-smoking person can be associated with the diet [17]. The consumption of edible plants or animals existing near pollution sources is very risky for people, as it plays an important role in the dietary exposure to PAHs. PAH have been detected in a variety of vegetables, or cereals, as a result of the deposition of airborne PAHs, and in fish, crustaceans, and mussels from contaminated waters.

Charring meat or barbecuing food over a charcoal, wood, or other type of fire significantly increases the concentration of PAHs, as they may be formed as a result of pyrolytic processes of organic matter during smoking, drying, roasting, baking, frying or grilling. PAH formation during charcoal grilling was shown to be dependent upon the fat content of the meat, the time of cooking and the temperature used. High levels of 200 μg/kg in food have been found for individual PAHs in smoked fish and meat; 130 μg/kg has been reported in barbecued meat, whereas the average background values are usually in the range of 0.01-1 μg/kg in uncooked foods [15].

Tea and coffee are old, worldwide popular commodities, due to its specific aroma and flavor, as well as for health-promoting properties, but under certain fermentation conditions, significant concentrations of PAHs may be formed in tea leaves and coffee beans. Refined vegetable oil, margarine, roasted peanuts, and many other foodstuffs may also contain PAHs. Contamination usually occurs during technological processes like direct fire drying,

In general, PAHs have a low degree of acute toxicity to humans. The LD_{50} values indicate that the acute oral toxicities of PAH are moderate to low. Acute effects ascribed to PAH exposure are: headache, nausea, respiratory and dermal irritation. Effects reported from chronic exposure to PAHs are: chronic cough, chronic bronchitis, dermatitis, skin photosensitization, and sebaceous reactions. The non-carcinogenic effects of PAHs engross the pulmonary, gastrointestinal, dermatologic, and renal systems. The most significant endpoint of PAH toxicity is cancer (Table 1.).

Table 1. Health effects correlated to the exposure to PAHs

Target organ	Health effects
Respiratory system	Cough, bronchitis, and bronchogenic cancer
Eyes	Irritation and photosensitivity
Skin	Erythema and burns on sun-exposed areas with possible progression to cancer; the toxic effects of coal tar are enhanced by exposure to UV light
Hematopoietic system	Leukemia and lymphoma
Gastrointestinal system	Leukoplakia, pharyngeal cancer, and lip cancer
Genitourinary system	Hematuria and kidney, bladder and testes cancers

The carcinogenicity of certain PAHs is well established in laboratory animals. Researchers have reported increased incidences of skin, lung, bladder, liver, and stomach cancers, as well as injection-site sarcomas, in animals. Animal studies show that certain PAHs also can affect the hematopoietic and immune systems and can produce reproductive, neurologic, and developmental effects [18-20]. Based on evidences of carcinogenicity in experimental animals, PAHs are classified as: known animal carcinogens, probably carcinogenic to humans and possibly carcinogenic to humans (Table 2.).

Not all PAHs are of the same toxicity because of differences in constitution that affect metabolism. The key factor in PAH toxicity is the formation of reactive metabolites. Another important factor in PAHs toxicity is the biologic effective dose.

Once absorbed, PAHs come into the lymph, circulate in the blood, and are metabolized in the liver and kidney. PAHs are predominantly metabolized via CYP enzymes (enzymes in the P-450 oxidase system) in the liver [22]. In addition to the liver and kidneys, metabolism of PAHs occurs also in the adrenal glands, testes, thyroid, lungs, skin, sebaceous glands, and small intestines [23, 24]. Metabolism is a precondition for biliary and urinary excretion and elimination through the feces. Biliary and urinary excretion of PAHs is relatively proficient because of the wide division of enzymes that may transform PAHs into polar metabolites. PAHs are transformed initially to epoxides, which are converted later to dihydrodiol derivatives and phenols. Glucuronide and sulfate conjugates of these metabolites are excreted in the bile and urine. Glutathione conjugates are further metabolized to mercapturic acids in the kidney and are excreted in the urine. The hydroxylated metabolites of the PAHs may be excreted in human urine as free hydroxylated metabolites and as hydroxylated metabolites conjugated to glucuronic acid and sulfate. A commonly measured urinary metabolite is 1-hydroxypyrene [5, 21, 24].

Table 2. PAHs carcinogenic classification by USA agencies [21]

Agency	PAH Compound	Carcinogenic Classification
U.S. Department of Health and Human Services (HHS)	• benz(a)anthracene, • benzo(b)fluoranthene, • benzo(a)pyrene, • dibenz(a,h)anthracene, •indeno(1,2,3c,d)pyrene.	Known animal carcinogens
International Agency for Research on Cancer (IARC)	• benz(a)anthracene and • benzo(a)pyrene.	Probably carcinogenic to humans
	• benzo(a)fluoranthene, • benzo(k)fluoranthene, •ideno(1,2,3-c,d)pyrene.	Possibly carcinogenic to humans
	• anthracene, • benzo(g,h,i)perylene, • benzo(e)pyrene, • chrysene, • fluoranthene, • fluorene, • phenanthrene, • pyrene.	Not classifiable as to their carcinogenicity to humans
U.S. Environmental Protection Agency (EPA)	• benz(a)anthracene, • benzo(a)pyrene, • benzo(b)fluoranthene, • benzo(k)fluoranthene, • chrysene, • dibenz(a,h)anthracene, •indeno(1,2,3c,d)pyrene.	Probable human carcinogens
	• acenaphthylene, • anthracene, • benzo(g,h,i)perylene, • fluoranthene, • fluorene, •phenanthrene, and pyrene.	Not classifiable as to human carcinogenicity

It can be concluded that many of PAHs are only slightly mutagenic or even nonmutagenic. The actual mutagenic are diol epoxides, the intermediate metabolites of PAHs which can affect regular cell replication as they react with DNA. Many of parent PAHs are only weak carcinogens that need metabolism to develop into more potent carcinogens. PAH-induced carcinogenesis result when a PAH-DNA adducts form at sites critical to the regulation of cell differentiation or growth [21].

Recently, the increased public concern and the scientific investigations have been focused on the occurrence of PAHs and their control in herbal and animal products to evaluate the potential health hazards more thoroughly. It was essential, in order to protect public health, to keep these contaminants, at levels which are toxicologically acceptable. Data from many studies in EU indicate that the estimated maximum dietary exposure of adults to each of PAHs such as anthracene, phenanthrene, fluoranthene and pyrene may be in the range of 60 – 80 ng/kg bw/day. The dietary exposure to the other PAHs, would be one order of magnitude lower [15].

The most known potent carcinogen, benzo(a)pyrene, B(a)P, is commonly used as a marker for the carcinogenic risk of PAHs in the environment. A recent directive of the European Commission sets a limit value for this toxicant, to be: 1 ng/m^3 [25]. Also, the Scientific Committee on Food in EU, concluded that B(a)P could be used as a marker for the occurrence and effect of carcinogenic PAHs in food [26]. Maximum levels of B(a)P in foodstuffs in EU have been set at strict levels, with a particular attention to the most sensitive part of human population - young children and babies (Table 3.) [27].

Table 3. Maximum levels of B(a)P in foodstuffs [27]

Agency	Focus	Maximum level
The Commission of the European Communities	Foodstuffs	2.0 µg/kg wet weight for B(a)P in oils and fats (excluding cocoa butter) intended for direct human consumption or use as an ingredient in foods
		5.0 µg/kg wet weight for B(a)P in smoked meats and smoked meat products
		5.0 µg/kg wet weight for B(a)P in muscle meat of smoked fish and smoked fishery products, excluding bivalve molluscs.The maximum level applies to smoked crustaceans, excluding the brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans
		2.0 µg/kg wet weight for B(a)P in muscle meat of fish, other than smoked fish
		5.0 µg/kg wet weight for B(a)P in crustaceans, cephalopods, other than smoked. The maximum level applies to crustaceans, excluding the brown meat of crab and excluding head and thorax meat of lobster and similar large crustaceans
		10.0 µg/kg wet weight for B(a)P in bivalve molluscs
		1.0 µg/kg wet weight for B(a)P in processed cereal-based foods and baby foods for infants and young children
		1.0 µg/kg wet weight for B(a)P in infant formulae and follow-on formulae, including infant milk and follow-on milk
		1.0 µg/kg wet weight for B(a)P in dietary foods for special medical purposes intended specifically for infants

Serbia shows an intention to establish regulations which should be harmonized with European law. According to current Serbian regulations, the limited value for B(a)P in smoked products should be no more than 5 µg/kg (Službeni list SRJ, br. 5/92, 11/92 i 32/02) [28]. PAHs are also perceived in National Implementation Plane (NIP) on realization of Stockholm Convention of persistent organic pollutants [29].

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THE EFFECT OF MINERAL MATTER CONTENT ON THE STATIONARY BURNING RATE OF BURLEY TOBACCO FROM DIFFERENT PRODUCTION AREA IN SERBIA

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ABSTRACT

The aim of this study was to determine the influence of production area on the mineral content in tobacco and to examine the influence of a particular element of the minerals complex on value of stationary burning rate (SBR). The special significance of SBR lies in the fact that it directly affects production of the total particulate phase of cigarette smoke. Large leaf tobacco type, Burley from five production areas in Serbia was used as a material for this research. Burley type tobacco accounts for 18% of the total production of tobacco in the Republic of Serbia. Mineral content was determined by the atomic absorption spectrophotometer AAS Perkin Elmer Analyst 300th. Stationary burning rate was determined by the device Free Burning Rate Meter.

Results have confirmed that there were some differences in the mineral content of tobacco, depending on the production area. Also, it was confirmed that the mineral content in Burley tobacco samples directly influences SBR value of samples. Among them, the amounts of potassium and magnesium were the most significant contributors on the rate of burning of tobacco samples. Additionally, it was shown that the ratio of K/Mg was one of the most important factors. Contents of calcium, sodium and iron in leaf also contributed to changes in SBR values. Heavy metals content had no influence on the rate of burning of tobacco samples.

Key words: burley tobacco, mineral matter, heavy metals, SBR_l, SBR_m.

INTRODUCTION

Tobacco is an industrial plant which occupies an important place of agriculture in the Republic of Serbia. The total production of tobacco amounted to 10000 tons, in 2011. Proportion of burley tobacco in total production is about 18%. Proportion of this tobacco is about 30% in cigarette blend (1). Given such a large share of burley tobacco in the composition, it is important to analyze its chemical composition, especially the amount and content of the mineral complex and its influence on the burning. The production of elements of tobacco smoke, inhaled by active and passive smokers depends on the burning rate of cigarette.

It is known that mineral matter is normally present in cultivated plants in quantities that vary depending of plant variety, climate, and other factors (2, 3). Mineral matter play an important role in tobacco metabolism during its growth (4, 5): they help build up materials in plant tissues; increase plant immunity to diseases and unfavorable environmental conditions, such as drought, high and low temperature; contribute to enzyme reactions which provide plant metabolism and burning process (6, 7). They are particularly important for the combustion process of tobacco, because they affect temperature and combustion conditions and ash characteristics (8). In addition, it is not important only the total content of minerals, but also their relationship (9). It should be noted that some of these elements are in the group of heavy metals that may be toxic and hazardous to health (10, 11, 12, 13). Based on previous research it was found that tobacco contains the highest percentage of calcium, potassium and magnesium and less phosphorus, sodium, silicon, iron, chlorine and sulfur (14,15).

Stationary burning rate (SBR) is a technological characteristic of cigarettes. By definition, the SBR represents the average of the burning rate at the beginning, middle and end of a cigarette, and in the center and edge cigarettes, since cigarettes do not have the same speed of burning along the whole of its volume and length. SBR value depends on the applied method of drying, on physical and chemical properties of material, especially of the content of mineral matter, which indicate the differences in the combustion of the tobacco types (16).

Table 1 shows the burning rate of three basic types of tobacco, calculated on the data derived of the five-year research (16).

Table 1. The values of SBR

Type of tobacco	SBR_l (mm/min)	SBR_m (mg/min)
sun cured	4.2	44
flue cured	5	62
air cured	6.9	71

Many researchers have studied the effect of not only the total mineral complex, than effect of its certain elements to the stationary burning rate (17). It has been established that potassium has positive influence on tobacco burning process; calcium and phosphorus have no influence, while chlorine, sulfur, magnesium and nitrogen have negative influence on burning rates. However, for good and proper combustion, it is important to their relationship. Based on previous studies (9), it was found that with the increase of K/Mg ratio, increasing SBR. In this way K/Mg ratio reduces the production of total particulate phase of tobacco smoke, and thus the nicotine.

The special significance of SBR lies in the fact that it directly affects the production of the total particulate phase of cigarette smoke. If the cigarette burns slowly and incompletely, the production of total particulate phase and thus the harmful components of smoke, are increased (18, 19).

MATERIALS AND METHODS

Large leaf tobacco type - Burley, cultivar B-92, from five production areas in Serbia was used as a material for this research. Each sample represented an average sample of 10 hectares of a typical production area: Senta, Čoka, Šabac, Bajina Bašta and

Vranje. Middle stalk position leaves (which are of highest quality for this type of tobacco) that have undergone a process of drying and fermentation was used in the experiment.

Determination of mineral content

Mineral content was determined by the atomic-absorption spectrophotometer AAS Perkin Elmer Analyst 300^{th} (20). Amount of pottasium (K), calcium (Ca), magnesium (Mg), sodium (Na), iron(Fe), copper (Cu), zinc (Zn), lead (Pb), cadmium (Cd) i mercury (Hg) in samples of tobacco was determined. The sample was prepared by a method which was adapted for examination of tobacco (1). Only the middle stalk position leaves were used as the leaves of the best quality. The whole leaf with the main stem was milled into a fine tobacco powder. Tobacco powder was dissolved in nitric acid and heated at 80^0C. The heating was stopped after the separation of yelow dark steam. Then, perchloric acid was added and heating was done up to 200^0C. The process was finished after the color of the sample has disappeared. A blind test was prepared in the same way.

Analysis was carried out in the triplicate. The values of different parameters were expressed as the mean value.

Determining of the stationary burning rate

For the determination of SBR Free Burning Rate Meter was used. Free Burning Rate Meter measures a weight loss of material (ISO 3612) and provides calculated data (21). The printer list includes data for all three of these characteristic values. For preparation of cigarettes, whole leaf tobacco was cut (lamina and stem) by semi-automatic laboratory cutter "Comas", which was set to the width of cut of 0.8 mm. From each sample of tobacco seven cigarettes were made (a total of 5 x 7 = 35 cigarettes). All cigarettes were made from the same raw-materials. Paper tube length element was 6 cm, length of the filter was 2.5 cm and weighs of paper tube was 0.18 g. Cigarettes are made by hand and conditioned on Borgwaldt Automatic Feeder and Weighting Unit to 12.5% moisture (22). Cigarettes weighting 1070 mg ± 0.5 were used in experiment.

RESULTS AND DISCUSSION

Results of investigations of mineral matter content in Burley tobacco leaves are shown in Table 2.

Table 2. Mineral matter content in Burley tobacco (ppm)

	Senta	**Čoka**	**Šabac**	**B.Bašta**	**Vranje**
K	9872	10112	8328	10812	6918
Ca	32937	32678	31268	33298	39417
Mg	8827	9821	7289	6820	7829
Na	36,01	38,29	45,26	35,18	28,13
Fe	463,26	392,12	360,33	412,82	410,74
Cu	13,31	18,17	21,46	17,21	19,31
Zn	38,17	44,12	41,78	49,22	50,21
Pb	1,91	1,98	2,02	0,91	1,12
Cd	0,14	0,2	0,38	0,31	0,17
Hg	0,48	0,08	0,51	0,18	0,08

From these results it can be concluded that there were significant differences in mineral matter content of tobacco leaves grown at different area.

Tobacco grown at Senta area contained significant amounts of K, Ca, Mg and Na. Compared to other tobacco samples, tobacco grown at Senta area had an optimal ratio of all necessary elements. It also contained the highest amount of Fe and high amount of heavy metals - Hg and Pb. Amounts of Zn and Cd were the lowest compared to other tobacco samples.

Tobacco grown at Čoka area contained the highest amount of Mg and a large amount of Na compared to other tobacco samples. There were no differences in concentration of other needed elements between these simple and other tobacco samples examined. Heavy metal found in the highest concentration was Pb. Cu, Zn and Cd were also found in high concentrations while Hg was heavy metal found in the smallest concentration in sample.

Tobacco grown at Šabac area contained the highest amount of Na, low amount of Mg and the lowest concentration of Ca compared to other tobacco samples. Compared to other examined samples, this one has contained the lowest amount of Fe and low amount of Zn. On the other hand, it contained the highest amount of Cu (21,46 ppm), Pb, Cd and Hg.

Tobacco grown at Bajina Bašta area contained the highest amount of K and a large amount of Ca compared to other tobacco samples. This sample contained low amount of Mg and had very small concentration of Na. Heavy metals found in the high quantities were Fe, Zn and Cd. Pb was found in a small concentration.

Tobacco grown at Vranje area contained the highest amount of Ca compared to other tobacco samples. Also, this simple had the lowest concentration of K and Na. Heavy metals found in high concentrations were Zn and Cu. Cd and Hg were found in low concentrations (the same values as for tobacco grown in Čoka area).

According to the literature data (9), concentration of K is essential for process of burning of tobacco. Amount of Ca is also significant for burning process and it was found that ratio of Ca to K in tobacco samples with good burning rates is 1. Because of correlation of K/Mg ratio with value for burning rates, the amount of Mg is also important (9).

Compared to the literature data (23), the toxic concentration of Cu (>20 ppm) was found only in tobacco samples from Šabac area (21,46 ppm). Concentrations of Zn in samples examined were in agreement with the literature data (20 - 100 ppm).

Concentrations of Pb in examined tobacco samples were lower than those reported in the literature. This was a significant finding because of well known toxicity of lead. The highest amount of Pb (2,02 ppm) was detected for tobacco grown at Šabac area. High concentration in these samples was probably a consequence of climate as well as proximity of heavy industry. These data are in agreement to those previously reported (12). Concentrations of Cd in samples were also lower to those reported in the literature (1,25 - 7,02 ppm). Amounts of Hg in samples were in range of 0,08 – 0,51 ppm which is in agreement with the literature data.

From results presented, it is obvious that the samples of tobacco grown at Šabac area had the highest concentration of Pb, Cu, Fe, Zn and Cd. It is well documented (24) that high concentrations of these heavy metals have a pronounced negative effect on tobacco plant. The amounts of heavy metals were within allowed, non-toxic limits. The only exeption was Cu with the concentration above the allowed limit. Also, these samples contained the lowest concentration of K and Ca. Low concentrations of K and Ca had negative effect on burning speeds.

Tables 3 and 4 and figures 1 and 2 shows the difference in burning speeds of cigarettes made from different tobacco samples.

Tobacco grown at Vranje area had the lowest values for SBR_l (4,98 mm/min). This tobacco sample also had a low amount of K (6918 ppm) and Na (28,13 ppm) and the highest concentration of Ca (39417 ppm). The K/Mg ratio was negative in these samples.

High values for SBR_l were detected for samples of tobacco grown at Bajina Bašta area (7,51 mm/min) and tobacco grown at Čoka area (6,96 mm/min). Tobacco grown at Bajina Bašta area had the highest concentration of K (10812 ppm) and the K/Mg ratio: 1,59. Amount of Ca and Fe in these samples was also high. SBR_l values for two other types of tobacco samples were almost the same (5,97 to 6,05 mm/min) and below SBR_l values reported for air-cured tobacco (16).

Table 3. SBR_l -Burning of line speed (mm/min)

Sample	Cigarette Weight (mg)	Bajina Bašta	Šabac	Senta	Vranje	Čoka
1	1070	7.5188	6.0025	5.7687	4.9965	6.9954
2	1070	7.4627	5.9987	5.7878	5.0147	7.0058
3	1070	7.5758	5.8965	6.1284	5.0003	6.8787
4	1070	7.5188	6.0111	5.8322	4.8699	6.9002
5	1070	7.5758	6.3294	6.2212	4.9971	7.0019
6	1070	7.4627	5.9952	6.2428	4.9993	7.0995
7	1070	7.4620	6.1002	5.7897	5.0033	6.8777
Mean value (μ)	1070	7.5109	6.0477	5.9673	4.9830	6.9656
Standard deviation (σ)		0.04719	0.1274	0.2028	0.0466	0.0768

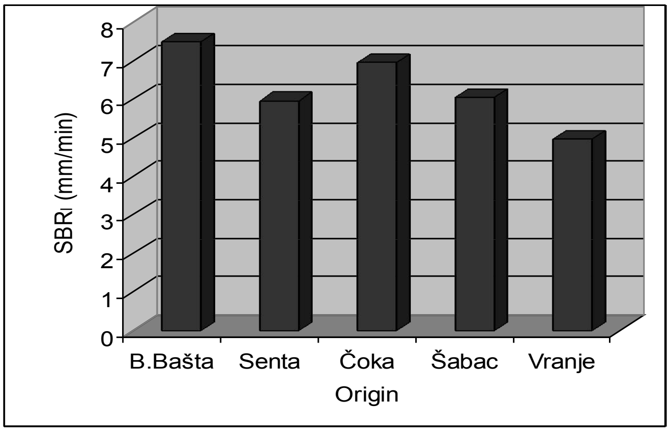

Figure 1. Mean values of SBR_l

Table 4. SBR_m - Mass burning rates (mg/min)

Sample	Cigarette Weight (mg)	Bajina Bašta	Šabac	Senta	Vranje	Čoka
1	1070	72.2632	70.3912	65.4132	69.3222	69.0023
2	1070	72.1986	70.2816	64.9382	70.1009	70.0009
3	1070	71.6514	69.9818	64.9244	69.4445	69.6566
4	1070	72.0507	70.1212	65.3286	69.8810	69.1222
5	1070	71.2215	69.8848	65.2886	69.1234	70.1369
6	1070	72.4190	70.2428	64.9982	70.0222	68.8766
7	1070	71.9811	69.9698	65.6262	69.7440	69.0011
Mean value (μ)	1070	71.9694	70.1247	65.2167	69.6626	69.3995
Standard deviation (σ)		0.3795	0.1738	0.2492	0.3443	0.4838

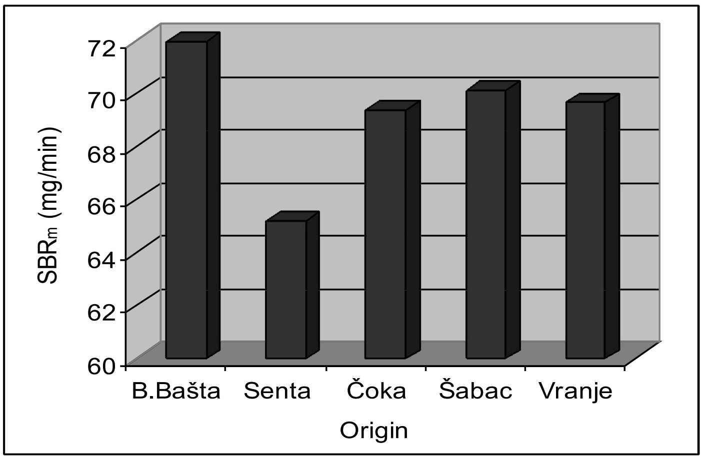

Figure 2. Mean values of SBRm

The lowest value for SBR_m was detected for samples of burley tobacco grown in area of Senta (65,22 mg/min). The characteristic of this sample is that none of minerals was found ~~in~~ either in high or in low amount.

Contrary to that, the highest SBR_m values was observed for tobacco grown in area of Bajina Bašta (71,97 mg/min). As previously mentioned, the highest amount of K (10812 ppm), high content of Ca and Fe, as well as an optimal ratio K/Mg (1,59) were all found in this sample. Therefore, as it was expected, the SBR_m and SBR_l values for this simple were also high. Also, the lowest amount of Mg and low amount of Na was registered for tobacco grown in area of Bajina Bašta.

As it can be seen from table 1, the values for SBR_l were lower and values for SBR_m were higher in comparison to the literature data. All deviations were in allowed limits (max 10%). Also, from results shown in this paper, it could be concluded that SBR values were depended not only by the amount of K and Mg and their ratio, but also by amounts of Ca, Na and Fe.

CONCLUSION

From the results shown in this paper, it can be concluded that the area in which tobacco were grown has influenced the mineral matter content in tobacco leaves. Amounts of heavy metals in tobacco leaves from all five areas were below toxic concentration. The only exeption was amount of Cu in tobacco leaves from Šabac area (>20 ppm). Amounts of heavy metals have not influenced the mass burning rates of tobacco leaf samples.

Strong correlation between mineral content and SBR_m and SRB_l values for Burley tobacco type was also found.

Burley tobacco type grown at Bajina Bašta area had the highest values for both speeds of combustion (7,51 mm/min for SBR_l and 71,97 mg/min for SBR_m). These tobacco leaves had the highest amount of K and an optimal K/Mg ratio. Contents of Ca and Fe were also high in this sample.

Burley tobacco type grown at Vranje area had the lowest SBR_l value (4,98 mm/min). This sample has the lowest amount of K and Mg and also the lowest K/Mg ratio. The lowest SBR_m value was found for samples of burley tobacco type grown at area of Senta (65,22 mg/min).

On the basis of experimental results, it can be concluded that both amounts of K and Mg, as well as their ratio have determined SBR values the most significantly. SBR values was also influenced by amounts of Ca, Na and Fe present in sample.

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DEVELOPMENT STARTER CULTURES FOR PRODUCTION FUNCTIONAL BEVERAGES FROM COW'S WHEY

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ABSTRACT

Organoleptic characteristics of fermented dairy beverages largely depend on the proper selection of bacteria used for the construction of starter cultures and purpose of this study was to evaluate activity of eight two-component starter cultures in cow's whey. During fermentation, some degreeof symbiotic relationship betweenthe correspondingspecies of the genus*Lactobacillus* or *Bifidobacterium bifidum* and*Streptococcus salivarius* ssp. *thermophilus* was noticed, as fermentation time has been significantly reduced, in comparison with single strains. All fermented whey beverages had satisfactory organoleptic characteristics and total bacterial count wasgreaterthan 106cfu/ml, so they fulfil criteriato call themprobioticbeverages.

Key words: starter culture, probiotic, lactic acid bacteria, cow's whey, functional beverage.

INTRODUCTION

During the last decade, consumer's interest in functional foods significantly increased as a result of greater awareness of importance of inclusion healthy food in the diet. For today's consumers are not only important to extend life span, but also tomakesuch a life healthier. This is supported by the fact that cost of medical care is rising every day and functional foods appeared as a cheaper and effective means to protect health and well-being without relying on expensive pharmaceuticals products.

Whey is the major by-product of the cheese and casein industry which has not been sufficiently present in the human diet, despite the fact that it has wide range of functional attributes significant for nutritional purposes. In comparison with casein, egg and soy proteins, whey proteins are a rich source of the essential amino acids which are thought to play a important role as anti-oxidants (methionine, cysteine) and metabolic regulators (leucine, isoleucine, and valine) in protein, glucose and lipid metabolism. Due to the latter effect and fact that it does not have a lot of calories, whey is recommended in a diet of obese persons as its regular consumption may have a role in weight control. In addition, whey proteins (α-lactalbumin, β-lactoglobulin, lactoferrin, lactoperoxidase, and bovine serum albumin) have antimicrobial and antiviral actions, immune system stimulation, anticarcinogenic activity and other metabolic features important for promotion of health and prevention of diseases. Beside proteins, whey is rich sources of minerals (copper, zink, iron, iodine) and water soluble vitamins (B5, B2, C, B6) which could also improve physiological functions in the body [1].

Lactic acid fermentation is the simples and safest means to transform large volume of whey into functional beverages with desirable sensory profiles. This way could be an interesting alternative for whey utilisation, since with fermentation, dairy factory could avoid expensive technological process, such as ultrafiltration and drying, which are mainly used during preparation whey powder or whey protein concentrate powder. Also for production of functional whey beverages dairy industry can use the same equipments as for the production yogurt or other fermented dairy drinks which allow utilisation of whey almost immediately after cheese production [2,3,4].

Many different species of lactic acid bacteria are successfully used as a starter cultures in the productionof variousfermented products and till now unwanted side-effects related with consummation of this food have never been documented. Presence of lactic acid bacteria in food can greatly improve the safety, shelf life, nutritional value, flavour and overall quality of the fermented products [5]. In recent years there has been a growing interest for production functional food which contains certain species of lactic acid bacteria and bifidobacteria with probiotic characteristics. Regular use of probiotics in the diet reduce signs and symptoms of lactose intolerance, contribution prevention and treatment of certain diarrhoeal diseases, stabilisation of gut mucosal barrier, reduction of bacterial enzyme activities and stimulation of the immune system [6].

Considering the potential of whey has, the aim of this study was to develop new starter cultures and to evaluate their growth and activity (fermentation time, titratable acidity (^{0}SH) and organoleptic characteristics) in reconstituted sweet cow's whey. Based on these resultswill be select starter cultures for production of a functional whey beverages.

MATERIALS AND METHODS

PREPARATION OF RECONSTITUTED COW'S WHEY FOR THE FERMENTATION PROCESS

Sweet whey powder with following chemical composition (lactose 69,62 g/100g, proteins 12,11 g/100g, lipids 1g/100g) was used for preparation reconstituted whey. Whey powder was dissolved in sterile distilled water under aseptic conditions to approximately 6,5% (w/w) of total solid. After reconstitution, flasks with whey were pasteurized in a water bath (60 °C for 1 hour) with constantmixing for bettertransfer of heat.After pasteurization whey is rapidly cooled to a temperature of 42^{o}C, which was chosen for fermentation process.

MICROBIAL CULTURES USED FOR DEVELOPMENT STARTER CULTURES

Seven strains from the genus *Lactobacillus* (*Lb. delbrueckii* ssp. *lactis* NRRL B-4525, *Lb. acidophilus* ATCC 4356, *Lb. helveticus* ATCC 15009, *Lb. reuteri* ATCC 23272, *Lb. rhamnosus* ATCC 7469, *Lb. delbrueckii* ssp. *bulgaricus* ATCC 11842, *Lb. johnsonii* NRRL B-2178) and one strain of *Bif. bifidum* NRRL B-41410 and *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) were chosen for construction starter cultures. Cultures were stored at -20 ^{0}C in MRS or M17 broth with 20% (v/v) glycerol and prior to experimental use strains were activated twice in MRS broth (*Lactobacillus* strains and *Bif. bifidum*) or M17 broth with lactose (*St. salivarius* ssp. *thermophilus*). All strains were incubated anaerobically overnight at the optimal temperature for growth (37 ^{0}C, no longer than 18h).

ACIDIFICATION ACTIVITY OF INDIVIDUAL STRAINS IN RECONSTITUTED WHEY

Before construction of starter cultures, acidification activity of all strains was tested in reconstituted cow's whey. Flask with 50ml of reconstituted whey was inoculated with 1% (vol/vol) of individual strain and incubated at 42^{0}C for 24h. Evaluation of acidification activity was performed on fermented whey samples after 6 and 24h of fermentation, measurement pH and titratable acidity (^{0}SH).

STARTER CULTURES USED FOR PRODUCTION FERMENTED WHEY BEVERAGES

Composition of eight two-component starter cultures is presented in a table 1.

Table 1. Composition of starter cultures used for production fermented whey beverages

Starter cultures	Composition of starter cultures
S1	*Lb. helveticus* ATCC 15009, *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)
S2	*Lb. delbrueckii* ssp. *lactis* NRRL B-4525, *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)
S3	*Lb. delbrueckii* ssp. *bulgaricus* ATCC 11842, *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)
S4	*Lb. acidophilus* ATCC 4356, *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)
S5	*Lb. rhamnosus* ATCC 7469, *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)
S6	*Bif. bifidum* NRRL B-41410, *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)
S7	*Lb. johnsonii* NRRL B-2178, *St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)
S8	*Lb. reuteri* ATCC 23272,*St. salivarius* ssp. *thermophilus* CNRZ S3 (389) (2:1)

Characteristics of eight developed starter cultures were compared with activity of commercial freeze dried starter culture (Lactoferm ABY-6) containing *St. salivarius* ssp. *thermophilus* 80%, *Lb. acidophilus* 13%, *Bif. bifidum* 6% and *Lb. delbrueckii* ssp. *bulgaricus* 1% (Biochem srl- Centro Ricerche Biochimiche). Inoculum was prepared by rehydrating 1 g of freeze-dried ABY-6 starter culture in 100 mL whey and then reactivated at 42 °C for 30 min. After reactivation, 2% (v/v) of inoculum was added in reconstituted cow's whey sample.

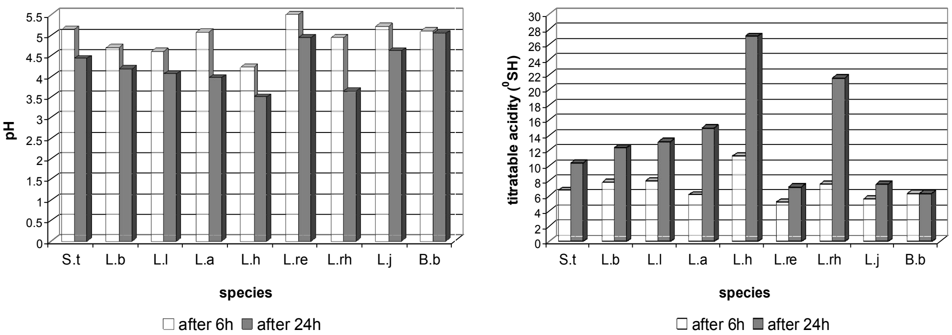
PRODUCTION OF FERMENTED WHEY BEVERAGES

Erlenmeyer flasks with 200ml of pasteurized cow's whey (temperature 42°C) were inoculated with 2% (v/v) two-componentstarter cultures presented in table 1 and previously activated ABY-6 starter culture. After inoculations, the contents of erlenmeyer flasks were thoroughly mixed and incubated at 42°C in a circulatingwater bath, until pH of around 4,6 was reached. At the end of incubation, the content of the erlenmeyer flasks was rapidly cooled in ice water to stop further whey fermentation. Cooled samples were analyzed for titratable acidity (^{0}SH) and the viable count of bacteria was determined using plate count method and results were expressed as cfu/ml. The count of lactobacilli and *Bif. bifidum* was estimated on MRS agar plates after microaerophilic incubation 3 days at 37 ^{0}C. Microaerophilic conditions were obtained by a one more layer of MRS agar over the MRS agar inoculated with bacteria. The count of *St. salivarius* ssp. *thermophilus* was determined on M17 agar plates with lactose after incubation 48h at 37 ^{0}C. After completing analysis, the samples were stored at 4°C and after 24 h were evaluated organolepticlly (appearance, taste, odor, body and texture).

RESULTS AND DISCUSSION

Characteristics of fermented products largely depend on proper selection starter cultures used for fermentation process. Acidification activity of strains is one of critical technological aptitudes which can have influence on selection strains for developing starter cultures [5]. Unfortunately, not all strains of lactic acid bacteria and bifidobacteria are capable to grow fast in media such as milk and whey. This is especially characteristic for probiotic strains that inhabit the intestinal tract of humans and animals, which usually have longer adaptation time and grow slowly in milk and whey, that results in a longer fermentation time required to reach a pH of 4,6 [7,8,9,10]. For these reasons in this study before developing starter cultures, the acidification activity of nine selected species of lactic acid bacteria and bifidobacteria was evaluated in reconstituted cow's whey prepared to have 6,5% of dry matter, similar to the liquid cow's whey obtained after cheese production. The pH value of reconstituted cow's whey at the beginning of the fermentation was around 6,15 while the titratable acidity was 3,48 ^{0}SH. Fermentation process was carried out at 42°C, temperature usually used for a production fermented dairy beverages (yogurt, sour milk, acidophil beverages).

Changes in pH and titrabile acidity values of whey samples after 6 and 24h of fermentation are presented in Figure 1. The quickest pH decrease was noticed in sample with the *Lb. helveticus* ATCC 15009, while *Lb. reuteri* ATCC 23272 had theslowest decrease of pH value (Fig. 1a).



a) b)

Figure 1. Acidification activity in reconstituted cow's whey a) changes of pH values of whey samples after 6 and 24h of fermentation; b) changes of titratable acidity (°SH) values of whey samples after 6 and 24h of fermentation

Abbreviations: **S.t.**- *St. salivarius* ssp. *thermophilus* CNRZ S3 (389); **L.b.**- *Lb. delbrueckii* ssp. *bulgaricus* ATCC 11842; **L.l.**- *Lb. delbrueckii* ssp. *lactis* NRRL B-4525 ; **L.a.**- *Lb. acidophilus* ATCC 4356; **L.h**.- *Lb. helveticus* ATCC 15009; **L.re**- *Lb. reuteri* ATCC 23272; **L.rh**.- *Lb. rhamnosus* ATCC 7469; **L.j**.- *Lb. johnsonii* NRRL B-2178; **B.b.**- *Bif. bifidum* NRRL B-41410;

From the study group, particularly distinctive are strains *Lb. helveticus* ATCC 15009, *Lb. delbrueckii* ssp. *lactis* NRRL B-4525 and *Lb. delbrueckii* ssp. *bulgaricus* ATCC 11842 which after 6h of fermentation decrease pH value below 4,7. Other strains (*St. salivarius* ssp. *thermophilus* CNRZ S3 (389), *Lb. acidophilus* ATCC 4356, *Lb. rhamnosus* ATCC 7469, *Lb. johnsonii* NRRL B-2178, *Bif. bifidum* NRRL B-41410), with the exception *Lb. reuteri* ATCC 23272, had the pH value after 6h of fermentation around 5,0. Trend of decreasing pH value continued between 6 and 24 h of fermentation and most samples at the end of fermentation process had pH value lower than 4,5. Again, sample inoculated with strain *Lb. helveticus* ATCC 15009 had the lowest pH values after 24 h of fermentation.

The highest titratable acidity after 6 h and 24h of fermentation was observed in sample inoculated with strain *Lb. helveticus* ATCC 15009 (°SH =11,3 and 27,1, respectively), which was expected, since the same sample had the lowest pH value at same period of time (Fig 1b). For the most other tested strains, the main increase in titratable acidity was observed between the 6th and 24th hours. Exception are strains *Lb. reuteri* ATCC 23272, *Lb. johnsonii* NRRL B-2178, *Bif. bifidum* NRRL B-41410 which in this period slightly increase titratable acidity. This species can be found as a normal microflora in intestinal tract of humans and animals and their strains usually show slow activity in substrate such as milk and whey since this media does not contain all the essential amino acids and vitamins necessary for growth this group of bacteria [6,7]. So strain *Bif. bifidum* Bb-12 need more than 28h in a milk, and around 20 h in whey, to reach pH around 4,5 which is slightly faster activity than results obtain in this studies for strain *Bif. bifidum* NRRL B-41410 [7].

Based on the results obtained for acidification activity of single cultures, eight two-component starter cultures are formed, to include one strain from genus *Lactobacillus* or *Bif. bifidum* and one strain of *St. salivarius* ssp. *thermophilus* in a rate 2:1. During the fermentation process following characteristicswere monitored: fermentation time to reach pH 4,6, titratable acidity and viable cell count of bacteria on MRS and M17 agar.Samples were incubated until pH of about 4,6 is reached, since from the literature is known that lower pH values can adversely affect the stability of the obtained fermented beverages during cold storage [7.8,9]. Characteristics of eight two-component starter cultures are presented in Figure 2.

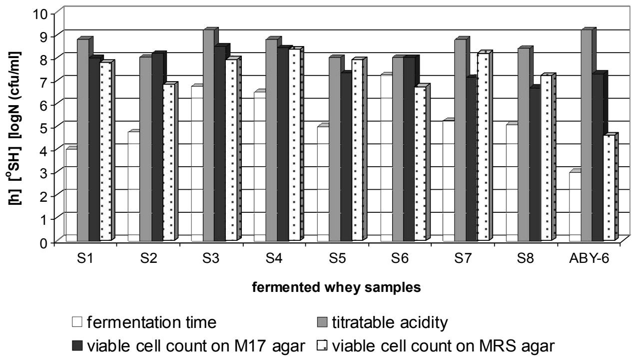


Figure 2. Characteristics of eight two-component starter cultures during fermentation in in reconstituted cow's whey

The duration of fermentation in reconstituted cow's whey ranged from 4 hours till 7,25 hours, while the titratable acidity was in the range 8.0 to 9.2 °SH which corresponds to the value achieved with culture ABY-6. (Figure 2). The shortest fermentation time is achieved with starter cultures S1 and S2, containing species *Lb. helveticus/St. salivarius* ssp. *thermophilus* or *Lb. delbrueckii* ssp. *lactis/St. salivarius* ssp. *thermophilus* respectively, which also as a single cultures achieved good acidification activity in the same kind of whey after 6 hours of fermentation (Figure 1). In comparison with activity of commercial starter culture ABY-6, fermentation time was slightlylonger with cultures S1 and S2 (3 hours, 4 hours and 4,75 hours, respectively). The longest fermentation time (7,25 hours) is achieved with starter culture S6, which beside *St. salivarius* ssp. *thermophillus* contains *Bif. bifidum* NRRL B-41410, which achieved slow activity as a single strain. In all examined starter cultures it was noticed some degreeof symbiotic relationship betweenthe correspondingspecies of the genus*Lactobacillus* or *Bif. bifidum* and*St. salivarius* ssp. *thermophilus* as fermentation time was significantly shortenedcompared with the results obtained for their single acidification activity. After fermentation, all fermented whey beverages had total count of viable cell more than 10^6 cfu/ml, with different prevalenceof strainsin the population. It was noticed that some fermented whey beverages (S2, S3, S6, ABY-6) had higher viable cell count of *St. salivarius* ssp. *thermophilus*, while other (S1, S4) had almost equally cell count of *St. salivarius* ssp. *thermophilus* and lactobacilli or the cell count of lactobacilli was higher

(S5, S7, S8). Particular, the very low proportion of strains from *Lactobacillus* sp. and *Bif. bifidum* species were found in fermented whey beverage from ABY-6 culture (around 10^4 cfu/ml). All fermented whey beverages had an excellent appearance and distinctive pleasant taste and odor, depending of starter cultures used

CONCLUSION

The results obtained in this study show that the whey isa suitable substratefor the growthof lactic acid bacteriaandthe production of functional beverages Developed starter cultures in this study have potential to be used instead of commercial starter culture ABY-6, since fermented whey beverages have satisfactory organoleptic characteristics. Further research will provide better information about stability of produced beverages during cold storage.

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THE ROLE OF THE MUNICIPAL POLICE OF ZAJECAR CITY IN THE ECOLOGICALLY SUSTAINABLEDEVELOPMENT OF THE COMMUNITY

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ABSTRACT

The municipal police are an internal organizational unit within the organs of city administration. This department is in charge of changing the cityscape and making the towns look neater. They monitor and control the protection of the environment regarding the following areas: protection and preservation of natural resources, urban ecology, soil and water preservation, water supply and water protection, environmental (ecological) ethics and environmental education, emergency ecological situations and capacities as well as other areas which are necessary for the life of people and other subjects.

Key words: Municipal police, sustainable development,environment, monitoring.

INTRODUCTION

One of the constitutionally guaranteed human rights and freedoms is a right to a healthy environment. According to the Constitution:

1. Everyone has a right to a healthy environment as well as to receive the timely and complete information about its condition.
2. Everyone, especially the Republic of Serbia and the autonomous province, is responsible for the environmental protection.
3. Everyone has a duty to protect and improve the environment. [1]

Environmental protection is regulated by the Law on Environmental Protection, which is of a general nature, and by special laws, of which the most important for the municipal police are the Law on Environmental Protection, the Law on Air Protection, the Law on Noise Protection and the Law on Waste Management. [2, p. 41]

Environmental pollution may be caused by the action or inaction of legal entities and individuals. The task of the municipal police is to prevent any activity that can pollute the soil, water or air, that is, natural resources, primarily by using preventive measures and powers they have at their disposal: frequent visits and controls, issuing warnings, giving verbal orders or conducting video surveillance. If preventive measures have not yielded any results and an offense has been committed, the municipal police will, depending on a case, apply measures it is authorized to use, under the conditions and in accordance with the law and relevant by-laws. [2,p. 63]

It is on the local community to manage the economic, social and ecological infrastructure, as well as to monitor construction and urban planning, decide on the local environmental policy, the relevant regulations, and to participate in the implementation of national and regional environmental protection policy. From the point of view of both politics and management, local communities are closest to ordinary people and thus have the key role in informing and mobilizing the population, which is a necessary step towards the environmental protection and sustainable development.

The municipal police are an internal organizational unit within the city administration. They are expected to change how cities look like and to make them cleaner and more organized. Such changes contribute to a healthy and well-ordered life and generally make life more beautiful and comfortable. One of the reasons for establishing the municipal police is a need to activate as much as possible other city services to take part in solving the security and safety problems of the city, as well as protecting the environment, people and their property.

The jobs of the municipal police are defined by the The Law on Municipal Police and are classified into five groups. All groups are associated with environmental protection and sustainable development.[3]

According to the Law on Municipal Police, maintaining public order encompasses order maintenance in the following areas and / or issues: water supply, rain and waste water collection, public sanitation, transportation and waste disposal, maintenance of local roads and streets, traffic signs and signals, parking, urban and suburban transportation, taxi transport, construction of temporary office buildings, fire protection, protection against noise in the environment, control of supervisors' working hours, maintenance of utility facilities, markets, cemeteries, parks, and other green public spaces, street lighting, housing and other facilities. [4]

THE MOST FREQUENT FORMS OF ENVIRONMENTAL DEGRADATION

In their two-year experience, Zajecar municipal police have noted the following most frequent forms of environmental degradation:

- creation of wild dumps;
- pollution of soil and water due to waste water discharge, industrial lubricants, waste oil and other hazardous materials;
- air pollution by tire burning and throwing around plastic containers and waste stubble;
- air pollution by building fires in forests, picnic areas and other green spaces;
- discharges from municipal sewage drains and leakage from septic tanks;
- disposal of waste, household garbage and other waste in unauthorized areas;

- destruction and damage of vegetation;
- improper disposal of battery and electronic waste;
- making and broadcasting noise in public places and open spaces, in cafes and restaurants;
- illegal storage of hazardous materials;
- non-compliance with measures stated in the Act on Natural Resources etc..

A municipal policeman arrives at a scene to determine the degree of environmental degradation and damage and uses his powers prescribed by the law and notifies the relevant institutions.

If a written request is filed, municipal police can offer their help to inspectors for environmental protection. If decided so by the the city council, municipal police may also help guards at national parks.

PROTECTION AND PRESERVATION OF NATURAL VALUES

Protection of natural values – air, water, soil, forests, geological resources and flora and fauna are regulated by a separate law. In order to protect nature, a series of measures and activities are undertaken to prevent damage of nature, natural values and balance.

Protected areas are declared by a relevant organ of the local selfgovernment:

- Natural monuments (caves, waterfalls, lakes, one tree or a group of trees, parks, botanical gardens, etc.),
- Sites of exceptional importance (natural or cultural landscapes of a recognizable scenery with significant natural, esthetic, cultural and historical values (e.g., the Great War Island in Belgrade),
- Nature park (an area with well preserved natural values).

No activities that could disturb or ruin the characteristics and values of these sites are allowed to be practiced at these places. [2, p. 57.]

There is an archeological site called *Felix Romuliana* located in the vicinity of Zajecar which is under UNESCO's protection. This is a site which Zajecar municipal police monitor very often. Should anything that may endanger the archeological site happen, the police notify the institution or ministry in charge of cultural affairs. *Felix Romuliana* is surrounded by farmer fields. After finishing their work, farmers leave their land in combines and tractors which cover the road leading to *Felix Romuliana* with mud thus endangering traffic safety not to mention how the road looks like with all the dirt and soil on and around it. The municipal police have the authority to order the offenders to clean the wheels of their vehicles as well as the road they have covered with mud. Also farmers often burn stubble and other waste on these fields. On more than one occasion have the municipal police prevented fires and several times they had to put them down on their own.

The local self-government is in charge of ***environmental protection noise*** regulations. According to the decision of the city council, the municipal police control working hours of cafés and restaurants applying the Act on public law and order. They warn café and restaurant's owners if the music is played too loud or if there is too much noise. If owners are not willing to cooperate, the municipal police issue orders and inform the Police Station in Zajecar about the problem. An environmental inspector is also informed and he orders the level of noise to be measured in a given period of time. The municipal police or regular police forces take the matters from this point and process the owner in accordance with the Act on public law and order and the local decision voted on by the city council regarding working hours of city restaurants and cafés.

URBAN ECOLOGY

Urban ecology encompasses areas near roads, paths, fences, sidewalks, pavements, gardens, embankments along railway lines, walls, roofs, river banks in urban areas, various waste disposal sites, meadows, construction sites, ruins, neglected lawns, abandoned lots, economic yards, cemeteries, boundaries, edges of cultivated fields and park areas, etc. [5]

A review of available literature shows that waste waters which drain into *sewer*systems are not the main cause of potentially toxic elements (PTEs) in urban wastewaters. [6]

Urban waste waters contain many harmful substances originating from various sources. Large sources of pollution connected to urban drainage whose control is law-regulated can easily be identified. However, it is much more difficult to pin down the impact of smaller sources such as households or small businesses. Unprocessed waste waters let loose are yet another problem. [7, p. 1].

Public parks and other green areas in cities are part of the city spatial and urban planning and are maintained in the way that ensures their preservation and improvement. If they get ruined or damaged in any way due to construction works, they have to be repaired and rebuilt in accordance with the city council's regulations. The task of the municipal police is to monitor that all regulations are carried out properly, which in the long run preserves the city's infrastructure and assets.

The municipal police supervise and control that the law is obeyed in all these areas which are part of urban ecology. The most efficient protection of the city's assets and facilities is ensured by permanent presence at and frequent visits to the facilities which are of importance for the city.

SOIL AND WATER PROTECTION

The contribution of the municipal police is seen in the policemen's application of authorities they have at their disposal when managing order at residential and agricultural land and watersupply sources. Municipal policemen operate in the following manner: through controls they gather data on the way the above mentioned resources are used; warn people if they disobey laws and regulatuions; inform the city's organs that they should undertake steps from their field of authority and issue spot fines when they have a legal right to do so or are given the right by other regulations or by the city council.

WATERSUPPLY AND WATER PROTECTION

"Water will not disappear if we draw it out from the well of human wisdom." [8]

All people have the right to consume water from natural watercourses, natural streams amd lakes, public wells and fountains.

The municipal police's task is to monitor that all waters are protected, and to prevent the introduction of hazardous and harmful materials, or of solid and liquid materials that can cause water pollution or make water muddy or salty or cause sediment deposition.

These are the most common offences the municipal police face: waste disposal at the edge of the lakes, on the river banks and in sewerage chambers, unprocessed waste water releases into the rivers, car wash with detergents on the river banks or near public fountains.

ECOLOGICAL ETHICS AND ECOLOGICAL EDUCATION

The municipal police of Zajecar city is one of the participants in the SSP Project (Sports + School + Police). It took part in the Project in 2012 and the program has continued in the following year as well. This program includes children of age between 6 and 12. Its aim is to use sport and play in showing children what a healthy life really means. Besides pointing to the right ways of preserving and protecting natural reaources and the environment, this project aims at educating children about the life in the community and how each one of them is to behave as an individual. Minucipal policemen give practical advice on preventive measures about the environment protection and proper behaviour regarding its preservation.

The aim of this educational program is the following: raising awareness about the importance of a healthy environment and a healthy life, reducing children's asocial behaviour towards nature, protecting nature and city green areas, motivating teachers and professors at schools as well as parents and other city services to help protect the environment, increasing children's safety and improving the quality of life in the community.

'Education in service of sustainable development' doeas not mean 'sheer enlargement of ecological education to social and economic aspects' but a strong connection between 'political education, global learning, ecological education and health education'[9].

ENVIRONMENTAL EMERGENCIES AND CAPACITIES

According to the Law on the Municipal Police, the tasks of the municipal police are, among other things, taking part in emergency situations and saving human lives. [10]

The municipal police control legal and physical entities and whether they obey the law and other city's regulations reagrding fire protection measures.

When controlling the fire protection measures, the municipal police check the following: construction of temporary objects at the roads toward objects where fire vehicles are planned to go through and people and their property evacuated; prohibition of setting fires in the forest and at least 200 metres from the edge of the forest except if there is a spots specially marked for such a purpose; the obligations of a person in charge of a protected area to do the job according to the previously defined plan and fire preventive measures; prohibition of putting inflammable materials within the range of 6 metres from the object or part of the object (if technical documents do not specify otherwise); employment of special precautions with stubble; prohibition of setting fire with stubble, waste or plant remains in the open; emergency evacuation plans and directions are to be held in such a place as to ensure the safest and most efficient evacuation time of all residents of residential units, offices, restaurants, etc.

In case of fire, the municipal police can undertake emergency steps to protect people from fire if other authorized institutions or organizations cannot act on time and inform these institutions/organizations about that immediately.

In case of danger caused by fire, the municipal police take part in saving people's lives and property and helps other organs and legal and physical entities in removing the consequences of fire.

When dealing with the consequences of fire the municipal police carry out the measures determined by the city's sanitation plan and other relevant acts as well as according to the directions given by the chief of the municipal police who organizes and directs work of the municipal police in the field. [2, p. 66]

In their work so far, the municipal police of the city of Zajecar have participated in putting down fires in the forests and apartment blocks. The emergency situation department within the Ministry of Internal Affairs and the emergency situation HQ of the city of Zajecar manage the process of putting down the fire together and coordinate the work of the municipal policemen.

In emergency situations generally, the role of the municipal police has been seen in frequent rides, supervision of ongoing fires, informing the emergency situation HQ within the Ministry of Internal Affairs and of the city of Zajecar about the current situation in the field; informing about new fires, participating in putting down the fire and preventing its further spreading (until fire units arrive), protecting people's lives and property and protecting the environment. In emergency situations the municipal police also assist traffic policemen when supervising the city traffic in the endangered areas.

CONCLUSION

The most difficult task of the munisipal police is changing the bad habits people have. These bad habits are a great problem both for the family which is the main cell of society and for the community and society in general. Citizens should change their bad habits and behaviour because in that way they not only make things better for people around them but for themselves as well. The municipal police play a major role in this process of changing habits. The education of citizens starts with the very attitudes and behaviour municipal policemen express. The task of the municipal police is to raise the population's awareness about the responsibility of every individual for the environment. In this way the municipal police help local and state institutions in applying and respecting the rule of law and ensuring law and order in every city.

It could be concluded that the municpal police are one of the rare services which have authority that are applicable in all spheres of social life. These authorities are in in some cases preventive but may grow into repressive.

Sometimes, the application of repressive measures may have a preventive effect on potential future offenders.

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THE CONCEPT OF LANDSCAPING THE EXTENSION ZONE OF THE ARBORETUM OF THE FACULTY OF FORESTRY IN BELGRADE

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ABSTRACT

The spatial entity of the Faculty of Forestry Arboretum offers a range of landscaping options in the process of reconstruction and revitalization of the whole area. The Arboretum is divided into the inner zone of a landscaped park area (3.56 ha) and the zone of extension (3.13 ha). The paper presents an elaborate study of the reconstruction of Hungarian oak and Turkey oak forest community in the south-eastern part of the extension zone, 0.18 ha in area. It is planned to plant both edificatory and accompanying species of the community, a total of 90 specimens of 20 tree species. It means that these tree species will be reintroduced on a modified and cultivated forest site, where the Arboretum was established as an area with education and research as primary functions.

Key words: Arboretum, Hungarian oak, Turkey oak, accompanying species, reconstruction.

INTRODUCTION

As a protected natural area, Arboretum of the Faculty of Forestry in Belgrade has a great functional and compositional value in the system of urban green spaces of the city of Belgrade. At the same time, this area is a dendroarchive of over 300 tree species and intraspecific varieties, which preserve the genetic, species and ecosystem diversity of the Balkans and its surroundings. The Arboretum (*Figure 1*) enjoys the status of a protected natural area in the category of natural monuments. Reconstruction of the forest community of Hungarian oak and Turkey oak, on whose altered site Arboretum was established, has been planned on one part of the zone of extension. Reconstruction of this community, which is the 'coenoecological synonym' for the central parts of the country, has arisen from the need to expand the plant growing stock and to improve the teaching and research functions of the Arboretum.

The forest community of Hungarian oak and Turkey oak (*Quercetum frainetto-cerridis* Rudski 1949. s. l.) is in Serbia a climatogenic community with great ecological and floristic heterogeneity [1,2]. This is the reason why the community has been sorted into a number of different syntaxa according to International Code of Phytosociological Nomenclature [3,4]. Today, much of the area of Hungarian oak and Turkey oak forest complexes in Serbia is in the stage of regression of the forest succession, primarily due to the negative impact of anthropogenic factors. The aim of this paper is to provide an elaborate study of the reconstruction of the typical association of Hungarian oak and Turkey oak, which will as an association in the immediate natural environment of the urban forest Košutnjak and in similar environmental conditions, follow its structural form and floristic diversity.

Figure 1. Map of the Arboretum

MATERIAL AND METHOD

The research was conducted in two stages. In the preliminary stage, we carried out the field survey, studied the environmental conditions and collected data on the current state. During the main stage we developed the master plan of landscaping the zone of extension in the Arboretum of the Faculty of Forestry. It included planting arrangement, specification and the planting stock production method. We applied the methodology of graphic presentation of the landscaping concept , with the use of AutoCAD 2013 [5,6] and digital modeling - 3D presentation[7] software packages.

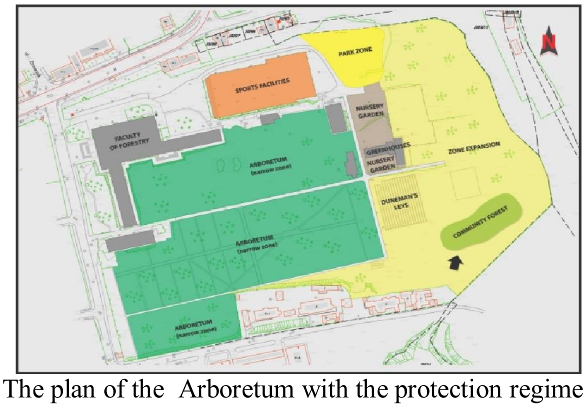
RESEARCH RESULTS AND DISCUSSION

Site conditions

The Arboretum is located on the northwestern slope of the city forest Košutnjak, at an altitude of 110-125 m. Its geographic coordinates are: 44˚48' of east longitude and 20˚28' of north latitude. The gross surface area of the inner zone is 3.56 ha, and the surface area of the zone of extension amounts to 3.13 ha[8]. Parent rock consists of silicate rocks covered with layers of loess and deluvial deposits. The soil can be described as lessive brown forest soil. This type of soil is typical of Serbia, especially of Hungarian oak and Turkey oak forests. The climate in Belgrade is classified as temperate continental climate, influenced by subatlantic, continental and sub-Mediterranean climate factors. This wide range of different factors gives it a translatory character. According to data from the Hydrometeorological Service of Serbia, for the ten-year period (1985-1995), macroclimatic conditions in Belgrade were characterized by the mean annual temperature of 11.7˚C, and the mean air temperature during the vegetation period of 18.6˚C. Winters are relatively mild, summers are hot. Rainfall regime is characterized by the total annual amount of atmospheric deposits of 690 mm. According to the hydric balance calculated after *Thorntweit*, the humidity index amounts to 19.21, the aridity index to 16.76 and the climatic index to 9.16. These values indicate that the wider area of Belgrade has a subhumid moist climate of C_2 type. Such favorable precipitation regime, its optimal quantity and temporal distribution made conditions favourable for the introduction of a large number of allochthonous woody and exotic species, which is particularly important for the plant growing stock of the Arboretum. According to earlier investigations [10,11,12], Kosutnjak area, as a fragment of oak forests in the city core of Belgrade, is in terms of phytocoenology largely seen as a site of recent vegetation of Hungarian and Turkey oak forests (*Quercetum frainetto-cerridis* Rudski 1949. s. l.). This locality also includes xerophilic zonal vegetation of the southern rim of the Pannonian plain: *Orno-Quercetum cerris virgilianae* Jov. et Vuk. 77 *subass. typicum* Tom. 90 [12,13]. The Arboretum itself was built on a modified and cultivated site that is, in large part, directly adjacent to the forest complex Kosutnjak, which makes it in phytocoenological terms close to the above mentioned plant communities.

Basic data on the current state

In the preliminary stage we performed spatial identification of the future zone of Hungarian and Turkey oak forest association. This forest area is planned to occupy the southeastern part of the Arboretum extension zone (*Map 1*). The existing vegetation was recorded and one isolated area showed a high degree of weed infestation and the presence of undesirable trees and shrubs that are of low functional and aesthetic value. A number of individuals are characterized by poor health. The area is dominated by native locust (*Robinia pseudoacacia* L.) trees, whose diameters range from 10.0 to 27.5 cm, and two decrepit specimens of wild cherry (*Prunus avium* L.), with respective diameters of 32.8 cm and 34.0 cm, are completely sapless. It is essential to keep the existing specimens of accompanying species: flowering ash (*Fraxinus ornus* L.), Tatarian maple (*Acer tataricum* L.), dogwood (*Cornus mas* L.), hawthorn (*Crataegus* sp.) and wild rose (*Rosa* sp.), as presented in the proposed planting arrangement. We also propose silvicultural-sanitary felling of marked trees, which must be followed by the preparation of the soil for the introduction of seedlings of the proposed woody species.



Map 1. The plan of the Arboretum with the protection regime borders

The concept of landscaping a part of the zone of extension

The concept of landscaping the southeastern part of the Arboretum`s zone of extension is based on forming a group planting that will represent reconstruction of Hungarian and Turkey oak forest communities on an area of 0.18 ha (*Figure 2*). *Map 2* shows the planting arrangement of edificatory and accompanying species. The 3D model solution, with the arrangement of greenery, is presented in *Figure 3*. As can be seen, 25 Hungarian oak and 11 Turkey oak seedlings have been introduced into this separate area. Since the stand mixture of natural Hungarian and Turkey oak communities is such that Hungarian oak trees are often suppressed and Turkey oak is the biologically stronger species[14], the planned mixture ratio of Hungarian oak and Turkey oak is 70%:30%.

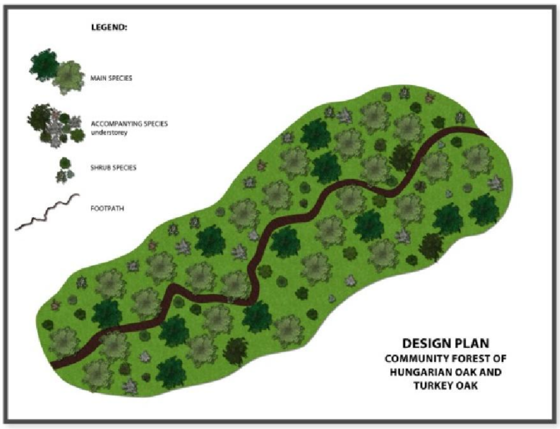
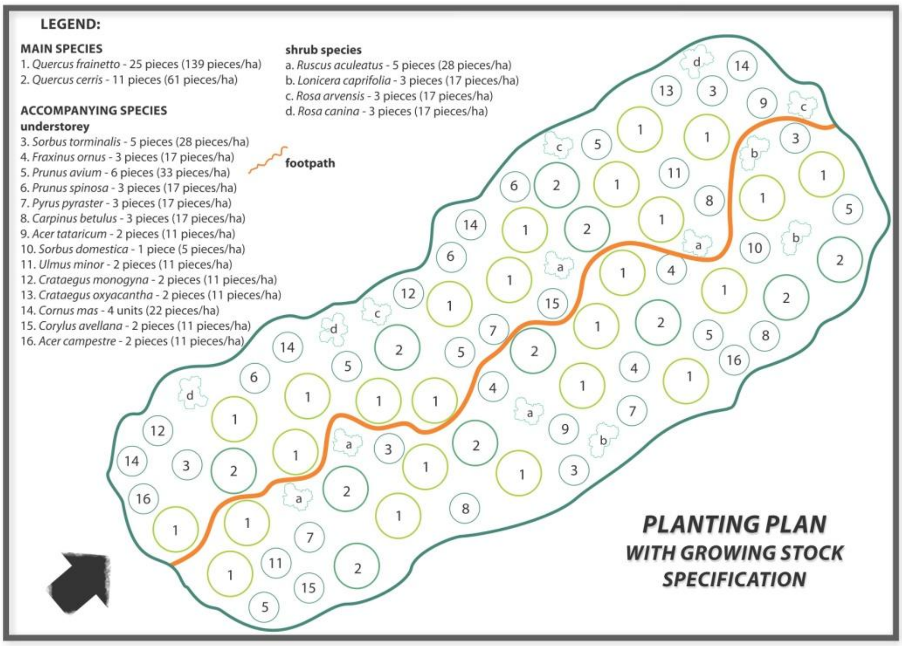


Figure 2. Planting design plan

This ratio of edificatory species in the future 'microarea' would follow the optimal ratio of these species in the best natural mature stands (200 mature trees per hectare)[15]. Given the importance of specific functions of the Arboretum, to establish this community it is necessary to use park seedlings that meet high genetic, physiological and morphological criteria of quality. Hungarian oak seedlings (*Quercus frainetto Ten.*) can be rarely found in the local nursery production. Therefore we are planning to purchase acorn from registered seed trees and from seed stands on the territory of Serbia and then to produce and raise seedlings in the nursery of the Arboretum. (*Table 1*). There is a nursery with Duneman seedbeds near the planned zone of Hungarian and Turkey oak forest vegetation (*Map 1*). The soil in the Arboretum is classified as lessive brown forest soil. This heavy, compact and rich soil is suitable for the production of oak seedlings. It is necessary to train the roots of the seedlings in such a way to prevent them from developing too long tap roots. The seedlings of Turkey oak (*Quercus cerris* L.) and other proposed species can be produced in the same seed facility and the seed material can be collected in the Arboretum. The proposed accompanying species are the most common species in Hungarian and Turkey oak forests, where they serve the purpose of auxiliary species. Since they make the forest understorey, they keep the trunks of mature

Hungarian and Turkey oak trees in shade and prevent the occurrence of water sprouts. Furthermore, their organic waste speeds up the process of organic matter decomposition. The soil prepared in such a way would in natural stands of Hungarian and Turkey oak trees make suitable conditions for natural regeneration. Mature seedlings (*Figure 4*) would be then easily transported to the site where they would be planted with irregular spacing (2x2 m, 3x3 m), in order to make an impression of `unforced nature` and establish persistent vegetation relatioships. After the planting has been completed, all specimens should be adequately marked (*Figure 5*). Intensive tending measures should be implemented in compliance with the purpose and the significance of the whole area.



Map 2. Planting plan in the zone of extension

CONCLUSIONS

As a human-made botanical value, the Arboretum of the Faculty of Forestry provides a number of functions within the teaching and research activities of the institution. The formation of the zone of extension includes, among other things, reconstruction of the natural composition of Hungarian and Turkey oak forest community on an area of 0.18 ha. There is a plan to introduce 20 indigenous tree species, presented with 90 specimens, which would in natural mature stands give 200 trees of edificatory species per hectare and 220 trees of accompanying (understorey) species per hectare. The spacing should be irregular, with the ratio of edificatory species in the mixture of 70%: 30% in favor of Hungarian oak.Other species are either accompanying species that make the understorey or shrub species. Some of these species are rare, valuable, endangered or protected indigenous tree species (*Sorbus torminalis (L.), Sorbus domestica* L., *Prunus avium L., Prunus spinosa L., Pyrus pyraster* Borkh., *Ruscus aculaetus* L.). Reintroduction of the proposed species will help preserve the natural heritage of the forest community typical of the central parts of Serbia, develop modern methods of propagating indigenous tree species, and promote educational and research functions of the Faculty of Forestry Arboretum.

Figure 3. The concept of landscaping the zone of extension of the Arboretum (3D presentation)

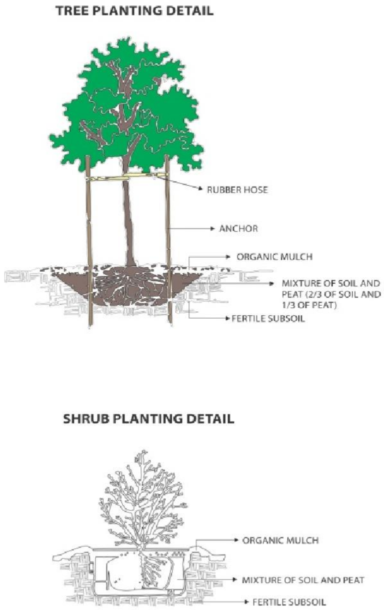


Figure 4. Planting a standard broadleaved balled and burlapped seedling

Figure 5. Conceptual design of tree specimen labelling

Table 1. Specification of the planting material and production methods

N°.	tree species	planting stock production method	seedling age (year.)	number of seedlings	notes
1.	Hungarian oak (*Quercus frainetto Ten.*)	generative propagation, container production	2+2	25	autumn or spring sowing, due to the weediness, use strong seedlings
2.	Turkey oak (*Quercus cerris* L.)	generative propagation, container production	2+2	11	autumn or spring sowing, due to the weediness, use strong seedlings
3.	Wild service tree (*Sorbus torminalis* (L.) Crantz)	generative propagation (only)	2+2	5	spring sowing, seed stratification
4.	Service tree (*Sorbus domestica* L.)	generative or vegetative propagation	2+2	1	vegetative propagation - grafting
5.	Flowering ash (*Fraxinus ornus* L.)	-	-	3	existing specimens
6.	Wild cherry (*Prunus avium* L.)	generative propagation	2+2	6	
7.	Blackthorn (*Prunus spinosa* L.)	generative propagation	2+2	3	
8.	European wild pear (*Pyrus pyraster* Borkh.)	generative propagation	2+2	3	spring sowing, seed stratification for 10-12 weeks
9.	Common Hornbeam (*Carpinus betulus* L.)	generative propagation	2+4+3	3	stratification till the next spring
10.	Field maple (*Acer campestre* L.)	generative propagation		2	autumn or spring sowing, stratification for 5 months
11.	Tatarian maple (*Acer tataricum* L.)	-	-	2	existing specimens
12.	Field elm (Ulmus minor Miller)	generative propagation	2+2+3	2	autumn sowing, immediately after collection
13.	Single-seeded hawthorn (*Crataegus monogyna* Jacq. emend. Lindm)	-	-	2	existing specimens
14.	Multi-seeded hawthorn (*Crataegus oxyacantha* L. p. p. et auct)	-	-	2	existing specimens
15.	Dogwood (*Cornus mas* L.)	-	-	4	existing specimens
16.	Hazel (*Coryllus avellana* L.)	generative or vegetative propagation	2+3	2	autumn sowing, seed stratification for 4-5 months
17.	Cladodes (*Ruscus aculeatus* L.)	-	-	5	transplant the existing specimens from fields B_4 and G of the inner zone of the Arboretum
18.	Honeysuckle (*Lonicera caprifolia* L.)	-	-	3	transplant the existing specimens from fields B_5, I of the inner zone of the Arboretum
19.	*Rosa arvensis* Huds.	-	-	3	existing specimens
20.	Dog rose (*Rosa canina* L.)	-	-	3	existing specimens

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THE CLASSIFICATION OF MAINTENANCE UNITS FOR A GIS BASED CADASTRE OF URBAN GREEN SPACES

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ABSTRACT

For decades great attention has been paid to qualitative and quantitative evaluation of urban green spaces as well as their constituents, and the results of research that have been presented to this end have always shown that the criteria are fairly easy to find, but very difficult to accept as generally applicable [1].

Almost all professionals in the field of landscaping have proposed their own methods of objective inventory and assessing of the value of green spaces' content, but a very small number of these procedures can be said to have been accepted, both professionally and scientifically.

This paper aims to present a systematization of maintenance units for the purpose of establishment of GIS based Cadastre of green spaces of Belgrade.

Key words: maintenance units, GIS cadastre, green spaces.

INTRODUCTION

Nowadays Urban Green Spaces Geographic Information System (UGS GIS) is undoubtedly the most advanced information system for display of data related to inventory and evaluation (both qualitative and quantitative) of the constituents of green spaces. By the establishment of GIS based Cadastre of urban green spaces and maintenance of efficiency within this information system conditions are acquired for processing of large amounts of data, improvement of their accuracy as well as their easier accessibility. Thus, efficiency in the implementation of protective measures, planning, establishment, maintenance and financing of urban green spaces is increased [2].

In order to meet the needs of its users an urban green spaces information system, must, above all, be comprehensive, i.e. it must possess all the necessary information for the purpose for which it is made.

The complexity of content design of an UGS GIS is reflected primarily in systematization of all necessary and relevant elements of the system. The basic elements of urban green spaces GIS are maintenance units comprising all elements of green spaces, both biological and construction elements, and their specific properties (characteristics, attributes). Therefore, systematization of maintenance units represents the axis of contents for the design of urban green spaces GIS Cadastre.

During the year 2002 in cooperation with Institute of Urbanism Belgrade and Secretariat for Environmental Protection of the city of Belgrade a project was launched focusing on the protection and development of green spaces of Belgrade entitled "Belgrade Green Spaces Legislation". The second phase of this big project focused on the preparation of the contents and program for the establishment of GIS based Cadastre of urban green spaces.

MATERIAL & METHODS

The basic scientific method used is systematization; furthermore the modeling method is also applied. In this paper a model represents a unique pattern of a system of urban green spaces maintenance units on the basis of which the inventory and valuation of maintenance units will be conducted for the purpose of establishment of GIS based Cadastre of green spaces of Belgrade.

As a starting point for the development of the model of maintenance units systematization the experience of German cities in the establishment of information systems of green spaces was used (GRIS-Grünflächeninformations-system), and especially GALK-guidelines ("GALK-Systematik") which were drawn up during the mid-1990's by the "Organization and economics" expert team within the Urban Green Spaces Administration Conference of the cities in Germany (Der Arbeitskreis "Organisation und Betriebswirtschaft" der Deutschen Gartenamtsleiterkonferenz Private Städtetag).

The model - a pattern of maintenance units of GIS based Cadastre of green spaces has been tested on eight representative green spaces of Belgrade. The aim of this test was to determine the comprehensiveness of the set model-pattern of maintenance units and the frequency of occurrence of individual maintenance units for the purpose of rationalization of contents within GIS based Cadastre of urban green spaces.

Green spaces which have been subjected to inventory of maintenance units fall into different categories of green spaces, namely: three green spaces fall into the category of city parks (the city parks are the most comprehensive according to the number of maintenance units) - the central part of Topcider Park, Finansijski Park, Mali Tasmajdan Park), squares (the Square in front of the Faculty of Economics), shielding vegetation (protective vegetation in Bele vode along the Ibar highway), green spaces within public use facilities (the park in front of the National Assembly), green spaces within sports centers (green spaces of Sports Centre Zemun), and green spaces within city blocks (a part of green space within Block 70).

RESULTS AND DISCUSSION

For the purpose of establishment of GIS based Cadastre of green spaces of Belgrade maintenance units are represented as specific spatial objects, and are classified, based on the functions they have within the green zone, into seven main categories, namely: plants, land objects, installations, civil engineering and architectural structures, hydro-technical structures, covered surfaces, green spaces furniture and equipment (Table 1).

Each of these categories contains the basic maintenance units and some maintenance units can also have their own types. A detailed review of the maintenance unit classification is given in Table 2.

Table 1. Categories of Urban Green Spaces Maintenance Units

№	*Categories of maintenance units*
1.	Plants
2.	Land objects
3.	Installations (surface and underground)
4.	Civil engineering and architectural structures
5.	Hydro-technical structures
6.	Covered surfaces
7.	Green spaces furniture and equipment

Table 2. Basic maintenance units given per maintenance unit category

№	*Maintenance unit*	*Type of maintenance unit*	*№*	*Maintenance unit*	*Type of maintenance unit*
1. Plants			24.	Screens	
1.	Trees		25.	Gates	
2.	Shrubs		26.	Railings	
3.	Hedges		27.	Sand boxes	
4.	Vines		28.	Small bridges	
5.	Ground cover plants		29.	Park sculpture	
6.	Flower beds	1-Roses	30.	Monuments	
		2-Perennial flowers	31.	Rockeries	
		3-Seasonal flowers	32.	Retaining walls	
		4-Flower bed combined with other greenery elements	33.	Freestanding walls	
7.	Lawns	1-Landscaping turf	***5. Hydro-technical structures***		
		2-Carpet lawn	34.	Drinking fountains	
		3-Flower lawn	35.	Pools	
		4-Park lawn	36.	Fountains	
		5-Meadows	37.	Cascades	
		6- Sport field lawn	38.	Water bodies	1-Lakes
		7- Anti-erosion lawn			2-Streams
		8- Escarpment lawn			3-Canals
		9- Raster lawn	39.	Catchments	
8.	Aquatic and marsh plants		40.	Embankments	
9.	Plants in rockeries		41.	Small earth dams	
10.	Plants in concrete planter boxes		***6. Covered surfaces***		
2. Land objects			42.	Paths	
11.	Escarpment	1-Escarpments in cuts	43.	Plateaus	
		2-Escarpments on embankment	44.	Curbs	
3. Installations					
12.	Underground drainage		45.	Sports fields	
13.	Gutters-surface drainage		46.	Steps	
14.	Manholes		47.	Playgrounds	
15.	Irrigation	1- Manual	48.	Ramps	
		2- Automatic	***7. Green spaces furniture and equipment***		
		3- Semi-automatic	49.	Benches	
		4- Drip irrigation	50.	Tables	
4. Civil engineering and architectural structures			51.	Waste receptacles	
16.	Pavilions and gazebos		52.	Sport field equipment	
17.	Pergolas		53.	Playground equipment	
18.	Buildings	1- Park buildings	54.	Notice boards	
		2- Outbuildings	55.	Bollards	
		3- Official premises	56.	Bicycle stands	
19.	Amphitheaters		57.	Concrete planter boxes	
20.	Terraces		58.	Lamp posts	
21.	Stands		59.	Masts	
22.	Awnings		60.	Floodlights	
23.	Fences				

An inventory of the maintenance units has been conducted on eight urban green spaces of Belgrade in order to determine the frequency of their reoccurrence within the green spaces of the city. On this occasion a total of 4,578 different maintenance units has been inventoried (Table 2).

The frequency of occurrence of individual maintenance units within the selected green spaces is presented in Table 4. By means of field inventory 48 different maintenance units were found, of a total of 60 covered by the system. In while inventorying there was not any maintenance unit that was not allready predicted in this classification model. Out of the total of 60 maintenance units 12 maintenance units were not found. The maintenance units that were not found by means of field inventory are as follows: vines, ground cover plants, marsh and aquatic plants, plants in rockeries, pergolas, screens, cascades, catchments, small earth dams, tables, notice boards, and bicycle stands.

Table 3. Total number of maintenance units per research subject

№	*Green Spaces of Belgrade*	*Number of biotic maintenance units*	*Number of abiotic maintenance units*	*Total number of maintenance units*
1.	Central part of Topcider park	437	153	590
2.	Finansijski park	280	260	540
3.	The Square near Faculty of Economics	94	124	218
4.	The park near the National Assembly	261	179	440
5.	A part of Block 70	353	314	667
6.	Protective vegetation Bele vode	585	101	686
7.	Green space of Sports Center "Zvezdara"	509	346	855
8.	Central part of Topcider park	363	219	582
	Total:	***2882***	***1696***	***4578***

It should be noted that these maintenance units are mainly related to the green spaces of picnic areas, park-forests and forest-parks, i.e. to the categories of green spaces that were not included in this inventory. According to Table 4, it is evident that the 12 maintenance units occur in all research subjects, which are as follows: trees, shrubs, lawns, buildings, paths, plateaus, curbs, benches, waste receptacles and lamp posts.

On 50% of green spaces surveyed 24 different maintenance units were reported, i.e. 40% of the total number of envisaged maintenance units. 30 maintenance units (50% of their total projected number) occur more than twice within the surveyed green spaces.

During the field testing of the maintenance units system the biggest problem occurred during their inventory on the green space of the Block 70. Green spaces of similar city blocks are rather neglected. There is a lot of wild vegetation and the civil engineering and architectural elements are mostly dilapidated or demolished, which makes the work on the establishment of a database for the Cadastre considerably more difficult.

By designing contents of maintenance unit for the purpose of establishing a GIS based cadastre of green spaces which encompasses seven categories and 60 different maintenance units (some of which have their different types), and also by adding information on the attributes (properties) of the maintenance units required for the management of urban green spaces, and adding timelines for setting up and updating of the database, a large volume of information that an information system should include is created, which in turn represents a considerable difficulty in designing the GIS based cadastre of green spaces.

In practice, in order to unburden the GIS based Cadastre of urban green spaces it has often been resorted to condensing and simplifying the classification of maintenance units. However, this proved to be inadequate. Instead of getting a modern tool that at any time gives all necessary information, we got a program that provides partial information. GIS based cadastre that provides incomplete or partial information loses its purpose.

Table 4. Frequency of occurrence of maintenance units per research subjects

№	*Maintenance unit*	*Frequency of occurrence*	*№*	*Maintenance unit*	*Frequency of occurrence*
1.	Tree	8	31.	Rockeries	1
2.	Shrubs	8	32.	Retaining walls	6
3.	Hedge	5	33.	Freestanding walls	3
4.	Vines	0	34.	Drinking fountains	2
5.	Ground cover plants	0	35.	Pools	1
6.	Flower beds	6	36.	Fountains	1
7.	Lawns	8	37.	Cascades	0
8.	Aquatic and marsh plants	0	38.	Water bodies	1
9.	Plants in rockeries	0	39.	Catchments	0
10.	Plants in concrete planter boxes	3	40.	Embankments	1
11.	Escarpments	7	41.	Small earth dams	0
12.	Underground drainage	8	42.	Paths	8
13.	Gutters-surface drainage	4	43.	Plateaus	8
14.	Manholes	7	44.	Curbs	8
15.	Irrigation	8	45.	Sports fields	3
16.	Buildings	8	46.	Steps	5
17.	Pavilions and gazebos	1	47.	Playgrounds	4
18.	Pergolas	0	48.	Ramps	4
19.	Amphitheaters	1	49.	Benches	8
20.	Terraces	1	50.	Tables	0
21.	Stands	1	51.	Waste receptacles	8
22.	Awnings	1	52.	Sport field equipment	3
23.	Fences	4	53.	Playground equipment	4
24.	Screens	0	54.	Notice boards	0
25.	Gates	2	55.	Bollards	4
26.	Railings	3	56.	Bicycle stands	0
27.	Sand boxes	4	57.	Concrete planter boxes	3
28.	Small bridges	1	58.	Lamp posts	8
29.	Park sculpture	4	59.	Masts	2
30.	Monuments	2	60.	Floodlights	2

On the basis of the above mentioned research of the frequency of occurrence of maintenance units on eight green spaces of Belgrade, in which of 60 envisaged maintenance units only 12 have not been found, it can be concluded that the rationalization of GIS software for the purpose of establishment of GIS based Cadastre of green spaces of the city cannot go in the direction of reducing the number of maintenance units, but in the direction of finding new technical possibilities and improving the software of the information system of GIS based Cadastre of green spaces.Rationalization of GIS based Cadastre can also be done at the level of use function, i.e. taking into account the fact that for various uses (planning, design, and maintenance of green spaces) more or less detailed information on the maintenance units is needed. Breaking the GIS based cadastre into different use functions can reduce the volume of information as well as the difficulty of updating databases and storing data.Whichever variant of rationalization is applied, rationalization of GIS based Cadastre of green spaces should never go in the direction of reduction or removal of certain maintenance units, as is shown within the research.

CONCLUSIONS

Within this maintenance unit classification model an inventory was performed on a total of 4,578 of various maintenance units carried out on eight different green spaces of Belgrade. Of a total of 60 maintenance units provided for by this classification model only 12 maintenance units were not recorded within the field survey. No maintenance unit was found within the field survey which was not already provided for by the model. Therefore it can be concluded that the maintenance unit model set up in this manner is comprehensive.This classification model of green spaces maintenance units can be applied for the purpose of protection, planning, design, maintenance and efficient management of urban green spaces.

The recommendation of the research is that the rationalization of the scope of GIS based Cadastre of green spaces can be carried out by improving the designing techniques of the very information system and by the rationalization of maintenance units and their attributes at the level of use function.

The maintenance unit classification model for the purpose of establishment of GIS based Cadastre of green spaces of Belgrade contains 60 different maintenance units which are classified into seven main categories of maintenance units (plants, land objects, installations, civil engineering and architectural structures, hydro-technical structures, covered surfaces and green spaces furniture and equipment).

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DENDROFLORA FUNCTIONALITY ASSESSMENTOF FINANCIAL PARK IN BELGRADE

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ABSTRACT

The main reason for the plants and green spaces existence in the city is their ecological and aesthetic effect on the immediate surroundings. This effect will be more prominent if plants are healthy, vital, have good vigor and decorativeness and if their selection is based upon their ecological adaptability to the given environmental conditions. Also, they have to be regularly and properly nursed, i.e.maintained in a highly functional state. This paper aims to present a functional analysis of the current dendroflora status of The Financial Park in Belgrade.

Key words: the ornamental plants functionality, the green spaces management.

INTRODUCTION

The ornamental plants functionality in city parks is manifested as a very complex property of the plant specimens. It depends on manyfactors and the most important among them are: the health of specimens, its decorative properties, the character of the plant-environment relation, the determination and the necessary maintenance intensity [1]. When creating new or reconstructing the existing green spaces in the city, it is important to properly, accurately and objectively assess the real values of the observed tree and shrub specimensas the main structural elements of the green space.

Detecting the ecological and biological elements of the space within the bio-ecological evaluationof thegreen space leads to real knowledge of the individual plant actual functionality on green areas, on the basis of which the improving and revitalizing methodsof the plant existing state can be predicted.

Only those plants that are healthy, vital, attractive, have good fettle and growth can make green space highly functional in both ecological and aesthetic sense.

MATERIAL &METHODS

The dendroflora total functionality assessment of The Financial Park in Belgrade was obtained on the basis of their overall vitality and decorativeness assessments, by the method of bio-ecological evaluation [2].The vitality assessment of the trees and shrubs represents the overallassessment, which is obtained based on direct observation of the woodyspecimens recorded *phenomena*such as: the total of deadand/or broken branches in the crown, theoccurrencesof dying tree topand/or lower branches, the intensity of leaves and needles wilting. For the assessment of the woody plants vitalityVTA (Visual Tree Assessment) method is used. The essence of this method lies in the visual inspection of trees in order to review the external changes in the terms of vitality, to detect internal treedefects [3]. If there is a constant stress factor for the tree trunk (such as the presence of diseases or pests, physiological defects, etc.), the plant will often react by forming callus in critical areas.The bigger bumps on the branches and trunk, the cavities, recesses, cracks and the ribs along the trunk and along the larger branches, visually indicate reduced vitality of the plantsthemselves. The specimens, on which the phytopathologcial disease or entomological injury is recorded, have reduced vitality assessment. The treevitality in the field is expressed by theassessment (rank) from 1-5 (Table 1).Thedecorativeness assessmentof the ornamental trees, ie. the aesthetic value of trees and shrubs, is expressed also on the basis of the assessment (rank) from 1-5 (Table 2), based on defined elements that determine the aestheticplant value such as:the line, area, mass, symmetry, movement,*valer*, coloristic properties, seasonal variability, etc. Theoverall functionality assessment of the woody plants*taxa* is derived from the sum of the mean values of thevitalityassessment and the decorativeness assessment. Although, from the standpoint of statistics, the average assessment essentially reflects an overall functional state assessment of a certain plant taxon on the green area.

Table 1. The vitality assessment for the ornamental woody taxa of the trees and shrubs

Assessment (rank)	The parameters that determine the vitality for the individual plantassessment
1	Dead tree (shrub) or a tree (shrub) near to death. Skewed or sick tree (shrub). Tree (shrub) on the verge of collapse. Broken or in any way mechanically damaged tree (shrub). Tree (shrub) with no chance for recovery.
2	Still vital tree (shrub) andin any way mechanically damaged or the impaired healthtree (shrub). Trees (shrubs) that is missing part of the crown. Extremely damaged tree (shrub) that still can survive.
3	Trees (shrubs) with the impairmentsthat can be revitalized. The crown with a clearly defined crown form. Trees (shrubs), which have a mean intensityof diseases or pests occurrence and mechanical damages.
4	Vital tree (shrub) with a low-intensity occurrence of diseases or pest attack. Tree (shrub) with minor defects that by appropriate care measures can be corrected.
5	Completely healthy and unharmed tree (shrub). Tree (shrub)of an extraordinary vitality, well-adjustedto environmental conditions.

Table 2. The decorativeness assessmentfor the ornamental woody taxa of the trees and shrubs

Assessment (rank)	Aesthetic parameters for the individual plant assessment
1	Visually unbalanced tree (shrub)without symmetry. Tree (shrub), which diminishes an overall impression of the space perspective. No distinct coloring, no versatility dynamics, without a clearly defined mass and surface.
2	Tree (shrub)with disharmonic silhouette and a disproportion, with lack of a clearly defined habitus. Poor color ratios. Poor masses and surfacesratios.
3	The crown shown in silhouette with a clearly outlined crown form.The uniform and monotonous coloring. Trees (shrubs) inadequately integrated into a given space, without harmonic proportions.
4	Tree (shrub)in the form of visual equilibrium, with less emphasis on asymmetry. Recognizable ratio of the colors, sizes and weights.
5	Visually impressive and aesthetically very valuable tree (shrub). Tree (shrub) with the clearly and well balanced proportion and symmetry that are typical for a given species. Coloristically emphasized tree (shrub). Trees (shrubs) that in any way positivelystand out in space by their line, figure or shape.

RESULTS AND DISCUSSION

By creating the bio-ecological basis of The FinancialPark in Belgrade the total of 237 different woody plant speciesspecimensin the fieldwere observed. In the group of trees there are 221 specimensand in the group of shrubs 16specimens. The group of treesconsists of 30 different tree taxa, while the group of shrubs encompasses 10 taxa (Table 3).

The ornamental trees overall functionality of The Financial Park in Belgrade was assessed witha very high assessment (4.19), and with even higher functionality assessmentfor the shrubs (4.76), which resulted in a very high overall functionality assessmentof the dendrofolora existing state of The Financial Park in Belgrade, which amounts to 4.47.

The proper selection of the taxa for the establishment and the reconstructionof The Financial Park, the species suitability to the immediate environmental conditions, a high nurturing degree of the greeneryon this central city green area – these factors primarily contributed to a highly functional state of the trees and shrubs on this green area. The highest assessmentfor the vitality and thedecorativeness of all green spacetrees inThe Financial Park have shown these species: *Acer platanoides* L., *Acer pseudoplatanus* L.,*Prunus cerasifera* Ehrh., *Fraxinus angustifolia* Vahl., *Aesculus hippocastanum* L., etc. Norway maple(*Acer platanoides* L.) is a species represented by 22 specimens in The Financial Park. It isone of the most abundant and best suited species to the given environmental conditions, with the average vitality assessment 4.18 and the average decorativeness assessment 4.22. Among the Norway mapletrees there are younger treesonly about 3mhigh and the older tree specimens of the height up to 15m.Theirdiameter at breast heightranges from 6-39cm, and crowns 1.5-9m widecan be found. These trees have the good vitality and growth with less dead branches in the crown. The Norway mapleand the Sycamore maple(*Acer pseudoplatanus* L.) showed the same characteristics in the Financial Park. 29 specimensof the Sycamore maple trees, with the average vitality assessment 4.34 and the average decorativeness assessment 4.24 were found. Among Sycamore trees younger and older specimens can be found as well.The height of the these trees varies from 3-18m, the trunk diameter at breast height ranges from 7-38cm, the crown width is from 2-15m. These trees are healthy and vital, without the significant presence of the visible defects and diseases.The Pissard Plum(*Prunus cerasifera 'Atropurpura'*)showed extremely high functionality within this green space, with the average vitality assessment 4.80 and the average decorativeness assessment 4.73. These are usually the trees up to 5m tall, with the trunk diameter at breast height from 8-26cm, the crown width of 2-6m, with good conditionand vitality, with no apparent diseases or damages. TheDesert Ash(*Fraxinus angustifolia* Vahl.)is a species that has also shown high functionality in The Financial Park.It is represented by 10 specimens whose average vitality and decorativeness assessment amounts 5.00. These are young trees, up to 3m and with the trunk diameter about 7cm, the crown width of 1.5 m. In The Financial Park 6 Horse-chestnut trees(*Aesculus hippocastanum* L.), with the average assessmentfor the vitality 4.33 and 4.83 for the decorativeness, were noted, including some old and valuable trees. The Horse-chestnutshave impressive dimensions;the tree heights range from12-18m, the trunk diametersfrom 25-93cm, the crown widths from 4m for younger specimens, up to 12m forthe older Horse-chestnuts. The mature trees are highly decorative, with the *high leaf mass* per area, with the lowerdeadbranches intensity. The young White beamtrees (*Sorbus scandica*Fries.) are showing high functionality, with the assessment for the vitality 5.00 and 4.00 for the decorativeness. These are very young trees of the average height about 2m, the trunk diameter about 5cm, the crown width around 1m, so it could be rather discussed of the planting stock than of trees. Based on the existing situation in the field, theWhite beam planting material have the good growth and the decorativeness. The Field Maple (*Acer campestre* L.) in this green area occurs with 6 specimens that are assessed for the vitality assessment 4.00 and 4.20 for the decorativeness. The Field Maple has the exceptionally good growth, vitality and decorativeness. The trees have the average heightfrom 8-10m, the trunk diameter at breast heightfrom 18-38cm and the crown width about 5m.By the trees examination, the low intensity of broken, dead and mechanically damaged branches in the crown was found. The Red oak (*Quercus borealis* Michx.)represented with three specimens of the average assessment - 4.66 for the vitality as well as for the decorativeness. On the red oak trees there are no visible signs of damages or diseases, the trees are vital, healthy and have a good growth. The Yew (*Taxus baccata* L.) on this green area is represented by four specimensof the average assessment – 5.00 for the vitality and for the decorativeness.It is of the exceptionally high functionality,primarily due to the good adaptability of this species to the urban environment. The yew specimens'heightsareup to 4.5 m, the trunk diameters are from 7-24cm, the crown widths are from 1.5-6m. In The Financial Park 10 individualsof the Peking willow (*Salix matsudana 'Tortuosa'*) were noted, for which one can say for sure to be one of themost decorative taxa in this green area. In addition to its exceptional decorativeness,the Peking willows are very vital, in the good condition with no visible damages or diseases. It should be noted,however, thatthese are young plants withthe tree heightsup to3m, the trunk diametersabout 5cm and the crown widths about 1.5 m.

Table 3.The dendroflora functionality of The Financial Park in Belgrade

№	Name of taxon	The overall number of specimens	The average vitality assessment	The average decorativeness assessment	The overall functionality assessment
TREES					
1.	*Abies concolor Lindl. Et Gord*	6	2.33	2.16	2.25
2.	*Acer campestre L.*	6	4.00	4.20	4.10
3.	*Acer dasycarpum Ehrh.*	1	3.00	4.00	3.50
4.	*Acer negundo L.*	2	3.50	3.50	3.50
5.	*Acer platanoides L.*	22	4.18	4.22	4.20
6.	*Acer pseudoplatanus L.*	29	4.34	4.24	4.29
7.	*Aesculus hippocastanum L.*	6	4.33	4.83	4.58
8.	*Betula verrucosa Ehrh.*	10	4.40	4.40	4.40
9.	*Catalpa bignonioides Walt.*	9	4.22	4.33	4.27
10.	*Cedrus atlantica Endl.*	8	4.38	4.00	4.19
11.	*Cedrus deodara Roxb.*	1	5.00	5.00	5.00
12.	*Corylus colurna L.*	1	5.00	5.00	5.00
13.	*Fraxinus angustifolia Vahl.*	10	5.00	5.00	5.00
14.	*Koelreuteria paniculata Laxm.*	2	4.00	4.00	4.00
15.	*Liriodendron tulipifera L.*	1	5.00	5.00	5.00
16.	*Quercus borealis Michx.*	3	4.66	4.66	4.66
17.	*Quercus robur L.*	1	4.00	5.00	4.50
18.	*Quercus robur 'Fastigiata'*	1	5.00	5.00	5.00
19.	*Picea abies Karst.*	3	2.00	2.00	2.00
20.	*Pinus nigra Arn.*	15	3.13	3.20	3.17
21.	*Pinus strobus L.*	1	4.00	4.00	4.00
22.	*Platanuus x acerifolia Willd.*	1	4.00	4.00	4.00
23.	*Prunus cerasifera'Atropurpura'*	15	4.80	4.73	4.78
24.	*Sophora japonica L.*	4	3.75	4.25	4.00
25.	*Salix matsudana 'Tortuosa'*	10	5.00	5.00	5.00
26.	*Sorbus scandica Fries.*	11	5.00	4.40	4.70
27.	*Taxus baccata L.*	4	5.00	5.00	5.00
28.	*Tilia argentea DC.*	2	4.00	4.00	4.00
29.	*Tilia cordata Mill.*	30	3.80	3.80	3.80
30.	*Tilia grandifolia Ehrh.*	6	3.16	3.16	3.16
	Overall/ Average:	221	4.15	4.23	4.19
SHRUBS					
30.	*Berberis thunbergii DC.*	2	5.00	5.00	5.00
31.	*Berberis thunbergii 'Atropurpurea'*	1	5.00	4.00	4.50
32.	*Cotoneaster dammeri Schneid.*	1	5.00	5.00	5.00
33.	*Cotoneaster horizontalis Decne.*	1	5.00	5.00	5.00
34.	*Deutzia scabra Thunb.*	1	5.00	4.00	4.50
35.	*Forsythia europea Deg. Et Bald.*	1	5.00	5.00	5.00
36.	*Euonymus europeus 'Variegatum'*	1	5.00	4.00	4.50
37.	*Jasminum nudiflorum Lindl.*	4	4.25	4.00	4.13
38.	*Juniperus horizontalisL.*	3	5.00	5.00	5.00
39.	*Prunus laurocerasus L.*	1	5.00	5.00	5.00
	Overall/ Average:	16	4.93	4.60	4.76
	The overalldendroflora functionality of The Financial Park in Belgrade:				4.47

The European white birch(*Betula verrucosa* Ehrh.)on this green area is represented by 10 specimensof the average assessment – 4.40 for both the vitality and the decorativeness. The birch tree heights are from 3.5-13m, the trunk diameters at breast height from 7-56cm, and the crown widths from 1.5-10m. The observed Birch trees have the lowdeadbranches intensity in the crown, with no visible diseases. The Atlas Cedar(*Cedrus atlantica* Endl.)on this green area occurs with 6 specimens of the average vitality assessment - 4.66 and ofthe average decorativeness assessment4.83. The tree heights of these trees range from 2.5-10m, the trunk diameters from 8-39cm and the crown widthsfrom 2 to 7.5 m, with no visible signs of injuries and diseases.

Following species showed high functionality assessment: *Liriodendron tulipifera* L., *Platanuus x acerifolia* Willd., *Pinus strobus* L., *Koelreuteria paniculata* Laxm., *Quercus robur 'Fastigiata'* and so on, although on their functionality can be discussed only tentatively, because they are represented by only one individualon this green area. In The Financial Park the Turkish Hazel tree (*Corylus colurna* L.) especially stands out by its dimensions,decorativeness and imposing appearance. It's height is about 13m, the trunk diameter at breast height amounts to38cm and the crown is about 10mwide. The slightly lower average assessmentof the vitality and the decorativeness on the green area of the Financial Park showed the following tree taxa: *Tilia cordata* Mill., *Acer negundo* L., *Sophora japonica* L., *Tilia grandifolia* Ehrh, etc.In The Financial Park the there are30 specimens ofSmall-leaf Linden (*Tilia cordata* Mill.), withthe average vitality and decorativeness assessmentof 3.8. Most of these specimens are young trees whose height is about 3.5 m, the trunk diameter of 7 cm and the crown width of 1.5 m; the older trees are with the height of almost 14m, the trunk diameter of 15-38cm and the crown width of 10 meters.The old Small-leaf Linden trees are in significantly worse state than the young plants of the same species. For these older specimens the greater presence of dead branches, decay and damages were noted. It is obvious that this species shows the lower functionality level over time under given environmental conditions. TheBoxelder Maple(*Acer negundo* L.), on the green area is represented by two specimens with the average assessmentfor both the vitality anddecorativeness- 3.50.

For the Box elder Maples the greater intensity of dead branches and the phytopathological occurrences were noted. For 4 Japanese Pagoda Trees (*Sophora japonica* L.) have 3.75 - the vitality assessmentand 4.25 - the decorativeness assessment. On these trees, as well as on theBoxelder Maples the increased presence of dead and broken branches in the crown and the presence of diseases were noted. The Large-leaved European Linden(*Tilia grandifolia* Ehrh.)is represented by five specimens - 3.2 is the average vitalityassessment and the average decorativeness assessment is 3.4. These are mostly older trees with the heights from 9-15m, the trunk diameters at breast height from 15-57cm and the crown widthsfrom 7 to 8.5 m, where the presence of mechanical damages, phytopathological diseases, rot, improperly healed wounds due to pruning and deadbranches, were found. The low functionalityassessments have the species: *Abies concolor* Lindl. et Gord, *Pinus nigra* Arn., *Picea abies* Karst., and some others. The European black pine(*Pinus nigra* Arn.) within this green space is represented by the 15 specimens that wereassessed for the vitality 3.13 and for the decorativeness 3.20. The Black Pinetrees are 3 to 7.5 m tall, the trunk diameter at breast height from 8-24cm and the crown width from 2 to 4.5 m. On these trees the great intensity of phytopathological diseases was noted, there are a lot of deadbranches, needles are wilted and the bark is cracked and peeled. The White Fir(*Abies concolor* Lindl. et Gord) in the Financial Park is represented by six specimens ofthe average vitality assessment 2.33 and the average decorativeness assessment 2.16. The White Firis one of the species with the worst functionality. The White Fir trunks are stunted, diseased, injured, have a poor growth, kinked, with a greater intensity of deadbranches in the crown. Their treeheights range from 5-8m, the trunk diameters from 10-24cm, and the crown widths from 2-4m. The Norway spruce(*Picea abies* Karst.)on this site is represented by two specimens of theoverallfunctionality 2.00. The trees are small, stunted, dried out, damaged and diseased.

The shrubs more or lessshow the high functionality. Among them the Creeping Juniper (*Juniperus horizontalis* L.) and the Winter Jasmine(*Jasminum nudiflorum* Lindl.)stand out. The following shrub species show high functionality level: the Red Japanese Barberry(*Berberis thunbergii* DC., *Berberis thunbergii 'Atropurpurea'*), the Bearberry Cotoneaster(*Cotoneaster dammeri* Schneid.), the BalkanForsythia(*Forsythia europea* Deg. et Bald.)and the Laurel-cherry(*Prunus laurocerasus* L.).

CONCLUSIONS

The overall dendrofolora functionality of the Financial Park in Belgrade was assessed- 4.47. Accordingly, it can be concluded that the woody plants of this green area are in a highly functional state, which is mainly the result of the proper species selection, the adaptation of these species to the immediate highly urbanized city environment and of a high nurturing and maintenance level of the green space in question.

Among tree species for their functionality in particular stand outthe following: *Acer platanoides* L., *Acer pseudoplatanus* L.,*Aesculus hippocastanum* L., *Betula verrucosa* Ehrh., *Fraxinus angustifolia* Vahl., *Prunus cerasifera'Atropurpura'* and *Salix matsudana 'Tortuosa'.* Tree taxa that showthe average vitality and decorativeness assessment on the green area of the Financial Park are: *Tilia cordata* Mill., *Acer negundo* L., *Sophora japonica* L., *Tilia grandifolia* Ehrh,etc. The low overall functionality is characteristic for the following species: *Abies concolor* Lindl. Et Gord, *Acer negundo* L., *Pinus nigra* Arn. and *Picea abies* Karst.

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INDOOR/OUTDOOR LEVELS AND CHEMICAL COMPOSITION OF PM_{10} AT A RESIDENTIAL ENVIRONMENT IN BOR, SERBIA

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ABSTRACT

The main goal of this study was to investigate the mass concentrations and chemical composition of PM_{10} in a residential environment in the town of Bor, Serbia. For the first time, simultaneous indoor and outdoor measurements of PM_{10} were conducted by the use of the European standard gravimetric samplers. Measurements, in duration of 7 days, were conducted in December 2012. PM_{10} was sampled on PTFE filters and element concentrations were quantified by ICP AES. The sampling site is located at a residential environment, 2 km southeast (SE) from the Copper Smelter Complex Bor. During measurements the Copper Smelter Complex Bor was out of operation for more than 50% of time. The mass concentrations of PM_{10} and of 19 elements in PM_{10} are presented in the paper. The results indicate that average PM_{10} levels measured indoors were very close to those measured outdoors (16.7 compared to 18.5 µg/m^3). Also, average mass concentrations of almost all elements detected in PM_{10} were lower indoors, but at the same order of magnitude as in the ambient air. There are few exceptions (Cr, Zn and Sn) with slightly higher average levels detected indoors.

Key words: air pollution, indoor air quality, particulate matter, PM_{10}.

INTRODUCTION

Particulate matter (PM) is one of the most important ambient air pollutants that adversely affect human health. Prolonged exposure to PM_{10} and $PM_{2.5}$ has been associated with respiratory and cardiovascular disease, and has been increased all-case mortality [1-4]. PM in indoor air originates form outdoor infiltration and additional indoor sources such as cooking and heating devices, tobacco smoking, etc. Current EU legislation only regulates PM in ambient air, while there is not specific limit or target values for PM in indoor air at the EU level [5]. Taking into account numerous studies performed primarily in the USA, the WHO has set air quality guidelines and interim targets for PM_{10} and $PM_{2.5}$ [6]. The annual average WHO guidelines are 20 µg/m^3 for PM_{10}. However, there are also short-term exposure guidelines of 50 µg/m^3 as 24-hour average for PM_{10}. These air quality guideline values for PM are set primarily for outdoor environments. However, recently published WHO guidelines for indoor air quality [7] have adopted the same PM guideline values for indoor environments.

The Bor Municipality is situated in the eastern part of the Republic of Serbia. It has been a major center for mining and processing of copper and other precious metals for more than 100 years. Air pollution is perceived as the main environmental problem in the Bor region because the emissions from the copper smelters are principally particulate matter and sulfur oxides [8]. Monitoring of particulate matter pollution is carried out in the town of Bor since 2003. These measurements were done at several measuring points in the town area with the Turnkey OSIRIS (Model 2315) portable device, which is intended for indicative measurements of dust pollution [9]. Measurements of ambient PM mass concentrations, using the European standard gravimetric samplers, have been carried out since 2009.

The aim of the present work was to determine mass concentration levels of PM_{10} and levels of metallic elements in PM_{10} in the indoor and outdoor microenvironment of a typical residence in the Bor town. PM_{10} mass concentrations were obtained from the Sven/Leckel LVS3 samplers [10] using gravimetric analysis of filters and sample volume automatically recorded throughout the sampling period.

MATERIALS AND METHODS

The instruments were operated for 7 days (8 PM–8 PM) in December 2012. One sampler was placed indoors, in the center of a dinning room in the forth floor apartment, and the other was placed at the apartment's balcony. The building is located in a residential zone (as shown in Figure 1) and its distance from the nearest main street is approximately 100 m. There were 4 regular occupants in the apartment, which had a volume of approximately 75 m^3. The flow rate of the LVS3 samplers (38.3 l/min) was calibrated using certified flow meters once during the measurement campaign, at the beginning of measurements.

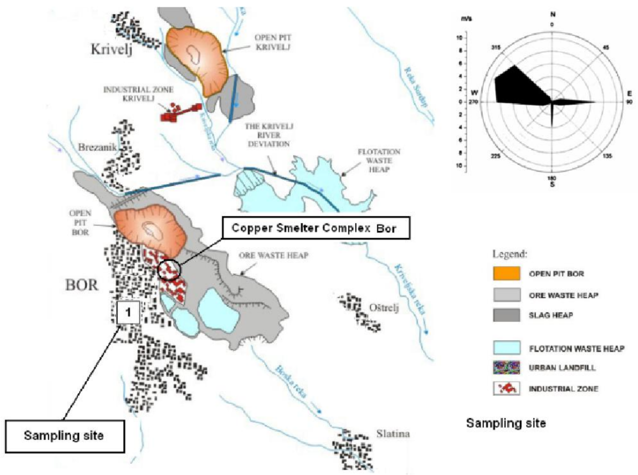

Figure 1. Map of Bor Municipality area with the position of sampling site and the wind rose diagram for the period 2009-2012

Cronus PTFE filters (47mm PTFE Membrane Disc Filter, pore size 0.45µm) were used throughout this study for gravimetric sampling. Pre-conditioning and post-conditioning of filters was undertaken in accordance with the requirements of EN 12341. Following completion of the sampling cycle, filters were equilibrated for a period of 48 hours in an air-conditioned room at a temperature of 20°C and relative humidity of 50%. Weighing was carried out with a Mettler Toledo microbalance with 10 µg resolutions. Approximately 10% of all gravimetric samples were exposed as field blanks. PM_{10} mass concentrations were calculated using average weights of filters (each filter was measured three times). The average change in the field blank weight (2.2 µg) was subtracted from the net mass of the collected filters. The detection limit was 2.5 $\mu g/m^3$, calculated as three times the standard deviation of net mass of field blanks divided by the nominal air sample volume. The loaded filters, after gravimetric measurements, were prepared for chemical analyses following the procedure from [11]. The filters were dissolved with an acidic mixture HNO_3 (concentrated 30%) H_2O_2/H_2O (3/2/5) using analytical grade reagents (Merck) and double distilled water (MiliQ, 18.2 MΩ). After that, samples were digested in closed 100 ml Teflon vessels in a CEM Mars 5 microwave accelerated reaction system with a two-stage programmed temperature progress up to 200 °C [12].

RESULTS AND DISCUSION

The average daily values of some meteorological parameters during measurement period are presented in Table 1. The average daily mass concentrations of PM_{10} are presented in Table 2 and the average daily mass concentrations of elements in PM_{10} are presented in Table 3.

Table 1. The average daily values of temperature (T), Relative humidity (RH), wind speed (WS) and pressure (P), during the measurement period

	T (ºC)	RH (%)	WS (m/s)	P (mbar)
Outdoor	1.2±4.6	84.6±11.0	0.8±0.6	963.1±6.0
Indoor	22.9±3.2	56.8±10.2		

Table 2. Indoor/Outdoor average daily PM_{10} mass concentrations ($\mu g/m^3$)

Date	PM10-IN	PM10-OUT	PM10-IN/OUT
1.12.2012.	24.56	24.02	1.02
2.12.2012.	17.15	25.04	0.69
3.12.2012.	8.89	4.57	1.94
4.12.2012.	17.03	15.17	1.12
5.12.2012.	13.35	25.11	0.53
6.12.2012.	13.82	15.70	0.88
7.12.2012.	22.05	19.79	1.11
Average	**16.69**	**18.49**	**1.04**

As seen in Table 2 results indicate that the average PM_{10} levels measured indoors were very close to those measured outdoors (16.7 compared to 18.5 $\mu g/m^3$). The exceeding of PM_{10} mass concentrations over daily limit value was not observed during the measurements period. The PM_{10} I/O average ratio (1.04) indicates no significant indoor sources of PM_{10}. The mass concentrations of chemical elements in PM_{10} presented in Table 3 show that the most abundant elements indoors, as well as outdoors, were Ca (1794 ng/m^3), followed by S (1091 ng/m^3). The average metal concentrations in PM_{10} detected outdoors are very similar to those reported in [14]. Average concentrations of Pb, Cd, As and Ni did not exceed limit values proposed in [15, 16].

Table 3. Indoor/Outdoor average daily mass concentrations of elements in PM_{10} (ng/m^3)

ELEMENT	INDOOR	OUTDOOR	IN/OUT
Cr	3.6	3.1	1.16
Mn	10.1	11.3	0.89
Cd	0.9	1.1	0.85
Zr	1.8	2.4	0.76
Ni	-	-	-
Sr	9.1	9.5	0.96
Ti	7.8	11.1	0.71
As	-	-	-
S	1091.5	2147.2	0.51
Fe	128.4	213.7	0.60
Cu	63.1	101.0	0.62
Zn	68.7	49.2	1.40
Pb	15.6	23.1	0.67
Al	119.5	148.3	0.81
Ca	1794.1	2887.0	0.62
K	180.9	204.5	0.88
Na	282.7	388.2	0.73
Mg	250.5	375.8	0.67
Sn	97.2	84.6	1.15

Table 4. Average mass PM_{10} (ng/m^3) and trace element concentrations (ng/m^3) in Belgrade and some European urban areas [13]

City	Belgrade	Stockholm	Vienna	Llodio	Frankfurt	Barcelona	Palermo	Madrid	Athens
Period	2003-2006	2003-2004	1999-2000	1999-2006	2001-2002	2003-2006	2005	1999-2000	2001-2002
PM10	70.1	36	30.38	32	32.6		36	47.68	73.8
Cd	1.86	0.31	0.44	1.2	0.2	0.5			2.6
Cu	85.1	76	11.1	33	12.4	80	49	112	51.5
Ni	22.6	3.9	1.6	33	2.6	6	5.5	4	11
Pb	47.8	15	22.1	103	11.6	26	18	118	46.6
Cr	9.8	3.7	0.79	25	3.8	6	6.5	9	13.1
V	38.3	3.3		8	3.2	12	20	4	9.5
Mn	24.5	18	6.7	87	9.7	20	12	22	19.1
Al	3896	548					733	970	
Fe	1408	1800	175				496	1930	
Zn	1221	43	35	420	105.6	103	48	93	188

As seen in Table 3, concentrations of almost all chemical elements detected in indoor PM_{10} were lover compared with those detected in the ambient air (0.51 – 0.96), with the exception of Cr, Zn and Sn. Relatively high concentrations was measured for Cu (63 ng/m^3 indoors and 101 ng/m^3 outdoors), which is characterized by high toxicity. The presence of Cu and Mn is related to the industrial activities [13]. Average PM_{10} mass concentrations recorded in Bor are the lowest compared to the values reported for other cities, as shown in Table 4.

CONCLUSION

Particulate matter is one of the most important ambient air pollutants that adversely affect human health. Prolonged exposure to PM has been associated with respiratory and cardiovascular disease, and has been increased all-case mortality. The main goal of this study was to investigate the mass concentrations and chemical composition of PM_{10} in a residential environment, since most individuals spend the majority of their time indoors. For the first time, simultaneous indoor and outdoor measurements of PM_{10} in a residental environment in Bor were conducted using the European standard gravimetric samplers. PM_{10} was sampled on PTFE filters and element concentrations were quantified by ICP AES. The results indicate that average PM_{10} levels measured indoors were similar to those measured outdoors. The average metal concentrations in PM_{10} detected outdoors are very similar to those reported in the previous investigations. Also, average mass concentrations of almost all elements detected in PM_{10} were lower indoors, but at the same order of magnitude as in the ambient air. There are few exceptions (Cr, Zn and Sn) with slightly higher average levels detected indoors. The exceeding of PM_{10} mass concentrations over daily limit value was not observed, probably because the Copper Smelter Complex Bor was out of operation for more than 50% of time. The PM_{10} I/O average ratio indicates no significant indoor sources of PM_{10}. The mass concentrations of chemical elements in PM_{10} show that the most abundant elements were Ca and S. Average concentrations of Pb, Cd, As and Ni did not exceed limit values proposed by regulations. Further investigation in this area should be continued, because there is still lack of data dealing with the air particulate pollution in residential environments in the Republic of Serbia.

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HUMAN PHYSIOLOGICAL PROCESSES AND POLLUTION OF THE RESOURCES

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ABSTRACT

Demographic development has a major impact on the development of the human civilization, and also on the carrying capacity of the nature, because man, with his activities (anthropogenic factors), is the main factor of the resource exhaustion and pollution.

One of the major problems nowadays is increase in the need for a variety of resources, as a result of human population growth. This phenomenon forces human society to solve the problem of pollution and depletion of resources, pointing out on the danger of direct or indirect negative impact on the environment, health and sanitary conditions of people's lives and, ultimately, the very existence of the human population.
The main impact on these problems have anthropogenic (technical) pollution, but the influence of the life processes (physiology) of man are very important, too.

In this work, the impact of life (physiological) processes of man, at air (atmosphere) and water (hydrosphere) resources pollution is examined.

Key words: human physiology, resource, air, water, population.

INTRODUCTION

The man in the ecosystem, the mutual influence of human and ecosystem, as well as changes resulting from this impact are objects of study of the human ecology.
The nature has the potential of the self-purification (carrying capacity of nature), which allows struggling with the environmental polluter by itself, up to a certain limit. The problem arises when a man performs any influence on the process and the state of the biosphere and its resources. Exceeding the limits of carrying capacity of nature causes the disturbance of the natural balance. This results in a negative impact on the biosphere and the human race itself.

Man does not affect the environment just by his actions, causing a change and disruption, but also with his very existence.

As a result of the man's physiological processes, the exchange of air, water, matter and energy in the human body, the physiological by-products appears in the form of the used gases (exhaled gases from the lungs), liquid (physiological fluids-urine and sweat) and hard (products of the digestion). These products represent potential pollutants of air, water and soil (living environment).

HUMAN PHYSIOLOGY IMPACT ON THE AIR RESOURCE

The planet Earth contains a significant amount of air, which is a basic resource for life. The amount of available air resources are very vulnerable to irresponsible attitude of the humans; by unreasonable use of fossil fuels man inflicts irreparable harm of the air layer and significantly contributes to climate changes, causing the Earth becomes poorer with healthy air for living world.

Scientific thought and technological advances are focused on the fight to reduce pollution, to protect the natural environment, which is all connected with the solution of the problem of climate changes.

The ultimate impact on these problems have technical (anthropogenic) pollution, but the importance and impact of human physiology in the process is very important, too.

In this sense, the impact of the physiological process of breathing, as a source of pollution of air resources, is discussed, seen through the human population's eyes.

Air resource

The atmospheric shell thickness around the earth is approximately 2000–3000 km [1]. The total mass of the atmosphere is estimated to be 5.15×10^{15} tons (t) [2]. About 50% of the total volume of air is concentrated in the layer up to 5 miles directly above Earth's surface (troposphere) [1].

Air is a mixture of gases [2]: nitrogen, oxygen, carbon dioxide, an inert gas (argon) and some other gases in a very small percentage. In addition, the air contains water vapor, dust and microorganisms. The composition of atmospheric air (in %) is: nitrogen–78.08, oxygen–20.95, inert gases–0.94 and carbon dioxide–0.03.

Inhalation of oxygen and exhalation of carbon dioxide from the body represents a gas exchange or breathing. The average number of man's respiratory motions (inhalation and exhalation) is 16 to 18 per minute; during normal breathing man inhales about 0.5 liters (l) of air [3]. The composition of inhaled and exhaled air, and the air in the alveoli [3], are shown in Table 1.

Table 1. Composition of inhaled (atmospheric), and exhaled alveolar air [3]

air	quantity (%)		Water vapor	quantity (g in 1 liter)	
	oxygen	carbon dioxide		oxygen	carbon dioxide
inspire	20.95	0.03	variable	0.299585	0.000594
expire	≈ 16.40	≈ 4.10	to	≈ 0.23452	≈ 0.08118
alveolar	14.00	5.50	saturation of air	0.20020	0.10890

Discussion

The total amount of air in the atmosphere is shown in Table 2.

Table 2. Quantities of atmospheric air on Earth

	participation (%)	density (g/dm^3)	volume in 1 liter (g)	total amount in the atmosphere (t)
air	100.00	1.29300	1.293000	5 150 000 000 000 000
nitrogen	78.08	1.25000	0.976000	3 887 661 254 000 000
inert gases	0.94	-	0.016821	80 794 833 870 000
oxygen	20.95	1.43000	0.299585	1 179 177 856 000 000
carbon dioxide	0.03	1.98000	0.000594	2 366 056 132 000

Every human being consumes oxygen and produces carbon dioxide, and this inevitably leads to changes in the composition of atmospheric air, which is a limited resource. So there is a certain interdependence of the man's physiology of breathing and air resources. During exhalation, carbon dioxide is related from the lungs, which contributes to its increase in the atmosphere. Participation of oxygen and carbon dioxide in exhaled air has the composition shown in Table 3.

Table 3. Composition of the exhaled air of a human being (in g)

	participation (%)	density (g/dm^3)	volume in 1 liter (g)	quantity for one respiratory movement
oxygen	16.40	1.43000	0.23452	0.11726
carbon dioxide	4.10	1.98000	0.08118	0.04059

Total impact of the human physiology of breathing on the air resource can be seen from the relationship shown in Table 4.

Table 4. Contribution of one human being to the pollution of the air layer of the Earth (g)

	for one respiratory movement	for one minute of breathing	for one day of breathing (24 hours)	for one year of breathing (365 days)
oxygen	0.0325325	0.5530525	796.39560	290 684.3940
carbon dioxide	0.0402930	0.6849810	986.37244	360 025.0136

The table 4 shows that every human respiratory movement adds to the atmosphere 0.0402930 grams (g) of carbon dioxide to the current amount of 2366056132000 t in the atmosphere and reduces the oxygen for 0.0325325 g of its total mass of 1179177856000000 t in the air layer. An average human being spends 796.39560 g of oxygen for one day, and produces carbon dioxide in quantities of 986.37244 g.

The human population is constantly increasing. For 111 years (1900.-2011.) the population has been increased by 4.4 times (in absolute amount of 1.6-7 billion). The Club of Rome and Population Division of the United Nations believes that the limits on population growth of some 15 billion souls carrying capacity of the Earth [4,5].

Applying the available data for human respiratory metabolism from Table 4 to the entire human population the following amounts are obtained (Table 5).

Table 5. Contribution of human population to the environmental pollution (in tons)

year	Earth population	total quantity					
		one breath		breathing for 24 hours		breathing for 365 days	
		oxygen	carbon dioxide	oxygen	carbon dioxide	oxygen	carbon dioxide
2011	7 000 000 000	227	282	5 574 769	6 904 607	2 034 790 758	2 520 175 095
2050[5]	13 440 000 000	437	541	10 703 556	13 256 845	3 906 798 255	4 838 736 182
2100[5]	15 820 000 000	514	637	12 598 978	15 604 412	4 598 627 113	5 695 595 715

Human population daily reduces the contents of oxygen in the atmosphere for 5574769 t, while at the same time, increases the amount of carbon dioxide in the atmosphere for 6904607 t. In other words, human population spends 2034790758 t of oxygen from the atmosphere yearly, and adds to the current amount of carbon dioxide a new quantity of ≈2.52 billion t. At the same time, according to the Energy Information Administration (EIA), a man's industrial activities in 2010. emit into the atmosphere 27.715 billion t [6].

HUMAN PHYSIOLOGY IMPACT ON THE WATER RESOURCES

In despite to the apparent richness in water, the planet Earth is poor in usable water, needed for everyday life. Nevertheless, the unreasonable use of water, along with human attitude toward water resources, leads to irreparable damage on nature, which further contributes to the water crisis.

The rapid growth of human population increases the need for water. The problem with pollution and depletion of water resources of the planet is appointed to the human population. There is always warning of the danger of direct or indirect negative impact on the health and sanitary conditions of people's lives. A lack of health water is directly related to the rapid growth in demand for water, as a result of higher living standards and human population.

In the field of environment protection, related to the solution of the water crisis, scientific thought and technological advances are directed to the fight against water leakage, pollution and mineralization (salinization) of the natural waters.

The demographic development of the humanity has a major impact on the hydrosphere pollution, because a man, together with his physiology represents a substantial factor of pollution of water resources.

Water resources

In nature, water is present in three interconnected states of matter: gaseous (vapor), liquid and solid. According to the origin and locations, water can be classified as: atmospheric, surface and underground water. These forms continually cross each other, forming the so-called hydrological cycle.

Water forms the hydrosphere, but it is also present in the lithosphere, atmosphere and biosphere of the Earth.

Estimated water volume on Earth [6] amounts to a total of around 1386 million km^3, where 97.5% of the water belongs to the world's oceans. Therefore, the reserve of fresh water is only 2.5%, more than 2/3 of that quantity is contained in the permafrosts and glaciers and only 0.32% is in lakes and rivers. The most important and useful are water from the rivers, which accounts for only 0.0002% of the total water reserves. This water can be used for different purposes without major technical and material investments.

Discussion

The water resource is necessary for the human population existence, firstly for the civilization needs (hygiene), and secondly for the physiological needs (fresh drinking water), which is reflected on the consumption of water resources. Water is also a resource which is constantly polluted by human actions on one side as well as by water discharges, used for physiological needs.

Table 6. Water reserve in the hydrosphere (thousands of km^3) [6]

water reserve	world ocean	fresh water	glaciers	lakes	soil moisture	water vapor in the atmosphere	river water
quantity	1 370 323	60 000	24 000	280	85	14	1.2

About 198 million m^3 of available water on Earth (1386 million km^3) belongs to each of the 7 billion people living on Earth. On the other side, about 172 m^3 of the total volume of river water (1200 km^3) belongs to each man.

Optimal daily water needs for a healthy man are about 3.5 l [3], summer physiological minimum consumption is 3.0 l, while winter consumption is 2.0 l. A total water consumption of the human population is shown in Table 7.

Table 7. Consumption of fresh drinking water (litres per day)

year	population of Earth	physiological minimum consumption		optimal consumption
		summer	winter	
2011	7 000 000 000	21 000 000 000	14 000 000 000	24 500 000 000
2050[5]	13 440 000 000	40 320 000 000	26 880 000 000	47 040 000 000
2100[5]	15 820 000 000	47 460 000 000	31 640 000 000	55 370 000 000

So, the whole human population (7 billion people) daily drinks about 24.5×10^6 m^3 of the 1200000×10^6 m^3 total available river water.

A man excreted about 1.2 to 1.5 l of urine per day [3], and the contribution to the pollution of the hydrosphere by physiological fluids is shown in Table 8.

Table 8. Pollution of the hydrosphere by physiological fluids (litres per day)

year	population of Earth	minimum quantity	maximum quantity
2011	7 000 000 000	8 400 000 000	10 500 000 000
2050[5]	13 440 000 000	16 128 000 000	20 160 000 000
2100[5]	15 820 000 000	18 984 000 000	23 730 000 000

Daily pollution of the whole human population (7×10^9 people) by physiological fluids ranges from a minimum 8.4×10^6 m^3 to a maximum of 10.5×10^6 m^3.

Man's urine is a liquid, which contains 20 g of inorganic (mineral salts) and 30 g organic (organic compounds) components per liter [3]. Table 9 gives the pollution of the hydrosphere with mineral salts and organic matter from physiological fluids.

Table 9. Pollution of the hydrosphere with mineral salts and organic matter from physiological fluids (in tons)

year	population of Earth	content in the minimum quantity		content in the maximum quantity	
		inorganic components	organic components	inorganic components	organic components
2011	7 000 000 000	168 000	252 000	210 000	315 000
2050[5]	13 440 000 000	322 560	483 840	403 200	403 200
2100[5]	15 820 000 000	379 680	569 520	474 600	711 900

The population of the whole human population, increases mineral salts in water resources for at least 168000 t (maximum 210000 t), while the increase of the organic matter in the water resource is at least 252000 t (maximum 315000 t).

The pollution caused by human physiology in the form of physiological fluids, which ultimately ends up in the water resources, should not be ignored and underestimated as a hydrosphere pollutant. So, the human existence by itself is a source of pollution of water resources.

Direct recipients of the polluted water are mainly rivers, and lakes and seas, rarely. Thus, the products of the human physiology, pollutes the water resource with highest quality (rivers), which are already in deficit. This also contributes to the mineralization of lakes, and also the world seas, because a large number of rivers are flowing into them. Salinization of rivers has resulted in reducing the available amount of water that can be used without major operations on them, in order to meet the biological needs of man. Intake of mineral salts in water resources contribute to the additional mineralization (salinization) of the water resources. On that way, adding organic matter specifically requires an increased biological oxygen demand (BOD) and chemical oxygen demand (COD). So, it is very important to pay attention on this occurence, in respect to the pollution of water resources.

CONCLUSION

Human physiology impact on the air resource

The influence of man on the air resource is reflected not only in terms of its technical activities, but also in his very existence on the planet Earth.

Thus, the physiological process of man's breathing is one of the sources of pollution of the atmosphere. It is important to note that the human population is growing rapidly, which increases the consumption of oxygen from the atmosphere, while, on the other side, it increases the production of carbon dioxide, which contributes to the pollution of the air layer. Disturbing fact is that the plants (forest ecosystem), which are the only producers of oxygen and large consumers of carbon dioxide, are more threatened, and the particular problem is the destruction of tropical forests that produces the most oxygen.

Human physiology impact on the water resources

The water resource is necessary for the human population, firstly for the civilization needs (hygiene), and secondly for the biological existence. The influence of the man's biological existence on water resources is reflected in two ways: the consumption of water for physiological needs and water pollution with by-products of physiological processes such as catabolism.

The use of water for physiological needs causes consumption of water resources. The increase in human population also increases the water consumption in order to meet the physiological needs. Water consumption for the physiological needs can't be significantly decreased, because it depends directly on the human population, so it has a direct impact on the reduction of the available quantities of water. The negative impact on the water resource have also physiology secretions, which represents a source of pollution. Population policy can decrease the negative impact of physiological fluids, as well as procedures for water filtering, reducing on that way their negative effects on water resources.

A direct impact on the sustainable development has:

- Excessive growth of resource consumption
- Excessive growth of the human population

Population policy is a tool which can direct effects of the population development, limiting the sources of pollution on that way.

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GREEN AND PHILANTROPIC MARKETING – A CONSUMER ATTITUDE SURVEY

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ABSTRACT

Consumers are nowadays increasingly aware of the effects and environmental and economic consequences of harmful impacts on the environment. Around the world people express their concern for the environment by changing their consumption behavior and choices. As a result, green marketing has appeared, demanding sustainable and socially responsible products and services. Around the world companies invest substantial funds into recycling, lower energy consumption, and other environmental programs. However, if consumers are not well informed, companies will not benefit from such an eco-marketing. This study aims to explore citizens' awareness of the green marketing concept and to estimate the effects of the activities of socially responsible companies in public. The results of the conducted survey demonstrated that more efforts should be invested into the promotion of humanitarian actions and environmental protection measures in the business plan of the socially responsible.

Key words: social marketing, green marketing, philanthropic marketing, environmental awareness, sustainable growth.

INTRODUCTION

Socially responsible business is a concept whereby companies voluntarily integrate social and environmental concerns into their own business, as well as, into their relationship with the employees, consumers, and partner institutions. To be socially responsible is not limited to fulfillment of legal obligations only, but it also includes investments in human capital, and into the environment.

"Social marketing is the systematic application of marketing, along with other concepts and techniques, to achieve specific behavioral goals for a social good"(en.wikipedia.org).

Social marketing can be built on:

- Green marketing concept and,
- Philanthropic marketing concept (1).

The term green marketing appeared in Europe in the twentieth century, at the beginning of the eighties and evolved from environmental protection movements. This form of marketing extends the concept of environmental protection to the protection of human living and working environment in general. Increasing economic growth inevitably leads to the environmental pollution. In order to decrease environmental deterioration technologies and resources used in production and selling have to be reassessed. Most of people consider green (or eco) marketing to be a mere promotion of environment friendly products. However, under this term a substantially wider concept is understood, which can be applied in consumer goods, industrial assets, services, and it includes a wide range of activities, such as product modification, production modification, product packaging, and advertising strategies modification (2).

The term strategic philanthropy was used first by Post and Waddock (1995) when trying to find a method to enhance strategic interests of a company, or engage into activities that bring wealth to shareholders via resources that do not yield immediately. There are two contradictory understandings of the economic essence of philanthropy:

1. Philanthropy is non-refundable distribution of the resources of a company-philanthropist or expense,
2. Philanthropy is an expense that brings profit to a company-philanthropist, either directly generating profit or increasing the amount of non-material resources (3).

In Europe and around the world the number of companies that promote the strategy of social responsibility as an answer to various economic and social pressures and social concern is increasing. A sustainable growth is a comprehensive concept that includes social, economic, political, and life goals. Despite the increased public awareness regarding sustainability in some segments, the undertaken measures for the protection against the harmful effects of economic growth remain insufficient (4).

Companies are a part of the society they operate in; therefore, apart from the realization of their economic goals, they have to take care of their impact on the society and the environment. In other words, companies should organize their business in a socially acceptable manner (5). Starting from the sixties, human rights movements, consumer rights organizations, environmental protection movements, all have contributed to the development of this concept. These organizations and movements introduced new demands on companies. Many companies started caring about the safety of their products, environmental protection, and treating the interest groups connected to their business in a moral manner (6).

METHODOLOGY

The survey conducted in this study was carried out in the city of Niš (Serbia) from December 2012 to January 2013. The sample set consisted of a hundred examinees (N=100) (men and women) of different ages, education levels, interests, and socio-economic disparities. For the purpose of the survey a questionnaire was formed. The questions were designed in a way that a person can select either one of the provided answers or gives his/hers opinion about certain claims. The results were statistically analyzed and graphycally presented in charts.

56% of the examinees were male and 44% female. A quarter of the examinees (25%) were between 31 – 40 years old, followed by the group between 21 – 30 (26%), the group that included 41 – 50 and over 50 years old examinees (19% respectively), and finally examinees aged 20 or less (11%). More than half of examinees (53%) had secondary education, 36% had high education, 9% had higher education, while 2% had only elementary education. 6% of the examinees were pensioners, 16% were unemployed or students, while 62% were emloyed. Most of the examinees have a monthly income between 25,000–50,000 RSD.

RESULTS

56% of the examinees shared the opinion that rapid economic growth and the inflation of mass production and distribution market have negative effects on the society and the environment. 20% of the examinees had an oposite opinion, while 24% stated that they had never thought about this problem.

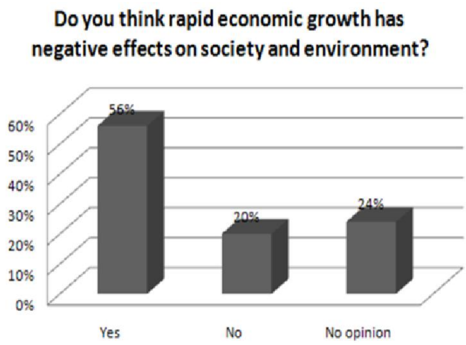

Figure 1. The effects of rapid economic growth

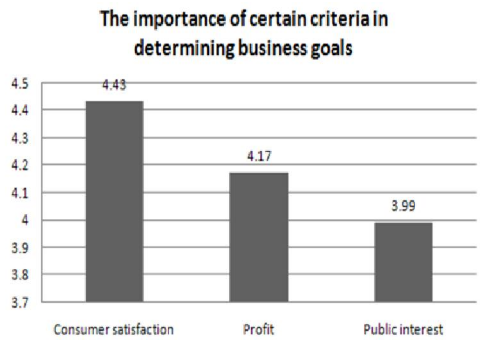

Figure 2. Three most important criteria in business

In general, the results demonstrate that women believe that the economic growth has a negative influence on the environmental quality and consequently on the society. The examinees mostly consider the satisfaction of consumers to be crucial in determining the business goals. More than half of the examinees (58%) have already heard of the concept of green and philanthropic marketing. A fifth of them have never heard of the existence of these concepts. No substantial differences among the age groups have been observed in terms of their familiarity with these concepts.

Healthcare, education, science, art, culture, sport, and social programs are all equally important in terms of the project realization of socially responsible companies.

According to the examinees, philanthropic activities in marketing have a great impact on all of the following areas: health system, education, science, art, and culture, sport, and social programs (Figure 3). However, education and sport have a slight advantage (3.79 and 3.76, respectively), while healthcare was estimated to be less impacted (3.49). Education and sport as well, were singled out by the examinees as the most probable affected areas, because they mostly involve young people, who give a lot of value to the importance of green marketing.

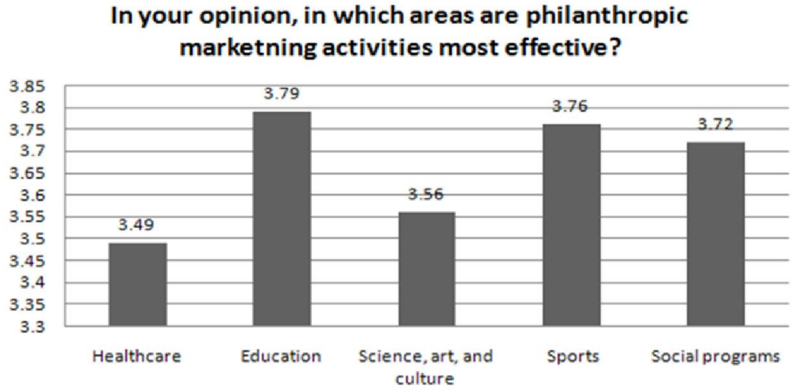

Figure 3. The effectiveness of philanthropic marketing activities (average mark)

As much as 56% of the examinees are willing to change their habits and would even be ready to consume more expensive products given that the producers support sound and socially responisible principles. 30% of the examinees were unsure about their decision, and 14% would not change their habits, regardless of the implementation of philanthropic principles in business.

The examinees consider schools and faculties to be the most desirable partners for socially responisble companies (3.96), followed by company employees and local governments, and eventually non-governmental organizations (NGOs), and citizen associations (3.4).

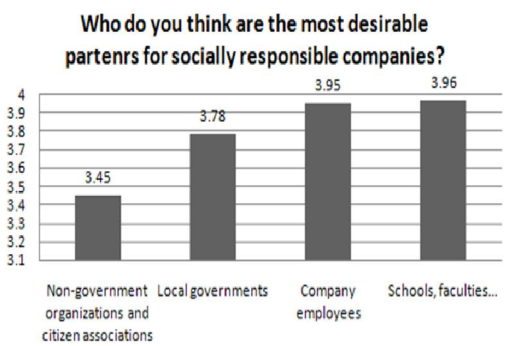

Figure 4. The most desireable partners for SR companies

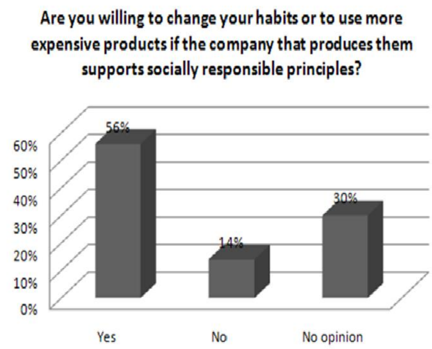

Figure 5. Willingness to change habits in favour of SR principles

41% of the examinees consider green and philanthropic marketing to have a future and believe that it is necessary to increase social responsibility of companies towards implementation of social and ethical principles into their marketing practice. 23% of the examinees state that large companies are only interested in increasing profit and that philanthropic marketing, unfortunately, does not have a future. 36% of the examinees think that philanthropic marketing can have a future provided that legal regulations force companies to accept it.

24% of the examinees think that philanthropic marketing will have an advatage over the classic one, while for 9% the classic forms of marketing are still ahead. As many as 67% are not sure what form of marketing would prevail in the future.

Figure 6. The future of the green marketing concept

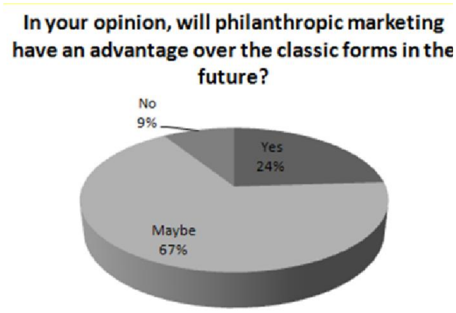

Figure 7. Philanthropic marketing versus the classic forms in the future

DISCUSSION

More than half of the examinees conisder that rapid economic growth and mass production and distribution market inflation lead to negative consequences on society and the environment.Almost a quater of the examinees state that they have never thought about this relation. In general, the examinees consider that customer satisfaction has a priority for setting the goals of a company over the profit and public interest .

The fact that more than half of the examinees are familiar with the concepts of green and philanthropic marketing is a good indicator of public awerness of their importance and benefits. Most of the examinees stated that they had heard of these concepts from a friend from television programes, informed themself from online information sources. The rest of the examinees did not remember the information source they received the information about the concepts of green and philanthropic marketing from. A small number of the examinees heard about these concepts in a college or school. Interestingly, the largest number of the examinees heard of green and philanthropic marketing from friends, which indicates that these concepts are a common and acceptable topic in unformal conversation among freinds. There has not been recognized any significant difference among the age groups regarding the level of information on green and philanthropic marketing, eventhough different age groups are expected to have access to different information sources. However, the older people pointed out television as the primary source, while the younger ones rely on the online sources.

Substantial number of the examinees considers green and philanthropic marketing to have a future and beleive that extra work should be invested towards increasing the social responsibility of companies. They also beleive that the companies should implement social and ethical principles in the marketing practice. However, the number of those who think that companies are only interested in enlarging their profit and that green and philanthropic marketing concept, unfortunately, cannot succeed in the future should not be neglected. Approximately one third of the examinees beleived in the future of these concepts only if legal regulations force the companies to apply them.

Socially responsible business was highly rated by the examinees, which speaks of their avareness of the importance of its concepts for the society in generall. Equally, all the mentioned areas: healthcare, education, science, art, culture, sport, and social programs represent the desirable areas for socially responsibe companies. According to the examinees, philanthropic activities in marketing are effective in all these areas. However, education, science, art, and culture are given a slight advantage over the remaining areas, while suprisingly, healthcare remains the least affected by the green and philanthropic marketing. The principles of socially responsible business are highly rated and the examinees consider them to be equally important. Although it can be concluded that citizens are generally familiar with the activities of socially responisble companies, humanitarian actions, and environmental protection measures, our results demonstrate that these activities do not attract enough publicity. More than half of the examinees claimed that they were willing to change their habits and even to consume more expensive products provided that the producers advocate sound and socially responsible principles. Only ten examinees said they were unconditionally interested to get involved in one of humanitarian actions initiated by socially resposnible companies, while nearly half of them would do it according to their own capabilities., For a fifth of the examinees the decision depends on the particular project. Some examinees said they even though they were interested, they did not have enough time to participate, while a small number of them were not interested in humanitarian actions.

Schools and faculties are seen as the most desirable partners for socially responsible companies, followed by local governments and company employees, NGOs, and citizen associations. A potential partner is any institution, association, or citizen group whose goal is promotion of ethical principles, philanthropy, or socially responsible behavior, as well as the support of philanthropic and environmental activities of socially responsible companies. We therefore conclude that citizens are not completely familiar with the advantages and the importance of green and philanthropic marketing and that they do not participate enough in the activitis of socially responsible companies. This is most likely caused by an insufficient promotion of these principles and their importance.

More than half of the examinees consider that an improved ethic code in companies is necessary, in order to conduct socially responisble business and to carry out philanthropic marketing. While most of the examinees think that this improvement depends on the company management, some of them do not value the significance of the improved ethic code for the application of ethical principles. 24% of the examinees think that philanthropic marketing will undoubtedly have advantage over the classic one, while 9% still see the classic forms of marketing as more advantageous. 67% have not a clear opinion on which of these marketing forms will prevail in the future.

CONCLUSION

Increased concern about energy, climate, harmful materials, and other enviromental issues enforced some of the biggest brands to enter the green market and to adopt the concept of green marketing in their services and products. Like the use of Internet, the green way of life, including green and philanthropic marketing, appears to become the standard by which many live, do business, and act in the society. Under corporative social responsibility Raymond Bauer implies the obligation of companies to consider seriously the impact of their activities on the society (7). Multinational company management understands that only one reckless decision can damage the reputation of a company and that the price of such a reckless business is very high. For that reason multinational company management tends to carefully monitor their business impact on the society (8). Environment friendly products, socially responsible business, and community care are marketing strategies that help gaining new clients and generating bigger profit. Nevertheless, company management is sometimes prone to giving exagerated statements about their environmental engagement and about the enviromental character of their products and services through a false maketing and public relations. In order to be effective, green and philanthropic marketing has to meet three major standards: honestly and authenticity, clients and customers education and involvement . Following these standards, an environmentally responsible company assures that the advertised is implemented in reality and that the business policy is in accordance with the principles of green and philanthropic marketing. This can be only achieved through strategies and messages that are credible and truthful to the customers.

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ECOLOGICAL ECONOMICS

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ABSTRACT

Flora and fauna are treasures whose value can not be expressed monetarily. Unfortunately, the nature as something obtained free as a remorseless destroyed if it provides tax. In order to prevent environmentalists team up with economists. Joint forces are trying to show the value of services provided to us by nature. This encourages rethinking economics. In industrial production processes, nature was only important as a raw material. Nature is seen only economically but not environmentally friendly. When a natural treasure was running experts have begun to think differently. Rapid disappearance of flora and fauna experts wonder whether disappear with neem specific funds.

Key words: economy, ecology, resources, funding.

INTRODUCTION

Way back in 1798. Thomas Malthaus wrote the book "An Essay on the principle of population" and set a rule with the terrible and inevitable outcome of the economy has brought to disrepute. Malthus was one of the first modern economist, and this is his most famous work. His first assumption is that stocks food only grow arithmetically (increasing at a constant rate, for example. 10 million tonnes of grain a year), and the population grows geometrically (doubling every 30 to 50 years), with the prospect of long-term human progress weak . He argues that population outstrips food supply, which affects the growth of poverty, disease, war and famine.

In the mid twentieth century, it was observed that the population of the planet increases rapidly, and the food less. For example, Mexico in the 50's of the last century imported half of wheat used and the country is threatened with famine. During 1956.god. Mexico will double production of wheat II eliminates the need for imports. Until 1964. Mexico began to export half a million tons of wheat a year. To date, we have managed to avoid a Malthusian fate of the technological development in agriculture and health care. We rye that technological progress has led to the assumption of Malthus.

The assumption that population grows geometrically, can not always be confirmed. For example, rich countries have low rates of population growth due to the availability of contraceptives that Malthus did not foresee, which means that families can control their reproductive preferences if they wish. In the nineties takes effect Malthusian assumption. Since 1984. to 1995. population growth was faster than the growth in grain production. How to explain this trend? We can say that the Green Revolution partially exhausted its potential. Until 1985. 80% of India's wetlands were turned into high-yield land. States, which was on the brink of a humanitarian catastrophe has become world's second largest rice exporter, behind China. 2 t of rice per hectare, India reached the figure of 6t per hectare. Apart from India, there are the Philippines, where production pitin?a for 20 years. increased from 3.7 to 7.7 million tons per year. In Pakistan's wheat production for ten years increased from 4.6 to 7.3 million tons, and so on. [1]

GREEN REVOLUTION

Technological progress of agricultural production is linked to the green revolution. We can say that the creator of the Green Revolution Borlag Norman (Norman Borlänge). He was born in Iowa and a Ph.D. in agronomy on plant pathology and genetics. The year 1970. was awarded the Nobel Peace Prize ceremony and heard that Borlag their work saved a billion people. Green Revolution refers to the transfer of a number of innovations in developing countries, ie underdeveloped and consists of three main components:

1. The introduction of new varieties of crops (selection)
2. Irrigation (irrigation) and
3. The application of modern technology, fertilizers and pesticides.

The introduction of new varieties of crops, in that order, in the second half of the twentieth century, created 13 international scientific and agricultural research systems in developing countries. They are found in Mexico (corn and wheat), the Philippines (for rice), Colombia (for tropical food crops), Nigeria (on food crops humid and sub-humid tropical areas), Cote d Ivoar (for rice production in West Africa), Peru (potato), India (for food crops arid tropical areas), and so on. The most famous are the top two centers. Thanks to the center of Mexico, wheat yields have tripled, and the country became the progenitors of the "green revolution." Experience of the "green revolution" have proved to be good in Pakistan, India and other countries. Significant success was the International Institute selection of rice in Florida. He introduced high-yielding varieties of rice, which received the name of EDSA. They not only give high yields, but also mature faster, which allows 3-4 seeding year. These varieties have spread to all the countries of Southeast Asia.

Irrigation is particularly important, because new varieties of cereals can realize their full potential only in favorable moisture conditions. Therefore, at the beginning of the "green revolution" in many developing countries, particularly Asian, special attention has been paid to irrigation.

The application of modern technology, fertilizers, plant protection products and the like. Especially important are nitrogen fertilizers, as a Mexican wheat varieties require up to three times more nitrogen fertilizer per acre than ordinary varieties.

The essence of the Green Revolution is a genetic cross that receive high-yielding varieties of wheat and rice using irrigation and synthetic fertilizer. Until 1970. developing countries has tripled production with the same amount of work. Double harvest become standard. [2]

CONSEQUENCES "Green Revolution"

The consequences of the "green revolution" have both positive and negative. Positive effects related to increased yields and negative on increasing capital investment and the creation of undesirable economic consequences in the community. The positive effects of the "green revolution" in developing countries are undeniable. They have led to an increase in food production, easing the problem of food and hunger in the world. India, Pakistan, Thailand, Indonesia, China, have reduced or stopped importing grain and become independent in this regard.

The first flaw "green revolution" refers to its periodic character. New high-yielding varieties of wheat and rice are distributed in Asia and Latin America and in Africa that is undeveloped "green revolution" takes up only 2%. "Green Revolution" has largely been applied in the production of three crops - rice, wheat and maize. Negative effects relate to the large capital investment that restrict use of modern agricultural requirements and its implementation can be used only wealthy farmers. The poor do not have the funds for the purchase of machinery, fertilizers, certified seed or sufficient land area. Many of them are forced to sell their land and become laborers or, or slum districts in the surrounding cities. Thus, the "green revolution" has led to the gradual social stratification in rural areas. The third drawback relates to the environmental consequences of the "green revolution." For example, in the areas of rice growing use of pesticides has led to a dead fish in rivers and irrigation canals. Planting varieties "Philippine miracle rice" in a neighborhood with traditional varieties, which have different periods of sowing and reaping, creates a favorable ecological environment for pests.

"Green Revolution" has increased the volume agriculture efficiency and diversification of production, but did not return to the throne of the most important economic areas and halt exodus. Agriculture has become dependent on the industry and the non-agricultural sector. Agriculture has lost the aura of an autonomous economic area, and became placement cost and highly dependent on non-agricultural sector. They resolved any issues of global food security and hunger. Only increase the existential gap between rich and poor. The poor are at one pole, millions populations that lack of food and drinking water. At the other extreme are citizens of developed countries with strong social pathology and disease type anorexia, bulimia, and obesity orthorexy. Solution to the issue of hunger is less in the area of technology, economics and politics, and much more ethical and cultural issues. The existence of hunger is not evidence of Malthus theory, because the profit above all else. [2]

CONCEPT OF SUSTAINABLE AGRICULTURE

Sustainable agriculture is a response to the decline in the quality of basic natural resources related to modern agriculture. The concept of sustainability includes a series of reflections on agriculture, which is based on the results of the co-evolution of social-economic and natural systems. Broader understanding of agricultural requirements include the study of agriculture, global environmental conditions and social systems, suggesting that the results of agricultural development resulting from the complex interaction of many factors. Sustainable agriculture is defined as the need for agricultural procedures that are economically viable, the need to provide people a biological food, and at the same time are positive in relation to the environment and quality of life. These objectives can be achieved in different ways, suggesting that sustainable agriculture is not related to any one of the special technological procedures.

Conventional agriculture is identified with industrialization and high needs, including pesticides and related to research and educational institutions. Alternative approaches include organic farming, organic agriculture, alternative agriculture, biodynamic agriculture and agricultural economics. Sustainable agriculture is developing farming system based on the Loose ecosystem, the natural processes that suppress pest populations and disrupt natural processes. These natural processes will be supported by biological control organisms and products, and pesticide resistant plants with narrow spectrum of action. [3]

Alternative development programs biological production of quality agricultural products include application of modern agricultural practices that enable cost-effective production. In the plains, wheat bearing regions of wheat production should be based on the basis of all major irrigation areas ecologically pure water. Besides the choice of alternative programs of wheat, there are opportunities to increase production of rye in the hilly regions. This production can be based on the areas where the recent past was realized wheat production, even in the land of poor quality, with the use of appropriate agricultural practices. In hilly areas should be extended to the production of quality barley. Especially important is the dedicated production of rye and barley as raw materials important for the production of various products in the export function. Intentional production and processing of corn can rely on finalizing the development of high current production using new technologies of production and processing. Soybean production is deficient in beans, as well as a meal for livestock and human nutrition. In particular, the increased demand of small frozen vegetables, aromatic herbs and forest. In animal husbandry should be developed for beef production in the mountainous area, based on more complete use of the area under quality lawns, meadows and pastures, an industrial and processing capacities and experiences. In this area there are favorable conditions for increased production of lambs. It is necessary to maintain high-quality production of meat and dairy sheep breeds. Parallel to sheep, goats should be grown for the production of milk and meat of kid. For the production of sheep and goat meat required relatively small investment compared to the space, increase forage production and increased health care. For fishery development should focus more capital investment in the reconstruction of fish ponds and open water stocking high-quality fish, at the same time changing farming technology and nutrition. Development of Beekeeping and bee products may be particularly attractive, because it exerts a multiplier effect beekeeping development of many types of spontaneous and cultivated flora. [4]

MEASURING SUSTAINABILITY

If natural resources are not ready for renewal, there is no point in spending the natural capital. Environmentalists use physical measures of elasticity eco-structure and the amount of resources and compare them with the pressures of population and consumption as their measures of sustainability. In ecology, the only way that future generations do not punish our activities is to turn over the amount of natural capital. This means that in the area of global warming and ozone depletion, our current impact is not sustainable. Economists have considered the environmental studies to find other measures "frontier" of growth. For example, Vitousek and others (1986). Calculated that so far 40% of people claimed by what are called "net primary production" of organic material on earth. In other words, people now spend about half of the plant material that grows on the planet. Environmentalists responds that there is no substitute for photosynthesis, and if this information is understood as an indicator of the capacity of the planet, and we assume that the economy is growing, which could lead to the seizure of 80% of photosynthesis, the planet will start from the half to the full carrying capacity in the next 35 years.

Example of calculating ecological sustainability refers to the use of fresh water. Postel and others (1996). Believe that people now use about 54% of surface water. They considered a technological possibility, including that the construction of new dams could increase accessible runoff by 10% over the next 30 years., But note that the expected population growth of 45% over the same period. Economists argue that the price of water to rise next year and will soon appear adequate substitutes. Environmentalists encourage us to consider the broader environmental impact of a significant increase in demand for water. The construction of dams in remote areas have a high environmental cost. Conflicts over water have led many organisms on brink of extinction. Economists believe that the scarcity of resources lead to a distortion of many ecosystems that influence our economic and cultural life. We can see that economists rely on physical measures, to assess the sustainability of natural capital. If natural resources are no substitutes, and the demand is high, then the unsustainable use of natural capital. Environmentalists believe that made capital can substitute natural. [1]

CONCLUSION

Malthus claimed that the greatest cause of misery that the livelihood growing in arithmetic progression, with a population at a geometric. In order to increase the population was reduced to increase the ability of livelihood operate a number of obstacles. The thesis that the population always tends to exceed the ability of food is not proven. Malthusian law formulation contains a permanent population growth rate and the growth rate decline means of survival. Following the relationship between population growth (geometric progression: 5,10,20, 40, ...) and increase food production in the world (an arithmetic progression: 5,6,7,8, ...), the mid-twentieth century to the fore puts the problem of food-poverty-population). Proponents of the "green revolution" to point out that triple food production in the world by the end of the twentieth century, or to accept the "hungry future" (Malthusian thesis). The creator of the "Green Revolution"

Norman Borloug, Nobel Prize in 1970. Research in the field of high-yielding varieties of wheat and rice. "Green Revolution" includes the development of new products, genetic crossing, the wider use of chemicals, agribusiness development, greater business efficiency, and so on. For the sake of short-term solutions have been created long-term problems that can be observed through the costs. Organic agriculture is a way out of the current situation. Agriculture in this model is based on Eco-development that promotes environmentally sound management of resources in modern agriculture in order to preserve them, ie. optimal use and to maintain a healthy environment and the health of future generations. The goal of modern agriculture is to move from high-intensity to high-efficiency agriculture and permanent preservation of the ecological balance.

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MODEL OF REORGANIZATION PROPOSAL TO LOCAL GOVERNMENTS STRENGTHENING OF SUSTAINABLECOMMUNITY DEVELOPMENT

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ABSTRACT

During the last thirty years in the Republic of Serbia there has been no proper interest in strategic and development planning instruments. This negligence can be explained by giving up the concept of comprehensive, centralized and several-year-old development plans in the period of socialism, that used to be rather inefficient and uneffective and were not aimed at management process that defines priorities and plans realistic implementation.

In order to fulfil its function, a local community (local autonomous entity) is to follow the changes within its society and even make a few steps in advance. Being a rather significant social factor, local community is exposed to various impacts on daily basis, both internal and external ones. In order to identify, analize and estimate such changes successfully, it is necessary to apply contemporary concepts of strategic and developmental environment planning, so that sustainable development strategy could be carried out. The process of implementing sustainable development strategy and local environmental development plans (or local ecological actions plans) initiates the process of creating sustainable local community.

Key words: strategy, planning, environment protection, management, sustainable development.

INTRODUCTION

The analysis of the environment in a number of communities in the Republic of Serbia(Bor, Majdanpek, Obrenovac, Sabac, Loznica, Kostolac)[9] are huge gaps that have been made over the past several decades, and are related to the lack of strategic developement planning and environmental protection at both the local and wider regional level.

In this way a number of local communities(Majdanpek, Sabac, Obrenovac, Loznica, Kostolac) [9] was placed into the category of endagered and environmentally devasted areas.

It is extremely necessary to alter the now dominant development paradigm of the local community since the consequences of environmental pollution due to rapid and poorly planned developement caused the unbalanced development of a largde number of local communities and entire regions.

Any local community, has to follow social changes and undertake appropriate measures to redefine and/or restructure individual management systems. One of the sub-systems is certainly management the development of the local community. Establishing efficient and effective subsystem of development activities creates basic preconditions for starting new development cycles that will put in motion concept of sustainable development and improve existing local community condition.

To reach developed local community and high-quality environment, the vision of each local community future development should be based on utilization of developing programmes including: environment protection, natural resources preservation, economic, social and technological development focusing on **concept of sustainable development.**

All social subjects in local community have their own interest in improving environment protection: state and its institutions, capital owners, companies, different associations and citizens as individuals. Therefore, it is necessary to start and/or continuously improve sustainable development management process as well as appointing organization in charge for system management.

PROPOSED MODEL OF STRATEGIC PLANNING FOR SUSTAINABLE COMMUNITY DEVELOPMENT

Strategic planning for sustainable development must be a decision-making process on which strategic measures are to undertake in the environment in the predicted time period. This process must be based on the identification, analysis and estimation of how to use available resources on the best possible way in order to get benefits from existing possibilities and reduce threats from immediate surrounding.

The benefits from strategic planning of sustainable development are the following: *setting priorities of local comunnity, mutual checking and exchanging ideas, possibility to include all interest groups into the process and, on that way, to oblige them to provide support to local government, and possibility to understand the environment better and to have influence on it.*

The process of strategic planning of sustainable development should include the following:*responsibile professions in local community, members of local parliament, local community bodies and personnel, institutions of local importance (educational, scientific and researching institutions), institutions of national importance, business sector, public institutions, NGOs, interested public (citizens, groups of citizens, associations of citizens and other organizations).*

Sustainable development concept implies consensus, negotiation, participation, partherhip and compromise on key development issues on local, regional and national level[2] [3].

Basically, sustainable development consists of six principles: ***environment quality, future, life quality, justice, precaution, comprehensiveness***[2] [3].

Defining aims of strategic planning for sustainable development

The aims of strategic planning for sustainable development of Municipality are:

- *establishing managemant system for environment protection;*
- *recoverying existing and preventing further environment pollution;*
- *starting new cycle of environment protection developing planning;*
- *improving existing strategies of economic development on the basis of agriculture, cattle breeding, and tourism;*
- *improving basic principles on sustainable development.*

Key factors for sustainable development strategic planning success

Key factors for the sustainable development strategic planning success for local commun. are:

- *increased interest in participating in local community sustainable development management process;*
- *increased intereste of govenment and NGOs for local community conditions, and*
- *participation of great number of authorities, organizations and interested public in improving the existing condition.*

Critical factors and restrictions of the concept of strategy planning for sustainable development

Restrictions of the concept of strategic planning for sustainable development of local community are:

- *few people working at preparation of local community development planning;*
- *lack of operation experience in strategic planning;*
- *insufficient motivation at the highest level of local community autorities and other professions;*
- *insufficient financial support for application and realization of the concept for sustainable development.*

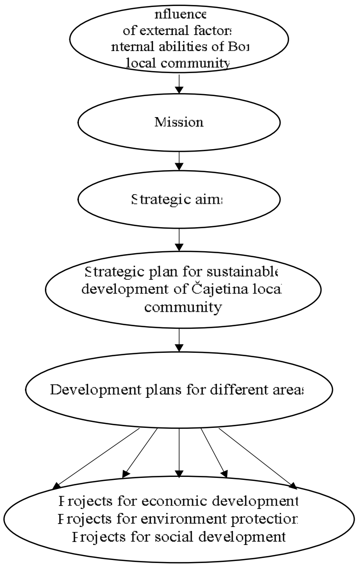
Strategy of local goverrnment system, being built [4]at long-term hierarchy decision-making system, adjusts its operations to corresponding conditions in the environment. On the other hand, system of local government permanently influences the environment, i.e. local community, depending on its internal potentials. It means that communication of local government is based on interaction of internal abilities and external chances, in accordance with SWOT analysis*(Markowitz P.,2000).*

The future development of Bor local community should be characterized and realized by identification of those relevant qualitative characteristics and qualitative valuation indicators that help to recognize instruments enabling assumption of possible chances of future local community development.

Strategic planning of local community development must find a mechanism that will enable an efficient implementation of the strategy instrument that is synthetized **in the**

project, i.e. in complete project cycle–**project management***(Staletović N. 2006, p.22).* Hence, establishment of the local community development management tool that will be enable the realization of the concept of sustainable development of local communities.

Projects related to specific fields should be derived from strategic planning for sustainable development of **Bor** local community as well as from development plans of individual areas, as it is shown at Figure 1. Strategic planning should constantly analysed the compatibility of realization of development activity projects and actual strategy for sustainable development of local community, i.e. to which extend existing projects realize strategic aims of Municipality *(Staletović N. 2006, p.23).* This interdependence is shown at Figure 2.



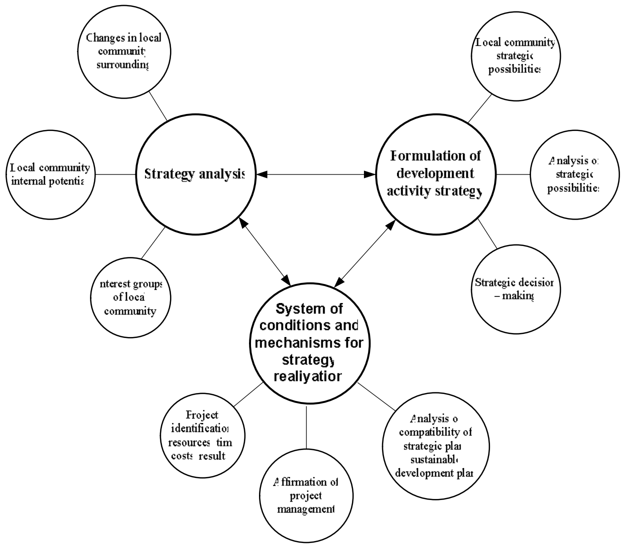


Figure 1. Projects as instruments for strategic aim realization

Figure 2. Compatibility of strategic and development planning realization[4]

HOW TO INTEGRATE THE STRATEGIC PLANNING MODEL IN THE LOCAL GOVERMENT SYSTEM

Achieving aims of strategic planning of sustainable development depend on the fact to what level local government system has prepared conditions to realize its strategy of sustainable development and development plannine as well as project management, and it can be seen in:

- *affirmation of project management function, and*
- *analyse of compatibility of strategic, tactic and operational management.*

From the point of view of management functions, project management can be located between strategic and operational management, as it can be seen in Table 1.

Table1. Comparison ofprojectmanagement functions

Aspect of Compari-son	Strategic manageme-nt of local community	Project manage-ment	Operati-onal manage-ment
Time aspect of management	Long-term	Medium - term	Short-term
Influence on local community system	Significant influence on long term	Significant influence on medium term	Significant influence on short term
Dominant influential factor(s)	Influence on system and environment	Complete or partial influence on system	Partial influence on system
Type of activity	Complex and innovative activity	Complex, innovative and partial activity	Routine activity
Type of function	Continual	Single	Continual
Dimension of function	Complete system	Complete or partial system of innovation activities	Some sub-systems

Subsidiarity is the base of each consistent decentralization, and it means that the local community or region should not depend on higher authorities (such province or state) for all activities that can be done independently (Handbook ofthe Lawon LocalSelf-Government, pages 3and 4; SCTMand the Ministry ofJustice and Local Government). Figure 3. shows model of authority organization at local level.

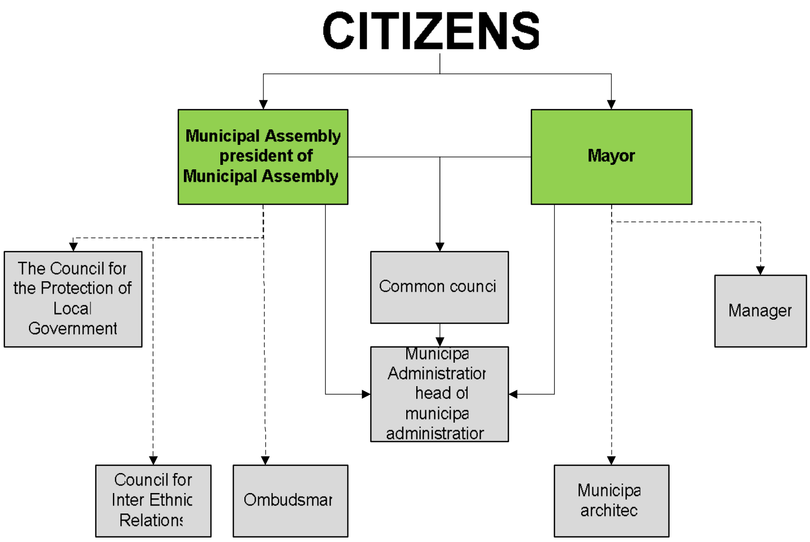


Figure 3. Model of authority organization at local level

Local community managementorganization of development

Management of subsystem development activitie should include planning, organization, monitoring and control of all aspects of local community development system in continual process in order to achieve aims of strategic planning for sustainable development of local community in accordance with process model of quality management system ISO 9001: 2008 i ISO 14001[6]. Aims of local community management are the same as the aims for the project management for local community development. One of the main principle for development activity project management is the fact that the first thing local government should do in to realize the management system is to define **the most convenient organization**, to take responsibility for project implementation management.

Depending on specific quality of local government system as well as on implementing project, the appropriate form for managing sub-system of developing activites and project management should be defined, according to Project - Management principle[1]. Taking into consideration current circumstances in some local governments and their economic, ecological and social issues, it is absolutely necessary to establish the subsystem of local development management as to define and realize strategic aims of sustainable development.

Having in mind tendency to improve coordination of main municipality management sectors and the change of concept of organizational structure, from functional to combined functional (matrix model of local community organization oriented toward project management), there are to be taken certain intervention in organizational structure to get more efficient way of operation. In the course of performing changes, the emphasise should be put on the efficiency and effectiveness of project realization as well as to implementation of the concept *Project-Management*.

The combined functional – matrix organization strengthens interaction of project team and organization competent for local community management, municipality Council for sustainable development and environment protection, teams for development planning and other authorities and organizations.

Analyse of current conditions in Bor municipality local community

Economic growth and development of local community cannot be limitless, as economic growth cannot function independantly from local community environment capacities[8]. There are numerous visible examples of economic growth and development without previous analyse of environment capacities in our country, and one of them is Bor [8]. To overcome such condition, it is required to undertake some organizational measures within local community reorganization. Existing organizational structure ofMunicipality government is an out-of-date functional model. The structure of the functional model enables concentration of critical mass of data and information required for responsible decision-making on issues from the domain of the functions themselves, yet it separates information required for performing some managing and operational processes (planning and control of project implementation, development process). The existing organization has not defined function of development and project management. In this context, it is necessary to indicate the need that activites of service providing shoud be performed centralized, and the project processes should be realized decentralized, ***so that is why the combined functional – matrix model of organization is to be supported.***

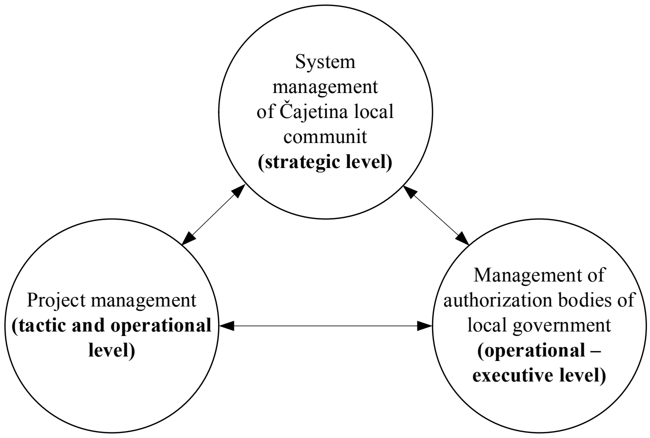


Figure 4. Three-level model of local community management

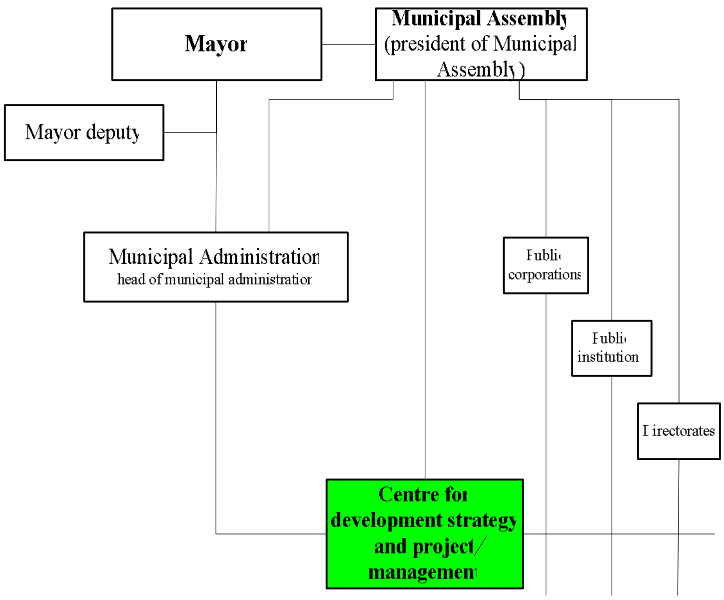


Figure 5. Proposal of new approaches to local government organization

It is recommended to remain the functional model of organization in the domain of service providing, and matrix model to be introduced in the function of strategy development and project management. With the aim to improve efficiency and effectiveness in local government, it is recommended to form **Centre for development strategy and project management** to give an incentive to local development, realization and development of programmes, projects and other activities in the field of carrying out the local policy of sustainable development. To provide preconditions for establishing **Centre for development strategy and project management** it is necessary to create conditions in which decisions on consolidation resources from local government would not derange local government plans and current operation. It means that resources from a project are autonomous in relation to local government authority body. In other words it means not to create new or increase the existing administration, but to allocate existing human resources in order to improve efficiency and effectiveness of local government. This proposal and the model further elaboration should focus to efficiency in project implementation, its monitoring and defining appropriate stimulative system of remuneration for efficient work at projects prepared for sustainable development local community.

Proposed measures will introduce three-level model of management consisting of: management of local government system (*strategic level- Mayor and his deputy,president of the municipal assembly*), project management (*tactic and operational level – manager of the Centre for development strategy and project management*) and management of authorization bodies of local government (*operational – executive level – head of local government*).

CONCLUSION

Modern trends in the activities of public sector organizations reqiure clear goals and strive to provide services that make it easier, better and more appropriate for users. Strategic orientation of public administration reforms in Republic Serbia, as well as reforms in most countries in the region, refer to the application of new management methods, primarily through changes in the operation of the organization, decision-making, motivation, public services, and the necessary expertise and accountability of the public administration.

Each local community should define, according to its needs and comparative advantages, the most convenient organization that will take the responsibility for managing strategic development, development planning and project management that are in the function of sustainable development and environment protection in the local community.

Considering the fact there are different comprehensions of sustainable development concept, there are also different appropaches to sustainable development operationalization. This work supports approach of applying operational principles through operationalization of the concept of enviroment protection planning.

The paper puts an accent on the concept of strategic planning in Bor local community, compatible with concept of sustainable development as a model for environment protection management system ISO 14001: 2004.

As the proposed concept is compatible with the model for environment protection management system it cannot be used in other local communities.

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ENVIRONMENTAL IMPACT ASSESSMENT OF THE EFFECTS OF CERTAIN PROJECTS IN EU COURT OF JUSTICE

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ABSTRACT

One of the European Union's objectives in the sphere of the protection of the environment and the quality of life refers to the need to asses effects of a project on the environment in order to take account of the concerns to contribute by means of a better environment to the quality of life. Hence, the European Union requires an environmental impact assessment to be carried out before approval can be granted for certain public and private projects.

Key words: European Union, environmental impact assessment, projects, Court of Justice.

INTRODUCTION

The environmental legislation of the Union includes provisions regarding participation of public authorities and other bodies in certain actions which may have a significant effect on the environment as well as on personal health and well-being. Among other EU rules, while best environmental policy consists in preventing the creation of pollution or nuisances at source, rather than subsequently trying to counteract their effects, it has been recognized that general principles for the assessment of environmental effects should be laid down with a view to supplementing and coordinating development consent procedures governing public and private projects likely to have a major effect on the environment. This assessment must be conducted on the basis of the appropriate information supplied by the developer, which may be supplemented by the authorities and by the people who may be concerned by the project in question.At the same timethere is a need to take effects on the environment into account at the earliest possible stage in all the technical planning and decision-making processes.Having all this in mind, it has been recognized that the principles of the assessment of environmental effects should be harmonized, in particular with reference to the projects which should be subject to assessment, the main obligations of the developers and the content of the assessment. Hence, certain rules has been adopted on EU level regarding environmental impact assessment which may be defined as a systematic process to identify, predict and evaluate the environmental effects of proposed actions and projects and may be described as a national procedure for evaluating the likely impact of a proposed activity on the environment.

ENVIRONMENTAL IMPACT ASSESSMENT IN EU

In 1985 Council of the European Communitiesadopted Directive on the assessment of the effects of certain public and private projects on the environment (EIA Directive)[1] which applies to a wide range of defined public and private projects, which are defined in Annexes Iand II. After the need for assessment of impact of certain activities on the environment was recognized, it was also found as useful to grant development consent for public and private projects which are likely to have significant effects on the environment only after an assessment of the likely significant environmental effects of those projects has been carried out. That assessment should be conducted on the basis of the appropriate information supplied by the developer, which may be supplemented by the authorities and by the public likely to be concerned by the project in question. In this sense it is appropriate to lay down a procedure in order to enable the developer to obtain an opinion from the competent authorities on the content and extent of the information to be elaborated and supplied for the assessment. State might in the framework of this procedure may require the developer to provide, inter alia, alternatives for the projects for which it intends to submit an application.

The EIA Directive of 1985 has been amended three times, in 1997[2], in 2003[3] and in 2009[4], and afterwards the initial Directive of 1985 and its three amendments have been codified by Directive 2011/92/EU of 13 December 2011[5].This Directive applies to the assessment of the environmental effects of those public and private projects which are likely to have significant effects on the environment.The environmental impact assessment identify, describe and assess in an appropriate manner, in the light of each individual case the direct and indirect effects of a project on the several factors. These are: human beings, the fauna, the flora, the soil, water, air, the climate, the landscape, the material assets and cultural heritage, as well as the interaction between these various elements.In that sense, Directive requires that an environmental assessment to be carried out by the competent national authority for certain projects

[1]http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1985:175:0040:0048:EN:PDF.

[2]Directive 97/11/EC brought the Directive in line with the UN ECE Espoo Convention on EIA in a Transboundary Context. The Directive of 1997 widened the scope of the EIA Directive by increasing the types of projects covered, and the number of projects requiring mandatory environmental impact assessment (Annex I). It also provided for new screening arrangements, including new screening criteria (at Annex III) for Annex II projects, and established minimum information requirements.

[3]Directive 2003/35/EC was seeking to align the provisions on public participation with the Aarhus Convention on public participation in decision-making and access to justice in environmental matters. The European Community signed the UN/ECE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the Aarhus Convention) on 25 June 1998 and ratified it on 17 February 2005.

[4]Directive 2009/31/EC amended the Annexes I and II of the EIA Directive, by adding projects related to the transport, capture and storage of carbon dioxide (CO2).

[5]As a result of a review process, on 26 October 2012, the Commission adopted a proposal for a revised Directive.

which are likely to have significant effects on the environment by virtue, inter alia, of their nature, size or location, before development consent is given. The projects may be proposed by a public or private person.

PROJECTS ASSESSED

An assessment is obligatory for projects listed in Annex I of the Directive, which are considered as having significant effects on the environment[6]. Other projects, listed in Annex II of the Directive, are not automatically assessed: Member States can decide to subject them to an environmental impact assessment on a case-by-case basis or according to thresholds or criteria (for example size), location (sensitive ecological areas in particular) and potential impact (surface affected, duration). The process of determining whether an environmental impact assessment is required for a project listed in Annex II is called screening[7].

In the sense of Directive, the term project means the execution of construction works or of other installations or schemes; other interventions in the natural surroundings and landscape including those involving the extraction of mineral resources. In its case-law, the Court has given a broad interpretation of the project. For instance, it refers to works and physical intervetionsin Article 1(2) of Directive 85/337[8]. The renewal of an existing permit (to operate an airport) cannot, in the absence of any works or interventions involving alterationsto the physical aspect of the site, be classified as a 'project' within the meaning of the second indent of Article 1(2) of Directive 85/337[9]. Regarding term 'construction', Court accepts that works for the refurbishment of an existing road may be equivalent, due to their size and the manner in which they are carried out, to the construction of a new road[10]. Similarly, the Court has interpreted point 13 of Annex II, read in conjunction with point 7 of Annex I, to Directive 85/337 as also encompassing works to alter the infrastructure of an existing airport, without extension of the runway, where they may be regarded, in particular because of their nature, extent and characteristics, as an alteration of the airport itself[11].

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[6] These projects include for example: long-distance railway lines, airports with a basic runaway length of 2100 m or more, motorways, express roads, roads of four lanes or more (of at least 10 km), waste disposal installations for hazardous waste, waste disposal installations for non-hazardous waste (with a capacity of more than 100 tonnes per day), waste water treatment plants (with a capacity exceeding 150 000 population equivalent).

[7] This particularly concerns for example the following projects: construction of railways and roads not included in Annex I, waste disposal installations and water treatment plants not including in Annex I, urban development projects, inland waterways, canalization and flood-relief works, changes or extensions of Annex I and II projects that may have adverse environmental effects.

[8] C-2/07 Abraham and Others, C-275/09, Brussels Hoofdstedelijk Gewest and Others, paragraph 20.

[9] C-275/09, Brussels Hoofdstedelijk Gewest and Others, paragraph 24; C-121/11, Pro-Braine and Others, paragraph 31.

[10] C-142/07 Ecologistas en Acción-CODA [2008] ECR I-6097, paragraph 36.

[11] C-2/07 Abraham and Others, C-275/09, paragraph 40.

ASSESSMENT PROCEDURE

The developer (the person who applied for development consent or the public authority which initiated the project) must provide the authority responsible for approving the project with the following information as a minimum: a description of the project (location, design and size); possible measures to reduce significant adverse effects; data required to assess the main effects of the project on the environment; the main alternatives considered by the developer and the main reasons for this choice; a non-technical summary of this information.

Article 1(2) of Directive 85/337 defines the term 'development consent' as 'the decision of the competent authority or authorities which entitles the developer to proceed with the project'. Article 1(3) [1(2)(f) as per codification] states that the competent authorities are to be that or those which the Member States designate as responsible for performing the duties arising from that directive. For the purposes of the freedom thus left to them to determine the competent authorities for giving development consent, for the purposes of that directive, the Member States may decide to entrust that task to several entities, as the Commission has moreover expressly accepted[12].

In a consent procedure comprising several stages, that assessment must, in principle, be carried out as soon as it is possible to identify and assess all the effects which the project may have on the environment[13]. Articles 2(1) and 4(2) of the EIA Directive are to be interpreted as requiring an environmental impact assessment to be carried out if, in the case of grant of consent comprising more than one stage, it becomes apparent, in the course of the second stage, that the project is likely to have significant effects on the environment by virtue inter alia of its nature, size or location[14]. It is apparent from settled case-law that an authorisation within the meaning of Directive 85/337 may be formed by the combination of several distinct decisions when the national procedure which allows the developer to be authorised to start works to complete his project includes several consecutive steps[15].

While the term 'development consent' is modelled on certain elements of national law, it remains a Community concept which falls exclusively within Community law. According to settled case-law, the terms used in a provision of Community law which makes no express reference to the law of the Member States for the purpose of determining its meaning and scope are normally to be given throughout the Community an autonomous and uniform interpretation which must take into account the context of the provision and the purpose of the legislation in question. Thus the classification of a decision as a 'development consent' within the meaning of Article 1(2) of the EIA Directive must be carried out pursuant to national law in a manner consistent with Community law[16]. It should be noted that Article 1(2) of Directive 85/337/EEC as

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[12] C-50/09, Commission v. Ireland, paragraphs 71-72.
[13] C-201/02, Wells, paragraph 52-53, operative part 1.
[14] C-290/03, Barker - Crystal Palace, paragraph 49, operative part 2.
[15] Case C-201/02 Wells [2004] ECR I-723, paragraph 52, and Case C-508/03 Commission v United Kingdom [2006] ECR I-3969, paragraph 102.
[16] C-290/03, Barker - Crystal Palace, paragraphs 40-41.

amended defines only a single type of consent, namely the decision of the competent authority or authorities which entitles the developer to proceed with the project[17].

With due regard for rules and practices regarding commercial and industrial secrecy, this information must be made available to interested parties sufficiently early in the decision-making process: the competent environmental authorities likely to be consulted on the authorisation of the project; the public, by the appropriate means (including electronically) at the same time as information (in particular) on the procedure for approving the project, details of the authority responsible for approving or rejecting the project and the possibility of public participation in the approval procedure; other Member States, if the project is likely to have transboundary effects. Each Member State must make this information available to interested parties on its territory to enable them to express an opinion.

Reasonable time-limits must be provided for, allowing sufficient time for all the interested parties to participate in the environmental decision-making procedures and express their opinions. These opinions and the information gathered pursuant to consultations must be taken into account in the approval procedure.At the end of the procedure, the following information must be made available to the public and transmitted to the other Member States concerned: the approval or rejection of the project and any conditions associated with it; the principal arguments upon which the decision was based after examination of the results of the public consultation, including information on the process of public participation; any measures to reduce the adverse effects of the project. In accordance with national legislation, Member States must ensure that the interested parties can challenge the decision in court.

RIGHT OF INDIVIDUALS

The provisions of the EIA Directive may be taken into account by national courts in order to review whether the national legislature has kept within the limits of the discretion set by it[18]. Under Article 10 EC [Article 4(3) TEU] the competent authorities are obliged to take, within the sphere of their competence, all general or particular measures for remedying the failure to carry out an assessment of the environmental effects of a project as provided for in Article 2(1) of the EIA Directive. The detailed procedural rules applicable in that context are a matter for the domestic legal order of each Member State, under the principle of procedural autonomy of the Member States, provided that they are not less favourable than those governing similar domestic situations (principle of equivalence) and that they do not render impossible in practice or excessively difficult the exercise of rights conferred by the Community legal order (principle of effectiveness). In that regard, it is for the national court to determine whether it is possible under domestic law for a consent already granted to be revoked or suspended in order to subject the project to an assessment of its environmental effects, in accordance with the requirements of the EIA Directive, or alternatively, if the individual

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[17] C-332/04, Commission v. Spain, paragraph 53.
[18] C-287/98, Linster, paragraph 38.

so agrees, whether it is possible for the latter to claim compensation for the harm suffered[19].

As regards the right of individuals to rely on a directive and of the national court to take it into consideration, it would be incompatible with the binding effect conferred on directives by that provision to exclude, as a matter of principle, any possibility for those concerned to rely on the obligation which directives impose. Particularly where the Community authorities have, by directive, imposed on Member States the obligation to pursue a particular course of conduct, the effectiveness of such an act would be diminished if individuals were prevented from relying on it in legal proceedings and if national courts were prevented from taking it into consideration as a matter of Community law in determining whether the national legislature, in exercising its choice as to the form and methods for implementing the directive, had kept within the limits of its discretion set by the directive[20].

It is on the basis of the rules of national law on liability that the Member State must make reparation for the consequences of the loss or damage caused, provided that the conditions for

reparation of that loss or damage laid down by national law ensure compliance with the principles of equivalence and effectiveness recalled in the previous paragraph[21].

It must, however, be pointed out that European Union law confers on individuals, under certain conditions, a right to compensation for damage caused by breaches of European Union law. According to the Court's settled case-law, the principle of State liability for loss or damage caused to individuals as a result of breaches of European Union law for which the State can be held responsible is inherent in the system of the treaties on which the European Union is based[22].In that respect, the Court has repeatedly held that individuals who have been harmed have a right to reparation if three conditions are met: the rule of European Union law infringed must be intended to confer rights on them; the breach of that rule must be sufficiently serious; and there must be a direct causal link between that breach and the loss or damage sustained by the individuals[23].Those three conditions are necessary and sufficient to found a right in individuals to obtain redress on the basis of European Union law directly, although this does not mean that the Member State concerned cannot incur liability under less strict conditions on the basis of national law[24].

It is, in principle, for the national courts to apply the criteria, directly on the basis of European Union law, for establishing the liability of Member States for damage caused to individuals by breaches of European Union law, in accordance with the

[19] C-201/02, Wells, paragraph 66-70, operative part 3; C-420/11, Leth, paragraphs 37-38.
[20] C-72/95, Kraaijeveld and Others, paragraph 56: C-435/97, WWF and Others, paragraph 69; C-287/98, Linster, paragraph 32, C-201/02, Wells, paragraph 57.
[21] Joined Cases C-46/93 and C-48/93 Brasserie du Pêcheur and Factortame [1996] ECR I-1029, paragraph 67.
[22] C-429/09 Fuß [2010] ECR I-12167, paragraph 45 and the case-law cited.
[23] Fuß, paragraph 47, and Case C-568/08 Combinatie Spijker Infrabouw-De Jonge Konstruktie and Others [2010] ECR I-12655, paragraph 87 and the case-law cited.
[24] Brasserie du Pêcheur and Factortame, paragraph 66.

guidelines laid down by the Court for the application of those criteria[25].In that regard, it has already been established, that Directive 85/337 confers on the individuals concerned a right to have the effects on the environment of the project under examination assessed by the competent services, and that pecuniary damage, in so far as it is a direct economic consequence of the environmental effects of a public or private project, is covered by the objective of protection pursued by Directive 85/337. However, the existence of a direct causal link between the breach in question and the damage sustained by the individuals is, in addition to the determination that the breach of European Union law is sufficiently serious, an indispensable condition governing the right to compensation. The existence of that direct causal link is also a matter for the national courts to ascertain, in accordance with the guidelines laid down by the Court.

To that end, the nature of the rule breached must be taken into account. In the present case, that rule prescribes an assessment of the environmental impact of a public or private project, but does not lay down the substantive rules in relation to the balancing of the environmental effects with other factors or prohibit the completion of projects which are liable to have negative effects on the environment. Those characteristics suggest that the breach of Article 3 of Directive 85/337, that is to say, in the present case, the failure to carry out the assessment prescribed by that article, does not, in principle, by itself constitute the reason for the decrease in the value of a property. Consequently, it appears that, in accordance with European Union law, the fact that an environmental impact assessment was not carried out, in breach of the requirements of Directive 85/337, does not, in principle, by itself confer on an individual a right to compensation for purely pecuniary damage caused by the decrease in the value of his property as a result of environmental effects. However, it is ultimately for the national court, which alone has jurisdiction to assess the facts of the dispute before it, to determine whether the requirements of European Union law applicable to the right to compensation, in particular the existence of a direct causal link between the breach alleged and the damage sustained, have been satisfied[26].

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HABITATS CONSERVATION IN EUROPEAN UNION LEGISLATION

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ABSTRACT

The continuing deterioration of natural habitats and the threats posed to certain species are one of the main concerns of European Union (EU) environment policy in order to maintain biodiversity in the Member States by defining a common framework for the conservation of wild plants and animals and habitats of Community interest.

Key words: European Union, Habitats Directive, European Court of Justice.

INTRODUCTION

In 2001 the European Union set the political objective of halting biodiversity loss in the EU by 2010. Under the Convention on Biological Diversity, the European Union agreed to a global target of 'significantly reducing the current rate of biodiversity loss by 2010'. In 2006 EN 3 EN in its Communication - 'Halting the Loss of Biodiversity by 2010 and Beyond'- the European Commission reaffirmed the target of halting biodiversity loss by 2010 and set out a road-map - the Biodiversity Action Plan - to achieve this objective. A prerequisite for both EU and international policy is a reliable measure of the status and trends in biodiversity. At EU level, the information collected and reported by the Member States under the Habitats Directive constitutes an important source of data on the status of some of the most threatened habitat types and most vulnerable species of animals and plants.

The cornerstones of Europe's legislation on nature conservation are Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (hereinafter "the Birds Directive") and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (hereinafter "the Habitats Directive"). These Directives represent the most ambitious and large scale initiative ever undertaken to conserve our natural heritage across the European Union. The Birds Directive aims to protect all wild birds and their most important habitats across the EU.The Directive puts an end to certain practices such as the keeping and sale of native wild birds, or indiscriminate methods of killing and introduces a legal mechanism for regulating other activities, such as hunting, to ensure that they are sustainable. The

Directive also requires all 25 Member States to protect the most important sites for all migratory birds and 194 particularly threatened species, paying particular attention to wetlands of international importance. The Habitats Directive introduces similar measures to the Birds Directive to protect Europe's wildlife but extends its coverage to a much wider range of rare, threatened or endemic species, including around 450 animals and 500 plants. Some 200 rare and characteristic habitat types are also, for the first time, targeted for conservation in their own right.

HABITATS DIRECTIVE

At the heart of both Nature Directives lies the creation of a Europe-wide ecological network of protected sites – called the Natura 2000. This network is the largest ecological network in the world. It comprises special areas of conservation designated by Member States under the current Directive. Every country has designated Natura 2000 sites to help conserve the rare habitats and species present in their territory. The individual Natura 2000 sites range in size from less than 1 ha to over 5,000 km2 depending on the species or habitats they aim to conserve; the majority are around 100–1,000 ha. Some are located in remote areas but most form an integral part of our countryside, and contain a range of different habitats, buffer zones and other elements of the landscape. As a result, Natura 2000, is not only safeguarding some of Europe's rarest species and habitats, but it also provides a safe haven for countless other animals, plants and wildlife features which, although more common, are an equally important part of our natural heritage. Annexes I and II to the Directive contain the types of habitats and species whose conservation requires the designation of special areas of conservation. Some of them are defined as "priority" habitats or species (in danger of disappearing). Annex IV lists animal and plant species in need of particularly strict protection. Special areas of conservation are designated in three stages. Following the criteria set out in the annexes, each Member State must draw up a list of sites hosting natural habitats and wild fauna and flora. On the basis of the national lists and by agreement with the Member States, the Commission will then adopt a list of sites of Community importance for each of the nine EU biogeographical regions (the Alpine region, the Atlantic region, the Black Sea region, the Boreal region, the Continental region, the Macronesian region, the Mediterranean region, the Pannonian region and the Steppic region). No later than six years after the selection of a site of Community importance, the Member State concerned must designate it as a special area of conservation. Where the Commission considers that a site which hosts a priority natural habitat type or a priority species has been omitted from a national list, the Directive provides for a bilateral consultation procedure to be initiated between that Member State and the Commission. If the result of the consultation is unsatisfactory, the Commission must forward a proposal to the Council relating to the selection of the site as a site of Community importance. The Natura 2000 network now represents around 18 % of the EU's terrestrial territory.

Member States must take all necessary measures to guarantee the conservation of habitats in special areas of conservation, and to avoid their deterioration and the significant disturbance of species. The Directive provides for co-financing of conservation measures by the Community. Member States must also: encourage the management of features of the landscape which are essential for the migration, dispersal and genetic exchange of wild species; establish systems of strict protection for those animal and plant species which are particularly threatened (Annex IV) and study the desirability of reintroducing those species in their territory;prohibit the use of non-selective methods of taking, capturing or killing certain animal and plant species (Annex V). Every six years, Member States must report on the measures they have taken pursuant to the Directive. The Commission must draw up a summary report on the basis thereof. The annexes to the Directive were amended to take account of the biodiversity of the countries who acceded to the EU in 2004 and 2007. The enlargement brought new challenges for biodiversity, as well as new elements, including three new biogeographical regions (the Black Sea region, the Pannonian region and the Steppic region).

Nevertheless, Report from the Commission of 13 July 2009[27] enabled the implementation of the Habitats Directive for the period 2001-2006 in the 25 Member States to be assessed. The report provides an overview of the biodiversity situation in the EU. It also constitutes a clear point of reference for assessing future trends in the status of its most vulnerable species and habitats. The results show that favourable conservation status has not been achieved for many habitats and species listed under the Habitats Directive. Certain habitat types (in particular, grassland, wetland and coastal zones) have an overall poor status. Signs of recovery have been observed for certain species (for example, the wolf, Eurasian lynx, beaver and otter). However, further efforts are required to establish healthy and sustainable populations. The Natura 2000 network must continue to develop; restoration measures for certain sites must be provided. The network and sites will then need to be managed effectively and properly resourced. Lastly, a large number of Member States do not invest sufficient resources in monitoring the status of species and habitats within their territories. In the absence of reliable data it will be impossible to assess the impact of conservation measures.

One part of our common experience is the way how the legal framework –i.e. the 'birds' and 'habitats' directives are interpreted. To ensure a common understanding, the Commission has provided clarification of specific requirements and provisions of the nature directives in some guidance documents dealing with managing of Natura 2000 sites, assessment of plans and projects significantly affecting Natura 2000 sites, hunting and financing issues. However in case of dispute or diverging views, it rests with the EU Court of Justice to provide definitive interpretation of a Directive. Even if most Court rulings primarily concern failures of individual Member States to fulfil their obligations or specific national situations, all EC and national authorities are bound by the general interpretation of the Court. In other words, the rulings of the Court are legally binding and both EC and national authorities are obliged to follow them. The Court rulings on nature conservation provide an important case-law. They are accessible to the public – nevertheless, their number is growing and it is sometimes quite complicated to the

27 Report on the Conservation Status of Habitat Types and Species as required under Article 17 of the Habitats Directive: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0358:FIN:EN:PDF.

persons not directly working as lawyers to find and extract the most important parts regarding specific interpretation of European law.

TRANSPOSING DIRECTIVE

As for the method of transposing the Habitats Directive, the argument that the most appropriate way of implementing the Habitats Directive is to confer specific powers on nature conservation bodies and to impose on them the general duty to exercise their functions so as to secure compliance with the requirements of that Directive cannot be upheld. First, it is to be remembered that the existence of national rules may render transposition by specific legislative or regulatory measures superfluous only if those rules actually ensure the full application of the Directive in question by the national authorities. Second, it is apparent from the 4th recitals in the preamble to the Habitats Directive that threatened habitats and species form part of the European Community's natural heritage and that the threats to them are often of a transboundary nature, so that the adoption of conservation measures is a common responsibility of all Member States. Consequently, faithful transposition becomes particularly important in an instance such as the present one, where management of the common heritage is entrusted to the Member States in their respective territories. It follows that, in the context of the Habitats Directive, which lays down complex and technical rules in the field of environmental law, the Member States are under a particular duty to ensure that their legislation intended to transpose that Directive is clear and precise, including with regard to the fundamental surveillance and monitoring obligations, such as those imposed on national authorities by Articles 11, 12(4) and 14(2).

However, it is apparent on examination of the national legislation that it is so general that it does not give effect to the Habitats Directive with sufficient precision and clarity to satisfy fully the demands of legal certainty and that it also does not establish a precise legal framework in the area concerned, such as to ensure the full and complete application of the Directive and allow harmonised and effective implementation of the rules which it lays down. The general duties laid down by the national legislation cannot ensure that the provisions of the Habitats Directive referred to in the Commission's application are transposed satisfactorily and are not capable of filling any gaps in the specific provisions intended to achieve such transposition. Consequently, there remains no need to consider the Member State's arguments based on the general duties contained in that legislation when analysing the specific complaints relied upon by the Commission[28].

OBLIGATION OF CONSERVATION OF HABITATS

With regard to the obligation to transmit the site list referred to in Article 4(1), first subparagraph, each Member State's contribution to the setting up of a coherent European ecological network depends on the representation on its territory of the natural habitat types and species' habitats listed in Annexes I and II to the Directive respectively.

28 C-6/04, Commission v. United Kingdom.

It is clear from a combined reading of Article 4(1) of and Annex III to the Directive that Member States enjoy a certain margin of discretion when selecting sites for inclusion in the list. The exercise of that discretion is, however, subject to compliance with the following three conditions: only criteria of a scientific nature may guide the choice of the sites to be proposed; the sites proposed must provide a geographical cover which is homogeneous and representative of the entire territory of each Member State, with a view to ensuring the coherence and balance of the resulting network. The list to be submitted by each Member State must therefore reflect the ecological variety (and, in the case of species, the genetic variety) of the natural habitats and species present within its territory; the list must be complete, that is to say, each Member State must propose a number of sites which will ensure sufficient representation of all the natural habitat types listed in Annex I and all the species' habitats listed in Annex II to the Directive which exist on its territory. The opinion of the Court is although it follows from the rules governing the procedure for identifying sites eligible for designation as SACs, set out in Article 4(1), that Member States have a margin of discretion when making their site proposals, the fact none the less remains, as the Commission has noted, that they must do so in compliance with the criteria laid down by the Directive[29].

The obligation to forward the list of sites mentioned in the first subparagraph of Article 4(1) was not conditional on adoption of the format. The format is not the first text to have defined the information allowing Member States to select the relevant sites. Once the Directive had been notified, the Member States were aware of all the selection criteria to be taken into consideration. Article 4(1) requires each Member State to propose, on the basis of the criteria set out in Annex III (Stage 1) to the Directive and relevant scientific information, a list of sites indicating which types of natural habitat under Annex I and which native species under Annex II they host. It follows from Annex III (Stage 1) that the relevant criteria are the degree of representativity of the natural habitat type on the site, the area of the site covered by the natural habitat type and its degree of conservation, the size and density of the population of the species present on the site, their degree of isolation, the degree of conservation of their habitats and, finally, the comparative value of the sites. Although it follows from the rules governing the procedure for identifying sites eligible for designation as SACs, set out in Article 4(1), that Member States have a margin of discretion when making their site proposals, the fact none the less remains, as the Commission has noted, that they must do so in compliance with the criteria laid down by the Directive. In order to produce a draft list of sites of Community importance, capable of leading to the creation of a coherent European ecological network of SACs, the Commission must have available an exhaustive list of the sites which, at national level, have an ecological interest which is relevant from the point of view of the Directive's objective of conserving natural habitats and wild fauna and flora. To that end, that list is drawn up on the basis of the criteria laid down in Annex III (Stage 1). Only in that way, moreover, is it possible to realise the objective, set out in the first subparagraph of Article 3(1), of maintaining or restoring the natural habitat types and the species' habitats concerned at a favourable conservation

29 C-67/99, Commission v. Ireland; C-71/99, Commission v. Germany; C-220/99, Commission v. France.

status in their natural range, which may lie across one or more frontiers inside the Community[30].

On a proper construction of Article 4(1) of the Habitats Directive, a Member State may not take account of economic, social and cultural requirements or regional and local characteristics, as mentioned in Article 2(3), when selecting and defining the boundaries of the sites to be proposed to the Commission as eligible for identification as sites of Community importance. The first subparagraph of Article 3(1) provides for the setting up of a coherent European ecological network of SACs to be known as Natura 2000, composed of sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II, to enable them to be maintained or, where appropriate, restored at a favourable conservation status in their natural range. Article 4 sets out the procedure for classifying natural sites as SACs, divided into several stages with corresponding legal effects, which is intended in particular to enable the Natura 2000 network to be realised, as provided for by Article 3(2). It follows from Article 1(e) 10 and (i) 11, read in conjunction with Article 2(1), that the favourable conservation status of a natural habitat or a species must be assessed in relation to the entire European territory of the Member States to which the Treaty applies. Having regard to the fact that, when a Member State draws up the national list of sites, it is not in a position to have precise detailed knowledge of the situation of habitats in the other Member States, it cannot of its own accord, whether ecause of economic, social or cultural requirements or because of regional or local characteristics, delete sites which at national level have an ecological interest relevant from the point of view of the objective of conservation without jeopardising the realisation of that objective at Community level. In particular, if the Member States could take account of economic, social and cultural requirements and regional and local characteristics when selecting and defining the boundaries of the sites to be included in the list which, pursuant to Article 4(1), they must draw up and transmit to the Commission, the Commission could not be sure of having available an exhaustive list of sites eligible as SACs, with the risk that the objective of bringing them together into a coherent European ecological network might not be achieved[31].

PROTECTIVE MEASURES

On a proper construction of Article 4(5), the protective measures prescribed in Article 6(2), (3) and (4) are required only as regards sites which, in accordance with the third subparagraph of Article 4(2), are on the list of sites selected as sites of Community importance adopted by the Commission in accordance with the procedure laid down in Article 21. This does not mean that the Member States are not to protect sites as soon as they propose them, under

Article 4(1), as sites eligible for identification as sites of Community importance on the national list transmitted to the Commission. If those sites are not appropriately protected from that moment, achievement of the objectives seeking the conservation of natural habitats and wild fauna and flora, as set out in particular in the

30 C-71/99, Commission v. Germany; C-220/99, Commission v. France.
31 C-371/98, United Kingdom – "First Corporate Shipping"; C-67/99, Commission v. Ireland.

sixth recital in the preamble to the Directive and Article 3(1) thereof, could well be jeopardised. Such a situation would be particularly serious as priority natural habitat types or priority species would be affected, for which, because of the threats to them, early implementation of conservation measures would be appropriate, as recommended in the fifth recital in the preamble to the Directive. The national lists of sites eligible for identification as sites of Community importance must contain sites which, at national level, have an ecological interest that is relevant from the point of view of the Directive's objective of conservation of natural habitats and wild fauna and flora. It is apparent, therefore, that in the case of sites eligible for identification as sites of Community importance which are included in the national lists transmitted to the Commission and, in particular, sites hosting priority natural habitat types or priority species, the Member States are, by virtue of he Directive, required to take protective measures that are appropriate, from the point of view of the Directive's conservation objective, for the purpose of safeguarding the relevant ecological interest which those sites have at national level[32].

CONCLUSION

Protecting biodiversity is a priority for the European Union and for our policies to be successful we must have a comprehensive and reliable measure of the status of our biodiversity. Therefore, it is vital that sufficient resources are invested in monitoring and reporting under both the Habitats and the Birds Directives. A key determinant for the success of the Directive is the level of investments made in biodiversity protection. The increase in EU funding for biodiversity during this decade is of particular importance and its effects and those of policy changes on practice need to be monitored to ensure they are providing a permanent improvement in the situation of biodiversity. Clearly the immensity of the challenge to halt the decline in biodiversity will require greater effort in coming years

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CORPORATE SOCIAL RESPONSIBILITY - INTERCULTURAL SENSITIVITY AND ENVIRONMENTAL AWARENESS IN TRANSITION

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ABSTRACT

Corporate social responsibility is a concept that is being used increasingly to interwoven the individual and overall social trends with the general social trends, and therefore the participants themselves were willing to significantly take responsibility for their actions. The overall "environmental image" of a society in transition shows signs of exclusive needs for improving the concept of intercultural sensitivity of environmental awareness and its integration into the social values and the system updates the concept, given the fact that the fall of the same "eternal companion" collapse of the totalitarian regime and general picture of the reality of the social map of any society in transition.

Key words: Corporate social responsibility, intercultural sensitivity, environmental awareness.

INTRODUCTION

Given the goal, survival, growth and development of superior transition economies many theorists have tried to find the roots of the correction and the coordination of resources in the cases of transition economies. Companies, more than any other institution, have the task to meet a social need and at the same time commit to solving social problems, making it an business opportunity. Everyone is responsible for his influence - intentionally or unintentionally. That's rule number one. The responsibility of each generation to the next generation before a permanent place to live for people. Natural environment should be given much importance in the framework of rights and obligations that determine other forms of social system and social responsibility. Recovering biodiversity can only be achieved through skilful fitting of science, capital investment and management: science to make way for research and development, in order to create sustainable markets and governance with capital investment and in order to foster unity of economic development and environmental protection. However, most scholars point to the sensitivity of the frequency components of the function of leaders in the organization. Shane is a renowned theorist who identified the following as essential. Specifically their essence and function they perform:

- *animators*, leader of an organization created in the initial phase of work and provides overcoming the crisis, resulting in development activities and the occurrence of poor results,
- *creators of culture*, the leader creates a quality culture in the corporation, indoctrination and socialization managerial employees to form, imposing their own behavioral styles, which are encouraged to identify with the corporation and the internalization of values and beliefs,
- *guardians of culture*, a leader who maintains accepted model of organizational culture and it is attained in the third stage of organizational development, which we call institutionalization.
- *agent of change*, change the culture of the organization. The leader has the ability through which noted the gap between the old and the size of the corporation, the new terms and Cultural Heritage Corporation.

We think that in this, the initial character, every word may still need buliding up or corporate social responsibility and intercultural sensitivity in particular. Taking into account the fact that the underlying theme is studying core elements of the concept of change management, point out the need for constant dimanizam research, whose main pillars in the future: corporate social responsibility and sustainable development. It can be said that one of the basic concepts of economics of natural resources and environmental protection concept of sustainability and sustainable development. Today this concept is central to the consideration of longevity and prosperity of mankind. Sustainable development occurs, not as a core requirement, but the ultimate goal of effective organization of many human activities. Therefore, it can be said that sustainable development is a harmonious balance between ecology and economy, in order to preserve natural resources for future generations. The very concept of change management, started work by Arnold Van Gennep "*The Rites of Passage*", in 1907, Kurt Lewin, "*Resolving Social Conflict & Field Theory in Social Science*," in 1947, and William Bridges "*Transitions*", 1979, and the analysis of individual aspects changes. Only in the last decade of the last millennium, the theory develops a new approach to the concept of change management, which is the observation of the effects of change on the individual level, moving towards business application change management within an organization. Authors Daryl Conners, the paper "*Managing at the Speed of Change*," Jeanenne LaMarsh work "*Changing the Way We Change*" and the work of John Kotter "*Leading Change*", set up a management change at the center of attention of scientific and business community. In circumstances where the above add the necessary efforts to establish an overall strategy, management comes to important goals, especially in the establishment of system harmonization under the new conditions.

CORPORATE SOCIAL RESPONSIBILITY (CSR)

Approach to corporate social responsibility has changed over time, adapting to the current social situation, and today the question in a socially responsible manner has become a key issue as the focus of attention. The very concept of corporate social responsibility has a wider range of meanings and definitions, as a result of different approaches to the study and research, and considering that this is a relatively new concept, is still searching for an adequate and precise definition. For this occasion, we will set aside two as follows:

1) The definition of the World Business Council for Sustainable Development, which states that corporate responsibility is seen as company's commitment to contribute to sustainable economic development by working with employees, their families, local communities and society as a whole, in order to improve their quality of life, because it is one of the most interesting topics explain the role of business projections Not at all, through the vision to 2050.god. in the world [7].
2) The definition of the European Commission, which defines the concept as "a concept whereby companies integrate the principle of voluntary care about social issues and the environment in their business activities and relationships with owners, shareholders, employees, customers, suppliers, government, media and the the public."

It is clear, therefore, that all who are interested in implementing corporate social responsibility need to make additional and innovative efforts in promoting its social initiatives to the awareness of stakeholders and the public at large position themselves as responsible corporate citizenship. Under the social responsibility of the companies we understand the commitment of the company to their business strategies, decisions and activities directed at improving the economic, social and natural environment in which it operates. The company should not only make profit but should have a positive impact on the environment in which it operates. Emphasizing the latter, we have particularly in mind the speech Ivana Boeskog (Ivan Boesky), a famous stock speculator who in his address to the students of the University of California (University of California, Berkeley, USA), said: "*I think greed is healthy. You can be greedy and to be at the same time feel good.* " Only a few months later, Boeski due to insider trading, was sentenced to three and a half years in prison, a fine of $ 100 million and a lifetime ban on working in the capital markets. The famous monologue Geka Gordon (Gordon Gekko), "Greed is good" in the cult film Oliver Stone (Oliver Stone) "*Wall Street*," is inspired by and based precisely on this true Boeskovom speech. The key question in this context may be asking is: Why should turn to corporate social responsibility? In addition to moral reasons in favor of corporate social responsibility, there are numerous examples of the business-a. Why be honest? Why do what's right, especially when many profit just in the wrong and deliberately caused by the crisis in which the right financial powers of the world become the generator of the crisis, despite the well-known maxim of the American investor and philanthropist Warren Buffett who said: "If at any no time to think of an activity could embarrass you or your company in front of his family, colleagues or customers - do not do it. " Perhaps even more clear, if at all possible, the advice of the famous professor of management Peter Drucker: The primary responsibility of a professional is spelled two and a half thousand years ago, the Hippocratic Oath of doctors in ancient Greece: "First of all, unconsciously harm. " No professional can not swear that he will really bring good to his client. All he can do is make the effort. But can not promise that he will not knowingly harm. For these reasons, the concept of the end of the first half of the twenty-first century should be the credo of every enterprise, and especially the company in a specific economic environment, given his mission, vision and goals, but the general social significance, continuing refining themselves and their knowledge as the only sure way of the future.

SUSTAINABLE DEVELOPMENT

The concept of sustainable development leads is most often associated with environmental protection, social development planning, environmental, economic and political issues.

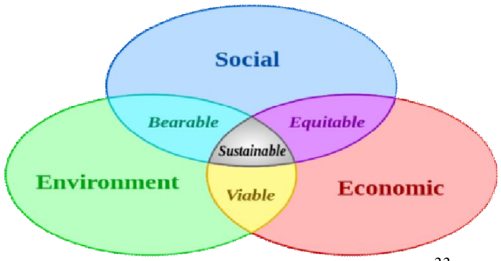

Figure 1. Sustainable Development[33]

At a time when humanity is post seven billionth resident, the issue of resources is set as the primary. It is obvious that the issue of resources in such conditions is crucial. We assumed so far that the most important factor in planning - time management as a primary risk factor. To the standard UK definition of resources is as follows: Any defining variable that is required to perform a task, project, and that may limit the project. Also, it can be:

- *not accumulated*, ie. such a resource that can access each new period of time should be restored regardless of whether the current period is worn or not,
- *accumulated*, ie. resource is permanently available and only wear it destroys. This type of resource can be supplemented with the processes that create lending / accumulative resources.

So, on the world stage government mounds would say we redefine the basic principles when resources company in question. Considering the above, the image of reality is based on the grounds that continuously improve and build.

BEHAVIORS, VALUES, SOCIAL NORMS AND THE DEVELOPMENT OF INTERCULTURAL SENSITIVITY

In social psychology, the word integrity has at least two meanings. First, a notion contrary to segregation, which refers to the establishment of minority group members in the same neighborhoods they live in other residents, and as the level of involvement of members of a subgroup of activity (in interaction roles) large groups (Lime, 1971). In addition, the expression of organizational integration, or integration, it is rare in the literature, especially those in management and public management as his special field. In a

[33]Source, adpted according to: *Wikipedia, the free encyclopedia on Internet.* Available on Web site: http://sr.wikipedia.org/wiki/Slika:Sustainable_development.svg (date of acces27.2.2013)

study of human resource management in different countries, organizational integration is mentioned as a key of the resulting eight variables, conditional human resources management system (in addition to the competence of employees, their commitment, flexibility of organization, etc.)[34].. Patterns of behavior are transmitted through the values that have adopted, or adopted by, the members of the organization. Under the values can be accepted definition of Allport known, that these beliefs according to which man acts, preferring certain actions in relation to others opposing them.[35] With the values, behavior patterns are transferred and social norms that apply to a particular group, organization or society, which determine what should be done and to what extent.

Social norms are valid for all members of the organization, regardless of their specific positions and roles.Organizational behavior of individuals, however, are mostly not done in fragments through isolated actions, but mostly within the whole that we call organizational roles. Organizational roles are partly certain formal organizational documents on the division of work and theworkplace (systematization), but also, and informally, očekivanjma, beliefs, personal requirements or interpretations of the role holders and other individuals in the middle of it. Gear cultural patterns of behavior are and sayings, stories, and myths, and. Stories and legends, whether it is about our or foreign, effectively transmitted and often glorify desirable patterns of behavior in organizations. Social stereotypes also convey cultural patterns of organizational behavior and condition. If informal communication among members of the service state body lives the stereotype of "all politicians are dishonest," then it makes reference to the disloyal and mistrustful attitude towards politicians. People vary in their ability to recognize and accept cultural differences. The subtlety in the treatment of cultural differences is developed from the stage of denying the existence of differences, ie. End of ethnocentrism, the stages of identifying and acceptance of cultural differences, which Bennett calls Ethnorelativism[36]. Bennett identifies three main stages and three stages of ethnocentrism ethnorelative, and within each of them has several development trans state.[37]

Etnocentrism			**Etnorelevitism**		
1	2	3	4	5	6
Denying	Defense	Minimization	Acceptance	Adaptation	Integration
Isolation	Disdain for separation superiority rotation in the opposite	Physical universalism transcendental universalism	Behavioral relativism value relativism	Empathy pluralism	contextual evaluation constructive marginality

Figure 2. The stages of development provides for Bennett[38]

[34] www.saborpsihologa.subotica.net/cukic.html (date of acces 15.1.2013)

[35] Allport G. (engl. Gordon Allport) (11 November 1897 - October 9, 1967) was an American psychologist. His most important works are: formation, individual and his religion, and perhaps the most influential Nature prejudice. Allport was one of the first psychologists to focus on the study of personality and is often considered the fatherofpsychology. He also dismissed psychoanalytic approach to personality, smatravši to go too in depth, and the behaviorist approach, feeling that does not go into enough depth.

[36] The world is not just a geographical or political, it is a set of principles and various institutions, individuals living in it and the rest of the world.

[37] Bennett's developmental model of intercultural sensitivity describes the stages people go through when faced with difficulties in dealing with other cultures, www.youth-partnership.net/.../youth-partnership

[38] Bennett, C. I. (2003), Multicultural Curriculum Development: A Decision-Making Model and Lesson Plans, Theory and Practice, 5 / E, Allyn & Bacon

The denial of difference is the initial stage and the people who are at this stage, its own view of the world are treated as the only possible understanding of reality, and hence deny that there are other, different views of the world. Typical behavior of this stage is the neglect, ignorance or indifference to cultural differences. People who are in the stage of defense observed differences are perceived as a threat. These differences represent an alternative to their view of the world and of their identity, so they tend to be out of defense. This stage is characterized by the existence of stereotypes about members of other cultures and simplified, often black and white thinking in the categories of "us-them". As an extreme form of odbrne may occur racism and all other forms of expression that are racially or ethnically based. Minimizing the difference is the third stage of ethnocentrism. At this stage of development, one sees that there are cultural differences, but is seeking to reduce, minimize advocating the view that all people are basically the same. Acceptance of differences is the first stage ethnorelative. A person at this stage of development of note and accept cultural differences. Cultural differences are no longer evaluated by the standards of our own cultural group, but the study of the cultural context. The guiding principle is cultural relativism: no culture itself is neither better nor worse than others. Adaptation of the differences is the second stage ethnorelative.A person at this stage of consciously trying to imagine how people from other cultures think about certain things. The person is aware of their own points of view on the world, and is able to deal with the internal point of view is moved outside the point from which you can examine different perspectives (worldviews) and so needed developing and changing personal view of the world, ie. Officers frame. The integration of the difference is the last stage ethnorelative. While on the stage adaptation of people manage multiple reference frames (which are parallel), at this stage a person is and the different cultural world views integrated into a single, its own view of the world. Her identity also includes, more importantly, surpassing cultural groups to which it belongs. Bennett's model has proven to be a good starting point for the design of different types of training and orientation which is engaged in development of intercultural sensitivity. In each of these models, he particularly stressed the importance of diversity, which means that learning process in which we learn how to live together, so we learn to live in a diverse world. In working with young people on an international level, many processes require to understand what is going on in these cont'd. This includes work on the deep-rooted beliefs about what is good and what is bad, a review of his world view and his own life. In other words, intercultural learning is a challenge for both personal identity, and the way of life and the way in which personal identity is enriched.

INSTEAD OF A CONCLUSION

Notwithstanding the foregoing it should be emphasized modern economic aspect of contemporary authors. Globalization is seemingly out of nowhere came the seventies of the twentieth century, fully developed, wrapped in an aura of inclusiveness. Now that very clear idea of globalization lost. "Most part of it is already gone. It was an experiment that is at the same time trying to reshape the economic, political and social fields "(Rushton Sol, 2011), and we must be aware of the future opening any issues with predominant economic factor. The prophets of globalization which emphasized "privatizujte, privatizujte, privatizujte", now say they were wrong because the national rule of law is important. Economists are sharply divided over whether to loosen or increase control over capital markets. All powerful nation-states, such as India and Brazil, challenging widely accepted principle of the global economy and we have to keep in mind in discussing the topic of organizational culture and organizational culture of the company in general. Therefore, companies must take the lead by making decisions that will provide the opportunity to business and society evolve together again. Some leaders of their thoughts and the sophisticated business moves seek to social issues moving from the periphery to the core business. Some sources say that the solution lies in the so-called. the principle of "Shared Value", which involves creating economic value so that it creates value for society. Finally, the "Shared Value" is the policy and practice that improves the company's competitiveness while improving economic and social conditions in the communities in which it operates. It is the creation of economic value while creating social value as the basis of corporate social responsibility and its separate elements - the intercultural sensitivity of environmental awareness in the construction of a society in transition.

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THE IMPLEMENTATION OF THE AARHUS CONVENTION BEFORE THE EUROPEAN COURTS

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ABSTRACT

The paper discusses jurisprudence of the European Court of Human Rights and the European Court of Justice regarding the issues of public participation in decision-making and access to information and access to justice in environmental matters, envisaged in the Aarhus Convention. This Convention is widely accepted in Europe and it found its place in the case law of these two European courts. Both of them are trying, within their competences, to confirm the rights of individuals and non-governmental organizations to challenge decisions which affect the environment and which are contrary to the relevant rules of environmental law.

Key words: Aarhus Convention, ECtHR, ECJ, environmental law.

INTRODUCTION

The Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) was adopted on 25 June 1998 and came into force on 30 October 2001 [1]. It is until now applicable in 46 countries in the world and in the European Union. It sets standards and regulates access to environmental information, public participation in decision-making in environmental matters and access to justice in this field. Among other issues, it obliges contracting parties to implement information, participation and litigation rights for individuals and non-governmental organizations.

The right to participation of civil society in environmental decisions may assume many forms such as voting, petitioning, debating etc. It enables that the results of a concrete environmental decision enacted are substantively better, more environmentally protective and more reflective of local needs and public values in general. However, it is not always clear whether environmental decisions benefited from public participation, but in most cases the assurance of a democratic process in environmental protection is achieved. Some arguments are also raised regarding the negative aspects of the participation of civil society. For example, the public is not competent to deal with technical matters, participation programs require a lot of time and large administrative resources, the existence of special interest groups that promote views opposed to public opinion on environmental matters.

The Aarhus Convention is based on an obligation that the Parties to the Convention must provide timely, adequate and effective public participation [2]. At the early stages of a decision-making procedure, each Party must inform the public concerned, by public notice or individually about the proposed activity, the nature of possible decisions, the envisaged procedure and possibility of participating, the time-frames and the place where information is being held. The public must be allowed to submit comments, in writings or at hearings that it finds relevant to the proposed activity. The public cannot cast a veto but the decision-making authority cannot simply ignore the comments and opinions without considering them seriously.

The Aarhus Convention has influenced on the case law of both the European Court of Human Rights and EU courts.

THE AARHUS CONVENTION AND THE EUROPEAN COURT OF HUMAN RIGHTS

Regarding Article 6(1) of the European Convention for the Protection of Human Rights, which guarantees a right to a fair trial, the European Court of Human Rights (ECtHR) held that the non-governmental organizations have an important role in defending certain interests before national authorities, especially in the field of environmental protection [3].

Participatory rights of the public in environmental matters are also present in the jurisprudence of the European Court of Human rights. Case law of this Court clearly indicates that States have a duty to provide essential environmental information. In the *Guerra* case [4] the applicants lived in a town near the *Enichem* agriculture company's chemical factory, which produced fertilizers and it was classified as "high risk". The factory released large quantities of inflammable gas in the course of its production cycle and the accidents due to the malfunctioning have already occurred in the past. The applicants alleged that they were the victims of a violation of Article 10 of the ECHR which resulted from the authorities' failure to ensure that the public were informed of the risks. Freedom to receive information prohibited a Government from denying to person information that others wished or might be willing to impart to him. Also, the severe environmental pollution might affect the individuals' well being and prevent them from enjoying their homes in such a way to as to affect their private and family life.

Also, states must ensure public participation in projects that have an impact on human health and environment. In a number of cases, the Court made direct references to the Aarhus Convention and to the obligations of States envisaged in it [5]. For example, in the Case of Tătar v Romania the applicants, father and son, who lived in the vicinity of the mine, were concerned about the health effects of the cyanide process employed by the gold mine "Baia Mare" operators and alleged that it had aggravated son's asthma. The Court has ruled that Romania has breached Article 8 of the European Convention on Human Rights (the right to respect for private and family life) because of its failure to provide citizens with information on the risks from the operation, by not making public the 1993 impact assessment on the basis of which the operating license had been granted.

That made it impossible for the public to challenge the results of this assessment. The Court pointed out that authorities had to ensure public access to the conclusions of investigations and studies. It emphasized that the State had a duty to guarantee the right of members of the public to participate in the decision-making process concerning environmental issues.

In the Case of Taskin v Turkey, the applicants alleged that granting by the Turkish national authorities of a permit to operate a goldmine in the district of *Bergama (Izmir)*, using the cyanidation process and the related decision-making process had infringed their rights under Articles 2 and 8 of the European Convention on Human Rights. The administrative authorities refused to comply with the national court decisions and domestic legislation and there was also a lack of a decision based on an environmental-impact report. Also, the Court stated that the individuals concerned must be able to appeal to the courts against any decision, act or omission where they consider that their interests or their comments have not been given sufficient weight in the decision-making process[6].

Some authors state that there is a difference in approach to procedural rights in the jurisprudence of the ECtHR as compared to the Aarhus Convention. The Convention has a broader public-interest approach, while the ECtHR has a narrower focus because it only relates to the convention rights of an affected individual. The right to participation from the European Convention on Human Rights is not available to everyone and it is not applicable to decisions relating to the environment in general [7].

THE AARHUS CONVENTION AND THE EUROPEAN COURT OF JUSTICE

In the European Union, significant legislative developments took place after the entry into force of the Aarhus Convention. It was incorporated into the Community legal order by means of (*inter alia*) Directive 2003/35. That Directive amended two environmental directives – the EIA Directive and the IPPC Directive. The Aarhus Convention was approved on behalf of the European Community by Council Decision 2005/370/EC of 17 February 2005. The provisions of this Convention are an integral part of the legal order of the European Union, which was confirmed in numerous cases before the ECJ [8]. Therefore, this Court has jurisdiction to give preliminary rulings concerning the interpretation of such an agreement. Since the Aarhus Convention was concluded by the former European Community and all the Member States of the EU, on the basis of joint competence, it follows that where a case is brought before a Court in accordance with the provisions of the Lisbon Treaty, the Court has jurisdiction to define the obligations which the EU has assumed and those which remain the sole responsibility of the Member States in order to interpret the Aarhus Convention.

In accordance with several environmental directives, individuals may invoke environmental requirements before national courts. One of the examples is the Directive on freedom of access to environmental information [9] which gives a right to access to any applicant. Article 6 of this Directive envisages that the applicants may introduce an administrative or judicial procedure against the acts of the public authority. Also, the Article 10a of the Environmental Impact Assessment Directive incorporates Article 9(2) of the Aarhus Convention into EU law. This article requires Member States to grant standing to bodies which have a sufficient interest or to those which are maintaining the impairment of a right. According to the Directive 2004/35/EC on environmental liability interested third parties may institute a review procedure against an administration which failed to enact the preventive or remedial measures against an environmental damage. In the EU it is improved the standing of non-governmental organizations which act in favor of the protection of the environment. Their role has been recognized in the case law of the ECJ and ECtHR and it must be interpreted in accordance with the objectives of the Aarhus Convention.

Article 9(2) of the Convention obliges the State Parties to ensure, within the framework of their national legislation, that members of the public concerned who satisfy specified criteria have access to a review procedure to challenge the substantial and procedural legality of any decision, act or omission subject to Article 6 of the Convention, which relates to the public participation in decision-making procedures. Article 9(3) requires that each State Party must ensure that members of the public , meeting the criteria laid down in national law have access to administrative or judicial procedures to challenge acts or omissions by public authorities which contravene provisions of national law relating to the environment.

In the *Case Lesoochranárske zoskupenie VLK*, the reference has been made in proceedings between Lesoochranárske zoskupenie VLK, an association established in accordance with Slovak law whose objective is the protection of the environment and the Ministry of the Environment of the Slovak Republic, concerning the association's request to be a party to the administrative proceedings relating to the grant of derogations to the system of protection for species, access to protected countryside areas, or the use of chemical substances in such areas. The referring court asked whether individuals and environmental protection associations, when they wish to challenge a decision to derogate from a system of environmental protection, such as that put in place by the Habitats Directive, may derive a right to bring proceedings under EU law, in accordance with the provisions of Article 9(3) of the Aarhus Convention on direct effect. The Court emphasized that it was for the referring court to interpret the procedural rules relating to the conditions to be met in order to bring administrative or judicial proceedings in accordance with the objectives of Article 9(3) of the Convention and the objective of effective judicial protection of the rights conferred by EU law, in order to enable an environmental protection organization to challenge before a court a decision taken following administrative proceedings which is contrary to EU environmental law[10]. However, a general right to standing for the purpose of enforcing environmental law is still missing [11].

In the *Solvay* case [12] the ECJ was asked to clarify the criteria allowing the Belgian authorities to qualify a national act as "legislative", within the meaning of Directive 85/337 (the EIA Directive) on the assessment of the effects of certain public and private projects on the environment and the Aarhus Convention. In 2008, the Wallon Parliament adopted a decree authorizing a number of works on the Brussels airport and railway. The administrative authorities have previously authorized these projects. The decree merely ratified the administrative authorizations, giving them a legislative effect. According to the Belgian law, legislative acts like the decree in question, could only be subjected to a review before the Constitutional Court. That review is less extensive than the review of the Administrative Courts. An action was brought before the Belgian Constitutional Court challenging the compliance of the decree with the Belgian Constitution, Article 9(2-4) of the Aarhus Convention and Article 10 of the Directive 85/337.

The referring court asked six questions to the ECJ. One of them is whether the decree falls within the scope of Article 2(2) of the Aarhus Convention and Article 1(5) of the Directive 85/337. The definition of "public authority" in the Aarhus Convention does not include bodies or institutions acting in a legislative capacity. The Directive does not apply to projects the details of which are adopted by a specific act of national legislation. In its third question, the referring court asked if the Aarhus Convention and Directive were to be interpreted as precluding the right to implement a project with the adoption of a legislative act for which the Law of a Member State provides no procedure allowing challenging its procedural and substantive lawfulness.

In its response to the third question, the Court recognized that the Member States enjoy considerable procedural autonomy in implementing Article 9, par. 2, of the Aarhus Convention and Article 10 of Directive 85/337, while acting in compliance with the principles of equivalence and effectiveness. However, the Court considered that both the Convention and the Directive would lose all effectiveness if an environmental project is granted with the adoption of an act that, by virtue of the Law of a Member State, is immune to any procedure of challenging its substantive and procedural lawfulness. The Court concluded on this point that if no such procedure is made available, any national Court before which an action is brought would have the task to carry out the stated review. In the main proceeding, if the referring Court finds that the decree at issue does not satisfy the conditions of Article 1(5) of Directive 85/337, and if Belgian Law provides no procedure allowing challenging the lawfulness of the decree, the latter must be regarded as incompatible with the provisions of the Directive and the Aarhus Convention.

In the *Case Djurgården-Lilla Värtan* the Land Council of Stockholm municipality has awarded a contract to a private enterprise to lay a high-voltage power line underground in the northern part of Djurgården in Stockholm. Certain arrangements for abstracting and recharging groundwater had to be made in order to carry out the requested work. On examining the project, the County Administrative Board in Stockholm County found the groundwater to be of such a nature that they could have significant effects on the environment and the matter was referred to the Environmental Chamber at the Stockholm District Court for an extended administrative procedure, including an environmental impact assessment. Djurgården-Lilla Värtan (DLV) is a small association for environmental protection, locally established in the area where the high-voltage tunnel was to be built. It submitted briefs within this administrative procedure opposing the application. After the environmental Chamber of the Stockholm District Court had granted the development consent, DLV appealed the decision to the Environmental Appeal Chamber of the Svea Court of Appeal. This Chamber found the appeal to be inadmissible, since DLV did not meet the requirement in the Swedish Environmental Code. The requirement is that it has to have a minimum of 2000 members in order to appeal against the decision at hand. DLV had only 300 members but it has been working actively with environmental issues in this area of Stockholm for 25 years. It appealed the decision to the Swedish Supreme Court arguing that Swedish law must be interpreted in light of the Aarhus Convention and Directive 85/337 and accordingly it would give DLV a right of access to the Court. The Supreme Court decided to stay the proceedings and refer three questions to the Court of Justice for a preliminary ruling. The second and the third question regarded the right to appeal decisions taken under the Directive – when does the right to access to justice apply and who may rely on the right? The Court of Justice stated that the right of participation and the right to a review procedure were two separate rights, with two separate purposes. Article 10a of Directive 85/337 gives concerned members of the public who fulfill certain conditions a right to a review procedure before a court of law or other independent body in order to challenge the substantive or procedural legality of decisions, acts or omissions falling within its scope. The concerned public was also guaranteed effective participation in environmental decision-making procedure with regards to projects likely to have significant effects on the environment. The Court of Justice concluded that the two stages are separate and with different purposes and therefore participation in the decision-making procedure had no effect on the conditions for access to the review procedure. National rules must ensure wide access to justice and second, render effective the provisions of Directive 85/337 on judicial remedies. They cannot nullify Community provisions which provide that parties who have a sufficient interest to challenge a project and those whose rights it impairs, which include environmental protection associations are to be entitled to bring actions before the competent courts [13].

In the *Case C-115/09* Higher Administrative Court for the Nordrhein – Westfalen Land in Germany requested a preliminary ruling concerning an environmental non-governmental organization that was seeking judicial review of an administrative decision likely to affect the environment. Under German law a party wishing to bring an action for judicial review must rely on the infringement of a substantive individual right. The referring court asked for an interpretation of article 10a of Directive 85/337/EEC (the EIA Directive) as amended by Directive 2003/35/EC. In doing so, the referring court asked whether the EIA Directive and the Aarhus Convention require Member States to give environmental non-governmental organizations the right to bring an action before the national courts, without demonstrating or relying on the infringement of a substantive individual right. In the Opinion of the Advocate General Sharpston it was stated that environmental non-governmental organizations should have standing to bring an action for judicial review by virtue of the effective participation in environmental decision-making and effective monitoring of the implementation of the EIA Directive [14].

CONCLUSION

The significance of the Aarhus Convention is global. It represents one of the most important international legal documents in the field of environmental protection. The Convention can be a global framework for strengthening citizens' environmental rights. It represents an important contribution to environmental rights but also to the human rights law. Its focus is strictly procedural and limited to public participation in environmental decision-making and access to justice and information. The Aarhus

Convention is widely ratified in Europe and has a significant influence on the jurisprudence of the European Court of Human Rights. It gives particular emphasis to public interest activism by non-governmental organizations. It empowers claimants with a sufficient interest to engage in public interest litigation when their own rights are not in issue and by allowing that, it goes beyond the requirements of the ECHR. However, the growing numbers of ECtHR cases involve issues from the Aarhus Convention. In the European Union the individuals and non-governmental organizations have the possibility to challenge before a court a decision taken following administrative proceedings which is contrary to EU environmental law, which includes *inter alia* the Aarhus Convention and related secondary legislation of the EU.

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ENVIRONMENTAL MANAGEMENT TOWARDS SUSTAINABLE DEVELOPMENT

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ABSTRACT

The nature dries up under the weight of man's disregard and disrespect to the absence of perception and therefore threatens their very survival on the planet. The motive for such a treatment of natural treasures is extremely low, immoral, irresponsible, selfish, and it can be also the increase of personal material wealth. At an apparent and immediate way to industrialization improved living standards for a large number of people, on the other hand it has a negative impact on the environment and human health. But resources are unconscionably exploited are not exhaustive and many are non-renewable. In order to explain the complexity it is necessary to introduce environmental management as a discipline to manage natural resources in a way that ensures their long-term quality and sufficiency. To achieve the goals of development, to maintain and improve them, it is possible only in one way - through sustainable development. Presentation of the importance of environmental management and its role in achieving sustainable social - economic development is the primary goal of this work as well as appeal to the consciousness and conscience of each of us in relation to the natural environment.

Key words: environmental awareness, ecological crisis, ecological management as a separate discipline, quality.

INTRODUCTION

Pollution and environmental protection for decades are very significant problem for humanity, regardless of the current level of development, of the productive forces of society and in some parts of our planet. Existing problems are imposed to the science and operations actuality and ait's more clearly conclusion that a healthy environment does too, that many of the elements in it are threatened, that the degree of self-regulation of some facilities and a little disturbed ecological relations, almost nothing and never can not be brought to its original condition. Despite the significant regional differences in the degree of vulnerability of the environment, particularly its natural components, plans, programs and actions for its protection and improvement are of the global problem. Modern society needs more quickly and better to understand the warnings of scientists and experts on the state of the environment, ie. the fact that there is less and less of a free, authentic and uncontaminated environment with less and less, and threatened, degraded and devastated more. Another is expanding at the expense of the first faster than many seem. Mush faster than a science of the end of this century could not determine and predict. The destruction of the ecological balance is the result of man's work activity, in which a man "appropriates" the nature and create products. And it comes not only with destruction of the ecological balance and the ecosystem, but also a threat to the integrity of the man and his existence. In this, the twenty-first century, society is faced with the following global issues:

- damage to the biosphere and its ecosystems
- a huge number of people - more than 6 billion with a forecast doubling by 2020. year
- exhaustion and reduced quantities of many sources of mineral and energy resources,
- pollution and degradation of air, water, soil
- global climate change,
- destroyed species of flora and fauna, and further threats to biodiversity,
- ¼ homelessness in world's population
- Damage to the human health and the threat to life
- large quantities of waste in all three aggregate states,

The survival of human societies in the past has often been threatened by natural disasters, epidemics, wars, famines and other influences. In contrast to the existential crisis of the past, the present crisis does not originate from natural disasters but the disparity in the global ideological and material terms of the whole of civilization. Until now, the man was able to create an ideal system to escape civilization and the emergency of that systems. Views to solvine this problem are different in science. Some of those approaches wiould be:

- the transition from the economic system of continual growth in inpatient status,
- build environmental awareness among the people,
- the introduction of social programs
- application of technical measures (for example: filters, electric cars, etc..)
- the capacity of nature and inventive power of man, to find every problem promptly and adequately addressed.

For now, there is no integrated system of studies which would clarify the real dimensions of the problem and the real possibilities of their solution. The idea of a consumer society that would produce cheaper and in bigger quantities, regardless of the technologies uses, or adverse effects that they have on the environment and that lead to more pollution. This approach imposes the development of environmental awareness in the light of the concept of environmental protection. Aiming at rational use of natural resources, sites and the introduction of countermeasures, which ultimately is only seemingly more expensive and limits the production or lead to impairment of profits.

Intensification of the global environmental situation - warming, ozone layer depletion, desertification - is a result of the deterioration of the ecological situation in the various countries and regions. Different attitude towards the environment is the only possible way of further human survival on the planet. The basic concept of economics of natural resources and the environment is the concept of sustainable development.

Despite the different interpretations that can be found in the literature, this concept now lies in central consideration in the longevity and prosperity of mankind. In conclusion that the essence of the concept of sustainable development lies in the correlation of economic development and environmental issues and respecting the laws of ecological systems. This concept is aimed at the rational use of natural resources of the state and accordingly, raising the quality of environment and quality of life. The necessity for the establishment of new social values based on knowledge, creativity and skills of human resources, the creation of a quality management that the current society in transforming society, which relates to the sustainability of development. This way of thinking is based on the fundamental principle of moral justice, that is that all people have equal rights in the broadest freedoms that do not contradict the freedom of others.

Our generations have a claim to the use of resources and a healthy environment but that appropriation must not compromise the same rights of future generations. Environmental management system and environmental management is an effort to eliminate negative tendencies and influences in relation to the environment and human health. Therefore it must be stressed that environmental protection is an urgent need and should not be limited to economic and social development level. Responsibly manage the environmental enforceability of a key strategic activities that define planning principles and criteria of protection, determine the resources and define the directions of the environment as well as an adequate form of supervision, control and sanction of not keeping the defined goals.

MANAGING ENVIRONMENT (ENVIRONMENTAL MANAGEMENT) RESPONSE TO ENVIRONMENTAL CRISIS

It may be noted that the challenges facing humanity increasing daily. Every day we hear warnings that indicate major problems that occur in all areas of one's life and work, whether at the local community or the global scale. This is because the most of the problems we face, that we have to fight and that will greatly impair the quality of life and the health of future generations just a man and his desire for advancement and personal gain. So it can be confirmed that the emergence and development of the ecological crisis going on in parallel with the emergence and development of human civilization, with the development of civilization develops and pollution of the environment. The global problems that are a manifestation of the crisis: the exhaustion of economic resources and those associated with the energy crisis, pollution and deteriorating quality of life in every sense. Along with the growing exploitation and processing of natural resources, increasing the quantity of various waste materials and objects in the environment. It is therefore essential that the globally radically change the current rate of exploitation of natural resources in this direction steer the further direction of scientific-technical and technological processes. Ecological disasters are increasingly common place in all parts of the globe and in most of them caused by man, directly or indirectly. Ecological imbalance is the result of man's work situation, in which a man "appropriates" the nature, and create products. Thereby not only increases the ecological balance disorders and ecosystems, but also a threat to the integrity of the man and his existence. Effects of environmental crisis are as follows:

- environmental pollution,
- climate change,
- ozone depletion and destruction of the ozone layer,
- lack of water
- lack of food.

It is impossible and unacceptable to "look the other way" since the transfer of responsibility will not solve the problem. With "doing nothing" the hole that increases in the ozone layer will increase the hole of shame in front of our children and future generations in our conscience.

It is time to be confronted with this situation with open eyes and try to do everything in our power in order to change it, transformed into a new, better and more creative. Nobody else can or will do it for us. The changes that occurred in the technical field of technology are such that they require fundamentally new - conceptually basically changed approach - and in many areas of life and work of man, even in the field of environmental protection. Just over a decade ago, the World Commission on Environment and Development aka Bruntlendov Commission published a report' 'Our Common Future" which indicates the risk to humans and the planet, from the politics of economic growth without taking into account the possibility of regeneration of the Earth . The Commission defines sustainable development as" development that meets the needs of the present without compromising the possibilities of future generations to meet their own needs". World leaders at the Earth Summit in Rio de Janeiro in 1992 have adoppted The Commission and one of the results of the summit was Agenda 21 which provides recommendations for the sustainable management of land, water and forest resources.

Different organizations respond differently to the environmental influences that can affect the interests of a positive or negative impact on the volume of achieving the set goals. Organizations in the protection of environment see the risks as well as opportunities. Organized and conscientious modern society is increasingly trying to manage these risks and opportunities. This operation is performed for a number of reasons which reason is the primary reason, money saving, cost reduction and the second, the risk of liability. The protection and enhancement of the environment is one of the most important processes of our time, requiring different aspects of knowledge, which is the ultimate goal of the survival of humanity. Environmental management is a thread that connects ecology and classical Management.

If we understand human ecology as the science for survival, and management skills as well as organizational management systems to set targets and if we accept the existence of man as the ultimate goal of all human systems on the planet, environmental management can be defined as the management of its survival by managing risks that threaten it's survival. It is important that the ecological management must be considered and applied at all levels of management on the personal level, families, companies (and other economic entities), at the local, regional and global levels of public administration, to the international, regional and global institutions. In each of the cases environmental management must be treated as a condition for the survival and development options.

From all the above, eco-management can be defined as the process of allocating resources, natural and artificial, but in such a way to achieve optimum use of the environment in meeting basic human needs to a minimum and if possible, on a sustainable basis. In other words, environmental management includes the processes of decision-making, regulating the impact of human activity on the premises. The basis of the concept of sustainability a central place capacity utilization of the environment for human progress and development but in a such a way that it (the environment) is not tarnished and completely exhausted. The need to preserve the environment should be derived from the human need for comfortable living. Because the only way the human mind will fit the view is that of a threat to one's own environment and endanger of themselves.

ENVIRONMENTAL MANAGEMENT AS A METHOD OF ENVIRONMENTAL MANAGEMENT SYSTEM ENVIRONMENT

Ecology is the science that studies the relationships between individuals, populations and communities of organisms, on the one hand, and environmental factors, on the other hand, as well as the interrelationships of living things. Management means taking measures and market conditions at the state level, taking into account the priorities of the managing investment policy, care and training of personnel organized labor, the introduction of the practice of scientific information, the application of new technologies and, finally, the long-term development planning to respect the definition of Bruntlendove Commission. Planning is one of the most important and valuable spectrum of problems that must be addressed.

In terms of time, at one side are the operational plans that deal with issues of what to do in the next few days, and the other can be a strategic plan for the planning ahead of 100 years or more. In terms of space, planning and decision-making are limited to local areas of a few acres, but in the vast spaces of several hundred thousand acres. Finally, in terms of organization and planning decision-making can be of the highest ranking executives, to low-skilled workers directly on the field. Protection and environmental management are an integral part of management - management at all organizational levels and in all business functions. To this end, management should introduce a continuous process that must be coordinated with social and economic processes (employee safety, health and others.). Management of environmental quality is a complex multidisciplinary task which is based on the strategic principles of sustainable urban development and can be successfully achieved if there is a well-conceived environmental management in the environment. Principles and elements of environmental management may use the following strategies:

1) Environmental policy,
2) Planning,
3) Introduction and implementation,
4) Checking and corrective action,
5) Review and improvement,
6) Continuous improvement.

In each of the aforementioned strategies of environmental management and environmental management, there are four basic steps:

1) The identification phase - obtaining information on which to obtain information on potential effects of pollution,
2) Monitoring phase - time monitoring and measurement of pollutants, their extent and localization
3) Evaluation phase - within the sum of all the information related to the environment that have been obtained in the earlier stages and
4) Phase control - use a variety of instruments and measures for the effective management of surrounding.

It is necessary to influence the development of methods of environmental management, both at the theoretical level and at the level of regulations, standards and guidelines. The management model must show a good relationship between the parties (the competent government authorities) and object management (environmental elements), asset management (laws and plans), and position management instruments (regulations, standards, offer standards, criteria, and information). Implementation of planning decisions based on the harmonized application of instruments and measures in different areas of directing the development, construction and land use as well as environmental protection. The right to protection the environment should be seen as a unique international, national and local entity primarily at base town of all others. Protecting the environment knows no boundaries. Therefore, regulation and action have to be carried out both at the universal, national, regional and local level.

Environmental management is one of the main tasks of present and future generations. Developing skills in people who work in this scientific discipline, was influenced by education and training.

Eco-manager can perform the following roles:

1) The regulator - the behavior of managers and create other influences on the behavior of others.
2) Innovation - managers are trying to create change and to adapt to changes caused by others.
3) Catalyst - innovations that are accepted must as far as possible to meet the growing demands for efficiency.
4) The authorized custodian - management must be economically related to the consumption of resources.
5) The mediator - mediates between application and system environment and requires
6) Leader - scientific management techniques, but also an emotional connection with his subordinates to motivate subordinates to perform maximum tasks.

Extremely important component of managing eco-consciousness contained is in the rejection of the idea that nature is threatened by the necessity of survival.

It may be noted that all necessary quality can never be found in a single person (Adizes model) and that there is no ideal manager. Environmental management is part of good business practice in all organizations that have a clear strategy, and the goal is based on the continuous improvement of its processes.

OBJECTIVES OF ENVIRONMENTAL MANAGEMENT TO SUSTAINABLE DEVELOPMENT

With rational resource! The essence of the concept of sustainable development through an interaction of the environment and mutual complementarity and coherence of development policy and political environment, which respect the laws of ecological systems.

The concept of sustainable development is focused on the conservation of natural ecosystems and the environment, as well as the rational use of natural resources. For sustainable development and applies of additional requirement that have a feedback loop of the environment and the environmental and social framework. Sustainable growth means that further growth is not threatened negative feedback, either from the biophysical, or the social environment. Preservation of the environment must be taken as a prerequisite to, the growth of welfare. Development is characterized as sustainable. It can be concluded that the characteristic three basic principles of sustainable development based on ecological sustainability, socio-cultural sustainability and economic viability. Ecological sustainability ensures that development is compatible with the maintenance of ecological processes, biodiversity and natural resources. Sociocultural provides sustainability to increase surveillance of the man's own life, and ensures the economic viability of successful economic development. It is clear that this is a concept that has its global and international meaning and content, but also the internal and regional character. The intertwining of global, regional and national, and local dimensions of sustainable development is one of the main features on sustainable development. Strategic planning of ecological management integrates the potential for change of management in that area, but also long-term time horizon taking a position as a catalyst for reconciliation of public, social and private interests. The concept of environmental management in terms of sustainable socio-economic development, the objectives pursued in contemporary business and life becomes a cornerstone of planning further development of human society. The main objectives of environmental management are:

1) the identification, prevention and remediation of environmental problems,
2) establishment of regulations and restrictions
3) the formation of agencies and institutions engaged in environmental research, monotoring and environmental management
4) focusing risks and identifying opportunities for overcome them
5) maintain and if possible improve existing resources
6) improving the "quality of life" along with protection
7) innovate new technologies with environmental standards and principles.

Important rules of environmental management are:

RULE OF SUBSTITUTION (non-renewable resources can be spent in so far as may be reimbursed as equivalent (renewable) replacements) - disappear resources.
RULE OF REDUCING (used amount of renewable resources should not exceed the amount of their renewability) - extinction.
RULE ASSIMILATION (emission of harmful substances should not exceed the absorptive capacity of the environment, ie. exceed the environmental load composition) - at the global level.

INSTRUMENTS ENVIRONMENTAL MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

Methods and instruments for environmental management are systematized means of obtaining information about the environment and help in making decisions about the environmental performance of current or planned activities in order to protect and improve the environment and achieve sustainable development goals. These funds can be used by all social actors (either from the private or public sector), in all sectors and at all levels, from local to regional, national and international up. In practice, it applies more resources for environmental management and sustainable development:

- a legal obligation (referenced to national or international standard),
- political means (aiming to create conditions for adequate public participation in decision-making processes on Environment and Development).

Instruments of Eco management:

Organizational legal instruments - the legal-institutional measures that directly affect the behavior of environmental pollutants by regulating production processes, prohibiting discharges of pollution, including the creation of the so-called. environmental administration.

Administration instruments are to identify eco standards and norms for the emission of pollutants by agreement of the local authorities and the enterprise including sanctions for violation of established norms.

Voluntary instruments - these are the agreements and conventions concluded between the various entities at different levels (local, regional and international) through the mechanism of free will and persuasion.

Economic instruments for environmental management include various taxes, subsidies and reimbursements, and are based on the "polluter pays".

IV Groups:

Levies on pollution – these are taxes, and fees for pollution sources that vary with the amount of pollutants emitted into the environment.

Subsidies - forms of financial assistance to be granted to companies to reduce pollution and ecological funding programs to reduce pollution in the future.

Deposit-refund system – imposes a fee for the polluter that is automatically paid by so called deposit for potential environmental damage to the environment, which is later returned to pollutant if he makes a positive action.

The system permits the exchange - the latest economic instrument where the relevant ministry or administration of environmental issues fixed number of licenses or "pollution rights" in a given region and then allows the development of the market in which polluters buy and sell to each other the right to pollution.

As already mentioned, the listed instruments fall into the category of effective measures, for the simple reason that basically represents expenses for the one who pays. Thus affecting the reduction of pollution and the pollutants and to void indirectly, to environmental protection and sustainable socio-economic development.

CONCLUSIONS

To the creation of man and his relationship to nature, the living world is ruled by mutual and harmonious relationship and dependence in ecological balance. Disturbance of the ecological balance is the result of man's work activity, which a man "appropriates" the nature, and create products. When it comes not only disturbs the ecological balance of ecosystems, but also threatens the integrity of man and his existence. Knowledge of environmental laws, processes and phenomena in nature enriches a man to look at nature as a whole. Decorating according to his needs he must not disrupt the process of it, or to disrupt the functional balance that exists between living things and their environment. This can be avoided only if the well-known environmental laws and if people behave in line with them. So, awareness is a form of life that respects and harmonizes with the natural laws of the circulation of matter, energy costs and the renewal of life, while encouraging the take from nature only what is necessary for the provision of basic human needs.

Because environmental ethics is an environmental human relation with the environment, which refers to a moral relationship between human / natural and techno sphere / biosphere. Striving towards the environment, as well as the transformation of the spirit of contemporary world of work is becoming imperative. The concept of sustainable development offers the possibility of harmonious development. Expansion of industrial growth enabled the penetration of the social system in working and living environment. As a result are exceeding the limits of endurance of natural system followed by the outbreak of the ecological crisis. Successful implementation of environmental management will enable the smooth industrial growth, environmental quality, and harmonious life for present and future generations.

Without vigorous and rigorous calculation of further pollution of the human spirit and the environment at all levels, there are no successful solutions to the problems in the domain of material goods and spiritual value. This approach to the environment is now much needed, both at micro as well as at the global level. The main motto is not to stop development, but to find ways of development that will not endanger the environment.

Consequently, environmental management is not limited to environmental management, but the management of human activities organized to reduce their negative impact on the environment. The hardest test that man had from the beginning till now, can be successfully overcome and lay solely and only the introduction of quality excellence and sustainable development.

The essence of politics for human environmental protection is not only reflected in the harmonization of socio - economic, social and technological development, but in aligning economic and environmental development. Environmentalism has taken the role of a public good and the target is a function of the community.

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CORPORATE SOCIAL RESPONSIBILITY INTEGRATION IN THE BUSINESS STRATEGY OF COMPANIES FROM WEST REGION ROMANIA

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ABSTRACT

Today's business world considers that the "3 Ps" philosophy (Population, Planet and Profit) are relevant for preserving natural resources and promoting sustainability. The profit that a company makes may bring benefits for everybody as long as the process used to obtain money does not affects the environment.

The concept of Corporate Social Responsibility (CSR) represents a new philosophy, showing responsibility that organizations have towards people, society and the environment, as they are or can be affected by companies' activities and this concept is strongly related to the concept of sustainable development.

This paper proposes a possible model for analysing the CSR policy within the Romanian West Region companies. Firstly, we defined three dimensions which are considered the most relevant for the CSR concept and we assessed these dimensions in order to detect which one is the predominant dimension of CSR policy in Romanian companies.

Key words: corporate social responsibility, environment, sustainable development, Romanian companies.

INTRODUCTION

Today's business world considers that the "3 Ps", that is Population, Planet and Profit, are relevant for preserving natural resources and promoting sustainability. The basic philosophy of the "3 Ps" is that, although financial success continues to be the main motivation in making decisions, economic development may be maintained by protecting the environment at the same time. The profit that a company makes may bring benefits for everybody as long as the process used to obtain money does not affects the environment. [1]

When speaking about companies, sustainability refers to adopting business strategies which satisfy company and shareholders' needs but, at the same time, they protect, preserve and increase human and natural which will be necessary for future generations. Stopping environmental degradation, taking care of the environment and of the natural resources, taking into consideration our common future, are issues that should be approached with maximum seriousness by everybody: authorities, civil society and the business sector.

In today's business world, Corporate Social Responsibility represents a new philosophy, showing responsibility that organizations have towards people, society and the environment, as they are or can be affected by companies' activities. [3] Corporate Social Responsibility (CSR) was defined by the European Commission as *a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis.* [4]

The CSR concept is strongly related to the concept of sustainable development.

Sustainable development has developed as a concept through several decades of active international scientific debate and has acquired distinct political connotations in the context of globalization. [2], [8]. "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* [7]

The CSR policy is integrated in the sustainable development strategy. Companies have the power to shape their actions so that they do not prejudice communities and the environment. The CSR policy enables companies to monitor voluntarily and to improve the social and environmental impact of their actions.

There are three aspects of the social dimension of corporate social responsibility, as follows [4]:

- **Internal aspects:** human resource management, health and safety at work (OSH), business ethics, adaptation to change, and organizational learning – requires participation of workers or their representatives;
- **External local:** local corporate citizenship - requires cooperation with business partners, local authorities and local NGOs;
- **External worldwide:** human rights, global environmental concerns, safety and health in supply companies, corporate citizenship worldwide - requires communication with consumers, investors, globally operating NGOs, etc.

A key component of the CSR concept is responsibility towards the environment, which can be called corporate environmental responsibility that implies obtaining concrete competitive on a market that has been strongly affected by the economic crisis. Recent studies have shown that employees who work for socially responsible companies tend to be very motivated at work, partly because they have the satisfaction to know that they work for an organization that puts community and environment on the first place. [5] If employees are motivated, they will be more productive. Also, more investors are interested by CSR policy of the company where they invest their money, especially in matters that refer to the environment and human rights. Thus, firms that consider the environment and the society will have more access to potential capital.

EXPERIMENTAL

Research methodology

The practical research presented in this study aims assessing the environmental dimension of CSR policy within the Romanian West Region companies, and comparing it with two other dimensions of the CSR policy: internal dimension and local external dimension.

The study was conducted on 41 companies with Romanian, foreign or joint capital from West Region Romania, working in different economic areas: industrial-production, trade, services. 14 of these companies are multinational companies (34%). We used as the research method the survey, and as the research instrument we used the questionnaire applied to managers of the investigated companies (during the year 2012).

Starting from the theoretical framework presented above, we defined three dimensions which are considered the most relevant for the CSR concept and we assessed these dimensions:

D1. Environmental dimension of the CSR policy refers to the **impact on the environment (global external dimension)**.

D2. Local external dimension refers to **relationships with stakeholders and local community** (relationships with shareholders, investors, creditors, competitions, suppliers, local authorities, other institutions, the public);

D3. Internal dimension refers to the **Human Resources Management** (the fairness and strictness of personnel policies, participative management, workplace security, etc.);

Each of the three dimensions is formed of an ensemble of essential characteristics which are considered evaluation criteria for that dimension.

Environmental dimension (D1) referring to the impact of company activities on the environment is evaluated based on the following criteria:

C11. Existence of some evaluations of the impact of company activity on the environment by using specific audit instruments (to evaluate in detail the degree of conformation or to identify opportunities to reduce costs, repercussions on the environment and resource waste);

C12. Existence within the company of a CSR policy with an environmental component and the existence of someone responsible to implement it;

C13. The degree of conformity with the environmental norms evaluated using the environmental standards (if fines or other warnings have been applied for not complying with the law);

C14. The degree of active participation of employees in protecting the environment evaluated by the existence of specific programs for employees' information, training and evaluation;

C15. Additional investments for implementing green technology (percent from total investments);

The next step was to compare this dimension with the other two dimensions in order to detect which is the predominant dimension of CSR policy in Romanian companies.

Local external dimension (D2) referring to relationships with business partners and local community is evaluated based on the following criteria:

C21. The degree of independence of managerial decisions towards administrative council decisions and fair treatment of shareholders;

C22. The degree of transparency of information and managerial decisions to creditors, investors, suppliers, local authorities by regularly informing them *about economic and financial results of the company;*

C23. Using loyal competition practices in establishing prices and promoting products, etc.;

C24. Information transparency for general public (including those referring to social responsibility);

C25. Paying fiscal obligations regularly (taxes to the local budgets);

C26. Company involvement in social or philanthropic actions with no advertising purposes.

Internal dimension referring to the **Human Resources Management - HRM (D3)** is evaluated based on the following criteria:

C31. Encouraging initiatives and free expression, transparency of information referring to company performances and actions;

C32. Participative Management: delegating authority, the degree of participation of employees in establishing working tasks;

C33. Fairness of recruiting and selection procedures;

C34. Existence of an integration policy of new employees and of the actors who put the policy into practice;

C35. Characteristics of the training policy of employees;

C36. Characteristics of the performance assessment policy and employees' career development within the investigated firms;

C37. Workplace security – respecting legislative norms regarding work protection and existence of internal norms which are established voluntarily;

The level for each criterion was evaluated by offering points on a scale from 0 to 4 (0 – very weak/inexistent, 1 – unsatisfying, 2 – satisfying, 3 – good, 4 – excellent). For each criterion, we have calculated an average for previous appreciation scales, so that the 0 value is a minimum level of appreciation, and the 4 value is a maximum level of appreciation. An average value between 3 and 4 indicates a good appreciation to a very good appreciation of those aspects.

The next step we have calculated a general score for each of the 3 evaluated dimensions as simple arithmetic average of the obtained averages for each criterion [6], (criteria being considered equally important).

Results and discussions

The general score obtained for each of the 3 evaluated dimensions is presented in table 1.

Table 1. General Score Obtained for Evaluated Dimensions

CSR POLICY DIMENSIONS	GENERAL SCORE
D1. Environmental dimension	**2.90**
D2. Local external dimension	**2.21**
D3. Internal dimension	**2.55**

The averages obtained for each criterion describing each of the three CSR dimensions are presented in the charts.

For **CSR - Environmental dimension** we obtained the results presented in figure 1.

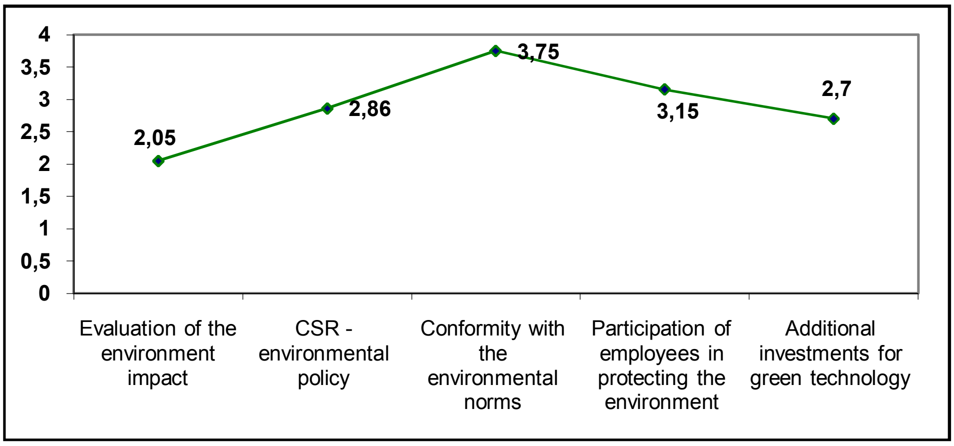

Figure 1. The Averages for Criteria Describing CSR - Environmental Dimension (D1)

As the figure 1 shows, the lowest averages are for the *C11 criterion - Evaluations of the impact of company activity on the environment* (2.05) - which means that not all companies are showing responsibility towards the environment not carefully analyzing the effects of their actions on environment.

C12 (2.86) and C15 (2.7) criteria recorded an average value close to 3, which shows a good appreciation about these issues. This means that many of the investigated companies have made efforts to assume responsibility for the environment by implementing a CSR environmental policy and by additional investments for implementing green technology, despite economic crises. Environmental CSR policy aims voluntary actions, donating money to green causes, donations of materials for green causes.

The average for C14 criterion (3.15) shows that the investigated companies were actively involved employees in environmental responsibility projects.

Criterion with the highest average is C13 (3.75) which shows that investigated companies comply with environmental standards, (noting the almost complete absence of fines or other warnings applied for not complying with the law).

The general score for **CSR - Environmental dimension** is 2.90 (the best score of all three CSR dimensions). This self-assessment of investigated companies, very close to level 3 (good evaluation), shows a growing concern for environmental protection in the context of environmental legislation was tightened.

For **CSR – local external dimension** we obtained the results presented in figure 2.

Criteria which obtained the lowest scores are C24 (1.27) and C26 (1.29). These values show a weak transparency of information to the public and a weak corporate involvement in philanthropy. We can therefore state that companies' reporting in the local community space is into a very early stage. A relatively low value recorded criterion C21 (1.88), on corporate governance. Criteria C22, C23 and C25 were registered close scores, being close to level 3, which means that social responsibility in relations with external stakeholders and local authorities is stronger aware than responsibility to the local community.

The overall score for *CSR - local external dimension is 2.21, the lowest score of all sizes.* This scoring confirms once again a low awareness of the companies' responsibility to the community.

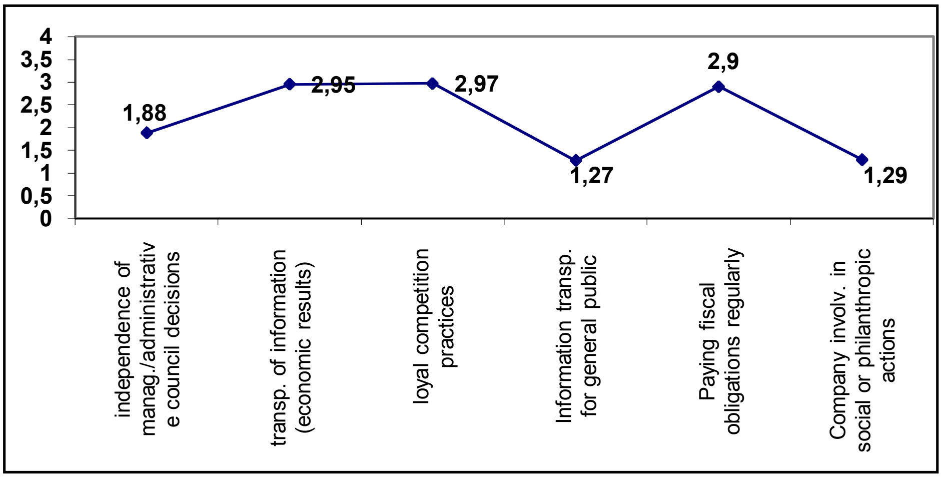

Figure 2. The Averages for Criteria Describing CSR - Local External Dimension (D2)

For each of the seven analyzed criteria **for the CSR - Internal dimension (D3)** the averages are presented in the figure 3.

As we can observe in figure 3 the lowest averages are for the C32 criterion (1.98) – *Delegating authority, the degree of participation of employees* in establishing working tasks and C34 (1.86) - Existence of an *integration policy* of new employees and actors who put the policy into practice, which indicates an unsatisfactory appreciation of these aspects, signalling problems related to applying participative management and the attention for new employees.

C33 Criteria – Fairness of *recruiting and selection procedures* and C37 - *Workplace security,* register the best score, above level 3, which indicates a good to very good appreciation of these aspects.

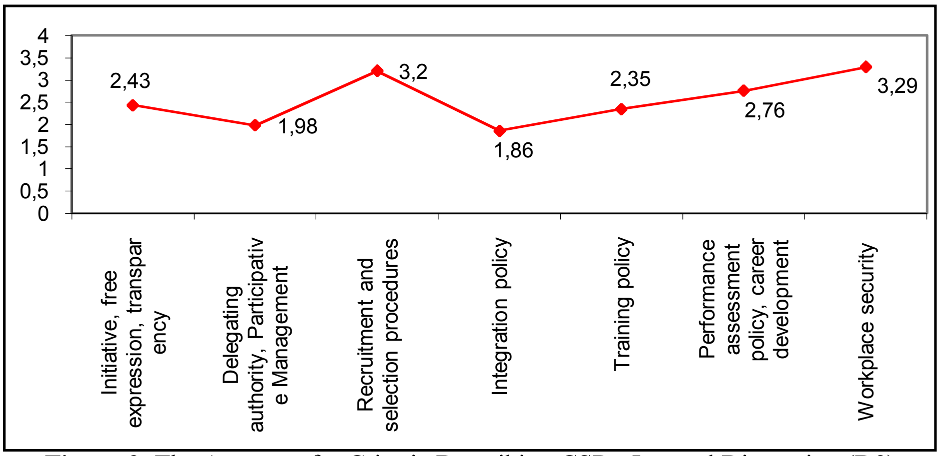

Figure 3. The Averages for Criteria Describing CSR - Internal Dimension (D3)

If we calculate a general score of the HRM dimension, as a simple arithmetic average of the obtained average for the 7 criteria considered as equally important, we obtain a value of 2.55, which indicates a situation which is not very favourable for the CSR internal dimension.

CONCLUSIONS

Following the results obtained we can formulated several remarks on CSR policy, especially on CSR – environmental dimension, in the companies from Romanian West Region:

- within investigated companies predominant CSR dimension is *the environmental dimension* (recorded the highest score, 2.90, close to level good); this result is explained by the penetration in this region of western culture and the need for business environmental standards compatible with EU law; within this dimension, the best assumed criteria are *the conformity with the environmental norms evaluated using the environmental standards* and also *the active participation of employees in protecting the environment* evaluated by the existence of specific programs for employees' information, training and evaluation;

- the CSR dimension recorded the lowest score is Local external dimension (D2**)** referring to *relationships with business partners and local community,* showing that companies' reporting in the local community space is into a very early stage; within this dimension there are differences in terms of assuming the responsibility towards external stakeholders (better assumed) and responsibility to the local community (less assumed).
- internal CSR dimension related to HRM practices (D3) recorded an average score between satisfactory and good (2.55), not very favourable; the negative aspects are related to participative management and delegation of authority, and also to policy of integrating the new employees;

The West Region of our country, placed on the second place from the point of view of development after the Bucureşti-Ilfov Region, received a massive infusion of foreign capital. [9] Most companies with a strong CSR policy are multinational companies, which have "imported" the corporate culture of the company in the country of origin.

Considering that the research was realised on a relatively small sample of companies, we do not argue its representativeness for all companies in Romania. However, the research can be a starting point for further national research.

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VIEWS ON FINANCIAL AUDIT

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ABSTRACT

Auditors provide to external users of information a reasonable assurance regarding the fact that the financial information was collected, processed and presented with the observance of the pre-established criteria and honestly. Usually, the users of information cannot check the quality of information and are forced to substantiate their decisions on the information presented by other persons, information which may be inaccurate or incomplete. The purpose of a financial audit according to ISA is to improve the degree of confidence of the concerned users of financial statements. This is obtained by the expression of an opinion by the auditor, regarding the fact that the financial statements are prepared under all significant aspects in accordance with the applicable general framework of financial reporting.

Key words: audit risk, evaluation of risks, response to risks, reporting, stages of financial audit, audit opinions.

INTRODUCTION

The objective of this article is to present the author′s opinion regarding the method of organisation and exercise of financial audit in economic entities.

The companies of public interest and those which exceed certain criteria of size have to audit the financial statements for the purpose of increasing the degree of confidence in the information published through financial statements. By the research carried out we tried to present the method of approach of financial audit based on risk and what the stages and limits of financial audit are.

THE CONCEPT OF RISK-BASED AUDIT

The audit risk represents the risk of expressing an inadequate audit opinion regarding financial statements. In order to obtain reasonable assurance, the auditor has to obtain sufficient adequate audit samples to mitigate the audit risk at an acceptable level and thus, to allow the auditor to draw reasonable conclusions on which to substantiate the audit opinion. The risk-based audit implies the going through the following stages: evaluation of risks, response to risks and reporting [4].

Evaluation of risks

The auditor's objective is to identify and evaluate the risks of wrong significant presentations, if they are caused by error or fraud at the level of financial statements, by the knowledge and understanding of the entity, its environment, internal control, offering this way a basis for the conception and implementation of answers for the evaluated significant risks of misrepresentation.

Response to risks

In this stage the auditor analyses the reasons for the evaluation of risks at the level of financial statements and elaborates appropriate audit procedures.

Reporting

In this stage we evaluate the audit samples obtained and the establishment of measure if it is sufficient and adequate for the mitigation of audit risk at an acceptable level.

After the establishment of conclusions, the acknowledgements of audit have to be reported to management and after the implementation of acknowledgments, an audit opinion must be formed and a decision must be made regarding the adequate formulation of the auditor's report.

STAGES OF AUDIT

In the carrying out of audit we go through the following stages: acceptance of the mission mandate, planning of audit missions, checking (application of substance procedures) and completion of audit mission.

Acceptance of mission mandate

In this stage the auditor analyses and decides on the following aspects: [1]

– analysis of calls for tender from customers, in view of establishing the type of mission wanted by them;
– evaluation of the reasons for which the customer wants an audit;
– if the Code regarding ethical and professional conduct in the field of financial audit and the national regulations allow him to accept the mission;
– if the particularities of transactions, operations and procedures of the customer company allow him to achieve the objective of the audit commitment;
– if there are reasons which impose the refusal to accept the audit commitment or the commitment of customer preservation;
– in case of recurrent (successive) missions, this knowledge about the economic entity is reviewed and completed every time, stating the significant changes which took place since the previous audit;

– realization of agreement with customer, which provides the terms and conditions of the audit mission. According to ISA (International Standards on Auditing), the terms agreed regarding the audit mission must be documented in a mission letter or another method of written agreement. On the occasion of recurrent (successive) missions, the auditors or the management of the entity analyse the necessity of amending this services agreement by drawing up addenda.

Planning of audit missions

By planning, the methodology of approaching audit is completed. By planning the activity we understand building a general strategy and the detailed establishment of tasks regarding the nature, duration and degree of comprehension (scope) of audit procedures. In the activity of planning an audit mission it is necessary that we consider the following activities in view of drawing up an audit strategy and a mission plan: obtaining the information necessary for the knowledge of customer, his environment; the performance of preliminary analytical procedures; the evaluation of risks of significant misrepresentation and audit risk; determination of the threshold of significance; evaluation of the internal control system; determination of sample; planning of activity, which implies the establishment of a general audit strategy, a mission plan of an activity program and a time budget.

Checking (Application of substance procedures)

According to ISA, the auditor has to design and perform substance procedures for each class of transactions, balance of account and significant presentation, regardless of the evaluated risks of significant misrepresentations [4]. According to ISA, a substance procedure is an audit procedure designed for the detection of significant misrepresentations at the level of financial statements, substance procedures which can be detail tests and analytical substance procedures or a combination of the two. If the auditor determined that an evaluated risk of wrong significant presentation at the level of statement is a significant risk, the auditor has to carry out substance procedures as response to the specific risk. The decision regarding the type of substance procedures carried out is based on the professional reasoning of the auditor regarding the degree of effectiveness expected and the efficiency of audit procedures available, in order to reduce the audit risk to an acceptable low level.

Depending on circumstances, the auditor can determine that: [4]

– the only performance of analytical substance procedures will be enough to reduce the audit risk to an acceptable low level, when there is no major risk of wrong presentations. For instance, where the evaluation of risk by the auditor is justified by audit samples obtained following the tests of controls (tests designed to evaluate the operational effectiveness of internal controls to prevent, detect and correct the significant misrepresentations);
– only detail tests are adequate;

- the best response to evaluated risks is a combination between the analytical substance procedures and the detail tests. An effective approach of the audit according to ISA is the combined approach, in which are used both tests of controls and substance procedures.

The substance procedures are used by the auditor to collect samples regarding balances and classes of transactions and to detect significant errors. The substance procedures imply the selection of a representative sample to: recalculate the registered values in view of accuracy; to assure the registration of transactions in the correct period; to inspect the justifying documents; to confirm the existence of balances; to notice the physical existence of inventory; to revise the adequate character of adjustments for depreciation, amortisation, provisions etc. [4].

Completion of audit mission

The completion of the audit mission implies the realization of the following activities: checking of subsequent events, performance of final analytical procedures, evaluation of continuity of the activity, revision of results, communication of audit observations and formulation of an opinion regarding the audited financial statements [1].

Checking of subsequent events

According to ISA, the auditor has to carry out audit procedures to obtain sufficient adequate audit samples, according to which the events which took place between the date of closure of fiscal year and the date of drawing up the audit report, which imply the adjustment of financial statements or a presentation in financial statements were identified.

For checking the subsequent events, the auditor uses as audit procedures:
- obtaining an understanding of the procedures, which the management established to make sure that the subsequent events are identified;
- interrogation of management regarding the production of any subsequent event which could affect the financial statements;
- questioning the management in relation to any accounting adjustments accomplished or envisaged;
- questioning the management in relation to any events which took place or are likely to take place and which will question the adequate character of the hypothesis of continuity or other accounting policies;
- examination of accounting records drawn up after the date of closure of fiscal year, journals, accounting registers or justifying documents;
- examination of reports of meetings of the board of directors or of the general meetings of shareholders, drawn up after the date of the balance sheet to discover important subsequent events which affect the financial statements [1].

If following the abovementioned procedures the auditor identifies subsequent events which imply the adjustment of financial statements or a presentation in financial statements, the auditor has to determine the extent that the event is appropriately reflected in these financial statements. The auditor also has to request the management a written declaration, according to which all the events which took place after the date of financial statements which require the adjustment or presentation were adjusted or implemented.

Performance of final analytical procedures

The auditor checks the presence of significant inaccuracies which were not noticed until that moment, going through the financial statements (unusual balances, which were not previously identified). Following this analysis, the auditor can draw the conclusion that it is necessary to collect supplementary audit samples.

Evaluation of continuity of activity

If the auditor discovers during audit that the entity could not repay a loan, lost his main customer or decided to sell assets for the repayment of the loan, the treasury flows are negative, etc., the auditor has to analyse the hypothesis of continuity. The responsibility of the auditor is to obtain sufficient and adequate audit samples regarding the degree of adequacy of using by management the presumption of continuity of activity and to draw conclusions whether there is a significant uncertainty regarding the capacity of the entity to continue its activity. If following the audit procedures the auditor concludes that the presumption of continuity is adequate, but there is a significant uncertainty, the auditor will proceed as follows:

- if an adequate presentation of significant uncertainty is made in financial statements, the auditor has to express an unchanged opinion (without reserves) and include an explanatory paragraph;
- if an adequate presentation of significant uncertainty is not made in financial statements, the auditor has to express an opinion with reserves or a contrary opinion, as applicable.

If the financial statements were drawn up based on the principle of continuity, but according to the reasoning of the auditor, the presumption of continuity of activity is not adequate (negative cash flows, very high net debt, substantial operational losses, incapacity of paying at deadlines, loss of a major market, lack of main raw materials, difficulties related to workforce etc.), the auditor has to express a contrary opinion.

Revision of results

In the end the auditor has to decide whether sufficient and adequate audit samples accumulated to support the conclusion that the financial statements are presented in accordance with a general framework of financial reporting, in this respect the auditor examines the whole audit program and evaluates if it is adequate.

Communication of audit observations

The significant observations resulted from the performance of audit, which can make the object of communication of the persons in charge with governance refer to:

- the point of view of the auditor regarding the qualitative aspects of accounting practices of the entity, including the accounting policies, accounting estimates and presentations of information of financial statements;
- other significant aspects resulted from audit, which have relevance for the persons in charge with governance, such as significant misrepresentations of information or inconsistencies in information which accompany the financial statements audited and which were corrected;
- the auditor will communicate to the adequate management level, in time, all the misrepresentations cumulated during the audit, except for the situation in which this is prohibited by law or regulation. The auditor will also request the management to correct those misrepresentations; if the management refuses to correct certain or all the misrepresentations communicated by the auditor, the auditor will obtain an understanding regarding the reasons of management to refuse the corrections and will take that understanding in consideration in the evaluation of the fact whether the financial statements as a whole do not contain significant misrepresentations. A discussion of completion can represent an adequate moment for the communication of audit observations, including, the auditor's vision on the qualitative aspects of accounting practices of the entity [1].

Formulation of an opinion regarding the financial statements audited

According to ISA (International Standards on Auditing), the objectives of the auditor are the following: [4]

- formulation of on opinion regarding financial statements, based on the evaluation of conclusions following the audit samples obtained;
- the clear expression of an opinion through a written report, which also describes the basis for that opinion. The audit report has to clearly express in writing the auditor's opinion and has to evaluate whether the financial statements were established according to a system of accounting references identified. There are several types of opinions: the opinion without reserves; the opinion with reserves; contrary opinion; the impossibility of expressing an opinion.

Opinion without reserves

The opinion without reserves means that the financial statements give a faithful image of the financial position, the financial situation and results obtained (or honestly present in all significant aspects), in accordance with the accounting references and, if applicable, they are compliant with the legal provisions. It is expressed when the auditor considers that the financial statements present a faithful image (financial statements faithfully present from all significant points of view, in accordance with an applicable framework of financial reporting. If the auditor has to make some observations or recommendations, which are useful to those who will use the report, they are written in a separate paragraph or in an annex to the report, stating that they do not represent a reserve.

Opinion with reserves

Such an opinion can be formulated when the auditor notices errors, anomalies or irregularities, which although are significant, are not sufficiently important to appreciate that the financial statements do not offer a faithful image. It is formulated when the auditor considers and as a whole the financial statements present a faithful image (the financial statements present significant, individual or cumulated misrepresentations, but they are not permanent).

Contrary opinion

Such an opinion can be formulated because of the disagreements between auditors and management, disagreements owing to either when the management refuses to apply some accounting principles, procedures, policies or when the management refuses to correct very significant errors. It is expressed when the auditor considers that as a whole the financial statements are significantly wrong (the financial statements present significant and permanent, individual or cumulated misrepresentations) so that they do not present a faithful image, and the disagreements with the company management are significant and have an important incidence on the balance sheet, which is incomplete, dishonest, misleading.

Impossibility of expressing an opinion

Such an opinion can be formulated when the effect of limitation of the audit is so significant that the auditor could not obtain sufficient and adequate audit samples and, therefore, cannot express an audit opinion.

INHERENT LIMITATIONS OF FINANCIAL AUDIT

It is not expected and it is not possible for the auditor to reduce to audit risk to zero. The auditor cannot obtain an absolute assurance regarding the fact that the financial statements do not contain significant misrepresentations owing to fraud or error. This is due to the fact that there are inherent limitations of an audit, which result from the largest part of audit samples based on which the auditor draws and conclusions and bases his audit opinion as convincing, rather than conclusive.

The inherent limitations of a financial audit result from: the nature of financial reporting; the nature of audit procedures; the need that the audit should be performed in a reasonable period of time and at a reasonable cost; the use of audit tests; inherent limits of internal control; the activity carried out by the auditor in the formation of opinion is also based on professional reasoning; other aspects such as: especially fraud, which involves management, transactions between affiliated parties, non-observance of laws and regulations, future events and conditions which could determine the cessation of the activity of the entity etc.

CONCLUSION

As far as it concerns the method of approach and realization of financial audit, we can draw the following conclusions**:**

- the financial audit is approached based on risks because the procedures of evaluation of risks do not involve the detailed testing of operations and balances, which can be applied long before the end of the period, and by understanding where risks of wrong significant presentations can appear in financial statements, the auditor can direct the efforts of the audit team towards the fields with high risk. Also, the audit procedures will considerably vary depending on the size of the entity and of evaluated risks, and the adequate exercise of professional reasoning is essential for the adjustment of procedures so that they adequately respond to the evaluated risks;
- usually, the users of information cannot check the quality of accounting information and are forced to substantiate their decisions on the information presented by other persons, information which may not be correct or complete. Therefore, the role of financial audit is to improve the degree of confidence of the concerned users of financial statements by the expression of an opinion by the auditor, regarding the fact that the financial statements are prepared under all significant aspects in accordance with a general applicable framework of financial reporting.
- as for the procedure of financial audit, it implies going through the following stages: acceptance of the mission mandate, planning of audit missions, checking (application of substance procedures), completion of audit mission, stages which were presented and developed above;
- the auditor cannot obtain an absolute assurance regarding the fact that the financial statements do not contain significant misrepresentations due to fraud or error. Because of inherent limitations of an audit, there is an inevitable risk that certain significant misrepresentations of financial statements are not detected, even if the audit is performed in accordance with the International Standards on Auditing. Therefore, the subsequence discovery of a significant misrepresentation in financial statements, as a consequence of error or fraud, does not indicate a failure in itself in the performance of audit in accordance with the International Standards on Auditing.

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ECOLOGICAL FOOTPRINT CONCEPT – WILL THE EARTH SUSTAIN THE HUMANITY?

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ABSTRACT

A review of the relatively new concept of sustainability - ecological footprint, is presented in this paper. Humanity needs what nature provides, but how do we know how much we're using and how much we have to use? The ecological footprint has emerged as the world's premier measure of humanity's demand on nature. It measures how much land and water area a human population requires to produce the resource it consumes and to absorb its carbon dioxide emissions, using prevailing technology.

Key words: resources, footprint, sustainability, ecology.

INTRODUCTION

In recent years, much of the discussion on finite global resources has focused on the depletion of non-renewable resources. However, it is increasingly evident that renewable resources, and the ecosystem services they provide, are also at great or even greater risk (*UNEP 2007, WRI 2007, UNDP 2008, UNEP 2007, World Bank 2000, Millennium Ecosystem Assessment 2005*). Global economies depend on the biosphere for a steady supply of the basic requirements for life: food, energy, fiber, waste sinks, and other life-support services. Any depletion of these services is particularly risky since human demand for them is still growing, which can accelerate the rate at which natural assets are liquidated. Out of this concern, the sustainability proposition emerges. Sustainability is a simple idea. It is based on the recognition that when resources are consumed faster than they are renewed, or wastes emitted faster than they are absorbed, the resources are depleted and eventually exhausted, and wastes are no longer sequestered and converted back.

The term sustainable society is commonly used to refer to the ideal situation where humans live within Earth's capacity to provide resources, such that the resources remain available for future generations. In order for society to become sustainable, human population will need to level out, and our per capita consumption of resources will need to be reduced. One way we can gauge our level of sustainability is through the concept of an ecological footprint, which is simply the amount of biologically productive land/sea area needed to support the lifestyle of humans. The idea behind an ecological footprint is that every human requires a certain portion of the biosphere for extracting the resources they use and for absorbing the waste they generate [1].

The ecological footprint is a measure of the demand human activity puts on the biosphere. More precisely, it measures the amount of biologically productive land and water area required to produce all the resources an individual, population, or activity consumes, and to absorb the waste they generate, given prevailing technology and resource management practices. This area can then be compared with biological capacity (biocapacity), the amount of productive area that is available to generate these resources and to absorb the waste. If a land or water area provides more than one of these services it is only counted once, so as not to exaggerate the amount of productive area actually available. Land and water area is scaled according to its biological productivity. This scaling makes it possible to compare ecosystems with differing bioproductivity and in different areas of the world in the same unit, a global hectare. A global hectare represents a hectare with world average productivity.

Ecological footprint and biocapacity accounting is based on six fundamental assumptions [2]:

1. The majority of the resources people or activities consume and the wastes they generate can be tracked.
2. Most of these resource and waste flows can be measured in terms of the biologically productive area necessary to maintain them. Resource and waste flows that cannot be measured in terms of biologically productive area are excluded from the assessment, leading to a systematic underestimate of the total demand these flows place on ecosystems.
3. By scaling each area in proportion to its bioproductivity, different types of areas can be converted into the common unit of average bioproductivity, the global hectare. This unit is used to express both Footprint and biocapacity.
4. Because a global hectare of demand represents a particular use that excludes any other use tracked by the Footprint, and all global hectares in any single year represent the same amount of bioproductivity, they can be summed. Together, they represent the aggregate demand or ecological footprint. In the same way, each hectare of productive area can be scaled according to its bioproductivity and then added up to calculate biocapacity.
5. As both are expressed in global hectares, human demand (as measured by ecological footprint accounts) can be directly compared to global, regional, national, or local biocapacity.
6. Area demanded can exceed the area available. If demand on a particular ecosystem exceeds that ecosystem's regenerative capacity, the ecological assets are being diminished. For example, people can temporarily demand resources from forests or fisheries faster than they can be renewed, but the consequences are smaller stocks in that ecosystem. When the human demand exceeds available biocapacity, this is referred to as overshoot.

HISTORY OF THE ECOLOGICAL FOOTPRINT CONCEPT

The ecological footprint concept was created by Mathis Wackernagel and William Rees at the University of British Columbia in the early 1990's [3-7]. Responding to then-current debates surrounding carrying capacity [8-11], ecological footprint accounting was designed to represent human consumption of biological resources and generation of wastes in terms of appropriated ecosystem area, which could then be compared to the biosphere's productive capacity in a given year. In focusing only on bioproductive area and on resources presently extracted and wastes presently generated, the method provided a focused historical assessment of human demand on the biosphere and the biosphere's ability to meet those specific demands [12].

The Footprint has been applied in a wide variety of ways. It can provide a global perspective on the current extent of ecological overshoot, as well as a more localized perspective on city and regional resource issues. Global and national accounts have been reported in headlines worldwide, and over 100 cities or regions have assessed their ecological footprint. At the national level, by 2003 Wales had adopted the ecological footprint as its headline indicator for sustainability. The Swiss government has incorporated the Footprint into the nation's sustainable development plan. Japan includes the footprint as a measure in its Environmental Plan.

The value of the Footprint as a sustainability metric depends not only on the scientific integrity of the methodology, but also on consistent application of this methodology across analyses. It also depends on results of analyses being communicated in a manner that does not distort or misrepresent findings. To address these needs, Global Footprint Network initiated a consensus, committee-based process for ongoing scientific review of the methodology, and for the development of standards governing Footprint applications.The National Footprint Accounts Review Committee supports continual improvement of the scientific basis of the National Footprint Accounts. The Ecological Footprint Standards Committee, comprised of representatives from Global Footprint Network Partner Organizations and representing academia, government, NGOs, and consulting firms, issued the Ecological Footprint Standards 2009 (Global Footprint Network, 2009). The Standards build on the Ecological Footprint Standards 2006 and are designed to ensure that Footprint assessments are produced consistently and according to community-proposed best practices. They aim to ensure that assessments are conducted and communicated in a way that is accurate and transparent, by providing standards and guidelines on such issues as use of source data, derivation of conversion factors, establishment of study boundaries, and communication of findings. The Standards are applicable to all Footprint studies, including sub-national populations, products, and organizations.

CALCULATION METHODOLOGY

The ecological footprint calculates the combined demand for ecological resources wherever they are located and presents them as the global average area needed to support a specific human activity. This quantity is expressed in units of global hectares, defined as hectares of bioproductive area with world average bioproductivity.

By expressing all results in a common unit, biocapacity and Footprints can be directly compared across land use types and countries. Demand for resource production and waste assimilation are translated into global hectares by dividing the total amount of a resource consumed by the yield per hectare, or dividing the waste emitted by the absorptive capacity per hectare. Yields are calculated based on various international statistics, primarily those from the United Nations Food and Agriculture Organization (*FAO ResourceSTAT Statistical Databases*). The ecological footprint, in its most basic form, is calculated by the following equation:

$$EF = \frac{D_{ANNUAL}}{Y_{ANNUAL}}$$

where D is the annual demand of a product, and Y is the annual yield of the same product. Yield is expressed in global hectares. The way global hectares are calculated is explained in more detail below after the various area types are introduced. But in essence, global hectares are estimated with the help of two factors: the yield factors (that compare national average yield per hectare to world average yield in the same land category) and the equivalence factors (which capture the relative productivity among the various land and sea area types). Therefore, the formula of the ecological footprint becomes:

$$EF = \frac{P}{Y_N} \cdot YF \cdot EQF$$

where P is the amount of a product harvested or waste emitted (*equal to D_{ANNUAL} above*), YN is the national average yield for P, and YF and EQF are the yield factor and equivalence factor, respectively, for the country and land use type in question. The yield factor is the ratio of national-to world-average yields. It is calculated as the annual availability of usable products and varies by country and year. Equivalence factors trasnlate the area supplied or demanded of a specific land use type *(e.g. world average cropland, grazing land, etc.*) into units of world average biologically productive area: global hectares and varies by land use type and year.

GLOBAL RESULTS FROM THE NATIONAL FOOTPRINT ACCOUNTS

Natural resource wealth and material consumption are not evenly distributed worldwide. Some countries and regions have a net demand on the planet greater than their respective biocapacity, while others use less than their available capacity. Humanity as a whole, however, is not living within the means of the planet. In 2007, humanity's total ecological footprint worldwide was 18,0 billion global hectares (*gha*); with world population at 6,7 billion people, the average person's footprint was 2,7 global hectares. But there were only 11,9 billion gha of biocapacity available that year, or 1,8 gha per person. This overshoot of approximately 50 percent means that in 2007 humanity used the equivalent of 1,5 Earths to support its consumption (*Fig. 1*). It took the Earth approximately a year and six months to regenerate the resources used by humanity in that year.

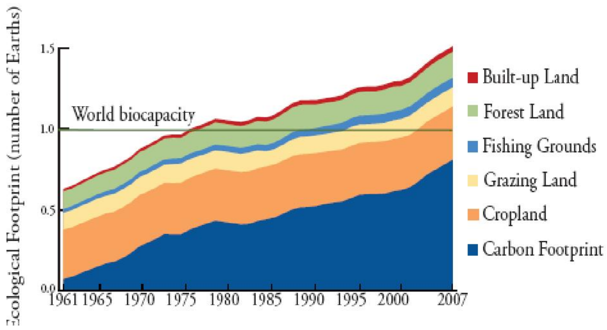

Figure 1. Humanity's ecological footprint during period 1961-2007 [13]

Figure 2 compares ecological footprint and biocapacity by land use type for the world. For components other than carbon footprint, where a region's footprint exceeds its biocapacity, the net deficit is made up by depleting its own ecosystem resource stocks, or by importing resources from elsewhere. At a national level, this latter option is less available to countries with fewer financial resources. Half of the global footprint was attributable to just 10 countries in 2007 (*Fig. 3*), with the USA and China alone each respectively using 21 and 24 percent of the Earth's biocapacity.

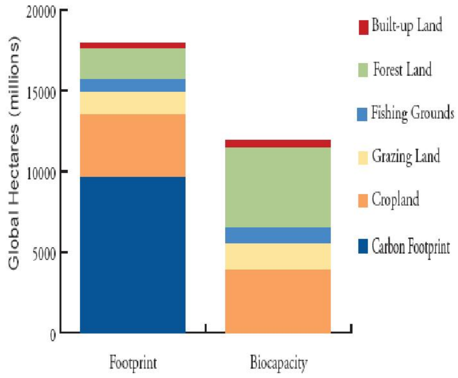

Figure 2. Humanity's ecological footprint, 1961-2007 [13]

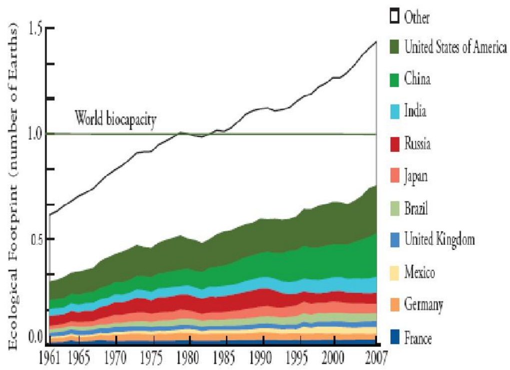

Figure 3. Humanity's ecological footprint by country, 1961-2007 [13]

The most recent edition of national footprint accounts shows that in 2002, the average Canadian required more than 7,5 average hectares to provide for his or her consumption. If everyone on Earth consumed at this level, we would need four additional planets. The average Italian lived on a footprint almost half that size (*4,0 global hectares*), the average Mexican occupied 2,4 global hectares, and the average Indian lived on about one-quarter of that (*0,7 global hectares*). The global average demand is 2,2 global hectares per person.

Figure 4 shows the average ecological footprint of consumption per person in 2007, the most recent year for which data is available, for 153 of the 240 countries covered in the National Footprint Accounts. Also, in 2007, the footprint exceeded the Earth's biocapacity — the area actually available to produce renewable resources and absorb CO_2 — by 50 per cent. Overall, humanity's ecological footprint has doubled since 1966.

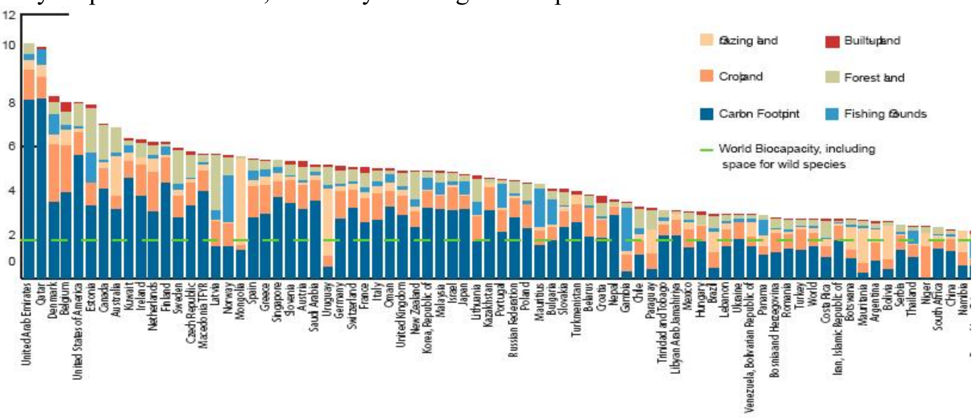

Figure 4. Ecological footprint by country per person in 2007 [13]

POSSIBLE WAYS TO REDUCE THE HUMAN'S FOOTPRINT

There are many simple ways for reducing the footprint that humans leave on the Earth. These ways are primarily focused on changing people's habits on a daily basis. For example, reducing the carbon footprint can be achieved trough use of the cleaner transport (*walking, using bike instead of a car, taking public transport whenever possible*). Have the vehicle serviced regularly to keep the emission control systems operating at peak efficiency. Checking the car's air filter monthly, and keeping the tires adequately inflated to maximize gas mileage. Also, adding energy saving features to our homes and adopting energy-saving habits, significantly decreases the carbon footprint.

Reducing the food footprint can be done trough eating more local, organic, in-season food, choosing foods with less packaging to reduce waste. Eating lower on the food chain-going meatless for just one meal a week can make a difference. Globally, it has been estimated that 18% of all greenhouse gas emissions are associated with meat consumption.

Decrease in housing footprint is possible if sustainable building materials, furnishings and cleaning products are chosen. Also, adopting water-saving habits (*taking shorter, less frequent showers, washing cars rarely, regularely looking for and fixing the leak*s) is very welcomed in reducing the housing footprint. Reducing the goods and services footprint is possible if people buy less and replace items only when are needed to, recycle paper, glass, aluminum, plastic and electronics, buy recycled products, particularly those labeled "post-consumer waste".

CONCLUSIONS

Rapid economic growth has fuelled an ever-growing demand for resources – for food and drink, energy, transport, electronic products, living space, and space to dispose of wastes, particularly carbon dioxide from burning fossil fuels. The humanity needs to revaluate how we design our communities, the way we get around, and power our homes. We need to live smarter and consume less water and electricity through choosing goods and services that have a low impact. In the longer term we can take energy use and waste production into consideration when making big decisions such as purchasing vehicles, major appliances and living spaces. There are many opportunities to save, not only reduce our impact on the natural world, but to save money as well. For example, switching to solar heating has been shown to be a cost effective way of supplying your hot water as well as reducing a major household source of greenhouse gases. The implications are clear. Rich nations must find ways to live much more lightly on the Earth – to sharply reduce their footprint, including in particular their reliance on fossil fuels. The rapidly-growing emerging economies must also find a new model for growth – one that allows them to continue to improve the wellbeing of their citizens in ways that the Earth can actually sustain.

Acknowledgement:

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LOGISTIC CHARACTERISTICS OF PACKAGING WASTE

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ABSTRACT

Intensive modern production, as well as marketing trends in trading tend to produce bigger quantities of versatile packaging. Used packaging is steadily becoming an independent branch in waste management and requires adequate handling. Logistic support is needed for proper management of packaging waste. Efficiency and effectiveness of the packaging waste logistics depend mostly on the logistic characteristics of the waste. With this motive for work, the basic characteristics of packaging waste, primarily the quantities, the dynamics and the speed of its creation are discussed.

Key words: logistics, packaging, waste.

INTRODUCTION

The need for adequate waste treatment, in other words its management, emerged with the growth of human population, the rise of towns and cities and industrial development. As this development took place, growing quantities of various waste emerged and the problems of its disposal/deposit.

Waste is generated by households, industry, administrative institutions and in all facilities and places where a person lives and works. Waste generation is the result of the total activity of each country, and it's in direct correlation with the national economy. Knowing the type of waste, its characteristics, place of origin, as well as quantity, is of great importance for functioning of the logistics of waste materials [1].

Packaging waste is in direct proportion with the improvement of production and the use of packaging for the purpose of placing the product in appropriate packaging. This will generate problems arising from the disposal of packaging waste. The formation of packaging waste and its increase calls for appropriate measures to be taken for the proper management and treatment of the waste to reduce the chance of potential adverse impact.

Packaging waste logistics is a complex system which arises from the complexity of waste management system. In order for packaging waste logistics to be successful, the basic logistic characteristics of the waste must be tracked and acknowledged.

BASIC LOGISTIC CHARACTERISTICS OF PACKAGING WASTE

In order to protect manufactured goods, its contents should be placed in appropriate containers, which in addition to the protective function have other functions such as storage, keeping, handling and delivery of goods. Packaging as a separate product has specific characteristics.

Items that are used as aids in packaging, wrapping, tying, hermetically sealing, labeling and preparation for shipping of goods are also considered as packaging [2].

Primary packaging is used for the initial storage and sale/delivery to the customer. This form of packaging is considered as the smallest packaging unit. Secondary packaging unit is used for grouping multiple products placed in primary packaging units for easier shipment and manipulation.

Disposable packaging is designed and manufactured with the intent to be used only once. On the other hand, reusable packaging is intended to be returned by consumers to be re-used for the same purpose. Operation in which the packaging is recharged or used for the same purpose for which it was planned is considered as re-using. This packaging is designed to carry a maximum number of discharging and charging during its use.

Packaging waste is waste generated from disposable containers, and from the packaging materials used to produce the containers which cannot be used for its original purpose. Packaging waste is defined in the Waste Catalogue under index number 15 00 00.

Packaging waste is contained in municipal waste, but also outside it. So under packaging and packaging waste law, packaging waste is divided into municipal packaging waste and packaging waste that is not municipal waste.

In households, industry, services and other activities, municipal packaging waste is created from primary and secondary packaging. Packaging waste which is not municipal waste comes from the primary, secondary or tertiary (transport) packaging, and it's created as a waste in the manufacturing, retail, services and other activities. Such waste is not collected through the system for collection of waste through the public utility company. This type of waste does not include reusable packaging.

The formation of packaging and other waste depends on the degree of industrial development, living standards, lifestyles consumption and other parameters of each individual community. This means that the formation of municipal packaging waste is mainly a function of the capacity of the consumer population. In addition to the above, the formation of the municipal packaging waste depends on the relationship of the public with this type of waste. For example: the use of used packaging and handling it, the degree of separation from the municipal waste stream, the degree of proper disposal and such.

Packaging waste is in direct proportion with the improvement of production and the use of packaging for the purpose of placing the product in appropriate packaging. This will generate problems arising from the disposal of packaging waste. The formation of packaging waste and its increase calls for appropriate measures to be taken for the proper management and treatment of the waste to reduce the chance of potential adverse impact.

All packaging waste can be conditionally divided into waste intended for disposal and waste intended for treatment.

Packaging becomes waste intended for treatment only when it's possible to re-use it trough recycling or reprocessing within the production process. It can then be used again for its original or other purposes.

Packaging becomes waste intended for disposal when it's not possible to re-use it trough treatment (recycling, biodegradation or controlled burning).

Waste management is an activity of general interest. It requires implementation of measures prescribed for the treatment of waste trough **collection, transportation, storage**, treatment and disposal, including the supervision of such activities and taking care of waste management facilities after closure [1]. Details speaking, waste management must include a broader set of activities, on a broader social level, which at first glance might not belong there.

They include:

- The activities of rational utilization of raw materials and energy,
- Use of waste for obtaining alternative fuels,
- Preventing improper disposal of waste,
- Reducing the risk of improperly disposed waste,
- Design and establishment of an adequate information system on waste,
- Massive public participation in an organized system of collection of municipal waste,
- Defining and establishing adequate standardization in the field of waste management system,
- Establishing and ensuring the implementation of responsibility principle for polluters/waste broadcasters and others.

Packaging waste logistics is the process of planning, control and implementation of flows, processes and activities of waste packaging materials from the place of its origin to the place for its accommodation, through the collection and transportation to the final destination (treatment, re-use, disposal or destruction) with a goal to meet the requirements of all parties at minimal cost.

Packaging waste logistics must be observed through the light of sustainable waste management, in efficient use of material resources and in reducing the amount of packaging waste at source. Generated packaging waste is observed through its treatment in a way that contributes to the economic, social and environmental objectives of sustainable development.

Basic characteristics of packaging waste that influence planning, efficient and effective implementation of packaging waste logistics are: volume, structure, dynamics and the speed of its creation.

VOLUME, STRUCTURE, DYNAMICS AND SPEED OF PACKAGING WASTE CREATION

Packaging waste can emerge at any place in the packaging flow chain, from the place of its production to the place of its discharge. Including:

- The place of production (defects in manufacturing, inappropriate packaging, etc.);

- During the packaging distribution from the manufacturer to the filling station (damage during transport and handling and such);
- At the filling station (damage from fillers and packers);
- During distribution of packaged product;
- At the site of its discharge (damage from consumer/end user, or from trader in retail network), (Fig. 1).

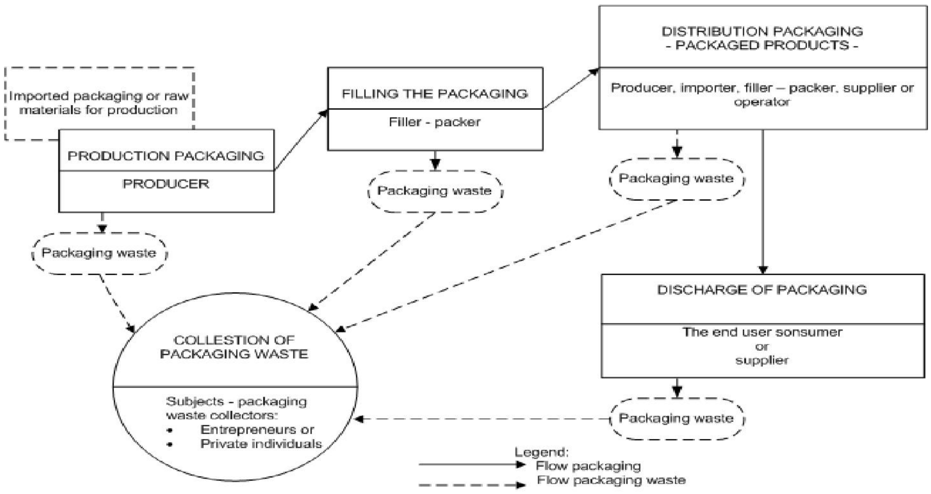

Figure 1. Packaging transport (flow chain) and the place of packaging waste origin

The basis for the planning of any logistic activities/tasks is in the quantity of generated waste and in dynamics of its generation. There is an obvious problem in reliable determination of the amount of waste in Serbia, in the amount of packaging and other types of waste.

The annual amount of packaging waste in Serbia is estimated at more than 334.500 tons per year. This information is obtained by measuring in a number of cities which include 30% of the population. It is estimated that the proportion of packaging waste in municipal waste is around 14% [3].

The amount if packaging waste in Serbia is steadily increasing. The reason for that is the increase of the share of non-refundable and disposable containers, especially plastic bottles and cans.

Estimated quantities of packaging waste for 2009 are given in "Waste Management Strategy of the Republic of Serbia for the period from 2010 to 2019" document, Table 1.

In addition to the amount of packaging waste and the dynamics of its generation, an important logistic parameter is also the composition of packaging waste. The choice of individual elements of the packaging waste logistic infrastructure such as mobile transport capacity, loading capacity and storage space depend on the composition of packaging waste.

Table 1. Estimated quantities of packaging waste in Serbia in 2009. [3]

	Type of packaging waste	Estimated quantities of packaging waste (tones per year)
1.	Glass packaging	90.000
2.	Plastic packaging	88.000
3.	Paper and cardboard packaging	115.000
4.	Composite packaging	17.300
5.	Aluminum packaging	5.200
6.	Iron packaging	19.000
	TOTAL	334.500

From the data presented in Table 1 it can be concluded that the maximum amount of packaging waste (around 88%) comes from packaging made of paper and cardboard, glass and plastic. The rest of the packaging waste (around 12%) is drawn from iron containers, composite materials and aluminum. Paper and cardboard, glass and plastic materials deserve a special place in the packaging waste table, with paper and cardboard generating 34.37%, glass at 26.90% and plastic at 26.30% of total waste materials generated [4].

The amount and composition of generated packaging waste is a logistic parameter which determines the further course of logistic activities such as the choice of transport and handling equipment and determination/choice of ways to harvest and dispose of the waste. Other than the total amount of generated packaging waste, the following amounts are also essential in the planning of logistic activities:

- The amount of waste separated for treatment and
- The amount of waste separated for disposal.

The pace and rate of packaging waste formation affect the means of transport planning and engagement. For proper logistic planning and organizing it's necessary to know the time dynamics of packaging waste formation (daily, monthly and yearly). Rate of packaging waste formation can be expressed differently, depending on its structure and type. Rate of packaging waste formation can be expressed as follows [5, 6]:

- For municipal packaging waste: kg of waste / person per week, kg of waste / ton of product and
- For non municipal packaging waste: kg of waste / box, kg of waste / ton of packaged products and such.

From the quantitative size of the packaging waste formation, due to relatively lower specific mass, in terms of planning and organizing the logistics, the most important is the volume and then the weight of generated packaging waste. Both volume and weight are crucial for the choice of transport means and roads.

CONCLUSION

The system of packaging waste logistics is a process implemented as a set of interrelated and interacting logistic activities at the source, in other words at the place of packaging waste origin, its transport and its logistic activities at the final destination.

For each occurrence of packaging waste, depending on the type of packaging waste and its main characteristics, specific logistic activities take place such as: collection, classification, storage, shipping, transportation, handling, unloading, manipulating (transfer, piling, etc.) and disposal (permanent storage).

Planning the packaging waste logistic flow and activities is a visionary view in which the logistic system is directed towards fully meeting the requirements of all parties. The logistic system has to take logistics of the mission into account – whether the packaging waste is found at the required place, at the required time, in the required (sufficient) amount, in the requested state, within minimum cost, while also taking the necessary measures to preserve the environment.

In order to plan a successful, efficient and effective realization of packaging waste logistics, it is necessary to know and establish a system of ongoing monitoring of its basic logistic characteristics, primarily the quantity, composition, dynamics and speed of emergence.

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ANALYSIS OF ENTERPRISE PERFORMANCES BASED ON THE FINANCIAL STATEMENTS

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ABSTRACT

Performance measurement and reporting, both to the past and anticipated, is a key management method in today's interconnected world, the world "24 hour news" where everything runs at a maximum speed. Strategic and operational complexities of today require an ongoing dialogue with investors, customers, suppliers and employees. Reporting is a key ingredient in building, sustaining and continuous improvement of participation to interested partners. Financial statements can contribute to more effective communication opportunities and the economic, environmental and social problems of a company than simply answer inquiries of interested partners..

Key word: performance, benefit, efficiency, cost,financial statements.

INTRODUCTION

Today, many observers, including accountants, recognize that description of how the accounting of the past, recording "bricks and mortar" is not sufficient to characterize today's accounting.

Breakthrough in "endless tunnel" economy in transition, trying to correct the errors, if not blunders. Begin to acknowledge the presence of risk. It triggers a process of reform accountants. Our system of evaluation and measurement collapses under the weight of rigidity, lack of relevance and reliability. But, surprisingly, the conservative accounting wakes up first.

Methodological arsenal to be adapted to new requirements. In her neighborhood, or confluence, a financial performance imperatives call for renewal. Those skilled in the art will recognize the crucial nature of the moment and begin to ask questions. It is right in the Romanian business practice, it is endowed with the cake served by the professional and intellectual force necessary to overcome mere crust findings and evidence.

The accounting policies adopted and made by company management is a decisive element in the drafting and presentation of financial statements that would be useful to users for decision making.

In the context of the harmonization of the laws of the Romanian accounting system, production and accounting policy making organization must fall within the spirit, principles and requirements of the European Directives and International Accounting Standards IAS / IFRS, in order to put into practice the prerequisites to obtain accounting information and quality of financial statements.

Adoption in Romania of a uniform financial reporting system and internationally recognized (IFRS) is the Romanian companies only way to ensure that their financial statements are reliable and based on this, users can make the best decisions.

Complex accounting environment, uncertain and risky undertaking active calls in accounting estimate, and more than that, the review estimates. Accounting policies require the company to appeal to one or more measuring bases. Integrating the concept of fair value accounting rules Romanian contribute to the implementation of accounting assumes the role of bridge to the future.

FINANCIAL-ACCOUNTING STATEMENTS - FAIR VIEW OF ENTERPRISE PERFORMANCE

New accounting vocabulary revolve around new trends in the financial statements and accounting comparability of the company for sending an image true to the company's performance that can be read and interpreted in any corner of the world.

Moreover, the current financial analysis is proven and the semantic level by changing the name well known IAS (International Accounting Standards) to IFRS (International Financial Reporting Standards).

Financial statements are useful to the extent that induce a vision or a bridge forward-looking, ie if it helps users to assess the company's ability to generate future cash flows, and the timing and certainty of their generation. In a dynamic economic environment in permanent annual financial statements can no longer be stuck in the past to describe.

Specialized accounting literature uses several terms to refer to the annual report of a company: annual accounts, annual reports and summary documents. However, each specification is variable depending on country-specific accounting normalization. In general, the *annual financial statements* comprise the balance sheet, income statement, statement of changes in equity, cash flow statement and notes to the annual financial statements. The annual report includes summary with doumentele, and general information about the company and its business analysis. It is a document which the company published annually to provide information about the work they carry out during the year.

In general, regardless of the accounting system in each country, annual report structure is the same, differences appeared especially in the presentation of financial information through documetelor synthesis. It must be said that the information provided summary documents must respond first to all its users.

In conclusion, of all the sources of information used synthetic documents are considered by all users as the most comprehensive and also best reflects the *official* *image of the company*. They are central to the whole process the information on which decisions are made.

Therefore, the quality of information presented to them, appropriate disclosure of the company, are elements of great importance for those who prepare financial statements and for those who require this information.

Understandability, relevance, comparability and reliability in which fair view, prudence, neutralityand respect other accounting principles are fundamental qualitative characteristics that must be taken into account in the preparation and presentation of financial statements.

Objective of financial statements is to provide information required for capital changes, year-end financial results, performance and dynamics to the source of income, expenses, results, financial claims and liabilities, profit and distribution, its ability to meet payments due Interest and repayment of loans, wage obligations, dividends to shareholders.

THE PERFORMANCE ANALYSIS BASED ON FINANCIAL STATEMENTS OF THE COMPANY

Information on the performance and cost / profitablitate is necessary to assess changes likely to occur in the short term in the size and structure of its economic resources.

Financial performance shows the extent to which the company has met its line to achieve profit. Economic theory considers that for any undertaking this objective involves maximizing profits. There are still managers who wish to obtain a satisfactory profit only.

Recognition maximum profit point is, however, a highly subjective process. For this reason, we can assume that a company has met the objectives of achieving profit line where shareholders are satisfied.

For assessing the profitability/return, users use information from the profit and loss account. This information *does not satisfy, but needs fully*. Thus, some numbers, even if it relates to the past, have only an estimate. Applicable depreciation, provisions and stock assessment.

The character of estimates of the size of these elements increases in the context of rising prices and technical progress, due to inability to draw a line between operating expenses and uses the benefits of economic ... there is no reason to support one decisive decisions in relation to the other. However, each choice leads you to a different result. Also, absolute profits may lead users to misleading assessments (eg, profit growth is not necessarily a positive change. Whom have seen this growth is due. Is this an effect of size of turnover, the greater efficiency, or the influence of both factors? Is it a consequence of the preceding financial year was a "good" as the previous year was a "bad" or is it just the result of choice between different accounting methods?

To get a satisfactory answer, users need comparable information over several years. Or, synthesis documents belonging to different exercises are not always comparable.

In addition, they provide information only about the options chosen by the company and not about the options left to one side, which could generate more profit.

On the other hand, we can not neglect the subjectivity of users of financial statements, which are reflected on the perceived image fidelity. Given that accounting information is presented in a coded language, it is necessary to show "mastery" of their beneficiaries, a knowledge of logic and accounting conventions.

Obviously, in this respect, a very important role lies and businesses should be concerned to submit recipient company image and its performance as accessible a form. However any company would make efforts to facilitate user understanding of the message transmitted through the financial statements, it can be said that the perceived image quality is strongly influenced by users than the accounting records.

It can also be said about the summary documents that meet generally different positions within the investment period of a year, depending on time of year and the nature and content from other sources. Thus, they are the basis for assessing the accuracy of previous forecasts. A detailed analysis of the differences between forecasts and financial results is necessary to understand the factors that lead individuals to record differences between them.

The financial statements also served to establish a trend of future performances, although it is used as a tool for direct extrapolation (eg disclosure of annual long-term debt interest expense forecasting helps).

Recognition of elements of financial statements is described that occurs when incorporating an item in the balance sheet or profit and loss, or when reality begins to act on the financial position and / or performance of the company.

As a result of the new guidelines that receives Romanian accounting system, cost previous underlying the recognition of assets, liabilities, expenditure and income have been replaced by new approaches that circumscribe the perimeter of judgment, being directed by the accountant accounting conceptual .

Dilemma options recognition elements described in the financial statements are reflected in the two criteria required by the IASB conceptual accounting framework, namely:

- the probability of future economic benefits;
- credibility assessment.

Likelihood criterion future benefits associated with a financial statement element circumscribes a complex dynamic realities, uncertain and risky undertaking acts refers to the uncertainty that such benefits will be in flux oriented or for business.

Probability of future economic benefit criterion limits themselves in the dilemma facing today's accounting environment, namely to take the test difficult to estimate at the present time and the future.

The second condition means that the item recognition recognized to possess a cost or value that can be measured reliably. IASB accounting conceptual framework emphasizes that, in some cases, cost or value will be estimated and the use of reasonable estimates will be an essential part of preparing the financial statements and does not affect their credibility.

International Accounting Standards often have cases where the accounting treatment at the present time is based on estimates of the evolution of future situations. Complex accounting environment, uncertain and risky undertaking active calls in accounting estimate, and more than that, the review estimates. The criteria used to achieve estimates are far from being objective, and objectivity is so necessary accounting.

Financial statements prepared in terms of historical cost provides a true and certain, but are confined exclusively in the past. Because financial statements are useful to decision-makers should not ignore the future and uncertainty.

Accounting should take responsibility to provide accounting information to be able to anticipate the financial position and performance. Even in matters related to evaluation examines the "going concern" should "target" company into the future. With a dynamic reality, complex, uncertain and risky option accounts face the dilemma between the different bases of measurement, taking into account the complementary advantages and drawbacks.

Accounting policies require the undertaking to have recourse to one or more measuring bases. Measurement bases are monetary attributes of the elements that comprise the financial statements - assets, liabilities, gains, losses and funding developments owners. Fourth European Directive authorizes a number of alternatives to the evaluation of historical cost, such as:

- evaluation based on the replacement value of tangible assets whose use is limited in time recipes, like stocks;
- evaluation methods that take account of inflation;
- revaluation of tangible and intangible assets;

International accounting body IASB normalization appeal to two fundamentally different options regarding the evaluation of business assets:

- historical cost;
- current values.

Although subsequent evaluations come to put "order" in the above uncertainties taken into account, however they are not without options attribute, precisely because of the fluidity of accounting. Subsequent evaluation depend extent that financial statements of companies fail to assist the user in evaluating company performance and certainty and its generation time.

Because harmonizing Romanian accounting regulations with European accounting directives by passing the application of international accounting standards and international accounting referential incorporation, companies will face difficulties in the determination of fair value, realizable value, present value, etc..

CONCLUSION

Given the accounting tradition of our country, the public was and still is normalized at home, it raises two questions:

- ✓ To what extent can we rely on the professional judgment of workers in the field of accounting to achieve desired performance?
- ✓ Accepting the idea that professionals will be able to proceed aceleopțiuni to ensure performance, how great will be their freedom of movement, so do not become subjects of penalties for violation of other rules and accounting principles?

The answer to the first question depends on the given second. It is hard to believe that supervisory bodies outside the enterprise (especially fiscal) will accept violations of tax rules under the justification accurate reflection of performance, while the state remains effectively a privileged user of accounting information.

Inevitably arise and answer the first question: in a small way, taking into account, on the one hand, fear of penalties due to violation of support and on the other hand, the lack of specific experience in general mainlanders generated Excessive application of legal provisions.

What has been found is that, due to insufficient knowledge of the concept of significant value (principle of relative importance) of the entrepreneurs and their accountants and obsession especially not to violate the law, it is preferred to provide information surplus some without any relevance to financial statement users.

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ELECTROLYSIS OF NaCl, HEMICAL RISKS ASSESSMENT AND MANAGEMENT

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ABSTRACT

This essay presents chemical characteristics of substances that are used or generated in the process of electrolysis NaCl. Those characteristics are the base element for assessment of chemical hazards and risks that exist in the plant, in order to prevent possible chemical accidents. Recognizing dangers of used chemicals, in any phase of their use in the production process, or during their storage, or during their transport, requires assessment of existing chemical risks and prediction the actions for their elimination. The level of chemical risk is defined as the product of the consequence, probability and frequency for appearing of chemical accidents. Calculated the overall level of risk in the electrolysis plant belong to the group of moderate levels of risks, a risk level III. This overall level of risk consider all effects of the risks of all chemicals that are used or generated in this production process.

Key words: Accident, level of chemical risks, risk management, consequences of risk, probability and frequency of risk.

INTRODUCTION

Chemical industrial facilities have a significant impact on environmental pollution. Because of their policies in the field of environment must be oriented to the implementation of various measures of protection with regard to sources emissions of pollutants that come from the industry, especially when it comes to the management of hazardous chemicals and the safety of industrial facilities. Exactly such a facility of electrolysis of NaCl, in which the total quantity produced chlorine and hydrogen consumed mainly in the industrial unit for the synthesis of hydrochloric acid for the production of sodium hypochlorite, although they may be the final product of the process of electrolysis.

TECHNOLOGY PROCESS

Process of electrolysis of aqueous solutions of salts may distinguish themselves in three different types of electrochemical reactors [1] as follows: diaphragm reactors,

reactors with mercury cathode and membrane reactors. In our country, in use is mainly the application of the mercury cathode electrolyser. Salt electrolysis of sodium chloride (NaCl) is an electrolyte decomposition of the electrolyte under the influence of direct electric current at which the products are made as chlorine, hydrogen, sodium hydroxide and sodium hypochlorite.

The process unfolds in a saturated NaCl aqueous solution in the electrolyser separated into elemental chlorine, which stands on a metal anode and sodium amalgam that is set aside on a liquid mercury cathode. The obtained chlorine goes for further processing or to be used for the production of hydrochloric acid. Incurred sodium amalgam leaves electrolyser and goes to decomposer where mercury is released and creates sodium hydroxide and hydrogen. Hydrogen generated in decomposer is cooled and sent for further processing. Sodium hydroxide from decomsposer is filtered, cooled and stored. Mercury is continuously recirculated into each individual cell, while impoverished electrolyte goes to re-prepared. Produced quantities of chlorine and hydrogen can be used for the synthesis of hydrochloric acid and sodium hypochlorite production, although incurred chlorine and hydrogen can be produced as final process of electrolysis. Chemicals that arise during the manufacturing process can be a raw material for other manufacturing processes (factories). For all chemicals used or created during the process is important to properly define their characteristics, dangers and hazards. To identify hazards for each of the chemicals, either within their transportation, storage or use in their production process, certain measures have been foreseen (actions) to prevent the risk [5,6].

RISK AND PROTECTION OF ACCIDENT

The method of analysis and risk assessment is intended to identify and quantify areas where potentially may appear a chemical accident. The process of risk assessment involves the following steps: hazard identification, risk of accidents, modeling and development of accident consequences, vulnerability analysis, risk assessment, plan of care and prevention of accidents, the process of reaction (response) to the accident and post accident monitoring the situation. The occurrence of accidents and procedures for accident response procedure is defined in the case of accidents in each company of NaCl electrolysis, taking into account the specificities of each company. This procedure is defined in a way appropriate coordination of work services, establishment continuous observation and monitoring, as well as planning and rehabilitation after the accident. Any accident is made a detailed report to be submitted to the relevant external organizations and public services.

The Law on Environmental Protection [2] initiated the implementation of the European Seveso II Directive on the control of major risk accident related to hazardous materials in our country. In compliance with the Regulations on the list of hazardous substances and their amounts and the criteria for determining the types of documents created by the operator Seveso installations or complex [3] defines the criteria for the production of documents or Accident Prevention Policy Statement on Safety and Emergency Plan is determined in compliance with a list of hazardous substances and their limit quantities and list hazard classes and limit the amount of hazardous substances. All operators of Seveso facilities are obliged to take all necessary measures to prevent chemical accidents and limiting effects of that accident on human health and the environment in order to create conditions for risk management.

ASSESSMENT OF CHEMICAL AND RISK MANAGEMENT

Based on the exhibited characteristics of chemicals that are used or have been created by the electrolysis of salt of NaCl, quantity used, the exposure time and frequency of exposure, made the identification of chemical hazards and risks that exist for each of the chemicals, either as part of their transport, storage or their use in the production process. The existence of chemicals risk assessment in a company is an indication of the seriousness of its long-term survival of enterprise, as well as improving the capacity, productivity and profit [7,8,9]. Assessment of the risk of chemical levels in the present study by KINNEY method [4], by estimated probability occurrence of chemical accidents, the severity and consequences for the working environment and the frequency of occurrence of chemical accidents. So the level of risk of chemical-R can be defined as the product of P-consequence, probability-V and frequency of chemical accidents - U.

$$R = P \times V \times U \tag{1}$$

P-consequences (possible damage) are ranked from 1 as a minimum of to 10 considered catastrophic. Probability of an accident happening in relation to the chemicals used or generated in the production ranks as the least of 0.1 to 10 as the maximum frequency of events predictable and chemical accidents that ranges from 1 as negligible up to 10 as a maximum-expected.

Display assess the level of risk by Kinney of chemical methods is given in Table 1, also having taken into account all the preventive measure against possible chemical accident at the factory in order to health protection of employees, living and working environment. Namely, in this paper we started from being used in the manufacturing process or chemical produced from the direct impact on human health, safety, and thus also the risk level of chemical in the living and working environment. When assessing risk is taken into account classification of chemicals as hazardous substances and safety data sheet where there are more details about the properties of chemical substances and their dangers to health of employees and the environment [10,11].

Table 1. Assessment of chemical risks

Used chemicals	P-consequences (rang 1-10)	V-frequency (rang 0,1-10)	U-formation (rang 1-10)
H_2	3	0,1	1
HCl	3	0,1	1
NaOCl	2	0,1	1
H_2SO_4	3	0,1	1
Cl_2	2	0,5	1
Hg	3	0,5	1
NaOH	3	0,1	1
Total	19	1,5	7
Total risk assessment R = PxVxU = 19x1,5x7 = 199,5			

The estimated level of risk for each chemical of chemicals that are used or generated in the process of electrolysis of NaCl is very low, ie. a level of acceptable slight risk, provided that all preventive and safety measures for the security of each of the chemicals listed have been implemented. However, the total level of risk, taking into account the effects of risk used in the manufacturing process or the chemical substance is formed on the upper limit of the moderate risk level 199.5 which is the third level of risk (R III), so-called medium level of risk.

Assessed risks can be managed but exclusively and must apply pre-defined organizational, technical and technological measures and compliance with prescribed procedures and instructions for safe operation of the production process, in the process of handling, transport and storage of all chemicals that are used or created in the production process of NaCl electrolysis. Prevention is therefore essential feature of effective management of chemical risk [12]. In this sense, all the chlorine from NaCl electrolysis process, section of hypochlorite is always ready to accept that it absorbs in aqueous solution of sodium hydroxide, making the sodium hypochlorite.

In addition to these measures, the risk management of chemical accidents, is carried out by regular basis monitoring of air quality in terms of the concentration of pollutants in the air, mercury, chlorine and hydrogen chloride in the production facilities in locations that were identified as risky. The results of this monitoring are the ultimate test for the effectiveness of functioning of applied preventive measures.

CONCLUSION

It was found that the method can be applied to Kinney chemical risk assessment of chemicals used in the production process or the resulting chemical substances, since they are directly affecting the employees' health, safety at work and the overall living and working environment. The level of chemical risks for each of the chemicals in the process of electrolysis is of acceptable at the level of low risk. Overall level of risk in the whole production process is 199.5 and the upper limit of the moderate level of risk, which is the III -intermediate risk.

Estimated risk can be managed and must apply pre-defined organizational, technical, preventive measures and compliance with prescribed procedures and instructions for safe operation (safety data sheet) in the production process in the handling, transportation and storage of the chemicals used or from the process. Chemical risk management measures and a number of preventive measures that should be undertaken in the technological process of electrolysis of NaCl (reservoir damaged, vents, safety vents, etc…) In order to limit the size of accident, and the results of monitoring of air pollution are the final check that preventive measures applied successfully operate.

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IMPACTS OF EMISSION CONCENTRATIONS OF DUST AND COMBUSTION PRODUCTS DURING EXECUTION OF WORKS ON CONSTRUCTION OF THE PIPELINE

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ABSTRACT

For the purposes of the Tivat Airport within the space of the Airline service Tivat there are reservoirs for reception and storage of kerosene. Kerosene deliveries to the warehouse of the Airline service Tivat is provided via the existing mooring of ships by Jugopetrol. As the existing pipeline is in poor condition, the need arose to build a new one. However, during the construction of a new pipeline, a problem occurs that the new pipeline cannot be installed along the same route as the existing one. During development of project documentation two variants of the route for the new pipeline have emerged as follows that the pipeline runs overland part of the route along the coast and the other variant that pipeline is placed in the sea. It is assumed that the potential impacts on air quality are important during construction of the pipeline on overland route, so in this paper calculations will be presented of emission and immission concentrations of dust and combustion products during construction works of the pipeline which will be used to transport kerosene for the purpose of the Tivat Airport. In addition to calculations of emission and immission concentrations of dust and combustion products, calculations of noise that occurs during execution of works are also presented.

Key words: air pollution, combustion products.

INTRODUCTION

For the realization of works along the route of the coastal promenade (land route) it is necessary to engage the appropriate mechanization. For executing works on digging canals an excavator will be engaged with appropriate characteristics whose total running time is not more than 3 working days. For removing the excavated material from the pipeline route a loading shovel will be engaged for whose work only one day, or one shift will be needed. Since the work of loading shovels depends on the work dynamics of a truck for transport of excavated material, or if one truck is engaged it will take about 5 working days to remove excavated material from the site of the route. As the technology of work provides that the pipeline for kerosene and diesel fuel is placed in sealed concrete channel, it takes about 15 working days for shuttering and concreting. Setting pipes and their connections can be completed in about 3 working days, and backfilling and planning of the covered channel after installing pipelines can be completed in about 2 working days.

On the basis of these preliminary data, if weather conditions are favorable realization of works is possible in approximately 28 working days.

AIR QUALITY IMPACT ANALYSIS

For realization of works on the construction of pipeline for kerosene from ship mooring to Airline service Tivat it is necessary to engage the appropriate mechanization and provide impact assessment of its operations on the environment in the immediate environment of the route of the concerned pipeline.

It is indisputable that operation of machines and their drive motors by combusting petroleum as fuel shall emit in the exhaust gas a certain amount of polluting gases and particulate matters.

AIR POLLUTION CALCULATION

For digging channels to set up pipelines for kerosene and diesel fuel, and other earthworks it is necessary to engage an excavator, loading shovel and a truck. The listed machines use diesel fuel as motor fuel, and its consumption is 0,2 kg/kWh.

Accordingly, exhaust gases from the machines working on the excavation of material can be calculated.

Calculation is conducted on the basis of specifications and standards to be met by drive motors of working machines and the planned annual number of working hours of machines.

All power machines must meet standard norms of limit emissions of the EU Directive 97/68/EC which defined standards for manufacturers. Implementation of regulations began in 1999 with EU Stage I, while the EU Stage II in 2001.

Applying much stricter standards of permissible emission of harmful substances of EU Stage III and Stage IV is connected with 2006 and 2014 in accordance with the Directive 2004/26/EC. Total emissions below are calculated according to the limit values for non-road machinery, i.e. operating equipment for standardized allowable emissions of CO, HC, NO_x and PM10. Thus, operating machines that would be used for digging canals for pipelines, shipping surplus of excavated material and its disposal at the landfill meet the specifications of EU Stage IIIb standards.

The following tables show the approximate values of emissions of harmful gases, dust (particulate material) and noise during execution of construction work for a specified period of time, and the emissions are calculated according to data on provided operating machines and their operating hours (calculated according to EU Stage IIIb). Considering that the calculated emissions represent the maximum allowable, actual emissions will be less. Therefore, the calculated emissions can be seen as so-called worst case (worst case) emission of exhaust gases.

Table 1. Stage III B Standard for non-road machinery

Cat.	**Power**	**Date**	**CO**	**HC**	**NO_x**	**PM**
	kW		***g/kWh***			
L	$130 \leq P \leq 560$	2011.01	3.5	0.19	2.0	0.025
M	$75 \leq P < 130$	2012.01	5.0	0.19	3.3	0.025

Impact assessment during excavation

Calculation of emission of harmful substances (gases and particulate matters) and noise from the machinery operating on the route of the pipeline is given in Table 2.

Table 2. Limit emissions of gases, particulate matters and noise occurring from operation of construction machinery

Type of equipment	Engine power (kW)	exhaust gases (m^3/s)	Limit emission of gases and particulate matters PM10 (g/s)				Noise dB(A)
			CO	CH	NO_x	PM10	
Excavator	92	0,0644	0,0894	0,0048	0,0511	0,006	87
Truck	162	0,1134	0,1575	0,00865	0,09	0,0011	85
Loader	230	0,161	0,223	0,0121	0,127	0,0015	87
Auto-mixer for concrete	200	0,140	0,194	0,010	0,111	0,0013	89

On the basis of the obtained data on emission values concentration values of immission of polluting substances were calculated.

Immission concentrations of polluting substances were calculated using the Gaussian model of diffusion. The calculation is based upon the composed computer program (Zic M, 2006, 2008) based on Gaussian dispersion model for the most common case of state of the atmosphere, the so-called "D" state or neutral according to the Pasquila scale, or TA-Luft III/1. Horizontal and vertical dispersion coefficients are related to the rural area (Briggs, 1973). The calculation results represent immission concentrations at the surface of the terrain, at respective distances from the place of emission in average atmospheric conditions (temperature and wind) during the year.
Calculations were carried out in work conditions of: bulldozers, excavators, loaders, transport vehicles.

The calculation results are given in Table 3.

In the "D" state of the atmosphere and winds from the south and southwest quadrants, and earthworks in these conditions, which can be said to have been unfavorable to the surrounding residential buildings, the following calculation of immission concentrations of polluting gases and particulate matters has been made. On the basis of calculation results (Table 3), it is obvious that the maximum concentrations achieved are at a distance of 162 m from the place of emission. Maximum immission concentrations are achieved with the wind from the SW quadrant and average wind speed of 2.4 m/s. Given the duration of execution of works (these are mobile pollution sources) it is not expected to perform work in one place for more than one tenth of a minute, and thus do not generate concentrations above the values limited by law.

Table 3. Immission concentrations of gases and particulate matters caused by operation of construction machinery at the concerned location

Source of emission	Direction, wind speed and frequency	Distance from place of emission to place of immission (m)	Immission concentrations of gases and particulate matters			
			CO (mg/m³)	*HC (µg/m³)*	*NO_x (µg/m³)*	*PM (µg/m³)*
Excavator	***S 3,6m/s č=14,45%***	***150***	***0,031***	***1,716***	***18,247***	***2,145***
		162	*0,032*	*1,725*	*18,366*	*2,156*
		180	***0,031***	***1,688***	***17,973***	***2,110***
	SW 2,4m/s č=4,5%	***150***	***0,047***	***2,574***	***27,411***	***3,218***
		162	*0,048*	*2,587*	*27,550*	*3,234*
		180	***0,047***	***2,532***	***26,960***	***3,165***
Excavator + Loader	***S 3,6m/s č=14,45%***	***150***	***0,136***	***7,420***	***77,602***	***0,929***
		162	*0,136*	*7,393*	*77,996*	*0,934*
		180	***0,133***	***7,298***	***76,327***	***0,914***
	SW 2,4m/s č=4,5%	***150***	***0,204***	***11,130***	***116,403***	***1,394***
		162	*0,205*	*11,187*	*116,993*	*1,401*
		180	***0,200***	***10,947***	***114,49***	***1,371***
Limit values			*Max. 8h, average value 10mg/m³*		*1h, average value 200 µg/m³*	*Daily average value 40 µg/m³*
					Annual average value 40 µg/m³	

NOISE CALCULATION

The work of construction machines on the route of the pipeline will generate a certain level of noise. Since the execution of the works is carried out in the coastal area (village Bonići) that is populated and with residential building in the immediate vicinity of the pipeline route, calculation is performed of the level of noise generated by operation of engaged construction machinery.

Considering the spatial position of the village Bonići and provisions of the Rulebook on limit values of noise in the environment, manner of determination of noise indicators and acoustic zones and assessment methods of harmful effects of noise (Official Gazette of Montenegro, No. 60/11), an area in which the works are executed belongs to the Zone III for which the limit values of noise are 50 dB for daytime and nighttime conditions and 45 dB at night.

The case of parallel work of loaders and trucks is adopted for calculation. The calculation was prepared under conditions of free propagation of sound for distances up to 25 m from the noise source and the distance of where the noise level is equal to limit (permissible) values. The calculation results are given in Table 4.

Table 4. Noise levels generated by operation of construction machinery at the concerned location

Source of noise	Distance from the source of noise (m)	Noise level (dB)
Loader + Pickup truck	***5***	***62***
	10	***56***
	15	***52***
	19,95	*50*
	25	***48***

On the basis of the above it can be concluded that the noise levels at a distance up to 20m away from the noise source is greater than the level allowed by the Law.

CONCLUSION

On the basis of the presented results of calculation of emission and immission concentrations of dust and fuel combustion products during operation of machinery in the course of execution of works on the construction of pipelines for kerosene and diesel fuel it has been shown that the maximum concentrations occur at distances up to 162 m from the place of emission. Maximum immission concentrations are achieved with the wind from the SW quadrant and average wind speed of 2.4 m/s. As these are mobile polluting sources, and duration of execution of works is not long (execution of works in one place longer than ten minutes is not expected), it can be concluded that in the area of the pipeline route no concentrations above the value limited by law will be achieved.
Based on the obtained results of calculation of emission and immission concentration of dust and combustion products, as well as the level of noise that will occur during the execution of the works is not necessary to perform monitoring, because it is a relatively short time interval required for execution of works.

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ENVIRONMENTAL IMPACT OF CONSTRUCTION OF THE SECTION OF THE PRIMARY ROUTE NIKŠIĆ -VIDROVAN

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ABSTRACT

The section of the primary route Nikšić - Vidrovan part of the primary route no. 18, which goes from the Serbian-Hungarian border over Sombor, Bijeljina, Sarajevo, Brod na Drini, Šćepan Polje, Nikšić to Božaj, i.e. Montenegrin-Albanian border.

Possible impacts of the construction of this primary route on the environment and their characteristics can be reduced to several impact categories such as: possible impacts of air pollution caused by emissions exhaust gases during the flow of traffic on this road and the section of the road, impact of noise due to operation of excavators, bulldozers, loaders and trucks (during the execution of works), and impact of noise on the environment during the flow of traffic on this road direction, and also impact on changing topography of the terrain (changes in the morphological structure of the terrain in the course of road construction).

This paper will present impacts that occur during execution of works which are manifested through impacts on air quality, land and water, as well as possible impacts present during functioning of this section.

Key words: construction machines and environmental impact.

INTRODUCTION

Any works in the nature, i.e. in the environment, justifies, socially useful, etc. disturb the existing equilibrium and have certain consequences and impacts on the natural environment. These impacts can be temporary or permanent.

In the concrete case of temporary importance are the negative consequences that arise due to execution of works on construction of the road and road facilities.

Permanent consequences are reflected primarily in the usurpation of land, increased traffic flow which entails increased level of noise, air pollution, vibration, water pollution, land and change of the landscape.

In addition to these, so to say, negative impacts the existence of the road is necessary, very useful and positive in terms of, first of all, safer traffic, faster communication of people, goods, etc.

The respective section of the primary route Nikšić - Vidrovan was designed with two traffic lanes, width of 3m or total of 6m on the part from Gornje Polje to Šćepan Polje. On the part from Gornje Polje to Nikšić (planned loops) road with two traffic lanes of 3.50 m, 7.00 m in total was planned.

Morphologically, the terrain in the area of the designed road is hilly with typical forms of the Dinaric karst. There are sinkholes, delves, karst field with alluvial deposits and more. In accordance with the regulations for road design the terrain was categorized as hilly.

In geological terms the area through which the designed road passes was built mainly of sediments represented by limestone and dolomites, and transitional varieties. Considering the geological structure the requirements for construction are very favorable.

The total length of the route of this section of the primary route is 14,920 m.

SELECTION OF MACHINERY FOR EXECUTION OF WORKS ON EXCAVATIONS, EMBANKMENTS, REMOVAL, TRANSPORT OF THE MATERIAL AND ASPHALT WORKS

During execution of construction works, i.e. during construction of the road from Nikšić to Vidrovan excavation of the rock mass of V and VI category and preparation of embankment will be done with construction machinery. As this machinery are fueled by oil that in the following tables we show the emissions and noise resulting from operation of these machines.

Table 1. Selection of machinery for excavation of materials of III and IV category

Machine	*Engine power kW*	*Air emissions from engine (EU STAGE IIIB) in g/kWh*				*Noise level dB*
		CO	*CH*	*NO_x*	*PM10*	
Bulldozer CAT D8H	***199***	***696,5***	***37,81***	***398***	***39,8***	108
Hidr.excav. Volvo EC460	***239***	***836,5***	***45,41***	***478***	***47,8***	*73*
Loader Volvo L120	***164***	***574***	***0,665***	***328***	***32,8***	***97***
Dump truck 243	***243***	***850,5***	***46,17***	***486***	***48,6***	97

Table 2. Selection of machinery for excavation of materials of V and VI category and for construction of embankments

Machine	*Engine power kW*	*Air emissions from engine (EU STAGE IIIB) in g/kWh*				*Noise level dB*
		CO	*CH*	*NOx*	*PM10*	
Rog with compressor	***186***	***651***	***35,34***	***372***	***37,2***	***78***
Hidr.excav. Volvo EC460	***239***	***836,5***	***45,41***	***478***	***47,8***	***73***
Loader Volvo L120	***164***	***574***	***0,665***	***328***	***32,8***	***97***
Bulldozer CAT D8H	***199***	***696,5***	***37,81***	***398***	***39,8***	*108*
Dump truck 243	***243***	***850,5***	***46,17***	***486***	***48,6***	*97*
Vibro roller	***93***	*325.5*	*17,67*	*186*	*18,6*	*92*

Table 3. Selection of machinery for construction of carrier layer of crushed stone

Machine	*Engine power kW*	*Air emissions from engine (EU STAGE IIIB) in g/kWh*				*Noise level dB*
		CO	*CH*	*NO_x*	*PM10*	
Loader Volvo L120	***164***	***574***	***0,665***	***328***	***32,8***	97
Dump truck 243	***243***	***850,5***	***46,17***	***486***	***48,6***	97
Bulldozer CAT D8H	***199***	***696,5***	***37,81***	***398***	***39,8***	108
Vibro roller	***103***	***360.5***	***19,57***	***206***	***20,6***	92
Water tank	***260***	***910***	***49,4***	***206***	***20,6***	64

Table 4. Selection of machinery for construction of asphalt layers

Machine	*Engine power kW*	*Air emissions from engine (EU STAGE IIIB) in g/kWh*				*Noise level dB*
		CO	*CH*	*NOx*	*PM10*	
Dump truck 243	***243***	***850,5***	***46,17***	***486***	***48,6***	*97*
Finisher	***88***	***264***	*19.72*	***176***	*17,6*	*90*
Roller	***93***	***325,5***	*17,67*	***186***	*18.6*	*92*
Rubber tyred roller	***59***	***206,5***	***11,21***	***118***	***11,8***	***89***
Vibro roller	***103***	***360.5***	***19,57***	***206***	***20,6***	*92*

PROCEDURE OF PROGNOSTIC CALCULATIONS OF EMISSIONS AND CONCENTRATION OF GASES AND DUST FROM THE STATIONARY AND NON-STATIONARY SOURCES DURING CONSTRUCTION ALONG THE ROUTE

In this chapter, an assessment was conducted of possible and expected impact on the environment of construction works on the road, road other facilities.

Environmental impact assessment and work on excavation of rock material, was done as these are performed in a single shift. Consequences of execution of works are certain emissions and concentrations of harmful components that may endanger the health of employees, or threaten both life, and working environment.

Drilling and blasting

For the calculation of emissions and concentrations of harmful components that occur during mining, we used the following data: length of the mine field, width of the minefield, surface of the minefield, the number of borehole rows in a minefield and the number of boreholes in a row, the distance between the boreholes in a row, the distance between borehole rows, the total number of boreholes in the minefield, the total length of drilling for one mining, line of least resistance, the length of the borehole, the quantity of explosives per borehole and the required quantity of explosives.

Emission of dust during drilling of mineholes depends on the manner and speed of drilling, borehole diameter and the mechanical properties of rocks.

In the particular case for determining the emission of dust during drilling of mineholes with the described set the following expression was used:

$$E = Q_v(N_{izl.} - N_p),\ \text{mg/s}, \qquad (1)$$

where:

E - Emission of dust during drilling (mg/s)

Q_v - Capacity of the device for air aspiration (m^3/s)

N_{izl} - Concentration of dust at the outlet pipe (mg/m^3)

N_p – Background radiation of dust in the surrounding atmosphere (mg/m^3)

Calculation of average values of emissions of polluting substances that occur during execution of drilling and detonating explosives

The mean value was used for calculation for these five zones, both for drilling depth and amount of explosives, and consequently for the emission values and calculating the time required for executing drilling works, as well as the number of machines needed for drilling.

Emission calculation was carried out for a drilling set, and for a minefield length of 10 m, width of 2 m and an average drilling depth of 6.3 m. Drilling of mineholes with the drill Atlas Copco ROC F6 will achieve the emission of dust of:
E = 80,64 mg/s.

The total amount of dust that rose with the cloud of gaseous products of explosives detonation represents dust emission in the time interval of mining duration (10-40 s). Considering the height of the cloud after explosive detonation and duration of explosion mineral dust concentration with the concerned facilities is negligible keeping in mind the increased speed at heights greater than 10 m.

Table 5. Mass emissions of polluting substances during execution of drilling and blasting works

Objects	Zone profile	PM10 drilling mg/s	Mass emission mg/s	
			CO	NOx
1 to 54	412 - 688	0.08064	2.03415	0.21965

Calculation of emissions of harmful substances (gases and particulate matters) from operation of machinery

Calculation of emissions of harmful substances (gases and particulate matters) of machinery operating on the route of road Nikšić (Grebice) - Vidrovan (Šipačno) is given in the Tables 6-11.

Table 6. Emission concentrations of polluting substances generated during construction of embankments on the section Nikšić (Grebice) - Vidrovan (Šipačno), subsection km 4 +055 to km 4 + 250 (profile 224-234; L = 195 m)

Machine	Ef. working hours	Engine power (kW)	Machine number	Emission for total working hours kg/ef. work			
				CO (mg/m^3)	CH ($\mu m/m^3$)	NO_x ($\mu m/m^3$)	PM10 ($\mu m/m^3$)
Loader	*80*	*164*	*1*	*45,92*	*2,492*	*26,24*	*0,328*
Bulldozer	*80*	*199*	*1*	*55,72*	*3,024*	*31,84*	*0,378*
Truck	*88*	*243*	*1*	*74,84*	*4,062*	*42,76*	*0,534*
Emission in kg/total ef. working hours				***80.48***	***9.578***	***100.844***	***1,24***
Maximum emission g/s				***0.254***	***0,0302***	***0,318***	***0,0039***

Table 7. Emission concentrations of polluting substances generated during construction of embankments on the section Nikšić (Grebice) - Vidrovan (Šipačno), subsection km 7 + 900 to km 8 + 300 (profile 445-471; L = 400 m)

Machine	Ef. working hours	Engine power (kW)	Machine number	Emission for total working hours kg/ef. work			
				CO (mg/m^3)	CH (μm/m^3)	NO_x (μm/m^3)	PM10 (μm/m^3)
Loader	*165*	*164*	*1*	*94,71*	*5,141*	*54,12*	*0,676*
Bulldozer	*256*	*199*	*1*	*114,92*	*6,238*	*65,67*	*0,820*
Truck	*243*	*243*	*1*	*217,72*	*11,819*	*124,41*	*1,555*
Emission in kg/total ef. working hours				***427,35***	***23,198***	***244,2***	***3,051***
Maximum emission g/s				***0,463***	***0,025***	***0,264***	***0,0033***

Table 8. Emission concentrations of polluting substances generated during construction of embankments on the section Nikšić (Grebice) - Vidrovan (Šipačno), subsection km 8 + 900 to km 9 + 200 (profile 506-526; L = 300 m)

Machine	Ef. working hours	Engine power (kW)	Machine number	Emission for total working hours kg/ef. work			
				CO (mg/m^3)	CH (μm/m^3)	NO_x (μm/m^3)	PM10 (μm/m^3)
Loader	*165*	*164*	*1*	*94,71*	*5,141*	*54,12*	*0,676*
Bulldozer	*165*	*165*	*1*	*114,92*	*6,238*	*65,67*	*0,820*
Truck	*184*	*243*	*1*	*156,49*	*8,495*	*89,424*	*1,117*
Emission in kg/total ef. working hours				***366,12***	***19,874***	***209,214***	***2,613***
Maximum emission g/s				***0,552***	***0,030***	***0,315***	***0,0039***

Table 9. Emission concentrations of polluting substances generated during construction of embankments on the section Nikšić (Grebice) - Vidrovan (Šipačno), subsection km 9 + 580 to km 9 + 800 (profile 530-564; L = 220 m)

Machine	Ef. working hours	Engine power (kW)	Machine number	Emission for total working hours kg/ef. work			
				CO (mg/m^3)	CH (μm/m^3)	NO_x (μm/m^3)	PM10 (μm/m^3)
Loader	*91*	*164*	*1*	*32,243*	*2,835*	*29,848*	*0,373*
Bulldozer	*91*	*165*	*1*	*52,552*	*2,852*	*30,03*	*0,375*
Truck	*140*	*243*	*1*	*119,07*	*6,463*	*68,04*	*0,850*
Emission in kg/total ef. working hours				***223,86***	***12,15***	***127,918***	***1,598***
Maximum emission g/s				***0,444***	***0,024***	***0,253***	***0,0031***

Table 10. Emission concentrations of polluting substances generated during construction of embankments on the section Nikšić (Grebice) - Vidrovan (Šipačno), subsection km 9 + 900 to km 10 + 100 (profile 572-584; L = 200 m)

Machine	Ef. working hours	Engine power (kW)	Machine number	Emission for total working hours kg/ef. work			
				CO (mg/m^3)	CH (μm/m^3)	NO_x (μm/m^3)	PM10 (μm/m^3)
Loader	*83*	*164*	*1*	*47,64*	*2,586*	*27,224*	*0,3403*
Bulldozer	*83*	*165*	*1*	*47,93*	*2,602*	*27,39*	*0,342*
Truck	*127*	*243*	*1*	*108,01*	*5,863*	*61,72*	*0,771*
Emission in kg/total ef. working hours				***203,58***	***11,051***	***116,33***	***1,453***
Maximum emission g/s				***0,445***	***0,0211***	***0,254***	***0,003***

Table 11. Emission concentrations of polluting substances generated during construction of embankments on the section Nikšić (Grebice) - Vidrovan (Šipačno), subsection km 11 + 730 to km 11 + 820 (profile 572-584; L = 90 m)

Machine	Ef. working hours	Engine power (kW)	Machine number	Emission for total working hours kg/ef. work			
				CO (mg/m^3)	CH ($\mu m/m^3$)	NO_x ($\mu m/m^3$)	PM10 ($\mu m/m^3$)
Loader	*37.2*	*164*	*1*	*21.35*	*1.159*	*12.201*	*0.152*
Bulldozer	*37.2*	*165*	*1*	*21.483*	*1.166*	*12.276*	*0.153*
Truck	*57,2*	*243*	*1*	*48.648*	*2.640*	*27.79*	*0.347*
Emission in kg/total ef. working hours				***61.481***	***4.965***	***52.267***	***0.652***
Maximum emission g/s				***0.298***	***0.024***	***0.2538***	***0.0031***

Considering that in the vicinity of the section of the main road Nikšić - Vidrovan there are 28 residential buildings registered, which are due to secured corridor at a proper distance, results of immission concentrations of polluting substances which generate during the construction of this section are not threatening for these facilities. Due to the extensiveness these results are not presented in this paper, and the calculations were made for all the sub-sections for which calculated emission concentrations are given in the tables above.

CONCLUSION

The obtained results show that during construction of a section of the primary route Nikšić - Vidrovan legal regulations which regulates norms that must be followed during the construction of roads will be respected, both in terms of procedures of mining and engaging the necessary machinery.

Results of emission concentrations of polluting substances, as well as immission values of the same show that their level is significantly below the limit values, primarily due to secured corridor for construction of this section of the road, so that the impact of construction on existing residential buildings in the vicinity is practically eliminated.

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TOXIC METALS AND METALLOID CONTENT OF TOTAL SUSPENDED PARTICULATE MATTER WITHIN NOVI SAD

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ABSTRACT

The chemical composition of particles in air is very important for the assessment of the impact of the air quality on human health.

The objective of this investigation was determination (AAS) of the content of six toxic metals (Pb, Cd, Mn, Zn, Cr, Ni) and one metalloid (As) in total suspended particulates matter, collected during 2012. at an industrial area of Novi Sad. Calculated average annual values for Pb and Cd were on the level of detection, and for Zn, Ni and As were 1.33 μg/m^3, 20.4 ng/m^3 and 4.1 ng/m^3, respectively. Average annual Mn concentration (40 ng/m^3), was over 3-fold lower than WHO tolerance level.

Key words: Trace Elements, Particulate Matter, Air Pollutants.

INTRODUCTION

Total suspended particulate matter (TSP) represents a complex mixture of organic and inorganic substances with particles size less than 100 μm (1). They include dust, dirt, soot, smoke and liquid droplets emitted into the air. Airborne particulate matters may be characterized by their physical attributes, which influence their transport and deposition, and their chemical composition, which influences their effect on health (2).

Some proportion of TSP consists of particles too large to enter the human respiratory tract; therefore, TSP is not good indicator of health-related exposure. TSP-based standards were used in the United States until 1987. Several countries in Central and Eastern Europe still monitor and set standards based on measurements of TSP. Recent evidence shows that fine particulates, which can reach the thoracic region of the respiratory tract, or lower, are responsible for most of the excess mortality and morbidity associated with high levels of exposure to particulates. The particles most likely to cause adverse health effects are the fine particulates PM_{10} and $PM_{2,5}$ – particles less than 10 μm and 2,5 μm in aerodynamic diameter, respectively(2).

Over the past two decades, a number of epidemiological studies has provided sufficient evidence that exposure to ambient particulate matter poses a significant threat on human health (3). In other to address this issue, the European Union has promulgated air quality standards for PM_{10}. Particle size distribution and particle number are considered closely associated to adverse health outcomes. It would be wrong to underestimate the importance of the chemical composition of particles and especially their content in toxic substances (4). The European Union has set two air quality standards: for lead (1^{st} Daughter Directive) (5) and 4^{th} Daughter Directive (6) which requires the long term assessment of arsenic, nickel and cadmium concentrations, setting certain assessment thresholds and render the fixed measurement of ambient concentrations mandatory when these thresholds are exceeded (7).

In this framework, during the association process to European Union, Serbian Ministry of Environmental Protection has adopted low acts for air protection, monitoring and air quality requirements. Regulation for monitoring and air quality requirements ("Serbian Book of regulation" No. 11/2010 and 75/2010), set annual limit value for lead of 0,5 $\mu g/m^3$ and target values for arsenic of 6 ng/m^3, cadmium of 5 ng/m^3 and nickel of 20 ng/m^3, annual limit value for PM_{10} of 40 $\mu g/m^3$, target value for $PM_{2,5}$ of 25 $\mu g/m^3$ and maximum allowed TSP concentration of 70 $\mu g/m^3$.

Elevated concentrations of lead can induce severe neurological and hematological effects to the exposed population and especially children. The main emission source of lead in the atmosphere for many years has been the use of leaded gasoline in vehicles. Since the lead content in fuels has been regulated during the past years, industrial sources and fuel burning activities have been assumed a bigger importance in ambient lead production (8).

Compounds of arsenic, cadmium and nickel are susceptible for inducing carcinogenetic effects in human, through inhalation. The main arsenic-emitting anthropogenic sources are the stationary combustion of fossil fuels (especially coal-burning) and to a lesser extent the metallurgy industry. Cadmium and nickel compounds in particulate matter, mainly originate from coal and fuel combustion processes, metallurgical industry and road transport (9).

Compounds of chromium at the sixth valence state are well known to be associated with toxic and most important with carcinogenic effects of the bronchial tree. There is some evidence that the abundance of hexavalent chromium in total suspended particles in urban areas is substantial. Chromium in ambient air originates mainly from metallurgical industries and oil refineries (10).

Concerning manganese, exposure to increased levels is known to lead to neurotoxical impairments. The suspension of crustal particles and industrial activities are mainly responsible for the ejection of manganese in the atmosphere (11).

Finally, increased levels of zinc can result to respiratory irritance. Emission of atmospheric zinc is mainly due to metal production and other industrial processes. However, there is mounting evidence that in urban areas, the road transport sector is a major zinc emission source (12).

The objective of the presented paper is investigation of seven toxic metals and metalloid content of total suspended particulates matter collected during 2012. at industrial area of Novi Sad.

MATERIAL AND METHODOLOGY

The sampling campaign was conducted from January to December 2012., on the sampling site Šangaj, 6 Školska Street, Novi Sad. Sampling site Šangaj is located in north-east part of Novi Sad at the end of residential area, industrial area on the east and river Danube on the south. Main industry in the city part is petrochemical industry with oil refinery. Samples were taken every month during 2012., by two to twelve samples per month frequency.

For total suspended particulate matter collection high volume sampler Proekos AT 2000 was used. Particulate matter was collected during 24 hours and the operation time was morning to morning. Total suspended particulate matter was collected on fiber glass filters (Whatman GF/A, diameter 110 mm) (13). Meteorological parameters (wind speed, wind direction, relative humidity and ambient temperature) were taken from Republic Hydrometeorological Service of Serbia.

Filters, after collection and weighting for quantification of total suspended matter, underwent chemical analysis, following hot acid extraction in order to determinate the metals and metalloids concentration. Extraction of filters was conducted with an acid mixture (HCl and HNO_3, 37% and 67%, respectively, Merck Germany) during 30 minutes on 140^0C. Ultrapure grade water was used during the analysis. Extraction details were exactly as defined by the relevant ASTMD 4/85-96 method (14). The final solution was analyzed for Pb, Cd, Zn, Ni, Mn, Cr using Flame Atomic Absorption Spectrometry (Perkin Elmer AAnalyst 300) and As using Hydride Generation Atomic Absorption Spectrometry (Thermo Scientific iCE 3000 Series with VP 100 vapor unit).

Assuming nominal daily collected volume of 160 m^3 the limits of detection were 0,02 $\mu g/m^3$ for Pb and Mn, 0,001 $\mu g/m^3$ for Cd, 1,0 ng/m^3 for Ni and total Cr and 0,5 ng/m^3 for As.

RESULTS AND DISCUSSION

Number of samples, monthly and annual arithmetic means and medians, as well as peak concentrations (maximum of single measurement values for the element), for six analyzed trace elements are displayed in Table 1. For statistical data processing, all values below detection limit were replaced with ½ of the value of detection limit.

The range of average monthly lead concentration was 0,01 $\mu g/m^3$ (January and July) to 0,04 $\mu g/m^3$ (March), and peak concentration was measured in one sample taken in May (0,10$\mu g/m^3$).

The minimal average monthly cadmium concentration was 0,001 $\mu g/m^3$ (all months except April and July) and maximum 0,004 $\mu g/m^3$ (April). Cadmium peak concentration was measured in April (0,021$\mu g/m^3$).

For both lead and cadmium, maximum average monthly concentrations were 4-fold of minimum ones. There were no indications of seasonal variations in Pb and Cd concentrations during the year. Monthly mean and median values were comparable mutually, as well as with annual mean and median values.

Considering manganese, the minimal average monthly concentration was 0,01 μg/m^3 (January, November and December) and maximum (March) was 9-fold higher (0,09 μg/m^3). Manganese peak concentration, measured in March, was 0,10 μg/m^3. Monthly mean and median were comparable. There was no indication that Mn concentration fluctuate with the seasons. Serbian Regulation for air quality, like European Directives, do not set limit nor target value for manganese in air, but Air Quality Guidelines of WHO 2000 include an annual tolerance manganese concentration of 150 ng/m^3 (15). Compared with tolerance level, average annual manganese concentration obtained in this study (40 ng/m^3), was over 3-fold lower.

In four of twelve months average monthly concentration of zinc was below detection limit. The range of average monthly zinc concentrations was very broad (0,07 μg/m^3 in December to 7,22 μg/m^3 in April), with maximum 103-fold higher than minimum value. Zinc peak concentration of 22,5 μg/m^3 was reached in April. The fluctuation in zinc concentration during the seasons was noticed, with average concentration during the summer months 17-fold higher than in winter months (2,24 μg/m^3 and 0,13 μg/m^3, respectively). Also, average summer Zn concentration was 7-fold of average annual concentration (1,33 μg/m^3). It should be noted that there were 4 to 5 measurable daily concentrations during the month, resulting with average monthly concentration above detection limit.

In case of nickel, only one of twelve months had average monthly concentration on the level of limit of detection. The minimal average monthly nickel concentration was 1,0 ng/m^3 (July) and maximum was 117-fold higher (116,6 ng/m3, April). It should be noted that higher average monthly concentrations of nickel in March, April and August were result of one or two very high daily concentrations measured during that months. Consequently, mean and median values were not comparable. Annual range of nickel concentration varied from below detection limit (< 1 ng/m^3) to peak concentration of 467,3 ng/m^3 measured in March. Seasonal variations of nickel concentration were not observed.

Table 1. Descriptive statistics for Pb, Cd, Mn, Zn, Ni and As concentrations measured at sampling site Šangaj

	N	**Pb**, μg/m^3			**Cd**, μg/m^3			**Mn**, μg/m^3			**Zn**, μg/m^3			**Ni**, ng/m^3			**As**, ng/m^3		
		mean	med	max	mean	med	max	mean	med	max	mean	med	max	mean	med	max	mean	med	max
Jan.	5	0,01	0,01	0,02	0,001	0,001	0,001	0,01	0,01	0,02	<0,02	<0,02	<0,02	4,1	4,2	7,1	2,6	2,9	3,4
Feb.	2	0,02	0,02	0,02	0,001	0,001	0,001	0,02	0,02	0,02	<0,02	0,02	<0,02	< 1	< 1	< 1	1,5	1,5	1,9
Mar.	5	0,04	0,04	0,08	0,001	0,001	0,001	0,09	0,09	0,10	<0,02	<0,02	<0,02	93,9	< 1	467,3	2,7	2,4	4,1
Apr.	7	0,03	0,02	0,06	0,004	0,001	0,021	0,05	0,06	0,06	7,22	5,80	22,50	116,6	7,1	442,0	3,6	3,2	7,0
May.	7	0,03	0,02	0,10	0,001	0,001	0,004	0,02	0,01	0,05	2,52	<0,02	11,60	1,6	< 1	6,0	1,2	1,4	2,2
Jun.	9	0,02	0,02	0,04	0,001	0,001	0,004	0,05	0,05	0,07	1,18	<0,02	4,80	4,2	< 1	25,2	3,3	2,8	7,8
Jul.	11	0,01	0,01	0,02	0,002	0,003	0,005	0,04	0,04	0,07	0,76	0,60	2,10	1,0	< 1	2,4	2,2	2,6	3,8
Aug.	12	0,02	0,02	0,07	0,001	0,001	0,002	0,05	0,06	0,09	1,09	<0,02	5,80	11,8	< 1	136,0	1,4	1,0	3,6
Sep..	3	0,02	0,02	0,04	0,001	0,001	0,001	0,04	0,04	0,04	0,70	0,60	1,50	2,2	1,8	4,2	4,6	3,0	9,0
Okt.	7	0,03	0,01	0,09	0,001	0,001	0,002	0,02	0,02	0,04	0,65	<0,02	2,10	2,4	2,7	4,2	3,6	3,2	5,9
Nov.	8	0,02	0,02	0,04	0,001	0,001	0,002	0,01	0,01	0,02	<0,02	<0,02	<0,02	13,0	1,5	53,9	4,2	2,8	11,7
Dec.	5	0,02	0,02	0,04	0,001	0,001	0,002	0,01	0,01	0,02	0,07	<0,02	0,30	2,7	1,5	6,5	25,1	18,6	62,4
All 12 months	81	0,02	0,02	0,10	0,001	0,001	0,021	0,04	0,03	0,10	1,33	<0,02	22,50	20,4	< 1	467,3	4,1	2,5	62,4

N – number of samples

The minimal and maximum average monthly concentrations of arsenic were 1,5 ng/m^3 (February) and 25,1 ng/m^3 (December), respectively, with maximum 17-fold of minimum, and peak concentration of 62,4 ng/m3 in December. Monthly mean and median values were comparable, with no large fluctuation in As concentration during the year.

Total chromium concentrations are not in given in the Table 1, because during the eight of twelve months average monthly concentrations were below the detection limit. Only in the January (1,2 ng/ m^3), August (3,72 ng/ m^3), November (4,0 ng/ m^3) and December (1,5 ng/ m^3) total chromium was found in measurable quantities. Information on the speciation of chromium in ambient air is essential since, when inhaled, only hexavalent chromium is carcinogenic in humans. The available toxicity data are derived from studies among chromium(VI)-exposed workers. It should be noted that chromium concentration in air is often expressed as total chromium and not chromium(VI). The concentrations of chromium(VI) associated with an excess lifetime risk of 1:10 000, 1:100 000 and 1:1 000 000 are 2.5 ng/m3, 0.25 ng/m3 and 0.025 ng/m3, respectively (15). From that reason, it is not possible to compare concentration of total chromium measured in this study with toxicologically relevant levels of chromium(VI) (15).

CONCLUSION

In conclusion, although it is not possible to compare obtained annual average values for Pb, Cd, Ni and As with values set in low, because of the difference between type of investigated particulate (TSP) and particulate defined in low (PM_{10}), results of this study can be valuable insight into toxic metals levels in the air represented by monitored sampling site in Novi Sad.

However, in case of manganese there is guideline that can be used for comparison. Average annual manganese concentration obtained in this study was below tolerance level recommended by WHO (15). Considering other investigated elements, some interesting points will be mentioned. The widest ranges of average monthly concentrations were observed for nickel and zinc. Only zinc showed seasonal variations. The reasons for the appearance of few measured daily peak zinc concentration in monitored year is not known. There were also measurable quantities of arsenic in TSP.
Finally, taking into consideration that levels of lead and cadmium measured in TSP in the present study were below the respective maximum/target values defined for PM_{10} fraction of particulate matter, it could be concluded that these elements do not pose risk for human health.

Further investigation should be directed towards determination of toxic metals content in PM_{10}, in order to find out is there any concern for human health. Also, influence of weather conditions on trace elements distribution in air should be investigated.

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MEASUREMENT OF ELECTROMAGNETIC RADIATION AT THE WORKPLACE -IN THE METALLURGICAL LABORATORY

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ABSTRACT

A large number of people is constantly exposed to the electromagnetic field at their workplaces. This paper presents the results of measurements of the magnetic field caused by laboratory furnaces in a metallurgical laboratory. The results show that staff in metallurgical laboratories are exposed to very high electromagnetic radiation (with magnetic induction $B \approx 220$ μT)

Key words: Electromagnetic field, Magnetic induction, Human health.

INTRODUCTION

Technological development caused that people are surrounded by artificially created electromagnetic fields (EMF). Therefore, people are exposed to electromagnetic radiation at home and at their work places [1].

The biochemical compounds in living cells are composed of charges and dipoles that can interact with electric and magnetic fields by various mechanisms. EMF penetrate cells unattenuated and so can interact directly with the DNA in the cell nucleus, as well as with other cell constituents. However, biological agents are impeded by membranes and require special mechanisms to gain access to the cell interior [2].

As a consequence of EMF presence the DNA can be damaged by free radicals that are formed inside cells. Free radicals affect cells by damaging macromolecules, such as DNA, protein, and membrane lipids [3]. Co-exposure to ELF-EMF and other oxidative stress-inducing pollutants could trigger the failure of the antioxidant response and the collapse of the homeostatic capability of the cell, leading to oxidative damage and functional impairment. This may significantly increase the risk of occurrence of neurodegenerative disorders, so oxidative stress is considered as one of the main pathogenic mechanisms [4].

The referent limit level can be defined as the critical radiation level above which the environment conditions are unsafe for humans.According to the international commission for the non-ionized radiation [5] the referent limit level of the magnetic induction for the EMF frequency, f, related on people is $5/f$, while the limit value for the employees within the risk working conditions is $25/f$. Low-frequencies EMF were classified as probably carcinogenic to humans (Group 2B) by the International Agency for Research on Cancer [6]. Accoridng to the safety rules possed by the the Ministery of Occupational Safety and Environment Protection [7], the referent limit level of the magnetic induction for the EMF frequency, f, from 25 Hz to 800 Hz is $2/f$. Thus the referent limit level for f = 50 Hz is 0.04 μT. The Ministery of Occupational Safety and Environment Protection brought the low on the non-ionized radiation protection [8], which determines the risk conditions and protection measures in the critical situations.

Values of magnetic induction at some characteristic work places in the Bor town (accesiblle to authors) are shown in Table 1. The great number of people are exposed to harmful effects of electirical equipment such as: computers, lighting equipments, cooling devices etc (for examples investigators and officers) [1]. Physical environmental factors in the beauty salons may contribute to health problems of the hairdressers, and the electrical equipments in the workplaces may have cumulative electric and electromagnetic effects [9]. In such cases people are exposed to relatively small electromagnetic radiation. In these situations long time exposure to electromagnetic radiation is of greater importance.

Workers that maintenance transmission lines, industrial workers (especially in the industries with strong electrical appliances) are exposed to high magnetic fields, as shown in Table 1. In these cases, it is clear that the problem of long time exposure to EMF is more pronounced.

Table 1. Typical values of magnetic induction (B) for some workplaces.

Objects	B (μT)
Office	< 2
Electric transmision lines	6 – 20
Transformer stations	> 15
Metalurgical Laboratory	≈ 220

Our paper presents the results of measurements of magnetic induction in a metallurgical laboratory at the Technical Faculty in Bor.

EXPERIMENT

Measurements of the magnetic induction are performed with the measuring device EMF 828 (producted by Lutron). Such instrument can be used to measure magnetic induction in the range from 0.01 μT to 2 mT and in frequency range from 30 to 300 Hz. The EMF 828 has three measurement extents: 20 μT, 200 μT and 2000 μT. The measurement precision depends on the measurement extent and is of the order of 0.01 μT for the mesurement extent of 20 μT, 0.1 μT for the mesurement extent of 200 μT and 1 μT for the mesurement extent of 2000 μT. The EMF 828 can measure all three components of the magnetic induction *x*, *y* and *z*, and the total intensity of the magnetic induction is determined by the expression $B = (B_x^2 + B_y^2 + B_z^2)^{1/2}$.

The magnetic induction is measured at diferent distance from three metallurgical furnaces: Electric resistance furnace Heraeus (13.2 A, 5 kW, 380 V, 60 Hz), Electric resistance furnace Harry W. Dietert (220V, 14 A) and midle-frequent induction furnace Elphiac (4000 Hz, 750 V). The measurements were performed while furnaces were operated without materials being melted.

RESULTS AND DISCUSSION

The values of magnetic induction for metallurgical furnace Heraeus, for indicated positions and distances are presented in Table 2. The measured positions are in front, beside (on the left and on the right), behind and above the furnace. For the several positions, the magnetic induction values are measured at diferent distances from furnace (*d*-distance from furnace, *d* = 5cm; *d* = 30 cm; and *d* = 100 cm).

Table 2. Values of magnetic induction measured for metalurgical furnace Heraeus.

HERAEUS			
Position	*B* (μT)		
	d = 5cm	*d* = 30cm	*d* = 100 cm
On the right side	1.80069	0.3015	0.03606
In front	1.51783	0.48062	0.04243
On the left side	1.21408		
Above	1.06701		
Beside	5.07169		

The values of magnetic induction *B* for Harry W. Dietert and Elphiac metalurgical furnace are presented in Figure 1 and Table 3. The measured values are presented as function of used electrical current. For greatest values of used electrical current (*I* = 14 μA) the magnetic induction is measure for different distances. Values of magnetic induction strongly decrease, from *B* =17 μT (correspond to *I* = 14 μA) for distances *d* = 5 cm, to *B* = 1.2 μT (for *d* = 30 cm) and *B* = 0.13 μT (for *d* = 100 cm).

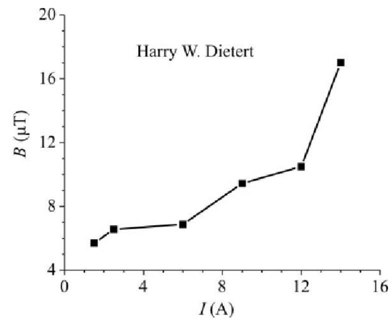

Figure 1. Magnetic induction *B* as function of applied electrical current measured at the distance of 5 cm far from furnace.

Table 3. Magnetic induction measured for metalurgical furnace Elphiac.

ELPHIAC			
Position	B (μT)		
	d = 5 cm	d = 30 cm	d =1 m
Melting pot – On the left side	151.24	21.37	3.21
Melting pot– In front	186.39	126.19	72.38
Melting pot- On the left side	220.23	12.37	0.68
Control unit – In front	2.45	0.29	
Control unit – Beside	1.04	0.37	
Engine generator	4.84	2.06	1.02
Junction box	9	3.02	0.76

As shown in Table 2 and Table 3, and in Figure 1, staff in the metallurgical laboratory are exposed to the very high electromagnetic radiation (magnetic induction B ≈ 220 μT). It should be noted that measurements are performed on relatively small laboratory metalurgical furnaces. In the industrial environment the quantities of metal melted are much higher so expected values of the magnetic induction are much higher compared to those presented in the paper. Therefore, the people that work in places with metallurgical ovens have to be properly protected.

CONCLUSIONS

The presented results indicates that workers in metalurgical laboratories are exposed to very high electromagnetic radiation. The measurements are performed to small laboratory metalurgical furnaces. In the industrial environment the quantities of metal melted are much higher as so as the expected values of the magnetic induction. Therefore, the people that work in places with metallurgical ovens have to be properly protected, and should avoid long time exposure to EMF.

Acknowledgments

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IMPACT QUARRYNG ADDITION TO A ROAD TRAFIC SAFETY IN THE KOLUBARA DISTRIKT

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ABSTRACT

This paper will present the negative impact of exploiting the mineral resources at the open pit mines in Kolubara district.Several quarries, such as Podbukovi, Brankovina, Slovac, Struganik, White Rock, and other smaller quarries are located in this region. These quarries are in close proximity to the transportation routes leading to Valjevo, Užice, Loznica, and Sabac. These companies operate in an environment with the population of over half a million people where the largest Serbian producers of vegetables, fruits, berries, milk, and meat are located. In this paper, a research has been done using a questionnaire asking the local people to identify the problems they face and the measures taken to improve their overall health as well as the traffic safety, since the exploited mines are located near the road and railway going from Belgrade to Bar. The purpose of this study is not to suspend or terminate the operations of these companies, but to point out the issue of inadequately issued work permits, and the failure to follow the regulations for environmental protection and health.

Key words: Environment, Safety, Degradation.

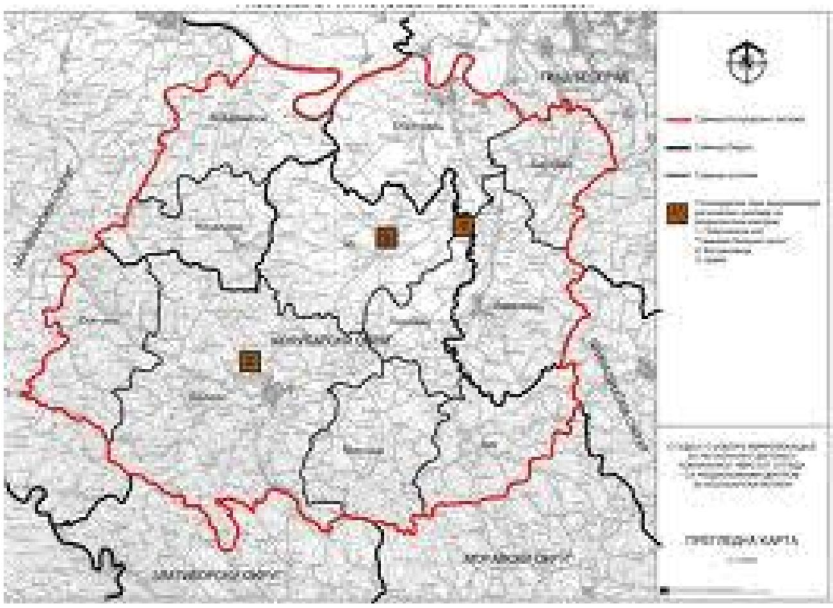
INTRODUCTION

Life environment represents a space in which life is being conducted, where a man lives and works and arranges his needs. All the greater environmental changes are the product of human activity. It has a negative impact on people in general, their health, as well as the well being of plants and animals. Therefore , environmental protection occupies our attention as well as the attention of the world community at a larger scale. Not taking the consequences into consideration, a man emphasizes the exploitation of natural resources, water, soil and air and by misuse of nuclear energy, chemicals and biological agents questions the very survival of the planet Earth. Mankind is today facing the ill- fated questions of its further existence and it has entered the third millennium with great global issues.

Each human activity in the space brings about certain changes and negative impacts on the maintenance of natural balance. According to the report of World Commission on Environment and Health (1987) sustainable development (SD) is defined as ‘’ development which meets the needs of current generations without compromising the ability of future generations to meet their own needs" . Sustainable development supports strong economic development along with the protection of the quality of life environment, one reinforcing the other. In a nutshell, the term 'Sustainable development' represents the achievement of economic and social development in the ways that don't exploit the natural resources of a country [1] .

Exploitation of mineral resources at the open pit mines is one of the man's long-term economic activities , which contributed to the cultural and industrial progress of mankind, but has had destructive effect on soil, relief ,flora and fauna and changed the original and recognizable image of a certain place. Stone exploitation inevitably causes the disturbance of naturally set balance by removing the vegetation and humus layer of the ground. The original stable ecosystems are disturbed and misplaced by steep, bare slopes , terraces and gangue formed hills .

Kolubara district is characterized by open pit mines' exploitation of mineral resources, rocks, sand and coal at some point . The construction of Belgrade-Bar railroad and commenced construction of Valjevo –Loznica railroad furthermore enhanced the development of this kind of activity. The above mentioned construction, as well as the existence of the railway traffic demanded great amount of construction material, especially all kinds of crushed stone, which is now being transported into the other parts of Serbia, especially for the needs of highway construction and the construction of the corridor 10. Here we want to point out the appearance of the negative impact of the exploitation of stone as a mineral resource at the open pit mines in Kolubara district. Kolubara district stretches across the middle part of Western Serbia and consists of the city of Valjevo and municipalities of Osecina, Ub, Lajkovac, Mionica, Ljig.



Picture 1. Kolubara district

THE ANALYSIS AND DISPLAY OF THE PRESENT STATE

Aggregates are defined as granular or particulate materials, which are either nature originated as sand and gravel, or produced by crushing (crushed stone) which when attached by binder (cement, lime or bitumen) or even without the binder, are used in the construction to form a part or the whole of a building or construction structure. They are also called 'construction aggregates' and used mostly as concrete, mortar, gravel, asphalt or drainage level or for construction fillings or railway curtains. Aggregates are very important in the infrastructural works, such as construction of roads. The amount of 30,000 tons of aggregates for the overall construction of 1km of road on a national level. For this purpose , aggregates are in the road base, or in the bitumen or concrete mixture of the road surface. The amounts which represent 20% of annual European consumption of aggregates are spent on the road construction , construction of runways , railroads and waterways. The overall European demand of aggregates is 3 millions of tons annually, according to the statistic data of UEPG , included in their annual reports for 2010-2011.

Picture 2. Stone exploitation, mobile crushing and sieving, 'Brankovina' quarry.

'Podbukovi' quarry occupies an area of 15 ha and it's located at the distance of 20km from Valjevo ,on the highway M-21 Valjevo-Kosjeric-Uzice. In the proximity of the quarry at the distance of 2km, there is a train station 'Lastra' , so there is a possibility of the stone transport by railway. The capacity of the crushing plant is 150t /h fractions. This quarry also is immediately beside the main road (Picture 3).

Picture 3. ' Podbukovi' quarry on the highway M-21

At distance of only 100m, there is an elementary school with few students, but nothing has been done in order to protect or relocate the object. There is also a small mountain river, 20 metres from there ,'Podbukovi' which suffers great pollution.

'Stubo' quarry

Located on the regional road R-111, 12 km from Valjevo towards Bajina Basta, there is a dolomite quarry. Picture 4

Road institute regularly controls and follows the quality of the stone aggregate which is used for lower and upper levels of the road constructions. For this purpose , the stone aggregate from the ' Stubo' quarry is being used.

Stone aggregate usage:

-construction of embankment dams.

-construction of traffic routes

Picture 4. 'Stubo' quarry on the regional road R -111

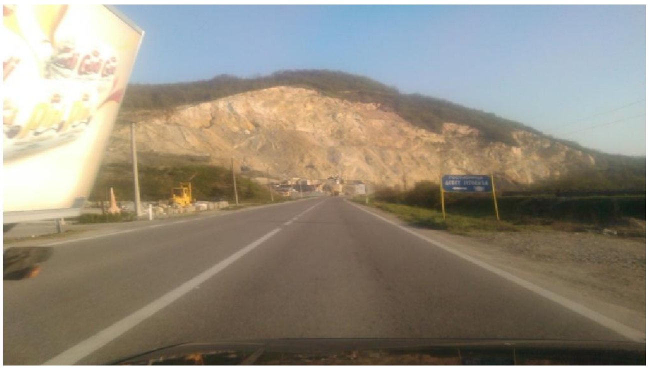
The company ' Borovica' performs the exploitation and crushing of the eruptive stones at the Tavani pit on Divcibare. Picture 5.

They perform drilling and mining of the eruptive rocks in the quarry. By using grinders and sieves, brands Bohringer, SBM& David, primary and secondary grinding and sieving of the eruptive stone is being performed, the product of which are different fractions of eruptive stones.

They also use deficient eruptive stone in their own asphalt factory. This kind of issuing permits and interruption of a green oasis is rarely found for comparison.

Picture 5. Tavani pit on Divcibare

Fifteen kilometres from Valjevo, there is ' Slovac' quarry, which is right beside the traffic route Valjevo- Lajkovac- Belgrade and railroad Belgrade- Bar. Picture 6. This quarry endangers the safety of the traffic participants and the whole population in this settlement. There are 21 households in this settlement, whose inhabitants are mainly engaged in agriculture, therefore their production is endangered too. Since the aggregates are being exploited mostly from the open pit mines, they have direct influence on the landscape. During the quarry and gravel pit' exploitation as well as during their transport, other consequences may appear. Besides , aggregate exploitation may influence also on nearby communities and their needs. Therefore, in order for exploitation without any problems, it is necessary to have social community approval. On the other hand, extraction of aggregates from the quarries and gravel pits is mostly a mechanical process which includes the transport of the larger quantities of materials which can disturb the local communities in several ways: 1) the surrounding landscape is changed , 2) life environment, natural habitats and species are affected 3) constant interruption caused by materials' transport across the villages etc. According to that, social questions which appear on the level of local communities are from two opposed views: a) the 'consumer' view, and b) the 'disturbed' population view. Many inhabitants do not support exploitation partly because they don't admit the fact that the society depends on aggregates. This syndrome ' not in my yard' may limit the development of aggregates. (2)



Picture 6. Quarry Slovac on the road Valjevo- Belgrade

For the purpose of the state analysis and endangerment of people who use the mentioned traffic routes and live in this area, 56 people in different locations have been questioned. Table 1.

Table 1. Questions and replies content from the questionnaire about the quarry impact on people' safety:

No.	Replies	YES	PARTLY	NO	COMPLETELY
1	To what extent quarries besides traffic routes influence the traffic safety?	53 or 94.6%	3 or 5.4%	-	56 or 100%
2.	Who is held responsible for this state of affairs? a) State- Ministry b) Vlasnika kamenoloma c)Local municipality	a) 37 or 66%	b) 13 or 23%	c) 6 or 11%	56 or 100%
3.	Does the emission of dust and specs affect the agricultural production in these areas?	YES 49 or 87,5%	PARTLY 7 or 12.5%	NO 0%	56 or 100%
4.	Have the citizens been consulted before the quarry started working?	YES- only 11 or 19.6%,	'we knew' was the reply of 29 or 51%	questioned, NO- 16 or 28.5 %	56 or 100%
5	Have you asked the authorities for help?	YES 45 or 80%		NO 11 or 20%	

If we take into consideration that according to the Law of ecological impact assessment, realization of a project cannot start before it's approved by means of Ecological Impact Assessment performed by the authorized administration, or institution , such as :

Administrative authority in charge of life environment protection on the municipality level. Administrative authority is obliged to organize public consultations, presentations and discussions about the studies of Ecological Impact Assessment and to inform all the interested sides about the places and time when this public assemblies take place , as well as the subject of the discussions. Ecological Impact Assessment Law also predicts suitable measures for those who do not respect legal provisions.

Nevertheless, the replies from the questionnaire conducted for needs of research say that the procedures, expert and legal limitations are not being respected nor applied sufficiently.

To the first question in the questionnaire, 53 persons questioned replied with YES, which represents 94.6% of citizens, and 3 persons replied with PARTLY wich represents 5.5% of citizens questioned. None of them replied with NO.To the second question, 66% of the people questioned held The Ministry of Life Environment Protection responsible. This all tells us that certain departments in local municipalities are not active enough and do not take preventative measures against this situation.

CONCLUSION

Ecological influences vary immensely from one quarry to the other, which mostly depends from the extraction method and methods of technical adaptation which are being applied, the overall project design and amplitude of extraction.Dust emission is also very important side effect of extraction and transport, as well as the traffic participants' safety in these areas in close proximity to the quarries, and to the quality of air and ground, to the people and settlements in general.Illegal exploitation activities vary from the lesser amplitude extractions, usually performed by individuals who are trying to satisfy their own need for aggregates, to the quarries at different stages of progress. The latter usually works for several months and it's very hard for the local authorities to control them.

Lack of studies about mid-term and long-term market demand for aggregates at the local level ,along with the complicated and long lasting processes of issuing permits, encourage illegal exploitation.Finally, the important factor which ' allows' the proceeding of illegal exploitation is possibly the lack of efficient and consistent processes and instruments of surveillance which would be applied by the authorities.Public involvement is usually procured during the phase of issuing permits for life environment protection, through public debates or written opinions. However, interpreting the summoning of ' affected public' can be pretty problematic, which leads to the involvement of juridical courts .Social permit for the work exists, when the project has the approval and general consent of the community in question and wider. It is the permit which cannot be procured solely from the authorities, political structures, or the legal system , but along with the consent given by the neighbours. This kind of consent must be realized on multitude of levels, but it must start with the firm base of local communities' consent for the development of mineral resources.

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ALEKSINAC OIL SHALE, SERBIA'S OIL HOPE OR ENVIRONMENTAL TIME BOMB

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ABSTRACT

Aleksinac oil shale deposit ore reserves are estimated to 2 billion tons with average kerogen content of 10 %. If extracted and processed this shale could produce 200 million tons of oil. This represents a significant energetic potential but also a potential environmental hazard if the issue is not approached responsibly.

Key words: oil shale, technology, environment.

INTRODUCTION

Aleksinac oil shale deposit spreads over the area of 1366 ha in the proximity and partly beneath the Aleksinac town, some 200 km south of Belgrade, Serbia. The deposit lies in the direction north-northwest – south-south east in the length of approximately 10 km. The dipping angle varies from 0^o to 90^o, dip direction is east-northeast – west-southwest. The deposit out-crops to the surface along the almost whole length in E-NE and reaches maximal depth of approximately 700 m in W-SW. The deposit is structurally divided into two separate seams underlying and overlaying the coal seam which was the main object of mining operations of Aleksinac coal mine until the mine closure back in 1989. Hence the names Roof oil shale and Floor oil shale. The thickness of the Floor shale varies from 3 to 30 m while the Roof shale have thickness of 50 to 80 m. Additionally, a number of faults divides the deposit into blocks, with significant vertical movements but generally the deposit can be divided into three fields (North to South), Dubrava, Morava and Logorište.

ALEKSINAC OIL SHALE DEPOSIT

The term oil shale can be considered wrong since the dominant organic matter is not oil but kerogen. Kerogen content in the deposit varies from 6% to 20%+ with an average of 10%. Geological reserves are estimated to nearly 2 billion tons (for the whole deposit) but the most accessible are the reserves in the Dubrava orebody.

The interest in Aleksinac oil shale deposit had its ups and downs during the last fifty years. The first mining operations in the Dubrava field started in the late forties with the pilot processing facilities built in the oil refinery in Pancevo. The operations seized in the early fifties. Again, during the eighties, and at the beginning of the new century, additional technological tests were performed in order investigate the possibility of oil shale application in cement industry.

During the last several years, due primarily to the leap in oil prices, Aleksinac oil shale, especially Dubrava field, came into focus again. The increased interest resulted in additional exploration drilling in the Dubrava field and presentation of the latest elaborate on geological reserves (Table 1). Since the significant amount of oil shale is at low depth and even out-crops to the surface (Fig. 1), open pit was logical solution for shale extraction in Dubrava field.

Table 2. Oil shale reserves in Dubrava field

Category*	RESERVES (t)		
	Balanced	Out of balance	Geological
A	56.332.090	9.067.080	65.399.170
B	99.353.350	36.721.540	136.074.890
C1	143.791.090	33.614.540	177.405.630
A + B + C1	299.476.530	79.403.160	378.879.690

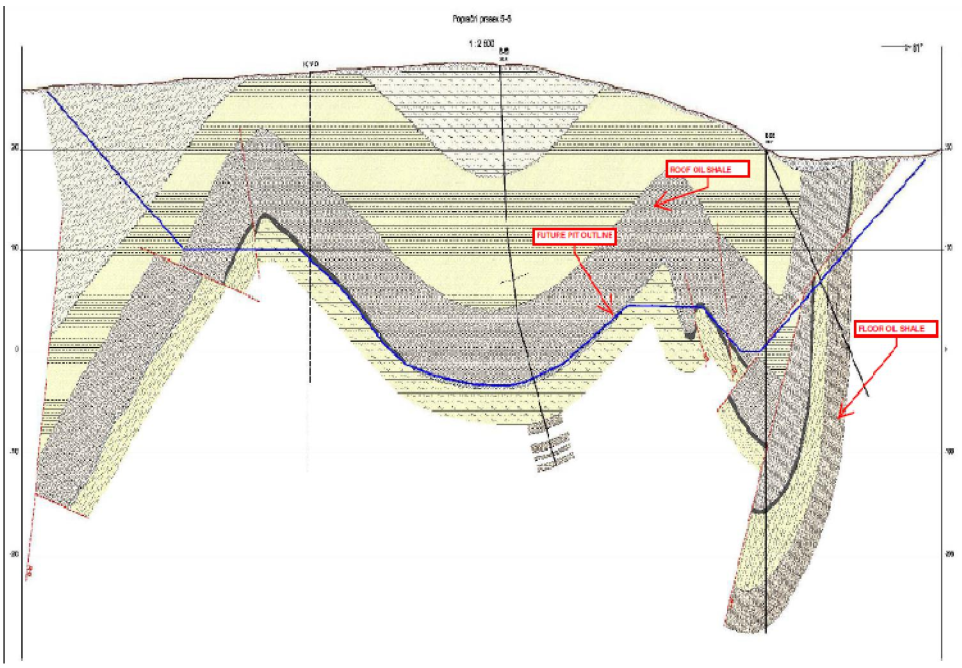

Figure 1. Cross section through the deposit and final pit outline

OIL SHALE TECHNOLOGIES

There are various technologies for oil shale recovery and processing developed during the last century and all of those can be roughly categorized into surface retorting and in situ retorting technologies. All surface retorting technologies require mining operations (surface or underground) on shale recovery, conditioning of the recovered shale and further processing in order to extract oil/kerogen and convert it to synthetic oil (shale oil). Retorting, that is oil extraction, requires heat and the heat carrier can be gaseous (Kiviter – Estonia, Petrosix – Brasil and Fushun – China) or solid (ENEFIT – Estonia, ATP – Canada) (Fig.2 and 3). The problem rising from surface retorting are large amounts of solid waste i.e. ash which needs to be disposed. The disposed ash occupies large areas of land and, in majority of cases, represents possible toxic hazard. In situ conversion or retorting takes place in the deposit itself. There are also various processes developed or under development for in situ retorting but common for all of them is opening of the deposit by drill holes, fracturing and heating of oil shale in order to convert kerogen to oil and hydrocarbon gases and pump it to the surface. This resolves the problem of ash disposal since ash remains underground but introduces a variety of other problems such as ground subsidence, groundwater pollution etc.

Once extracted, by surface or in situ retorting, kerogen must be further processed. If fed to refinery in its basic form kerogen can be converted to so call black fuels since it lacks in hydrogen. Enriching kerogen with hydrogen in the process of hydrogenation gives the product which can then be treated in the refinery to extract white fuels (diesel, kerosene, gasoline…).

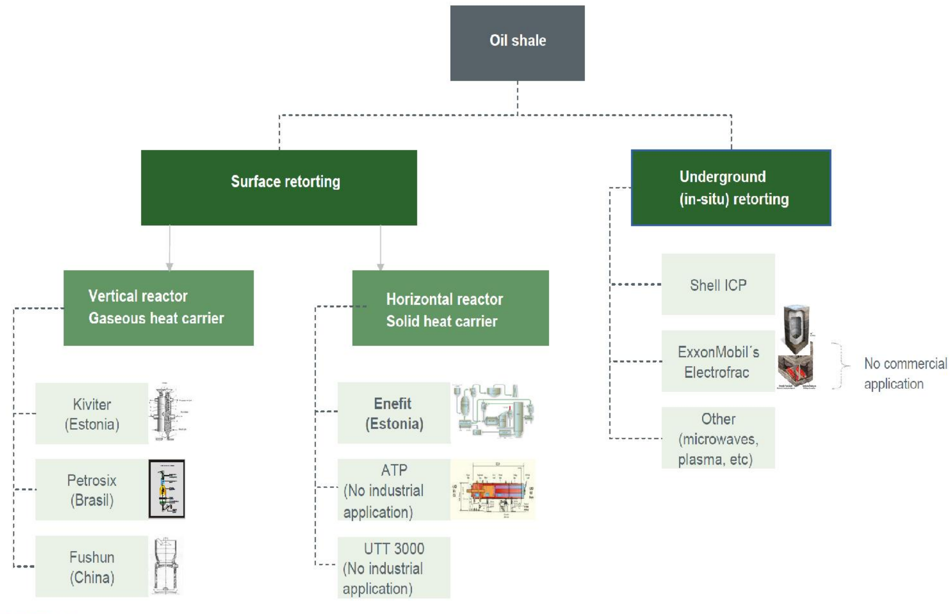

Figure 2. Leading oil shale extraction and processing technologies [1]

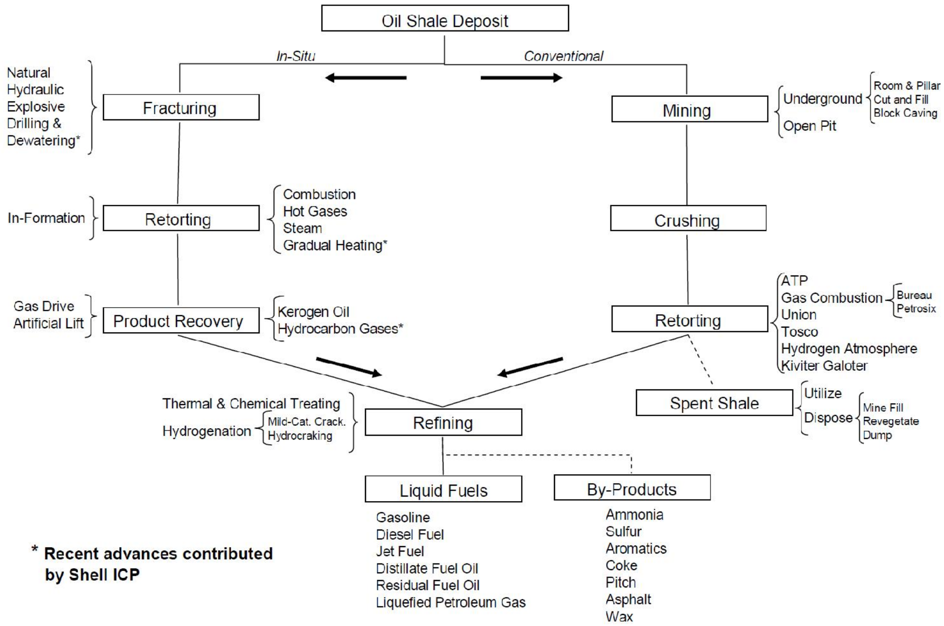

Figure 3. Generalized processes for oil shale conversion to fuels [2]

ENVIRONMENTAL ISSUES

Oil shale industry is categorized as dirty and environmentally hazardous. There are several reasons for this opinion. Surface oil shale mines and accompanying waste dumps occupy vast areas of land. However, the solutions of this problem are inner dumps and rapid reclamation of degraded area. On the other hand, the product of oil shale processing and kerogen extraction is spent shale, or commonly referred to as semi coke. It is in fact an inorganic ash which, after leaving retort, still contains an amount of organic matter. Semi coke is disposed onto dumps which also occupy land but the greater problem is leaching of the organic residue, acid drainage, heavy metals etc. The process of kerogen extraction and treatment results in the air pollution from particulate matter, nitrous and sulfuric gases and carbon dioxide. There are also concerns on use of large amounts of water for kerogen hydrogenation, varying from one to five barrels per barrel of produced oil.

Because of these problems numerous companies in the world are conducting research in order to define environmentally friendly and economically justified technology for both surface and in situ retorting. The most promising in situ process is Shell's freeze wall ICP, unfortunately it is still in experimental phase and has no commercial application. On the other hand Estonian EESTI Energia and Finnish Outotec have jointly developed new generation of ENEFIT technology as a successor of proven ENEFIT 140 technology. Improvements of the technology resolved all the major environmental issues of oil shale processing resulting in environmentally acceptable technology. The new ENEFIT 280 facility is constructed in Narva, Estonia, and became operational in December 2012 *[3]*.

ALEKSINAC OIL SHALE DEVELOPMENT

More than 2 billion tons of oil shale with average kerogen content of 10% presents a significant energetic potential for a country like Serbia. Serbian energetic resources for electricity generation are coal (Kolubara, Kostolac and Morava thermal power plants) and rivers (Danube), which are mainly sufficient to meet the demand. On the other hand Serbia relies on imported oil and because of that Serbian government (both former and present) is taking seriously Aleksinac oil shale deposit. The flywheel started turning and the project is gaining weight. The first step was additional exploration drilling in order to confirm the data gathered during previous years in terms of oil shale quality and quantity. As said this resulted in the presentation of the new elaborate on geological reserves. At the same time, several initial studies, drafts of feasibility study, have been performed and indicated considerable economical benefit of oil shale extraction and processing measured in hundreds of billions of dollars for the whole deposit. However, development of mining operation in order to simultaneously cover the whole deposit would be an enormous undertaking and would require investments Serbia cannot afford. Instead, the idea is to develop the project gradually starting from the most accessible point which is Dubrava field. Draft design of the open pit is already created with annual productivity set to 5 million tons of oil shale and 8.35 million cubic meters of waste rock. The main mechanization complex to meet the designed productivity is roughly selected in terms of types and quantity. A draft solution of the Dubrava open pit is showing that the pit and the initial waste dump will occupy less than 2.5 km^2 of land. The designed final pit outline will allow recovery of 147 000 000 t of oil shale and 1 230 000 t of coal with the stripping ratio of 1.67 m^3/t or 3.1m^3/m^3 of shale. Large volume of waste rocks would occupy and degrade large area of fertile land in the valley of river Moravica. To prevent this, the pit outline and the dynamics are designed in such way to create space for inner dump in the shortest possible time. During that time the waste rock will be dumped to initial (outer) dump which will occupy less than 0.5 km^2 of land. To mitigate the environmental impact it is necessary to perform rapid reclamation of affected area (outer and inner dump) along with the mining operations. River Moravica needs to be rerouted in the length of 1 360 m. The physical and mechanical characteristics of the rocks (both waste and shale) allow direct digging so there is no need for drill and blast operations hence no noise, airblast or ground vibrations. The probability of environmental impact to surface and underground waters lies in the possibility to cut some underground streams and flows. However, some hydro-geological explorations showed that underground waters are in the same level as Moravica indicating that their origin is seepage. The other threat are atmospheric waters which will fall within the pit outline and wash off loose material into the Moravica riverbed. All of these waters must be collected and sent to a water treatment facility to precipitation and treatment prior to their discharge into Moravica.

With additional exploration drilling completed and draft pit design finished everything is set for the next step, which is the selection of strategic partner. According to the headlines of Serbian press, several international companies or investment funds have already sent their letters of intentions to Serbian ministry of mining.

Even if the budget would allow simultaneous investments in mining and processing operations Serbia does not have an oil shale processing technology which is proven at commercial scale, energetically and environmentally sustainable and acceptable and which could be applied in given conditions. Because of that Serbia is looking for a solution in strategic partnership. The first step was a selection of a consulting company which will help Serbian government to prepare bidding documents and select strategic partner. The public call was announced in Serbian official gazette in February 2012, but with parliamentary and presidential elections and the establishment of the new government the results, the name of the consulting company and the whole process were not presented to the public and are forgotten.

The primary condition which the technology offered by strategic partner must meet is to be environmentally acceptable and proven at commercial scale. The role model should new generation of Estonian ENEFIT technology developed as a joint effort of Eesti energia and Outotec. The new ENEFIT succeeded in resolving all major environmental issues. Improvements in oil shale processing technology introduced with new ENEFIT resulted in reduced emission of pollutants below the European norms (PM<25 mg/m^3, SO_2<50 mg/m^3, NO_x<200 mg/m^3). CO_2 emission is of average intensity (0.36 t/bbl of oil). Semi-coke leaving the retort is additionally burnt in the aero-fountain furnace. Ash leaving the furnace is totally inorganic and relieved of any organic residue which could lead to acid drainage or other environmental issues. Energetic efficiency is achieved through recharging the hot ash into retort along with oil shale charge so ash acts as main heat carrier. Vapors and gases leaving the retort are sent to condensation and the product (kerogen) is hydrogenated using hydrogen instead of water. Hydrogen is generated from the retort gas so there is no need for water consumption.

According to Estonian experience one ton of Aleksinac oil shale can give 86 kg of oil, 430 m^3 of retort gas, 700 kg of ash and less than 0.36 t of CO_2 or 329 kWh of electric energy. With planned annual production of 5 000 000 t the open pit Dubrava and accompanying processing facilities could annually produce 430 000 t of synthetic oil, $2.15\text{x}10^9$ m^3 of retort gas and 3 500 000 t of ash. By-produced retort gas is used to heat the process (65%) in order to improve energetic efficiency. Remaining 35 % can be sent to either thermal power plant or remote heating plant. The remaining problem is large amount of ash. However, ash can be used as raw material for cement production, as filler in asphalt plants etc. With the forecasted price of oil of 97 $/barrel and estimated costs of 63 $/barrel annual profit could reach 140 000 000 $ not accounting by-products such as electricity/heat from retort gas and cement from ash.

Sadly, Serbian ministry of mining is openly favoring Russian investors standing behind NIS Petrol, Serbian oil industry owned by Gazprom neft. Russian representatives at "Role of Oil Shales in Overcoming the Energy Crisis" round table, held in Belgrade and organised by the Balkan Magazine energy internet portal presented Galoter UTT 3000 as state of the art technology. However it is not the case and furthermore, this technology still has no commercial application. In addition this technology is all but environmentally friendly and could lead to slow but certain devastation of Aleksinac municipality.

Fortunately, Serbian ministry of energy and environment is opposing and insists on additional exploration and consulting services prior to the selection of the strategic partner. Hopefully, this opposition will establish an environmentally sustainable criterion for the selection of the oil shale processing technology.

LOCAL COMMUNITY REACTION

The opinion in local community is divided. On one side there are people who realize that Aleksinac municipality practically has no healthy economy and that Oil shale industry could be a *spiritus movens* for the revival and development of both municipality and region. On the other side there are those who oppose shale industry and who are concerned about the environment. The "shale issue" has raised environmental consciousness in the town resulting in establishment of Environmental Movement Aleksinac (EPA). From environmental aspect, reaction to oil shale industry is justified and desirable. Environmental movement should be included and actively participate in the development of Aleksinac oil shale industry in order to construct the best possible solution. The public has the right to be informed about all the aspects of oil shale industry, especially environmental, and environmental organizations are the best means of spreading information. The people must be educated, but the data and knowledge given must originate from reliable sources and be up to date.

The fear that oil shale industry will devastate underground and surface waters, pollute the air and dust the fields, orchards, vineyards and gradually but surely lead to destruction of Aleksinac should lead to joint action of the local community, environmental organizations, local politicians and The Ministry of environment against any proposition which is not based upon environmental criteria.

CONCLUSION

To conclude, Aleksinac oil shale deposit could really contribute to Serbia's partial energetic independence in the forthcoming years and make Aleksinac one of the richest towns in the region but only through careful planning and responsible behavior of all the involved parties. Otherwise, Serbia's oil hopes could stay only a dream and environmental disaster will become frightening reality.

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BASIC PRINCIPLES OF SAFE MANAGEMENT OF HAZARDOUS WASTE

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ABSTRACT

This paper describes the way of hazardous waste management in accordance with the applicable legal requirements related to packaging, temporary storage and transport of hazardous waste. Operators - owners and generators of hazardous waste from the production processes, have to temporarily store hazardous waste on a safe way to the point of permanent disposal, which includes its reuse or handing over to the authorized operator for transport and permanent disposal of hazardous waste.

In order to protect the environment, a special attention is paid to the waste management, with special emphasis on the management of hazardous waste. The system of safety management of hazardous waste means the obligation of waste owner to: establish a proper system of classification of hazardous waste at the site of its formation, provide a facility for temporary storage of hazardous waste in accordance with legislation, develop a study of impact of this facility in the environment if the competent authority instruct this by its decision on a need for development the study and on content and scope of the same and take the proposed measures of environmental protection during operation the storage of hazardous waste.

The owner of waste appoints a person responsible for waste management, with the responsibility to prepare the List of wastes which defines all types of waste intended for temporary storage. It is necessary that procedures prescribe a way of handling with hazardous waste from the list and comply with all legislation related to this area of environmental protection (for each listed waste from the list, the owner must have a Report on waste testing, the a Document in waste movement that have to be filled in delivery of hazardous waste to the authorized organization for the purpose of its final disposal).

Key words: hazardous waste, temporary storage, transport **.**

INTRODUCTION

One of the aspects of environment and factors that directly threatens the air, soil, surface and ground water is a waste. It can also have a negative impact on wildlife on the earth. With increased number of population on the earth and a need for modern way of life and work, the amount of generated waste is also increases. Due to these reasons, there is a need for formation the framework that would allow sustainable direction with minimum or no adverse effects of generated waste. This approach is particularly important in regulation the issues of hazardous wastes, whose uncontrolled release into the environment results into extremely negative long-term consequences.

In order to protect the environment, the legislation prescribes the rules and standards for each company which is the generator of waste. One of the responsibilities of each company is a definition of waste management strategy, based on the realization of the following objectives:

- Establishment the effective system for management of hazardous waste (transport and storage);
- Determining the precise data on the type, quantity and flow of hazardous waste;
- Reconciliation the ways of hazardous waste storage with the legislation and regulations;
- Maximum use of storage waste whose occurrence cannot be prevented (treatment of hazardous waste by the authorized institution);
- Further flow of hazardous waste removal for handing to licensed operators;
- Realization the cooperation with the representatives of authorities.

MANAGEMENT OF HAZARDOUS WASTE

In accordance with the legal provisions, adopted policy and management strategy, it is necessary to determine a responsible person for waste management and job responsibilities to define the responsibility in waste management plan by systematization of jobs as well as a Plan of waste management in the company, which is reflected in the following activities:

- Development the Plan proposal for waste management for temporary storage of hazardous waste, and
- Adoption the Plan proposal for waste management for temporary storage of hazardous waste by the company management.

The Plan for hazardous waste treatment, in the frame of temporary storage of hazardous waste, predicts:

- contracting with a licensed operator for each type of hazardous waste on taking the temporary stored hazardous waste;
- continuous removal of hazardous waste from temporary storage location;
- records on quantities of hazardous waste to be received, stored and transported.

A responsible person of a temporary storage of hazardous waste keeps daily records of waste with indications of the date of receipt the hazardous waste, quantity of received waste, quantity of handed hazardous waste to the authorized operators and the existing quantities of hazardous waste in temporary storage.

TYPES OF WASTE

Depending on the hazardous characteristics that affect the human health and environment, the waste can be:

- inert – the waste that is not subject to any physical, chemical or biological changes
- non-hazardous - no characteristics of hazardous waste
- hazardous – the waste, according to its origin, composition or concentration of hazardous substances, may cause danger to the environment and human health,

and it has at least one of hazardous characteristics that are determined by the special regulations.

Testing of waste

In accordance with the Law on Waste Management (Official Gazette of RS No.36/09), the owner of the waste must have a Repost on testing of waste, issued by an authorized organization for testing of waste for each waste from the list of waste subjected to the temporary storage

Test report on testing of waste include obligatory the index number of waste from the Catalog of waste and it is made in accordance with instructions of the Basel Convention, EPA and ISO Standards. Testing of waste implies determining the content (physical and chemical composition) and properties (characteristics) of waste. Testing of waste is carried out by the authorized institutions.

Classification of waste is done in accordance with the Regulations on categories, testing and classification of waste (Official Gazette of RS, No. 56/2010). Under the Regulations, the division of waste on non-hazardous and hazardous is clearly pointed out, i.e. any waste that is listed in the regulations and it was already classified as hazardous, marked with the index number and star, while the non-hazardous waste is marked only with the index number. In a case that the owner of waste generates the waste that is not classified under the Rules on categories, testing and classification of waste (Official Gazette of RS No. 56/2010), it is necessary to cooperate with the authorized testing organization for waste to test the waste in accordance with Appendixes 9 and 10 of the same Regulations, and based on the obtained test results to classify waste into the appropriate class and category of waste.

Packaging, storage and marking of hazardous waste

After performed reception, the storage of waste is done in/on a space defined for particular type of waste. Depending on whether or not the waste has a property of hazardous substances, whether it is in liquid or solid form, as well as whether or not it has further usable value, in use, the location of its storage will depend.

As those are different types of hazardous waste, for example: waste batteries, waste motor oils, solid oily waste, and it is stored in the same storage area, they must be mutually protected and separated by compartment, shoulder, embankment, wall or other secure manner. To prevent the accident situation, in this case for the above hazardous waste, it is necessary to provide the reservoirs of minimum volume corresponding to total volume of material that can leak in case of an accident.

Also, at the entrance to the temporary storage of hazardous waste, it is necessary to indicate that the hazardous waste is stored in the subject facility with a clear identification of index number of specified waste and characteristic that makes its hazardous, as well as the procedure for handling and storage.

An example of a safe and properly stored waste is shown in Figure.

Figure 1. Properly stored hazardous waste

Packaged hazardous waste should be visible and clearly marked with a sticker, protected or made of materials that are resistant to weather and external influences (metal, plastic, etc.).

Color and display on a sticker should be such that the designation of hazardous waste is easily visible.

Text should be striking, easily legible and printed in a way that cannot be erased. Sticker is fixed on a package so that the text can be read horizontally when the package is in the normal position.

Sticker should be attached on a package over its whole surface in a manner that ensures its presence until the waste is not completely removed from a package.

Sticker marking packaged hazardous waste shall contain the following data:

1) Warning: HAZARDOUS WASTE in Serbian and English;
2) Index number and name of waste from the Catalog of waste, in accordance with the special regulations;
3) Y label according to the List of category or similar types of hazardous waste according to their nature or activities that create (Y list), in accordance with the special regulations;
4) C label according to the List of components of waste that make waste hazardous (C list), in accordance with the special regulations;
5) H label according to the List of characteristics of waste that make waste hazardous (H list), in accordance with the special regulations;
6) data about the owner of the waste who packed it: name, address, phone/fax, date of package, name and family name of a qualified person, responsible for expert work;
7) physical property of waste: powder, solid, viscous matter, paste, slime, liquid matter, gaseous matter, others of the Report on testing of waste, in accordance with the special regulation;
8) amount contained in the package, and if it is the group package, then the amount of each individual package;
9) NOTE: Other data, important in handling of hazardous waste, are recorded here and pertain to how to handle these waste to ensure the safety and minimum risk of pollution, hazards and adverse effects on human health and environment and, depending on the purpose of disposal.

Hazardous waste is collected and transported separately and it cannot be temporarily stored on the site of waste producer or owner for more than 12 months.

During collection, classification, storage, transport, recovery and disposal, the hazardous waste is packaged in a manner that ensures the safety of human health and environment, i.e. in special containers that are made according to the characteristics of hazardous waste (flammable, explosive, infectious, etc.) and marked with clearly and visible labels.

EPA has defined containers for accumulation of hazardous waste (Figures 2 and 3) as any portable device in which hazardous waste may be stored, transported, treated or disposed or otherwise way to manage it. Tanks or reservoirs are fixed containers, designed for the needs of storage the hazardous waste and, due to adequate strength, are generally made of concrete, steel, plastics and other solid and resistant materials.

Figure 2. Stationary storage containers for waste

Figure 3. Portable storage containers for hazardous waste

Distribution of waste to the authorized institutions for its further treatment

The legal regulations has provided, for the purpose of tracking the movement of waste, to follow any delivered amount of waste the pattern **Document on movement of hazardous waste**, which consists of six identical copies, out of which the first one is a copy of prior notice which is filled in by the producer/owner of waste and send to the

Ministry of Environment and Spatial Planning (the Ministry), three days before the start of movement.

The second copy is retained by the owner of waste, the third copy is retained by the waste carrier, the fourth copy is retained by the recipient of waste, the fifth copy is sent by the recipient of hazardous waste to the Ministry, as the competent body of autonomous province is the movement of waste is on the territory of autonomous province, and the sixth copy is submitted by the recipient of hazardous waste to the original manufacturer/ owner within 10 days of the receipt of waste.

Proper and safe disposal of hazardous waste by the authorized operator for dealing with this type of waste is shown in Figure 4, respectively, and it was conducted in accordance with the relevant legislation, in accordance with the ADR requirements and demands of foreign plants.

Figure 4. Proper packaging and disposal of liquid waste

CONCLUSION

Dangerous properties of products, technological processes and waste are more numerous every year, and testing (testing of physical-chemical properties of hazardous waste can only be performed by professional institutions) on harmfulness are more and more extensive and long. It is important to determine the proportion of hazardous substances in waste, i.e. which amount of hazardous substance is more dangerous and poisonous and in what conditions.

The proper way of handling with hazardous waste, as required by the legislation and regulations in the field of waste management, minimizes the negative impact on the basic factors of environment: water, air and soil. Regarding to this, the base hazardous waste management is the application of existing legislation in this field without any further concessions.

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KEY ASPECTS OF ENVIRONMENTAL RISKS ASSESSMENT AND MANAGEMENT IN MINING

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ABSTRACT

Mining industry is faced with difficult task to ensure their activities so that they do not cause unacceptable changes in environment. The aim of this study stems from constant threat due to the complexity of mining systems. Dangerous and hazardous flotation tailings dams can have negative impact on living environment and damages incidents in flotation tailings dams can cause ecological catastrophe. The main objective of this paper is to show the possibilities and the importance of risk assessment procedures in the incidents in flotation tailings dams and research potential risks, guidelines and methods for their identification.

Key words: Mining, environmental risk, flotation tailings dams.

INTRODUCTION

Mining has a long tradition of creating major impact on environmental. According to that, current conditions in the mining industry require timely decision-making and effective planning, monitoring and risk management. Risk management is a prerequisite for the proper planning of prevent actions as responses to risk and recovery potential consequences.

Starting literature that inspired this research is about environmental impact of mining. Ripley, Redman and Crowder felt that there is a potential impact on the environment in all stages of mining production.[1] Some of the effects are modified characteristics of the soil and vegetation, degradation of existing surface and ground water, reduction of reproduction of fauna and contamination of surface area of toxic chemicals. Research about causes of accidents in the flotation tailings, conducted in the Mining and Metallurgy Institute Bor, seen flotation tailings as a major threat to the ecological environmental factors and finds the causes of accidents in the technical shortcomings in the construction of dams and natural disasters.[2]

MATERIALS AND METHODS

Focus of this research is based on the methods of analysis and synthesis. The next phase of research used a method of modeling which allowed easier explanation of accidents on flotation dam and the structure of ecological risk as a result of aforementioned event. Also is used a comparative analysis of the phenomenon – comparison a flotation tailings dam failure in Majdanpek, 1974, Serbia, with flotation tailings dam failure in Baia Mare, 2000, Romania. Based on the analysis of the possible sources of risk a conceptual model of possible causes of flotation dam failures can be constructed, made on the principles of Fault Tree Analysis. Construction and processing of the fault tree was done using a software program OpenFTA. From the tree structure we see that if in each of the branches one of element of system failures, the failure dam of the flotation tailings will happen.

RESULTS AND DISCUSSION

The concept of risk is a probability that the result of exposure to certain phenomena occur adverse effects.[3] Mining can never have zero impact on the environment and there will always be some degree of negative impacts and the need for assessment and risk management. Risk identification is the process of determining those factors that may have an impact on a project.[4] Looking at the operation of mining system, the classification of the major risks in the mining industry would include the following categories: - The risk to the health and safety of employees, environmental risk, social risks, risks of land use, legal and financial risks and technical risks.[3]

However, given the complexity of the operation and durability of effect, the main risks in mining are environmental risks. Term "environmental impact of mining" has full meaning only when viewed through the basic parameters of the environment. Based on this, the potential risks to the environment can be classified as: the risk to surface and ground water, risks to soil and geological structure, the risk for air and atmosphere, the risk to flora and fauna, and risks to human health and safety.

By its nature, mining involves the production of large amounts of waste. Disposing of such large quantities is a major challenge for the mining industry and a great threat to the environment. Experience in the mining industry constantly demonstrates that the greatest risk in mining operations, in terms of environmental impact, is the result of tailings.[1] The main risks associated with the problem of tailings concerning: The potential impact on air quality (due to the emission and deposition of harmful dust from tailings), The potential impact on groundwater quality (caused by underground tailings disposal), The potential impact on surface water and species that are found in it (due to the deposition of tailings into the surface waterways), The potential impact on soil, The potential impact on the flora and fauna and The potential impact on human health (as a result of the overall effects of previous factors).

Tailing is the most common type of technogenic waste and the largest polluter of the environment in the process of refining copper. Flotation tailing Valja Fundata in Copper Mine Majdanpek is used for depositing material residue after concentration of useful components from the ore. In January, 1974, there was a failure of tailing dam. Tailings pond is located in the canyon of the stream. In the structure of the terrain, water resistant andesite is dominated (about 85%), shale and agglomerates, but about 15% of the terrain is constructed of permeable limestone. Due to the lack of detailed research and the negligence of permeable limestone, the construction of tailing began.

Also competent did not know about any of the caves in the side of the tailing. Approximately 7,000,000 t of tailings and water through up the cave opening and polluted river Veliki Pek to the mouth of the Danube River and wider area of Majdanpek and Donji Milanovac. Pek river took about 20 years to completely regenerate.[5].

Another observed incident occurred in 2000 when there was a failure in the tailings dam in Baia Mare in Romania. That chance spill of 100,000 m^3 of waste rock that contained inside 50 to 100 tons of cyanide and heavy metals. The dam's failure was due to a combination of still under construction dams and unpredictable working conditions, all in a very unfavorable weather conditions. Bursting of a dam is partly caused by the heavy rains and rapid melting of snow and a rise in the lake level was higher than the growth of the dam as the dam is planned to gradually grow and built upon in order to prevent overflow of wastewater and tailings.

Consideration of the above situations can define key aspects relevant to the analysis of the incidence of risk due to the failure of flotation dam (Figure 1). For the stability and normal functioning is necessary to ensure technical factors in engineering and design, and also in using. Failure of one of these factors results in a potential risk. Therefore, the main sources of risk can be divided into sources with technical and technological background and sources with operating background. The first type includes areas of preparation, planning and construction of the tailings, while the second type involves the situation arising from the use of the system and the impact of external factors.

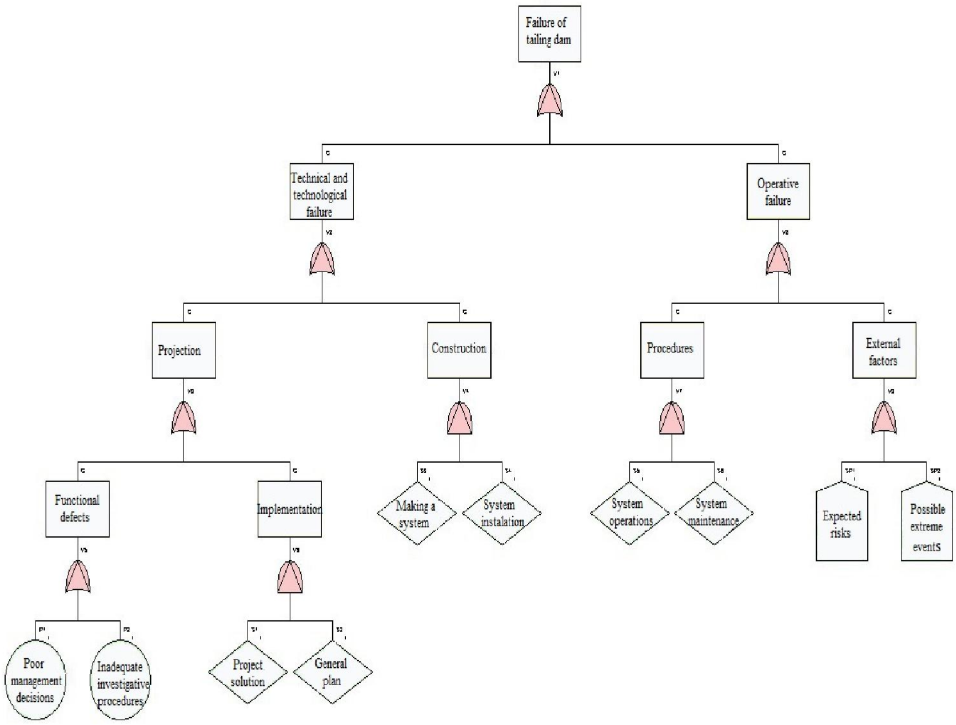

Figure 1. Conceptual model of possible causes of flotation dam failures

Based on the Fault tree analysis it's recognizes that the main risk of a tailing dam failure are in poor management decisions, inadequate investigative procedures, expected risks and possible extreme events or activities at least one of these factors. Poor management decisions and a lack of investigative procedures are often the basis of the greatest risks to the functioning of the dam, which includes:[5]

- Spilling over the crown of the embankment (dams)
- Stability of embankment slopes
- Problems in the foundation of the dykes and dams
- Problems on a spillway
- Problems in the structure of the embankment.

Spilling over the embankment crown is created during heavy rains when in the short term inside of the reservoir appears unusually large amount of water. The most common causes of overflow are wrong choice and calculation with the insufficient capacity of the spillway body, poor maintenance of facilities for the evacuation of water and the inability spillway to accept and safely take all the water that suddenly appears within the tailings, poor design or failure to maintain the required relationship between the dam crest and deposited tailings so there is sufficient capacity to temporarily retain the high water, the destruction of a upstream dam, or the formation of landslides within the contours of the tailings.

Great risk to the stability of a flotation dam is instability of the slopes that can occur for several reasons: overstretching of the foundation soil, overstretching the material from which the dam was built and filtration disorders in embankment caused by elevated pore pressure. As a rule, slope instability does not occur instantaneously and leads to the unexpected collapse. Routine measures observation can be noticed signs announcing the disorder and the potential destruction of the embankment.

Regarding the issue of the structure of the embankment, they are built concurrently with mining tailings. Disorders can be not only in the geometry of the embankment, but also in its structure. The basic rule is that the embankment is made only of materials that meet the design characteristics and the safe exploitation is combined with the good work of hydraulic structures.

Tailing pond should have at least one spillway. The purpose of this facility is that it takes clarified water from the tailings and the capacity and the quality is regulated by changing the height of spillway. The problem that arise from this facility can be different: long-term use and aggressive action of water and reagents can reach material damage which may result in damage, destruction or leakage of water and tailings deposited at levels below the overflow, also it can occur partial or total blockage of manhole with branches, planks or other objects in the aperture or falling into a manhole, also the earthquake can cause collapse and closure of the manhole and drain sump for clarified water.

In addition to poor management decisions, potential risks can be based also on the external factors - potential risk and extreme events. Earthquakes or sudden dynamic shock from blasting, movement of vehicles, are intractable problem in maintaining tailings in stable condition. Earthquakes usually occur on the crown deformation and downstream slopes of the embankment, and it is often the cause of the collapse of drainage facilities.

CONCLUSIONS

The main sources of environmental hazards in mining lie in tailings. The tailings contain harmful metals, and reagents used in the flotation of the ore. Mentioned toxic substances can easily contaminate surface water, groundwater, and soil and create conditions for large-scale ecological disturbance. The key principles of effective management of tailings ponds can be seen in the adoption of approaches to risk, reducing production of tailings and maximize its re-use in processing, ensuring that all structures tailings are operationally stable, considering the economic, environmental and social aspects of all phases of tailings to minimize short-term and long-term impacts. Although there are many reasons for potential danger and a lot of unexpected situations as a result of the complexity of the activities themselves, but it can be argued that most of the effect on the environment can be avoided through effective risk management.

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ECOLOGISTS AS FAMOUS SCIENTIST, POLITICIAN AND NOBEL PRIZE AWARD WINNERS

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ABSTRACT

This study shows excellent results of the latest achievements of ecology in the last two decades. Most importantly, shows the work of the Nobel Peace Prize in 2007, which belonged to the Intergovernmental Panel (IPCC), the climate change as an organization that works with the World Meteorological Organization (WMO) and the Environmental Protection Programme of the United Nations (UNEP), as well as one of the famous environmentalist Al Gore, Jr. (Albert Arnold "Al" Gore Jr.).. The paper describes the careers and programs implemented by the IPCC chairman Pachauri (Rajendra Kumar Pachauri). The paper discusses the publications presented an excellent climatologist Hatné (Sir John Theodore Houghton), the skilled British scientist for atmospheric science and specialist in covering global warming, ozone and paleoclimático Watson (Sir Robert Tony Watson), and Professor Lindzina (Richard Lindzen), whose works in the first IPCC working Group were an important study on the dynamics of the middle layer of the atmosphere and its hypotheses about the effects of infrared (IR) radiation at the Earth and the effects of CO2 emissions. The most important figure in the Alliance for Climate Protection in this study is presented career and creativity of Al Gore Jr.

Key words: 2007, Nobel Prize Award Winners, Intergovernmental Panel on Climate Change (IPCC), United Nations Environment Programme (UNEP), World Meteorological Organization (WMO).

INTRODUCTION

The 2007 Nobel Peace Prize was shared, in two equal parts, between the Intergovernmental Panel on Climate Change (IPCC) and Albert Arnold "Al" Gore, Jr. The Intergovernmental Panel on Climate Change is a scientific intergovernmental body, it was first established in 1988 by two United Nations organizations, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). Its mission is to provide comprehensive scientific assessments of current scientific, technical and socio-economic information worldwide about the risk of climate change. The IPCC published its first assessment report in 1990, a supplementary report in 1992, a second assessment report (SAR) in 1995, and a third assessment report (TAR) in 2001. A fourth assessment report (AR4) was released in 2007 and a fifth is due to be issued in 2014. Each assessment report is in three volumes, corresponding to Working Groups I, II and III. Unqualified, "the IPCC report" is often used to mean the Working Group I report, which covers the basic science of climate change. The 1992 supplementary report was an update, requested in the context of the negotiations on the UNFCCC at the Earth Summit (United Nations Conference on Environment and Development) in Rio de Janeiro in 1992. It is chaired by Rajendra K. Pachauri (Rajendra Kumar Pachauri (राजेन्द्र कुमार पचौरी; 20. August 1940. in Nainital, India).

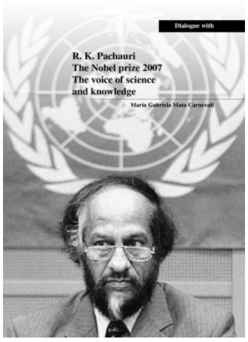

Figure 1. Rajendra K. Pachauri (1940)

Rajendra Kumar Pachauri, has been serving as the chairperson of the Intergovernmental Panel on Climate Change (IPCC) since 2002, which was awarded the Nobel Peace Prize in 2007 during his tenure. He has also been the director general of TERI (New Delhi, India), a research and policy organization in India, and chancellor of TERI University; besides being the chairman of the governing council of the National Agro Foundation (NAF), as well as the chairman of the board of Columbia University's International Research Institute for Climate and Society. Pachauri has been outspoken about climate change. He has been appointed as Senior Adviser to Yale Climate and Energy Institute (YCEI) from July 2012 prior to which he was the Founding Director of YCEI (July 2009 – June 2012). Pachauri was born in Nainital, India. He was educated at La Martiniere College in Lucknow and at the Indian Railways Institute of Mechanical and Electrical Engineering in Jamalpur, Bihar. He belongs to the Special Class Railway Apprentices, 1958 Batch, an elite scheme which heralded the beginning of mechanical engineering education in India. He began his career with the Indian Railways at the Diesel Locomotive Works in Varanasi. Pachauri was awarded an MS degree in Industrial Engineering from North Carolina State University, Raleigh, in 1972, as well as a joint Ph.D. in Industrial Engineering and Economics in 1974. He lives in Golf Links, New Delhi. He is a strict vegetarian, partly due to his beliefs as a Hindu, and partly because of the impact of meat-production on the environment. He served as Assistant Professor (August 1974 - May 1975) and Visiting Faculty Member (Summer 1976 and 1977) in the Department of Economics and Business at NC State. He was a Visiting Professor of Resource Economics at the College of Mineral and Energy Resources, West Virginia University. On his return to India, he joined the Administrative Staff College of India, Hyderabad, as Member Senior Faculty (June 1975 - June 1979) and went on to become Director, Consulting and Applied Research Division (July 1979-March 1981). He joined The Energy and Resources Institute (TERI) as Director in April 1981. and presently heads the organisation. He was also a Senior Visiting Fellow at the Resource Systems Institute (1982), and Visiting Research Fellow at the World Bank, Washington DC (1990). On 20 April 2002, Pachauri was elected Chairman of the Intergovernmental Panel on Climate Change, a United Nations panel established by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to assess information relevant for understanding climate change. Pachauri was on the Board of Governors, Shriram Scientific and Industrial Research Foundation (September 1987); the Executive Committee of the India International Centre, New Delhi (1985 onwards); the Governing Council of the India Habitat Centre, New Delhi (October 1987 onwards); and the Court of Governors, Administrative Staff College of India (1979–81) and advises such companies as Pegasus Capital Advisors, GloriOil, the Chicago Climate Exchange, Toyota, Deutsche Bank and NTPC. He has served as member of many societies and commissions. He has been the Member of Board of the International Solar Energy Society (1991–1997), World Resources Institute Council (1992), while Chairman of the World Energy Council (1993–1995), President and then Chairman of the International Association for Energy Economics (1988–1990), and the President of the Asian Energy Institute (Since 1992). He was a part-time advisor to the United Nations Development Programme (1994—1999) in the fields of Energy and Sustainable Management of Natural Resources. In July 2001, Dr R K Pachauri was appointed Member, Economic Advisory Council to the Prime Minister of India. On 20 April 2002, Pachauri was elected Chairman of the United Nations established Intergovernmental Panel on Climate Change. [1]

The IPCC does not carry out its own original research, nor does it do the work of monitoring climate or related phenomena itself. A main activity of the IPCC is publishing special reports on topics relevant to the implementation of the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty that acknowledges the possibility of harmful climate change. Implementation of the UNFCCC led eventually to the Kyoto Protocol**.** The UNFCCC is an environmental treaty with the goal of preventing "dangerous" anthropogenic interference of the climate system. The Protocol was adopted by Parties to the UNFCCC in 1997, and entered into force in 2005. The IPCC provides an internationally accepted authority on climate change, producing reports which have the agreement of all the leading climate scientists and the consensus of every one of the participating governments. It has successfully provided authoritative policy advice with far-reaching implications for economics and lifestyles. In a context of unremitting opposition from fossil fuel interests, governments have been slow to implement the advice. As UN climate change talks in South Africa struggle to produce a binding commitment to cut greenhouse gases, Welsh scientist Sir John Theodore Houghton (30. December 1931 in Dyserth) warns of the dangers of putting economic growth before the environment.

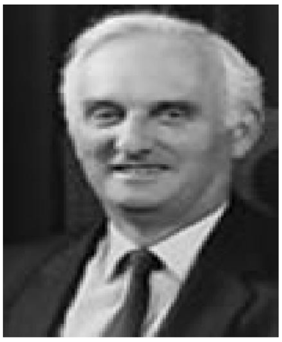

Figure 2. Sir John Theodore Houghton (1931)

Sir John Theodore Houghton is a scientist who was the co-chair of the Nobel Peace Prize winning Intergovernmental Panel on Climate Change's (IPCC) scientific assessment working group. He was the lead editor of first three IPCC reports. He was professor in atmospheric physics at the University of Oxford, former Chief Executive at the Met Office and founder of the Hadley Centre. He is a founder member of the International Society for Science and Religion. He is also the current president of the Victoria Institute. The previous IPCC chair was Sir Robert Tony Watson, (March 21, 1948) is a British scientist who has worked on atmospheric science issues including ozone depletion, global warming and paleoclimatology since the 1980s. (**Watson, Robert T.** (13 November 2000). "Presentation of Robert T. Watson Chair Intergovernmental Panel on Climate Change at the Sixth Conference of Parties to the United Nations Framework Convention on Climate Change". International Panel on Climate Change. Archived from the original on 4 June 2007.) [2]

Figure 3. Sir Robert Tony Watson, (1948)

He was Chairman of the Global Environment Facility's Scientific and Technical Advisory Panel from 1991 to 1994, Chair of the Intergovernmental Panel on Climate Change (IPCC) from 1997 to 2002 and Board co-chair for the Millennium Ecosystem Assessment from 2000 to 2005. He is currently Director of the International Assessment of Agricultural Science and Technology for Development and co-chair of the

International Scientific Assessment of Stratospheric Ozone. He has been Chair or co-chair of other international scientific assessments, including the IPCC Working Group II, the United Nations Environment Programme/World Meteorological Organization (UNEP/WMO), and the UNEP Global Biodiversity Assessment. Professor of Environmental Sciences; Director of Strategic Development, Tyndall at the University of East Anglia, MIT professor Richard Lindzen, one of the lead authors of the IPCC Working Group I Report, has criticised the IPCC Summary for Policymakers document before the U.S. Senate Committee on Commerce, Science and Transportation. Richard Siegmund Lindzen (February 8, 1940 in Webster, Massachusetts) is an American atmospheric physicist and Alfred P. Sloan Professor of Meteorology at the Massachusetts Institute of Technology. Lindzen is known for his work in the dynamics of the middle atmosphere, atmospheric tides and ozone photochemistry. Lindzen hypothesized that the Earth may act like an infrared iris. A sea surface temperature increase in the tropics would result in reduced cirrus clouds and thus more infrared radiation leakage from Earth's atmosphere. This hypothesis suggests a negative feedback which would counter the effects of CO_2 warming by lowering the climate sensitivity. Satellite data from CERES has led researchers investigating Lindzen's theory to conclude that the Iris effect would instead warm the atmosphere. Lindzen disputed this, claiming that the negative feedback from high-level clouds was still larger than the weak positive feedback estimated by Lin et al. Lindzen has expressed his concern over the validity of computer models used to predict future climate change. [3]

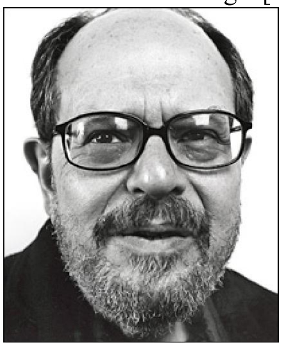

Figure 4. Richard Siegmund Lindzen (1940)

Albert Arnold "Al" Gore, Jr. was born in Washington, D.C., March 31, 1948 the second of two children of Albert Gore, Sr. and Pauline (LaFon) Gore. Gore is partly descended from Scots-Irish immigrants who first settled in Virginia in the mid-17th-century, and moved to Tennessee after the Revolutionary War. He graduated 25th in his class of 51, applied to only one college, Harvard, and was accepted.is an American politician, advocate and philanthropist, who served as the 45th Vice President of the United States (1993–2001). Gore is currently an author and environmental activist. He has founded a number of non-profit organizations, including the Alliance for Climate Protection, and has received a Nobel Peace Prize for his work in climate change activism. Gore was previously an elected official for 24 years. He was a Congressman from Tennessee from 1977–85 and from 1985–93 served as one of the state's Senators.

Figure 5. Albert Arnold "Al" Gore, Jr. (1948)

"This year's Nobel Peace Prize laureates, Rajendra Pachauri, right, of the U.N. climate panel, and Al Gore show their certificates on the podium in Oslo on Monday.")Gore is the founder and current chair of the Alliance for Climate Protection, the co-founder and chair of Generation Investment Management, the co-founder and chair of Current TV, a member of the Board of Directors of Apple Inc., and a senior adviser to Google. Gore is also a partner in the venture capital firm, Kleiner Perkins Caufield & Byers, heading its climate change solutions group. He has served as a visiting professor at Middle Tennessee State University, Columbia University Graduate School of Journalism, Fisk University, and the University of California, Los Angeles. He is also a member of the Board of Directors of World Resources Institute. Gore has received a number of awards including the Nobel Peace Prize (joint award with the Intergovernmental Panel on Climate Change) (2007), a Grammy Award for Best Spoken Word Album (2009) for his book *An Inconvenient Truth*, a Primetime Emmy Award for Current TV (2007), and a Webby Award (2005). Gore was also the subject of the Academy Award-winning (2007) documentary *An Inconvenient Truth* in 2006. In 2007 he was named a runner-up for *Time's* 2007 Person of the Year. On 11 December 2007, Pachauri (representing the recipient IPCC) and co-recipient Al Gore delivered their acceptance speeches at an awards ceremony in Oslo, Norway, on a day when delegates to a United Nations climate conference were meeting in Bali, Indonesia.[4]

CONCLUSION

Zaključak: U ovoj studiji je pokazana važnost i uloga poznatih ličnosti i najvažnije svetske organizacije koja se bavi problemima zaštite životne sredine. Kao primer se navode: Nobelova nagrada za mir za 2007. i rad i stvaralaštvo poznatog naučnika i političara Gora, Votsona, Pačauria, Hatna i Lindiza. Značaj publikacija IPCC-a i saradnika je usmeravanje studija za klimatologiju.

Acknolewledgements

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SUSTAINABLE DEVELOPMENT IN FORMAL EDUCATION

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ABSTRACT

Entering the second decade of the third millennium, the mankind faces great and exceptional problems, such as pollution and damage of the environment, including higher levels of the atmosphere and the ozone layer. The exhaustion of the energy resources and the raw materials (especially minerals) together with the decrease of forests and agricultural surfaces is growing faster. The increase of society wealth is followed by the growth of waste, including the dangerous substances, contaminating air, water and earth. As the resources are exhausted, the production decreases and the following pollution are almost equal in the world, just a few countries of great power have noticeable economic development of goods and economy, which is why Earth and mankind are in the critical phase considering developing ecological politics that can decrease pollution and encourage recycling. Instead of fast exhaustion of the fossil energy sources reserves, the more efficient development is needed, as well as the economic use of the sustainable and renewable energy sources.

Key words: university education, sustainable development, implementation, formal education.

INTRODUCTION

One of the most significant properties of the other half of the 21st century in the development of the ecological ideas, such as sustainable development. Although it is rather a new concept it takes rather an important place.

Serious challenges come from the ecological field in many social life areas – not only politics, but also science and based on it, new demands are made in university education.

The demands in university education are made for the integrative approach which would enable the complex problems of the relationship between the nature and the human race to be overlooked from all angles. The co-operation between all scientific fields is necessary today. No serious ecological problem cannot be successfully analyzed or explained, as well as solved, if it is not visualized by the perspective of natural, technical, medicinal and social sciences. University education, which recently favors the know-how model damages the development of the critical and open thinking, capable of solving serious problems the mankind faces today because of their relationship with nature and survival on Earth.

THE ORIGIN OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT

The term sustainability means the capability of lasting and comes from latin sustineo, sustento, meaning support, lasting.

The whole idea of sustainability has a simple base in reality, which can be found in nature and in man's activities.

Natural of economical sustainability is obvious in examples of rainforests or similar great forest systems which remain for centuries and thousands of years and renew themselves. It is the same with the same water systems (oceans, seas, swamps…) and other complex bio and eco systems. Hereby we mean renewable resources, considering rational use. There are, however, nonrenewable resources, such as limited quantities of oil, coal, natural gas, mineral wealth. The modern industrial societies based their explosive development in the last centuries on them. Sustainability in such cases creates a new dimension – responsibility in use of them considering the possibility of future generations. From the point of the ecological ethics, the responsibility of the existing generations towards the future ones is important, the development conditions should get better as time passes.

It is usually thought that the concept of sustainable development is formed for the first time in the '80 of the last century, when preparing for the Rio de Janeiro Ecology Summit. That is, however, only partially correct.

The international conference was held in May 1971. in Menton, on human environment. 2200 scientists from the whole world have signed the appeal which warns the Mankind of the serious situation regarding the demographic expansion and the damage of the balance between the human and the biosphere, as well as the environment pollution.

The same year (1972) the first report of the Roman Club appeared, with the clear note of the growth limits, the firs United Nations conference was held on the protection of the environment. The most important result was the forming of the United Nations Environmental Program (UNEP). The idea of sustainable development was born somewhat later in civil environment, in year 1980. by the famous non-government organization International Union for Conservation of Nature and Natural Resources with the co-operation and financial support of the UNEP as well as the World Wild Fond. This strategy was primarily focused on the ecological sustainability meaning the conservation and protection of liver resources and did not pay much attention to wider politic, economical and social development questions.

Later, the General Assembly of the United Nations formed, in 1983., the World Commision for environment and development. The commission engaged a lot of considerable experts and organized many debates, based on which they published the annual report named Our Future Together. Is served as a bas to the Second World Economy Summit, held in Rio de Janeiro in 1992. This report expanded the concept of sustainable development and launched the concept in such a successful manner that it became inevitable in the field of a considerable number of international organizations.

At the Second World Economy Summit several important documents were accepted, that have not been surpassed up to today. Agenda 21 is the general document that formed the strategy od the inevitable changes in the attitude to nature at the beginning of the 21st century.

One of the important achievements of the ecological movement in the last five decades is the knowledge that the raise of the ecological awareness as well as the education for the sustainable development the significant conditions for successful solving of problems between human race and nature. It is interesting to mention that the university professor have early seen the need to import the contents of the sustainable development in the education.

The proof of that is the action plan of the conference of the Association of the University Leaders for sustainable future, held in 1990. in Taloir, France. The action plan accepted by the representatives of 350 universities in 40 countries defines the next aims:

- The development of the ecologically sustainable development
- The creation of the institutional culture sustainability
- The education of the ecologically responsible citizens
- The improvement of the ecological literacy for everyone
- The establishment of the institutional ecology and practical ecology politics
- The inclusion of all persons, groups, organizations or institutions than can have some interest in this field
- The co-operation of teachers with the environment keepers in the development of the interdisciplinary approach to researches and initiatives
- The advancing of the capacities of the earlier knowledge levels for the interdisciplinary teaching of population, environment and sustainable development.
- The co-operation of national and international organizations in order to promote the university efforts for the sustainable future
- To maintain the wide university movement of education for the sustainable development.

On the meeting of the General Assembly of the United Nations in 2002. the UN decade of education for the sustainable development was proclaimed. Coming from the judgment that the education for the sustainable development is the priority and that there is work for everyone , the General Assembly of the United Nations formed the aims to work on in the decade 2005-2014.

- Strengthen the piece,as the sustainable development concept is not possible without it
- Fight against the global warming
- Decrease the difference between the developed North and the undeveloped South
- Fight against the marginalization of women
- Sustainable development means having different visions of the world taking the specific parts into consideration.

It is expected from the education decade to help enabling people to face the challenges of today and tomorrow and from leaders to make relevant decisions for the sustainable world.

In order to implement the aims, the decade should be focused on:

- The promotion and improvement of the quality of education

- Reorientation of the education programs
- Development of the public understanding and consciousness
- The practical trainings
- The developments of the education programs
- The change of lifestyles and behavior
- The dedication to the sustainable development

The significant move in the ideas of the sustainable development concept is the UNECE strategy at the meeting of the ministers of environment and education in Villnus 2005. It defines the five following aims:

1. The support for the conditions for political, regulatory and operative process of education for sustainable development
2. The promotion of the sustainable development through formal and informal study
3. The support for the teachers training for sustainable development
4. The support of the adequate resources and work materials for education in sustainable development
5. Working on the development of the education for sustainable development

IMPLEMENTATION OF THE EDUCATION FOR SUSTAINABLE DEVELOPMENT

New technologies demand the expanding of the educated experts with new professional skills. As the education process becomes longer and the need for new knowledge is more expressed in all fields. The process of advanced development of knowledge leads to defining of the intellectual capital, which is nowadays one of the key business terms.

There is a set society process, a part of work and development process, **lifetime education**, defined as the activity of studying with the aim of the advance of knowledge and skills in personal, social, civil, and business perspective. It is carried out through formal non-formal and informal education. It is a continuous process of getting practical knowledge and facing new circumstances in the company and in the society in general. It means the following new scientific fields in order to improve knowledge and skills.

As integrative education conception, the education for the sustainable development includes the wide circle of interest groups from administration, politics, manufacture, civil society, media etc. The institution responsible for the activities determined by the action plan, and the institutions which should support them are the institutions in the field of education, science, culture, finances, economics, work and social politics, strategy coordination etc.

At first, through the reforming of the primary school education, it is achieved that te elements of environmental protection are inserted into education plan (the subject "World Around Us" in the first two grades and the "Nature and Society" in the second two grades of primary school). Both the subjects have an aim to develop the awareness and responsibility for the natural and social environment. There is also an optional subject "Guardians of Nature"

The reforming of the secondary school system has also started and make smaller contributions to the understanding of sustainable development. The subjects that can be explained from the point of sustainable development exist in a few education profiles: forestry and wood processing, mechanical engineering and metal engineering, electrotechnical engineering, civil engineering. In three year education profiles there is a separate subjects "Ecology and Environment protection".

Considering university education there are recently founded departments for environment protection, both on basic and PhD studies.

Basic academic studies can take 840 1st year students (270 environment analysts on 4 accredited faculties, 60 ecologists on one accredited faculty and 510 environment protection engineers at 5 accredited faculties.

Certain faculties have special departments for environmental protection, that can include 200 1st year students (70 chemists on 2 accredited faculties, 50 agricultural engineers, 50 agroecological engineers, 50 geographers for environment protection and 27 biologists).

There are also professional studies with 590 places for professional ecologist, environment engineer. One of the solutions is the lifetime education, so-called non-formal education. From BELLS enquiries there can be concluded that there is the need for courses that do not exist on most universities. The Council for Economic Subjects has come to the same conclusion in 2011., which is pointed out at the meeting of the section for environment protection.

The similar messages come from the National Employment Service, there is a discrepancy between demand and offer as there are a lot of applicant with occupations there are no interests for, which calls for the accreditation of courses that do not exist at te universities so far.

CONCLUSIONS

The sustainable development concept is complex and consists of three integrative components – economy, society and environment. In accordance with that, the understanding of its principles and the way of implementation demands multidisciplinary approach between social, natural and humanistic sciences.

The aim of education for sustainable development is to enable an individual for practical skills which will lead to further development of obtaining new knowledge in the field, even after formal education.

The education for sustainable development should facilitate understanding and interpretation of global problems, but also consideration of local problems in global context, history backgrounds and further development planning.

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TRAGEDY OF THE COMMON RESOURCES – LIMITS TO FREEDOM AND GROWTH

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ABSTRACT

In a globalized world, in-depth knowledge of the unseen structure of the process - the generic structures that are dynamic character allows more efficient management of sustainable development of complex systems taking into account natural limits. Cohesion and integrity of the archetypes of deep structures applied to the management of natural resources to their proper use and conservation.

We see that today's consumption of raw materials is significantly greater than their rates of regeneration and forecasts of the UN to us, if you do not change anything in our behavior, by 2030, will have the equivalent of two countries to support our consumer desires, and we, of course, we have only one. Transformation of resources into waste faster than the same waste we can go back to some of the resources brings us to the situation of the exhaustion of resources upon which human life and biodiversity. Sustainable management for the sake of preserving the ecological balance involves the successful management of a generic structural archetypes. This paper presents the identification of an archetypes, their description and recommendations for their application for sustainable management of natural resources.

Key words: archetypes, natural resources, Ecological footprint, sustainable management.

INTRODUCTION

Systematic research is based on established principles of influence and in-depth knowledge of the dynamic structure characters that are the outcomes of certain behaviors and the consequences of the results that may be it positive or negative. It is well known that the structure generates a problem, and to procure that the forms of behavior, and that the problems of the same result or outcome that is a great feedback mechanism of three-phase structure.

The work of identification of components of the dynamic structure nevidiljivog physical shape that forms the basis for the determination of the elements in which it is possible to make relationships and solutions with the goal of providing signposts and maps for sustainable functioning of natural resources in order to preserve as long as possible. Depth (in)visible structures are defined archetypes as identified by many researchers with Peter Senge as a leader.

The goal of structural research work that lies ahead is to confirmed using knowledge of generic structures (archetypes), defined functionally optimal basis for sustainable management of natural resources, in order to present connections and interdependence of generic structures with a view to their joint action to preserve the already worn-out natural resources. This achieves the goal of systems research defining all the necessary generic structure to ensure sustainable growth and ongoing success of survival of the remaining natural resources, eliminating the typical mistakes that reduce their lifespan. [1]

ECOLOGICAL FOOTPRINT – OUR IMAPCT ON PLANET

Ecological footprint gives us the relationship between human demands and regenerative capacity of the biosphere, and shows how the Earth's surface, in global hectares, is needed to accommodate our infrastructure (houses, factories, roads,...) using renewable sources (crops, fish, wood,...) and recycling (currently only CO2 is included). Footprint only applies to renewable sources. Use of an unrenewable sources, such as their name suggests, is not sustainable.

Ecological footprint and biocapacity are expressed in global hectares (gha). In the U.S. footprint is often expressed in the global acreage (ha). One U.S. acre is equal to 0.405 acres.

Ecological footprint of mankind 2007a. was 2.7 gha per capita, which is 51% higher than the Earth's total biocapacity (which amounts to 11.9 billion gha, or 1.8 gha per person). In other words, humanity is already needed a second planet to meet the demand for food, energy and other natural resources. Developed countries usually have a much higher demand on the earth's ecosystem of the poor, less developed countries. Today's ecological footprint measures more interesting because we can compare the different lifestyles of the people in different countries because it actually shows how each of us pressure planet. [2]

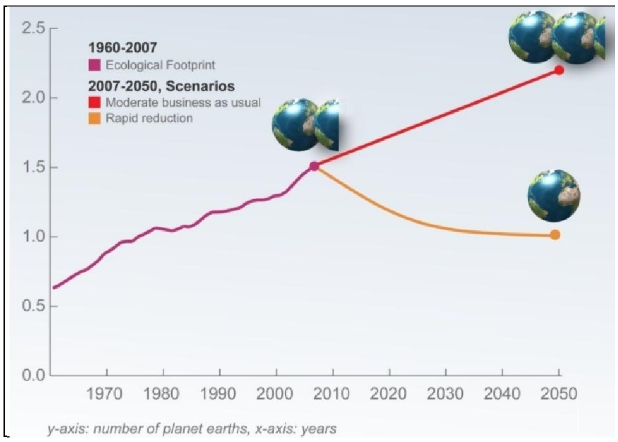


Figure 1. UN forecast - How much planet do we need?
(http://www.nootrol.com/sustainability/environmental-overdraft)

TRAGEDY OF THE COMMON RESOURCES

An environmental footprint talk about how alarming our situation is. If you do not start with the serious thinking about useage of limited resources, and does not take adequate corrective action can very quickly get to the collapse of the global scale, known as the tragedy of the common resources.

Shared resources are defined as: the ability of rivalry as using shared resource by one person reduces the ability of others to use it. Common property resources have exclusivity, they are those who want to use them available - for free. On the other hand, the "tragedy" is: a parable that illustrates why common resources are used more than is desirable from the standpoint of society as a whole.

It is necessary to ask ourselves where we are today and how much time we have the resources at our disposal, if we continue with the current trend of consumption.

The limitations of our resources and the environment complicates the rise of the middle class in countries like China and India that will shape the rest of this century. The American magazine "Scientific American" made a pretty accurate forecast period resources that today almost every day use.

1976-2005 - *melting of glaciers*

The glaciers are losing mass rapidly in recent decades. In some regions, such as Europe and America, the glaciers lost more than half a meter every year.

2014 – *"peak oil"*

The most common answer to the question "How much oil is left?" is "It depends on how you want to look at." New technologies allow oil companies to ekspoloatišu difficult to reach locations (such as 5,500 feet below the Gulf of Mexico). It is anticipated that global oil production will peak in 2014.

2025 - *„Battle of water"*

In many parts of the world, a large river provides water to several countries. Climate change, pollution and population growth puts significant pressure on the stock. In some areas of renewable water reserves are in danger of falling below 500 cubic meters per person per year which is considered the minimum for a functioning society.

Potencial hotspots:

- Egyptian coalition of countries led by the Ethiopian challenge the old agreement which allows Egypt to use more than 50% of the Nile flow. Without the river, the entire territory of Egypt would be a dry desert.
- Eastern Europe: Decades of pollution have left their impact on the Danube, leaving downstream countries such as Hungary and Moldova to find new sources of water.
- Middle East: Jordan River is mostly due to the drought, and for diverting the flow of Israeli, Syrian and Jordanian dam, lost 95% of its former course.
- Former Soviet Union: The Aral Sea, once the fourth largest inland sea in the world, has lost 75% of its water for agricultural programs initiated in the 1960**.**

2028 - *Indium*
Indium is a silvery metal that is widely used today in the industry. Indium is a thin wire that is often used for making flat screen TV. In accordance with the current level of production, is known to have reserves of indium in another 15 years.

2029 - *Silver*
Because silver is used as a tool that naturally kills germs, is increasingly being used for making bandages as well as coatings for consumer products. In accordance with the current level of production, the country's stock left for about 16 years but exploitation in support of recycling should Tallyho expand in the coming decades.

2030 - *Gold*
The global financial crisis has increased the demand for gold, which is seen by many as an excellent material for inveristanje. It is estimated that it was probably still about 17 years of gold mining.

2044 - *Copper*
Copper is used in the overall infrastructure of the production tubing to the production of electrical equipment. Known reserves currently stand at 540 million tonnes, but recently conducted geological work in South America suggests that there may be an additional 1.3 million metric tons of copper that are hidden in the Andes.

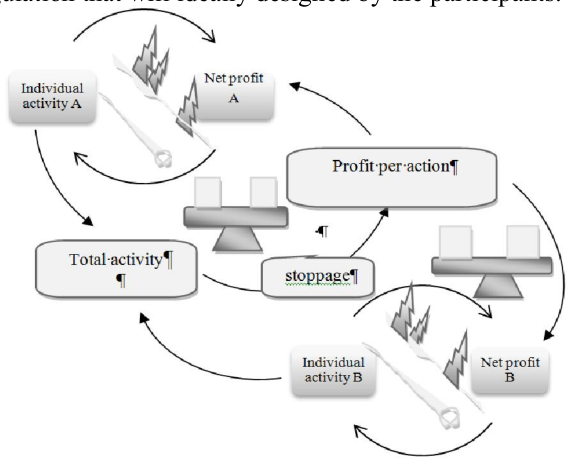
2072 - Unlike oil, coal is considered to be virtually inexhaustible. Exploitation of coal has been uneven. Production grew during the 19th and early 20 century, and then pala.Ukupna curve in Britain and other regions have followed a predictable S shape. Extrapolation to other world deposits of coal, it can be concluded that the world will extract 90% of the coal to 2072. [3]

Bearing in mind some of the listed stocks, we conclude that the management system is almost necessary and as soon as possible to understand the mechanism of action of archetypes and apply them in practice.

IDENTIFICATION OF ARCHETYPES FOR SUSTAINABLE MANAGEMENT OF NATURAL RESOURCES

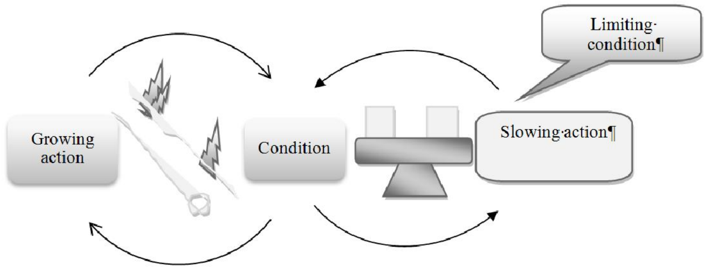
Peter Senge has defined in total of 10 generic structures or archetypes for managing complex processes in the system. When it comes to natural resources, their availability on the Earth, we can say that the best identify and explain the three archetypes such as - the tragedy of the common resources, limit growth and escalation. We chose these three archetypes because their actions seems a whole,in other words, excessive use of limited resources, can lead to a general collapse of the raw material on which the human life and biodiversity, and if such a situation occurs, it automatically found in a limited area, where we have possibilities for further development. [4] Do not come to this, and to think about the future generations and leave them and the resources at least to the extent to which they and we still use today, and for this reason it is necessary to identify the archetype of escalation and the actions that follow it, to make the ecological balance in the best way and preserve the resources that surround us. [5]

Archetype VIII – Tragedy of the common resources
Description: One common use of available resources, because over time due to the exhaustion of resources getting less and less, so they have to step up their efforts because there is not enough for everyone.
The principle of management: Must learn to manage shared resources through the mechanism of regulation that will ideally designed by the participants. [6]



Archetype II – Limits to growths
Description*:* Nothing grows forever, and it is often not that people behave, which can be kontraproduktino. Limit growth helps to see the change of balance between resources over time. The cause of the growth stage process ojačavajućeg feedback, while limit growth products balancing process close to the border. The limit is associated with limited resources. If there is a rapid decline of the cause of action he will be the limiting process in the opposite direction in order to reach an increasing reduction.

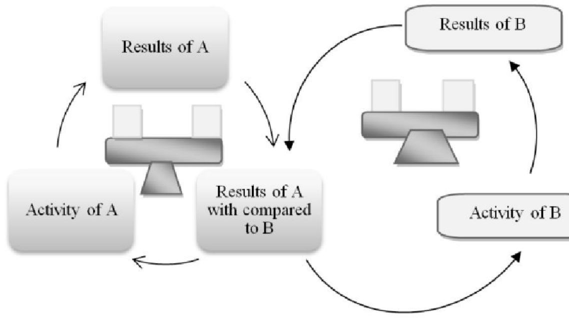
The principle of management*:* In the case of the process of strengthening feedback and that growth, we should not put pressure but should find ways to eliminate or minimize the factors that constrain it. [6]



Archetype VI - Escalation
Description: It is the relationship between present and future generations, with each generation of future stability depends on the advantages it has in relation to the present

generation. Advancing one threatens the other, whereby it acts aggressively to regain its lost the advantage of the threat first and then it leads to aggressive actions. It is a process that is constantly moving in a circle, which produces aggressive behavior as a defensive response to the aggression of the other side, leading to an increase in aggression that exceeds any desires.

The principle of management: It is necessary to enjoy their current generation enchanted spiral turn in the direction of taking aggressive action to peaceful future generations would not have felt threatened. [6]



DISCUSSION OF RESULTS

The shown example of the duration of resources we note that the current consumption and the usual habits, we have a few years left for exploitation. It's certainly not encouraging information because if we spend the listed years, which will leave a legacy for future generations? The most important an archetype is the limit of growth. Just because people are often not aware of the limitations of our resources, constantly increase consumption, which can lead to big problems. Record growth is produced by reinforcing the process until it reaches a peak, in this case, the peak of the thoroughness of available resources. To stop this growth is due to limited non-renewable resources. However, if the borders are known, previous methods are always applied, but more aggressive. It causes the opposite of the desired state - a system failure. The solution lies in the weakening or elimination of the causes of limitation. In this model, to a large extent by switching to renewable resources and to a lesser extent, derive non-renewable resources in order to avoid the "fall" of the system that we call the tragedy of the situation of shared resources. A tragedy shared resources occurs when individuals are heavily used shared resources for the sake of personal profit, and thus leads to a full utilization of resources or a severe degradation. To prevent this occurrence, a solution is proposed to introduce specific regulations that would, in their own fashion the pace of exploitation of non-renewable resources. We can rightly say that today's resource consumption to some extent recognized in the fifth archetypes - escalation, because it is the relationship between present and future generations by advancing one threatens the other. It's logical conclusions in the fact that today's pace of resource extraction, question the future exploitation. This prototype is comparable to the non-cooperative game in which both players (current and future generations) under the assumption that only one of them can win. Juxtaposed In this respect, increasing aggression and can lead to self-destruction. This vicious circle can come by a single player to stop responding in defense and include the cooperative game with your teammates, because cooperation is the key to successful conservation resources. Today is a very important step on the way to excessive consumption of non-renewable resources, so you would know exactly where, when and to what extent they need specific resources, if necessary, the process is established and the legal and thus prevent a tragedy that we necessarily imminent . There should not be "battle" with the generations to come, but think ahead and leave sufficient resources so that they continue our process began smoothly. Only the successful combination of these archetypes described, we can save resources and to establish the ecological balance and thereby fulfill a goal in the UN Conference on environment and development.

CONCLUSION

Taking into account the described problems the world faces today, and the limitations of resources, whose ultimate limits, hastily approaching, it is clear that it is more than necessary for a systematic approach to solving them. Fossil fuels and metals that we use the most today, , unplanned exploit and question the duration of their future generations. Thus, for example, forecasts that we have a year to reach the so-called. "Peak oil", or the maximum oil production so far, around 2025, we will experience a "water crisis", which will lead to a real war over a small clean drinking water, especially in developed regions, and that we will remain 2044. without reserves of copper which is now the basis of many things we use in everyday life. Generic structure for managing complex processes in the system, in this case, the Earth's ecosystems, are crucial for identification, and removing obstacles and limitations to be able to freely evolve in the direction of sustainability. We need to be aware that nothing grows forever, and neither consumption of resources can not continue the current trend, otherwise it can lead to the collapse of the system, known to us as a tragedy of common resources. Shared resources are a common good and thus should behave towards them and leave them as a legacy to future generations because, in principle, all the earth's resources the common heritage of all people in the world and should be treated in that way, and there is no space for greed, envy, deliberate and excessive exploitation.

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TEMPUS-MCHEM PROJECT ACTIVITIES AT TECHNICAL FACULTY IN BOR IN PERIOD 2010-2013

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ABSTRACT

The project 511044-TEMPUS-1-2010-1, under the title *Modernization of Post-Graduate Studies in Chemistry and Chemistry Related Programmes* (MCHEM), coordinated by University of Greenwich, United Kingdom, started in 2010, to be finished in 2013. Many European universities took part in that project - RWTH Aachen University (Germany), Brno University of Technology (Czech Republic), University of Nova Gorica (Slovenia), University Lower Danube in Galati (Romania), as well as all different Serbian universities - University in Belgrade, University in Niš, University in Novi Sad, University in Kragujevac and HS Užice, presenting a wide forum of expert high education institutions at which chemistry is studied. Technical Faculty in Bor actively participated in MCHEM project activities and their review is given in this paper.

Key words: TEMPUS, MCHEM, project activities, Technical Faculty in Bor.

INTRODUCTION

The tradition of higher education (HE) in Serbia is very long and distinguished, with widely recognized reputation – especially in fundamental sciences. HE modification started in 2002, when the Government of Serbia decided to adopt the Bologna process, which is ongoing in all Serbian Universities [1].

Tempus MCHEM international project, under the title *Modernization of Post-Graduate Studies in Chemistry and Chemistry Related Programmes,* was created to contribute to creation of a more flexible and a more responsive system of high quality master programmes and courses in chemistry that meet professional, employer and workplace needs and the wider desires of Serbian society [1]. That aim is presented through following objectives:

- Modification and regulation of learning outcomes and competences of existing master programmes in line with best EU practices
- To modernize curriculum delivery and quality standards of the Master programmes in chemistry in line with the recommendations for the Euromaster label; and
- Development of new interdisciplinary master programmes at universities in Serbia,

and the project team undertake a range of activities that will contribute to meeting these objectives, including [1]: the development and implementation of benchmarking and quality control/assurance procedures; modernization and harmonization of curriculum outputs with best European practice; updating academic and professional skills of Serbian faculty; modernization of IT and laboratory facilities; development of teaching materials using e-technologies; implementation of continuing professional development and lifelong learning strategies; and stakeholder and thematic support network building. Project outputs were and still are widely disseminated through workshops, seminars and conferences [1]. Maximum use will be made of web-based social networking tools to widely discuss and highlight project achievements and outcomes, which should be disseminated widely and adopted extensively in HEIs in Serbia and designed to directly address the agenda of sustainable environmental development in Serbia, in accordance with EU regulative and best practice [2-6].

Following participants were included in the project team: The University of Greenwich (UK) – project manager Prof. dr Steve Leharne and project coordinator Prof. dr Milan Antonijević, The RWTH Aachen University (Germany), Brno University of Technology (Czech Republic), University of Nova Gorica (Slovenia), University Lower Danube of Galati (Romania), University of Belgrade-Faculty of Chemistry, Faculty of Physical Chemistry, Faculty of Mining and Geology, Faculty of Technology and Metallurgy, Technical Faculty in Bor (Serbia), University of Niš-Faculty of Sciences and Mathematics, Faculty of Technology (Serbia), University of Novi Sad-Faculty of Science (Serbia), University of Kragujevac-Faculty of Science (Serbia) and High Business-Technical School of Užice (Serbia). So, our Faculty was actively involved in MCHEM and this work presents main and most important activities during the project period 2010-2013.

MCHEM ACTIVITIES ORGANIZED BY TECHNICAL FACULTY IN BOR

Our Faculty was engaged as the organizer of two important activities in the scope of Work Package 4 - **Development of new interdisciplinary MSc programmes in Environmental Chemistry, and Work Package 5 - Strengthening the work of the stakeholder and professional networks.**

Work Package 4: Workshop "Remediation"

One of the activities in the frame of TEMPUS MCHEM project Work Package 4 was a Workshop "Remediation", held in Bor from 4-6 April 2012. During the Workshop, the participants worked on development of the course "Remediation" within new MSc programme in Environmental Chemistry. Workshop was coordinated by Prof. dr Dragana Živković, with assistance of PhD students team - Marija Petrović, Aleksandra Mitovski, Milan Radovanović and Ljubiša Balanović. Participants from five different universities from three countries took part in the work of the Workshop - University of Greenwich, UK, University of Nova Gorica, Slovenia, University of Niš, University of Kragujevac and High Technical School Užice.

During the Workshop, two lectures:
1. Prof. dr Polonca Trebše - University of Nova Gorica, SLO: Application of different AOP for pesticide removal
2. Prof. dr Colin Hills - University of Greenwich, UK: **I**ntroduction to stabilisation/solidification for the treatment of contaminated land and waste
were given for the wider public – students, professors and other colleagues engineers from Technical faculty in Bor, Institute of Mining and Metallurgy Bor, and RTB Bor Company. Also, terrain visit to RTB Bor mining landfill material and flotation tailing was organized for the workshop participants.

Figure 1. Details from Workshop "Remediation" – the lectures, participants and terrain visit to RTB Bor mining landfill material and flotation tailing

Work Package 5: Continual Professional Development (CPD) Course "Wastewater treatment methods"

Within the work package WP5 of MCHEM project, the Continual Professional Development Course (CPD) named "Wastewater treatment methods" was organized at the Faculty in period 25-26. 03. 2013. The lecturers were Prof. dr Milan Antonijević, Prof. dr Velizar Stanković and Prof. dr Grozdanka Bogdanović from Technical Faculty in Bor. The course gathered the participants from various institutions, such as faculties, i.e. postgraduate students, institutes dealing with the analyses of different kinds of waters, and also some industrial plants representatives. The result was dissemination of good practices and new trends in wastewater treatment, as well as very valuable exchange of experiences among the professionals dealing with the wastewater from different points of view.

The information regarding course was disseminated through the Serbian Chemical Society, and also through the connections with the local industry, while the publication containing course material "Wastewater treatment methods" was prepared and distributed to the participants.

Figure 2. Details from CPD "Wastewater treatment methods" lectures and the publication

MOBILITIES OF STUDENTS/PROFESSORS DURING MCHEM PROJECT

TEMPUS MCHEM gave numerous opportunities for students/professors mobility. So, during the project, in the frame of the Work Package WP3 "**Modernization of teaching methodology and student assessment procedure",** professors and teaching assistants from Technical Faculty in Bor visited large number of HE institutions in the European Union (EU).

So, Ljubiša Balanović, assistant at Technical Faculty in Bor visited University of Nova Gorica, Slovenia in the period from 31 05 to 06 06 2011, while in the period from 08 01-13 01 2012 Marija Petrović, assistant at Technical Faculty in Bor visited the same institution. The main scope of those visits were introduction with structure of the Faculties of the University, as well as exploring study programmes and curricula at School of Environmental Science. The hosts have provided visit of laboratory and research centers where presented current research conducted at the University.

The RWTH Aachen University, Germany was also visited twice - 26 06 - 01 07 2011 and 26 02 -02 03 2012. Milan Radovanović and Marija Petrović, at that time the assistants at Technical Faculty in Bor, visited this reputable institution which is ranked in the top 10 German universities. These visits included introducing with the study of Environmental Geochemistry at the Institute of Geology and Geochemistry of Petroleum and Coal and the study of Environmental Chemistry at RWTH Aachen University, as well as introduction to e-support in education.

During the stay at RWTH Aachen five round tables were organized which enabled exchange of experiences concerning accreditation of study programmes, curricula and the evaluation process. Discussions with the colleagues from the Institute of Geology and Geochemistry of Petroleum and Coal at RWTH Aachen University enabled establishing similarities and differences in the organization of postgraduate studies at our universities. Also, one of the main task was a preparation of small power point clips and their possible implementation into the education on environmental chemistry. After the preparation of the clips, there was a discusion about advantages and disadvantages of using PPT clips as a teaching tool. One of the conclusions from that meeting was that PPT clips as a teaching tool enabled better visibility, involving the students with previous experience in the learning subject and increasing motivation of students.

Figure 3. Details from some of mobility visits to partner universities in EU

In the scope WP3 task „Implementing training programme: Innovation in teaching and learning design", Aleksandra Mitovski, teaching assistant at Technical Faculty in Bor, visited Brno University – Faculty of Chemistry (FCH) from 30 10 2011 to 06 11 2011. During the staying at FCH, the group from all Serbian consortia members was introduced in topics of "E-learning skills and programs" and "Ecotoxicology". These issues have been introduced through the demonstration classess and modern lectures given by the FCH stuff. During these courses the project participants from Serbia were introduced to the fundamentals of "MOODLE", useful and efficient e-learning software which is used at Brno University.

In november 2011 Prof. dr Grozdanka Bogdanović visited Dunarea de Jos, University of Galati (Romania), where the all visitors from Serbia and other countries had the opportunity to familiarize themselves with the work and facilities at that University and to exchange experiences regarding the study programs and curricula.

Prof. dr Dragana Živković and Doc. dr Snežana Milić visited the coordinating university for TEMPUS MCHEM project - University of Greenwich (United Kingdom) in december 2011, while in the mobility of students, Dragana Medić MSc student spent a month in 2013 at the same HE institution with other students from Serbian universities in joint research work in the frame of project.

EQUIPMENT AND BOOKS PURCHASED IN THE FRAME OF TEMPUS MCHEM PROJECT

One of the main aims of the MCHEM project was to improve creation of more flexible and approachable system of high quality study programs through modernisation of teaching equipment. According to that 4 interactive tables were installed in the classrooms at Technical Faculty in Bor and 4 digital voice recorders, 1 digital camcorder, 1 digital camera and 4 external hard drives were provided, too.

To modernize program transfer and quality standards of the Master programs in chemistry, in line with the EU recommendations and to provide better learning outcomes and competences of existing master programs with best EU practices, 20 books from the following scientific fields was purchased: Environmental science and engineering, Impact assessment of recycling, Environmental (air and soil) pollution, Wastewater treatment and Bioremediation technology.

European Commission
TEMPUS

MCHEM

Figure 4. One of the classrooms at Technical Faculty in Bor with new installed interactive table purchased by TEMPUS MCHEM project

CONCLUSIONS

The needs of educational institutions in Serbia, which are fundamental of the scientific field of chemistry, and participating in the TEMPUS project, are to adopt uniform educational reference standards for chemistry and related disciplines resulted from Bologna Process, which came into effect in all Serbian educational institution. Unified attitudes and common text, based on the fact that the same standards already exist in Europe, accredited by the European Association "The Chemistry Quality Eurolabels" [5] and accepted by "European Association for Chemical and Molecular Sciences" in 2003 [2], presents one of the main results of joint work on TEMPUS project „Modernization of Post-Graduate Studies in Chemistry and Chemistry".

It is very important to underline that all existing faculties in Serbia dealing with chemistry, and especially - environmental chemistry, were involved in this project, working together on further development and modernization of existing MSc curricula, based on good EU practice and experiences. The outcomes of TEMPUS MCHEM project, being of great importance for Technical Faculty in Bor, are presented in this work.

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PROMOTION OF THE ECOLOGICALLY SUSTAINABLE DEVELOPMENT OF TOURISM ON STARA PLANINA

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ABSTRACT

The issue is the development of the nature park and the tourist region of Stara Planina and its accomplishment in relation to the sustainable devlopment, the consensus regarding the economic and ecological problems and management including the so-called ecological management. The point of development and use of the capacities at this particular region is related to the two following aspects: the development of the region and its protection. The strategy of development and preservation of Stara Planina has been defined through the concept of ecotourism. Raising people's awareness about the environment and encouraging the whole society to act as the so-called sustainable community means preserving biodiversity which is the most valuable heritage for the future generations.

Key words: nature park, sustainable development, ecological management, eco-tourism, sustainable community, social consesus regarding economy and ecology.

THE AREA OF STARA PLANINA AS A NATURE PARK AND A TOURIST REGION

Stara Planina is also called Balkan; that is why the whole region i.e. peninsula on which this mountain is located, is called the Balkan Peninsula. It makes a natural border between Serbia and Bulgaria. It runs about 100 kilometres from Vrska Cuka in the north to Dimitrovgrad in the south. The overall mountain area located on the territory of Serbia is 1802 km^2. Among its impressive peaks we can mention Babib Zub (1780 m) and Midzor (2169 m), the latter being the highest peak of Stara Planina in Serbia. The highest peak in Bulgaria is Botev (2376 m). Stara Planina is rich with waters and is a place where two rivers – the Nisava and the Timok meet. Other important rivers in this area are the following: the Toplodovska River, the Visocica, the Dojkinacka River, the Jelovicka River and the Rosomacka River. It is also worth mentioning that the so-called 'kackavalj from Stara Planina' was produced in this region. Famous for its high quality it was the main export product and was most used in the White House. After the Second World War there were up to 500,000 sheep grazing on the meadows of Stara Planina.

Serbia has recognized the importance and role Stara Planina could play as a specific natural jewel whose value in the international context may be immense. In relation to this, in 1997 Stara Planina was declared a nature park and thus all its natural reserves and monuments are put under the state's protection. It is a unique eco system with various flora and fauna. Thanks to the specific and diversified flora and fauna, a large number of locations have been declared protected areas, reservations and nature monuments.

When the overall tourist promotion is taken into account, a special emphasis has been given to rural tourism. It is a complementary part of mountain tourism which employs in a specific way natural beauties, traditional values and all anthropogenic values.

This is a list of protected areas which are of special importance for the Republic of Serbia and thus undergo special proetctive measures [1, p.592]:

1. Nature reserve
2. National park
3. Protected plant and animal species
4. Nature monument
5. Nature park
6. Area of special natural characteristics

The development project of Stara Planina is based on natural and anthropogenic values of this area as well as on the economic, social, demographic, cultural and other values municipalities around Stara Planina share (municipalities of Zajecar, Knjazevac, Pirot and Dimitrovgrad) and also the values that are present in the wider surrounding, outside these municipalities. The two aspects of the overall tourist supply are the following:

a) Summer season tourism: mountaineering, walking, various activities in nature, bicycle riding in the hills, paragliding, kite running, horseback riding, holiday in the sun and fresh air, natural and cultural attractions.
b) Winter season tourism: alpine and nordic skiing, snowboarding, sleighing.

Built accomodation capacities in total number about 500 beds, and the most popular is a newly built four-star hotel, the Stara Planina which started working in 2012 and has 380 beds organised in 146 accomodation units. Beside this one, a high level of sevice and quality are also offered by the Babin Zub and the Planinarski Dom owned by the municipality of Knjazevac.

Based on the analysis of the existing international contracts and the instruments known as the soft law, it could be said that there are two most recognizable general goals with regard to politics and environmental laws. These are [1, p.20]:

1. Sustainable development
2. Man's right to a (proper) environment, which in a wider sense means good quality of life.

It can be said that the man's crucial response to the ecological crisis is seen in the term 'sustanable development'. This term occupies a central place in all categories and there is no other term in modern politics and environmental law today that has so much importance or which has been so much emphasized. [1, p.6]

Sustainable development means a harmonious relation between the environment and economic development, which ensures that a country's natural wealth is to be preserved for the future generations. In otehr words, sustainable development is a general direction, a tendency to create a better world striking a balance among social, economic and environmental factors. The World Commision on Environment and Development, known as the Brundtland Report, defined sustainable development as the kind of development that meets the needs of the present without compromising the ability of future generations to meet their own needs. [2, p.445]

The economic growth and development cannot be limited because economy does not function independantly from the ecological concept of natural environment. Usually, there is a kind of deal between the quality of the environment and the country's economic development. The means and volume of production is necessary to be adapted to the environment, i.e. the issue of modern development cannot be formulated in this way: economy vs ecology. It is necessary to reach a social consensus about 'sacrificing' the ecological quality of the environment for the economic well being. [3, p.11]

In a broader sense, sustainable development means not only economic and social sustainability but ecological as well. It is a complex issue and requires balanced and homogenous unification of objectives which can be classified into the following categories: [3, p.29]

- Economic objectives (production increase, reducing the gap between the rich and the poor)
- Ecological objectives (quality of the environment, climate change, 'the ozone hole', waste disposal, etc.)
- Social objectives (education, living standard, health and social insurance).
- Spatial objectives (balance between urban and rural areas and territorial economic activities).
- Cultural objectives (relying on the eco-development concept paying attention at the same time to the local, economic, cultural and social specific characteristics).

Summarizing the cultural and spatial objectives and putting them in a wider social subsystem, a simplified version of sustainable development would have only the following three subsystems:

1. Economic,
2. Ecological,
3. Social,

which are mutually dependant.

With regard to sustainable development – and the relation between economy and ecology ("Eco-Eco"), the emphasis is put on the basis of the perception of th eenvironment as a source of economic activities but aslo as a recipient of waste (taking into account pollution tolerance indices). [3, p.53]

The spatial plan for the Nature park and the tourist region of Stara Planina was presented in Knjazevac in 2008 and was made by the Institute for Architecture and Urbanism and supported by the relevant Ministry of Infrastructure, Spatial Planning and Regional Develoment. The point of this document – Plan proposal is to take int oaccount all basic principles of sustainable development which in turn require the fulfillment of the following three conditions: [4]

1. Ecological suitability, which means the development of tourism and other complementary activities that can be realized in the areas with extraordinary natural resources,
2. Economic feasibility, which means investments and development of energy and telecomunications infrastructure,
3. Social acceptability, which means the protection of the community's interests, the improvement of living and working conditions through active participation of local population in the tourist supply and the environmental protection

The specific characteristics of the Spatial Plan of Nature Park and the tourist region of Stara Planina which are important when making spatial decisions are related to the following special purpposes:

- Special natural values – such as a nature park
- Special tourist values – with specific potential for the development of tourism
- Water springs – at both national and regional level
- Special purpose zones – border line and border crossing with the Republic of Bulgaria
- Agricultural fields and forests – areas where cattle are fed.

The integral solution adopted in all documents concerning the area's development make it possible for Stara Planina to further develop. This is of crucial importance in all official documents issued and signed at both local and republic level.

The following documentation has been considered during the Spatial plan making: [4, p.22]

1. Tourism Development Strategy of the Republic of Serbia (Official Gazette of the Republic of Serbia, No 91/06)
2. Programs by the Ministry of Agriculture, Forestry and Water Management designed to support and preserve agro-diversity, sustainable development of agriculture and rural tourism in Stara Planina and its surrounding.

When managing a particular area in or around Stara Planina, it is not advisable to use what is usually referred to as ecological management. Ecological management may be defined in the following way: Looking for the best possible ecological option in order to promote sustainable development or the decision-making process which regulates the impact of human activities on the environment in such a way as not to disturb the environmental capacities in relation to sustainable development.'. [5, p.85]

Besides the term of sustainable development (first mentioned at Nairobi Conference in 1982), there is also a modern social community, a community that is highly aware of ecology, which is in scientific literature referred to as sustainable community. It is defined as 'a community that uses its resources in order to meets the needs of the present without compromising the ability of future generations to meet their own needs'. [5, p.213]

In 1991 the International Ecotourism Society / TIES gave one of the first definitions of ecotourism: " Ecotourism is responsible travel to natural areas that conserves the environment and improves the well-being of local people".[6]

Various discussions at different conferences have led to general consensus about the components of ecotourism:

- It contributes to biodiversity preservation
- It maintains wellbeing of the local people
- It involves the experience of understanding and learning
- It involves responsible behaviour of tourists and the tourist economy
- It is primarily directed to small groups by small enterprises
- It requires the least possible spending of nonrenewable resources
- It stresses the importance of the participation of the local people / community, ownership and entrepreneurial skills, especially for rural people

USE OF TERMS

This is a list of the most commonly used terms with their definitions: [1, p.288]

- 'Protected area'- geographically defined area which is determined or controlled, and which is managed in such a way as to preserve biodiversity
- 'Sustainable use' – use of components of biological diversity in the way and manner which will not reduce this diversity in the long run, thus preserving the potential to meet the needs of both the present and the future generations.
- 'Natural resources' – parts of the living or non-living nature which man can use to meet his needs
- 'Bio-diversity' – means a variety of living organisms of all ecosystems as well as a variety within a species, among species and their communities.
- 'Protected natural areas'- refers to a conserved part characterised by special or extraordinary natural values and features, thanks to which it has a permanent ecological, scientific, cultural, educational, health-recreational, tourist etc. importance and thus, being of general interest, receives special kind of protection.
- 'Monitoring' – is a systematic and regular surveillance and measuring of environmental parametres (water, air, soil, biodiversity and the like) and changing the qualty and quantity of the environemnt, pollutant emissions and use of natural resources.
- 'Agenda 21 [7, p.5] - an action plan for the 21stC, the document adopted at the UN Conference on the environment and development held in Rio de Janeiro in 1992.
-

CONCLUSION

The development of the area of Stara Planina relies on the strict adherence to and application of the principles of the modern development, on the so-called sustainable development concept. All relevant documents, both local and republic, prove this: the National Strategy of Tourism of the Republic of Serbia, the Development Stategy of Knjazevac Municipality,the proposed Spatial Plan for Stara Planina, etc. In practice, this is evident from the investments made in Stara Planina (the State has invested about €50m in the last several years): ecologically sustainable investments with economic and social effects which contribute to the local development, help raise the citizens' awareness about the importnace of ecology, participation of the local poeple in tourist activities and active participation in the environmental protection. In this way employment has increased in this part of the country, which has led to the increase of the living standard of the local people, which has ultimately increased the living standard of the region of Timocka Krajina as a whole.

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MANAGEMENT OF NATIONAL PARKS AS A FACTOR OF TOURISM COMPETITIVENESS

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ABSTRACT

Latest global tourism trends demonstrate the need for sustainable tourism products. By creating sustainable products a higher level of competitiveness can be achieved. Therefore, national parks and other protected areas could play a significant part in meeting contemporary tourism demand's needs. In order to be able to do so, protected areas need to have well defined management goals and objectives adapted to individual area's resources that need to be protected. Tourism activities must be inherent part of the management plans and processes. Sustainability principles underpin the protected areas protection and tourism management and represent the linkage of the two main goals of protected areas.

Key words: national parks, protected areas, competitiveness, management tourism.

INTRODUCTION

Tourism products that are primarily based on the preserved natural and cultural resources are increasingly necessary incontemporary tourism.„There are many opportunities for the industry to reap the rewards of being biodiversity-friendly, including market differentiation and increased competitiveness, the development of premium products and services, and new business propositions as well as emerging markets“[1].

In order to develop a product that meets the standards of modern tourism demand, it is necessary to take into account notonlythe needs of tourists today, but also the opportunity for future visitors to enjoy the preserved natural and cultural resources, the customs and traditions of the local people.In this way,tourism products and destinations, as well as all aspects of business an deconomic activities related to it become sustainable, that is are on the way which allows them to survive in the long run and successfully operate in the market. By making the present product sustainable, product competitivenessin the market is increased for two reasons-to meet the needs of tourists today who especially value nature and culture protection causing the product to be more competitivein the market today; competitiveness is increased for the future by building production and service systems that keep pace with the changing needs of the tourism market.

For this reason it is necessary that the principles of sustainable development are not only included in the management of national parks and protected areas, but set as the basis of suchplanning at all levels: national, regional, local.

TOURISM MANAGEMENT IN NATIONAL PARKS

The entire system of management planning in the national parks contains planning of tourism in them.Tourism plays a significant roleas an engine for the designation of protected areas, although their primary role is to preserve natural and cultural resources therein.„In many cases, travel to the sites by people have created the initial impetus for site designation and protection. Travel to experience protected areas has been an integral part of park operations for a very long time" [2].In addition, "the tourism industry is intimately connected to the protection of natural and cultural areas and often a high quality natural or cultural environment is the main attraction that draws the visitors to the area" [3].

At the same time, the impacts of tourism onvarious aspects of protected areas can of ten be negative.This observation of tourism in national parks of tenprevails. For this reason,there is an ongoing debate aboutthe functionand purpose of theprotected areas.It represents twoopposing primary orientations - 'preservational' and 'user' –and tourismin protected areas is the embodiment of this very dilemma. However, these statements should not be considered as mutually exclusive, but can beviewed through asymbiotic relationship.

For better conservation of protected areas financial resources are needed. The fostering of tourism and recreation al activities in protected areas can contribute to creating greater financial resources which canbe directed to preservation and protection. At the same time, visitors get the opportunity to meet their travel needs which are directly linked to stay in clean and preserved environment. For such arelationship to function, it is necessary to have a well planned and implemented effective management of the national park which also contains a specialized planning and management of tourism as an integral part of the life of the national park.

Good governance will create additional economic benefits for the local communities, who will give support to the operation activities. For these reasons it is important for all stakeholders to better understand mutual goals through the partnership,toreconcile themandwork together on their achievement. To achieve sustainability, conservation should be given not only to the preservation of pristineandun disturbed ecosystems in the present,but also meet the needs of visitors in the nearandin thedistant future including economic terms. Finally, tourism canbea means, not an excusefor the existence of protected areas.The link between ourism and national parkscan be seen in Figure 1.

There are four main links between tourism and the environment:

1. Components of the natural environment are the basis for a marketable tourism attraction or product
2. Management of tourism operations should minimise or reduce their negative environmental impacts
3. Direct and indirect economic contributions should be made by funds generated through tourism to conservation of the environment being visited
4. Attitudes of tourists towards the environment are impacted by the environmental and cultural interactions provided by tourism operators and park staff.

Figure1. Links between tourism and the environment

Source: Buckley, R. (1994). A framework for ecotourism. *Annals of tourism research,* 21(3), 661-669. in Eagles, Paul F.J., Bowman, Margaret E., and Tao, Teresa Chang-Hung. (2001). *Guidelines for Tourism in Parks and Protected Areas of East Asia.*IUCN, Gland, Switzerland and Cambridge, UK, p. 4

It canbe concludedthat moreoverlapbetween the management ofresourcesin the national parkandtourism managementin it is needed. On the orher hand, similar tourism planningat national or regionallevelis often notclosely related toprotected areas.Thisoverlapshouldincludethe ways inwhichthenumber of touristsin protected areascould be increased, provided that all theprinciplesof sustainability inthis caseare complied with. Therefore, tourism in protected areascan producebenefits, but alsocreatethe needfor investing inthem.Benefitsshould befor all stakeholdersin tourismin protected areas.Touristsvisit themto havethe opportunity toappreciate and enjoy thevalues for which the area isdesidnated.„One overall goal should be protection of the high quality natural or cultural environment that attracts tourists and enriches the quality of life of the local people" [4].

TOURISM OBJECTIVES IN NATIONAL PARKS

To be ableto extract all thepotential benefits, it is necessary that tourismin national parks andother protectedareasisincluded in theplansand regulationsprimarilyat the state level.Such plansand regulationscan be:

- National or regionalsector plans thatencompass a widerange of issuesand impact protectedareas that aretheir integralpart.Examplesof such plans are regional development plan, the plan of management of naturalresources, the national tourism development planor traffic strategy.
- Policyof tourism developmentin protectedareasat the nationallevel,the application of whichbodiesoragencies that managethe systemof protected areasare approvedby the state.This regulationprovides a frameworkfor closer cooperationandmutual understandingbetweenthe park managementandtourism servicesproviders.

Consequently, any planning of tourism in protected areas and the development of relevant plans should result from higher levels plans. In that case, they would have clear specific objectives for each park, and the development and appropriate action plans based onthe principles of sustainability would be possible so the set goals are accomplished. In the broadest term, these goals should be divided as given in Figure 2:

Environmental Objectives
- Ecological conservation, including conservation of biodiversity, land conservation, watershed management, and air quality maintenance,

Cultural Objectives
- Better knowledge and awareness of conservation among local people and visitors
- Appreciation of local natural and cultural heritage
- Making sustainable tourism part of local and national culture,

Social Objectives
- Visitor satisfaction and enjoyment
- Improvement of living standards and skills of local people
- Demonstration of alternatives to mass and package tourism and promotion of sustainable tourism everywhere
- Enabling all sectors of society to have the chance to enjoy protected areas,

Economic Objectives
- Improvement of the local and national economies
- Provision of local business and employment opportunities
- Generation of increased revenue to maintain protected areas.

Figure 2. Objectives of sustainable tourism for protected areas

Source: Federation of Nature and National Parks of Europe. (1993). *Loving them to death? Sustainable tourism in Europe's nature and national parks.* Eupen, Belgium: FNNPE inEagles, Paul F.J., Bowman, Margaret E., and Tao, Teresa Chang-Hung. (2001). *Guidelines for Tourism in Parks and Protected Areas of East Asia.*IUCN, Gland, Switzerland and Cambridge, UK, p. 36

Finally, the objectives of which are determined in the process of national park management should be directly derived from the regulations that exist at the state level.So, when designating a protected area, the state determines its category together with the primary and the other purposes that their administration needs to fulfill.Because of the discrepancies of the term "national park" which is widely used to refer protected areas of different categories the objectives of management for different categories are presented in the followingTable 1.

Table 1. Protected area categories and management objectives

	Protected area categories						
Management objective	Ia	Ib	II	III	IV	V	VI
Scientific research	1	3	2	2	2	2	3
Wilderness protection	2	1	2	3	3	-	2
Preservation of species and genetic diversity	1	2	1	1	1	2	1
Maintenance of environmental services	2	1	1	-	1	2	1
Protection of specific natural/cultural features	-	-	2	1	3	1	3
Tourismand recreation	-	2	1	1	3	1	3
Education	-	-	2	2	2	2	3
Sustainable use of resources from natural ecosystems	-	3	3	-	2	2	1
Maintenance of cultural/traditional attributes	-	-	-	-	-	1	2

Key - Categories:Key – designations:

Ia	*Strict Nature Reserve*	1 = Primary objective
Ib	*Wilderness Area*	2 = Secondary objective
II	*National Park*	3 = Potentially applicable objective
III	*Natural Monument*	-- = Not applicable
IV	*Habitat/Species Management Area*	
V	*Protected Landscape/ seascape*	
VI	*Managed Resource Protected Area*	

Source: adapted from Davey, A.G. (1998). *National System Planning for Protected Areas*. IUCN, Gland, Switzerland and Cambridge, UK, p. 49

According to IUCN [5] classification, national parks are II category protected areas. Therefore, their management objectives are derived from their deffinition:

"Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.....Their primary goal is to protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation"[6].

NATIONAL PARKS MANAGEMENT STRATEGIES

Giventhat tourismin national parksdepends on thepreserved naturalresources, andthattheir protectionmight dependon tourismin them, „tourism destination management is a complex and multidimensional challenge.... There are two primary parameters that must be satisfiedif the destination is to be successful. These are competitiveness and sustainability" [7].

Sustainability, in most generalterms,is the abilityto maintain qualityof a destinationwith purpose to be competitive. Thus, specific activities and their impactsmustbeallowedunder certainconditions.The principal issue that park tourism management must resolve is to determine what degree of impact may be acceptable.In order to respondto itsome principles of visitor management should be takeninto account:

- appropriate management depends on objectives
- diversity in resource and social conditions in protected areas is inevitable and may be desirable
- management is directed at influencing human-induced change
- impacts on resource and social conditions are inevitable consequences of human use
- impacts may be temporally or spatially discontinuous
- many variables influence the use/impact relationship
- many management problems are not dependent on numbers of users
- limiting use is only one of many management options
- the decisionmaking process should separate technical decisions from value judgments [8].

In numerous sources that deal with protected areas management there can be found various management strategies and frameworks such as: carrying capacity, the recreation opportunity spectrum – ROS, limits to acceptable change (LAC model), visitor impact management – VIM, visitor activity management process (VAMP), limits of use, zoning, entrance fees, environmanet adaptation, environment quality standards, design standards, environment audit andenvironmental impact assessment, research and control, educational and marketing strategies, interpretation.

Depending on the category and specific characteristic of a protected area, one or omre of the strategies can be used.

CONCLUSION

In the case of protected areas which are as a tourist destination specific for the fact that the principles of sustainability underpin their management, setting management goals is only the first step in the process. What follows is the realization of the objectives of each category so the benefits issuing from tourism could be maximized.

Inthis processtourism plays an importantrolein the way that"conservation interests hope to use tourism as a tool in tourism development. Both promote partnerships, but with different political aims." [9]. Further attentionshould be paid tothe specific objectivesof each protectedarea soappropriate strategiesare implementedin the processas well as combined with each other.

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ECOTOURISM IN THE MUREŞ FLOODPLAIN

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ABSTRACT

In a more and more polluted world, the need for fresh air, escaping the daily hustle of a stressful environment is growing dramatically. Sustainable tourism, especially through ecotourism meets the needs of the modern tourist who comes from the urban area.

The development of ecotourism in Romania can be achieved in the ecologically protected areas, taking into consideration the existing legal norms and the principles of sustainable tourism.

One of the country's natural parks is located in the lower part of the Mureş River, the Mureş Floodplain Natural Park, where there are ecotourism activities going on.

Key words: sustainable tourism, ecotourism, Natural Park.

INTRODUCTION

Worldwide intensive industrial development has as a negative effect the appearance of pollution. The majority of the economic branches, through the technologies used, pollutes more or less. Environmental pollution can be physical, chemical, cultural and moral, and the effects are seen immediately, on long term, indirectly or by irradiation.

Tourism is one of the activities that relies on the environment, but which, in its turn, can have negative effects.

Recently, a series of principles, known as principles of sustainable development, were adopted in order to diminish the intensity of pollution.

The fundamental criteria of sustainable development in Europe were set by the European Commission on the occasion of the signing of the Maastricht Treaty in 1992 and refer to:

- maintaining the quality of life;
- permanent access to natural resources;
- avoiding the permanent deterioration of the environment.

The tourist resources exploitation problem was discussed in April 1995 at the World Conference on Sustainable Tourism in Lanzarote, Canary Islands Spain.

By sustainable tourism we understand the tourism form that tries to meet the present and future tourists' needs by maintaining intact the culture of the area and the environment. Ecotourism is one of the forms of sustainable tourism known as „green tourism", „mild tourism", „ecologic tourism".

The International Ecotourism Society (TIES) considers ecotourism to be the „responsible travel to natural areas that conserves environment and improves the well-being of the local people." (Information Bulletin, REC – Romania, 2002).

According to the definition, ecotourism takes place in the protected areas and targets the preservation of natural and cultural resources and the minimization of the negative effects people have on them. This form of tourism can be the source of funds for the conservation and management of protected natural areas. Compared to a simple trip in nature, in the analysed case, the emphasis is on conservation, education of tourists, making them responsible and active involvement of the local community.

From a tourist point of view, the protected areas are very attractive and are characterized by location, accessibility, area and structure of the existent species.

Several IUCN (International Union for Conservation of Nature) Management Categories are recognized:

1. Strict protection:
    - Strict Nature Reserve;
    - Wilderness Area;
2. National Park - conservation of the ecosystem and recreation;
3. Natural Monument or Feature - conservation of natural features;
4. Habitat/Species Management Area - conservation through active management;
5. Protected Landscape/Seascape - conservation of land and sea landscapes and recreation;
6. Protected area with sustainable use of natural resources - sustainable exploitation of natural ecosystems.

In Romania, the protected areas are grouped in reserves of the biosphere, national or natural parks, reserves and natural monuments.

The natural park is considered „protected natural area whose purpose is the protection and conservation of landscape ensembles where the interaction of human activities with nature along time has created a distinctive area with landscape and cultural value, often with a great biologic diversity."[3]

The activities that can be performed in a protected natural area are:

- scientific research;
- wilderness and species diversity protection;
- tourism and recreation;
- education;
- sustainable use of ecosystems;
- maintaining of the cultural and traditional features.

There are 17 natural parks in Romania, 10 of them being under the administration of the National Forest Company – Romsilva.

Table 1. Natural Parks in Romania

Name	Location (County)	Year of establishment	Year of declaration	Area (ha)
Dumbrava Sibiului	Sibiu	1963	2000	993
Bucegi	Braşov, Dâmboviţa, Prahova	1974	2000	32.663
Balta Mică a Brăilei	Brăila	1978	2000	17.529
Grădiştea Muncelului Cioclovina	Hunedoara	1979	2000	38.184
Apuseni	Alba, Cluj, Bihor	1990	2000	75.784
Iron Gates	Caraş-Severin, Mehedinţi	1990	2000	115.665, 80
Vânători-Neamţ	Neamţ	1999	2000	30.818
Cindrel	Sibiu	2000	2000	9.873
Comana	Giurgiu	2005	2005	24.963
„Ţara Haţegului" Dinosaurs Geopark	Hunedoara	2005	2005	102.392
Low Floodplain of the Lower Prut	Galaţi	2005	2005	8.247
Mureş Floodplain	Arad, Timiş	2005	2005	17.455
Maramureş Mountains	Maramureş	2005	2005	148.850
Mehedinţi Plateau	Gorj, Mehedinţi	2005	2005	106, 50
Putna-Vrancea	Vrancea	2005	2005	30.204
HigherMureş Gorge	Mureş	2007	2007	9.156
Cefa	Bihor	2010	2010	5.002

Source: *ro.wikipedia.org/.../Lista_parcurilor_naționale_și_naturale_din_România*

Starting with the year 2000, all natural parks in Romania were declared, once the Law no. 5/6.03.2000 was set into force.

Their total area is of 667.885,300 ha, that is 2,8 % of the entire country area. For a good management, a functional zoning was established:

- total protection or strict protected area;
- tampon or sustainable management area;
- economic or human activities development areas;
- ecological reconstruction area.

Park management has as objective the maintaining of harmony between people and nature, through the protection of habitats and landscape, but also the support of tourism and other educational and scientific activities, all complying with rules and principles of environment and culture conservation.

Mureş Floodplain Natural Park

The Mureş River springs from Hăşmaşu Mare Mountains, from 1406 m d.M., has the longest inner course in Romania, that is 761 km and crosses the entire Transylvanian basin westwards, its hydrographical area being 27.890 km^2. This river is the main tributary of the Tisa River.

In Arad County the length is 191,6 km, and in Timiş County 21,14 km, which is also the border with Hungary.

Mureş Floodplain Natural Park is a mixed protected area located in the west of Romania, which stretches along two counties, Arad and Timiş, and includes the impounded area of the Mureş. Its geographic coordinates are:[5]

- North (46°19'01" Lat. N / 20°50'05" Lat. East)
- East (46°18'89" Lat. N / 20°49'94" Lat. East)
- South (46°07'15" Lat. N / 20°91'89" Lat. East)
- West (46°16'82" Lat. N / 21°27'72" Lat. East)
- average altitude: 100m
- minimum altitude: 82,5m
- maximum altitude: 135m

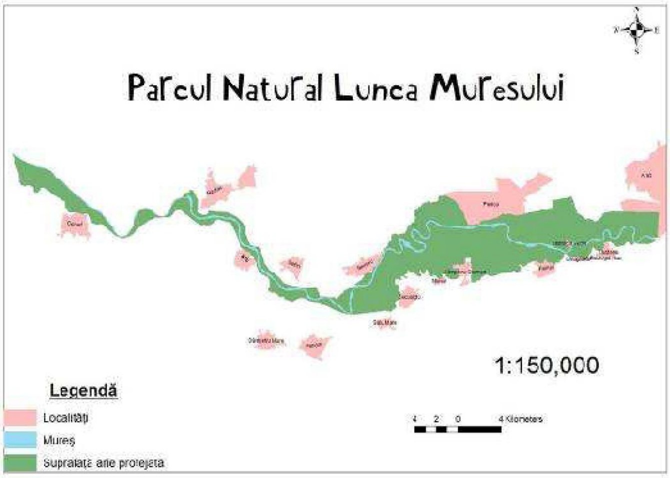

Figure 1. Park map
Source: Management Plan

The park's area is 17.455,2 ha (14.297,41 ha in Arad County and only 3157,79 ha in Timiş County), of which 40% forests, 10% meadows, 34% arable land, 3% localities and roads, 2% meadows, 8% waters and 3% land.

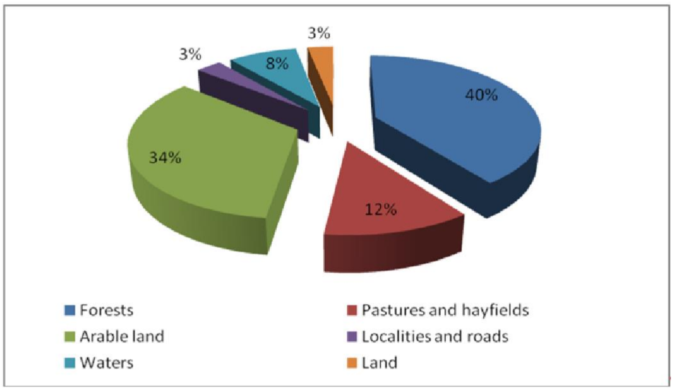

Figure 2. Structure of the park's area

Mureş Floodplain Natural Park or the Lower Mureş Floodplain falls under the ecosystem type named wetland due to the running and still waters, alluvial forests, willows and poplars, groves and country roads.

The natural conditions are an ideal place for the nesting and migration of about 200 bird species, many of which are under international protection.
This natural park has several areas, some of which under strict protection:

- Prundul Mare (717,9 ha);
- Cenad Forest (310,5 ha);
- Great Isle Cenad (2,1 ha);
- Igriş Isles (7,0 ha).

These areas represent 5,94% of the total area of the Mureş Floodplain Natural Park.

In the '70s they managed to protect an area of 91,2 ha, having as objective the protection of the grey egret that nested in these areas.

Another important step for the establishment of this park was made in 1998, when 12.000 ha of the area were declared Important Bird Areas.

Following the activities of the Environmental Protection Agencies in Arad and Timisoara and the Forest Directorate Arad, in 2005, the Romanian Government acknowledged the Mureş Floodplain Natural Park which, in 2006, was nominated for the inclusion on the Ramsar List of Wetlands of International Importance.

Another organization that activates in the environmental protection field in Romania is Natura 2000. In 2008, the organisation considers the park a community importance site (RO SCI 0108) for the protection of certain species (30) and habitats (12), and a special bird protection area (RO SPA 0069) for the protection of 41 bird species.

In Hungary, the forests in the flooded area of the Mureş River are part of the Körös-Maros National Park, and are protected.

The National Forest Company – Romsilva with the headquarters in Arad, Ceala Forest, provides the administration of the Mureş Floodplain Natural Park. The annual budget is about 100.000 Euros, and the activities allowed are greening, fishing and hunting (respecting the legislation in force), as well as tourism (ecotourism).

The access is quite easy, the location is reachable from Arad, Zădăreni, Pecica, Felnac, Semlac, Şeitin, Nădlac, Sâmpetru German, Munar, Periam, Igriş and Cenad, the road access being on European roads E6 and E68.

ECOTOURISM IN THE MUREŞ FLOODPLAIN NATURAL PARK

Ecotourism is the form of tourism that takes place in protected natural areas and has a low impact on the environment. In 1991 the International Ecotourism Society (TIES) defined ecotourism as: „responsible travel to natural areas that conserves environment and improves the well-being of the local people."

All things considered, ecotourism activities are welcome in this park. Therefore, tourist activities are included in the Management Plan of the Mureş Floodplain Natural Park.

Tourist information is provided by the tourist information centres in Arad, Pecica and Cenad, while accommodation is provided by the pensions and hotels located in the towns and villages close to the park (Arad, Ceala, Pecica, Cenad).
Tourist attractions are natural and anthropic:

- the park's biodiversity;
- numerous and varied bird species;
- the remarkable landscape (the beach, the 40 islets, the vegetation);
- Prundu Mare Natural Reserve (the water lilies pond);
- Mortăreţ pond in the Ceala area;
- the Third Isle in the Ceala area;
- the orthodox monasteries Hodoş – Bodrog (Romanian) and Bezdin (Serbian);
- Ceala fortress;
- Periam port.

Tourist activities that can take place are:

- kayaking or canoeing on the Mureş River;
- motor boating on the river;
- visiting the fortress and the monasteries;
- bicycle tours;
- animal watching and photographing (Prundu Mare watch tower) and bird watching (Bezdin watch tower);
- fishing and hunting.

Several tourist packages were made for this park:

- Package I – Ecotourism in the Mureş Floodplain Natural Park and the Runcu Groşi Natural Reserve;
- Package II – Canoe trip and return on bikes in the Mureş Floodplain Natural Park;
- Package III – Admiring the floodplain landscape and the islets on the Mureş from a canoe or kayak;
- Package IV – Bird watching from the Bezdin watch tower;
- Package V – Wild big mammals watching from the watch tower;
- Package VI – Admiring the forest and visiting archaeological and/or religious sites on bikes;
- Package VII - Admiring the forest and hiking to archaeological sites and wonders of nature;
- Package VIII - Visiting the Prundul Mare Natural Reserve – aquatic, forest ecosystems, the Water Lilies Pond.[5]

The appreciated and requested tourist tours are:

- Arad-Pecica, 25 km, with the kayak or the canoe on the Mureş;
- Arad-Periam Port, 60 km, a two-day tour with a canoe or kayak, or with a night in the Pecica area;
- Ceala circuit, 13,4 km, on bikes (Ceala Forest);
- Arad-Pecica, 25 km cyclotourist tour.

A cross border tour supported by the project Ecotour on the Lower Mureş is Periam Port-Mako, it can be done with the canoe or kayak, with a bike, or on foot along the protection dam of the Mureş.

Accommodation facilities and renting of specific equipment are not very numerous.

Table 2. Accommodation facilities in the area

Name	No. of rooms	No. of beds	Fees (lei/room/day)
Ceala Visitor Centre	13, of which: 10 double; 1 triple; 1 with 4 beds; 1 with 7 beds;	34	between 99- 206
Pecica Information Point	2 double rooms	4	79
Cenad Information Point	1 double room	2	69
Maria – Zădăreni Pension, 3 daisies	4 double rooms	8	80
Zori de zi Pension, Ceala Forest, 1 star	6, of which: 5 double; 1 single	11	50
Mac Don Pension, Ceala Forest, 1 daisy	7 double rooms	14	50

One can notice that the accommodation facilities are not of high category, addressing nature lovers, hikers who are not very demanding, who seek adventure and not the comfort of a room.

Maria pension offers the possibility to fish (20 lei/day), play tennis (20 lei/day), to stay in the sun. Sportive fishing can be practiced in the two pools of 1 ha populated with catfish, carp, and pike.

Table 3. Transport and renting fees

Service	Fee
Ferry Pecica	Between 0,5 – 20 lei
Transport with car	2,5 lei/km
Transport with van	3 lei/km
Transport with motorboat	79 lei/hour
Transport with canoe or kayak	9 lei/hour
Bike rental	3 lei/hour sau 15 lei/day
Conference room rental at the Ceala visiting centre (70 seats)	199 lei/day
Translation equipment rental for 20 persons at the Ceala visiting centre	199 lei/day
Lab rental at the Ceala visiting centre	49 lei/day
Tourist guide services	17 lei/ person/day

Camps for children are organized at the Ceala Visitor Centre with the purpose to present educational programmes regarding the protection of nature.

CONCLUSIONS

Mureş Floodplain Natural Park, located in the western part of Romania, is one of the protected areas where ecotourism activities take place.

Tourists are of all ages, the majority being adventure, movement, recreation and knowledge lovers.

Tourist tours are possible on water and on land, with camping places, accommodation facilities, observatories, and services of equipment rental.

This area is good for the ongoing development of ecotourism and environmental protection.

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ENVIRONMENTAL LEAD EXPOSURE AND NEUROTOXICITY IN CHILDREN: NEW ASPECTS

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ABSTRACT

Lead, a ubiquitous and potent neurotoxicant, alters the function of multiple organs and systems, but primarily affects the central nervous system. The present review discusses the current knowledge state concerning the neurotoxicity of lead in children. Researchers found that children with blood lead levels of 50-100µg/l attained significantly worse results in reading and mathematic tests, even when compared results were adjusted for the children's Full-Scale IQ scores. Lowering the lead exposure in childhood continues to be an important public health objective in many countries.

Key words: lead, exposure, children, neurotoxicity.

INTRODUCTION

Lead exposure remains a public health problem in both developed countries and in the developing world (1). Research on the toxic effects of lead continues and due to them, in the last decade a lot of new information has been provided (2, 3). The communal environment sources of lead include food and drinking water, air, smoke cigarettes, packaging, toys for children, colors of different origin, cosmetic products, appliances etc.

Children are particularly sensitive to the effects of lead for several reasons. A greater proportion of ingested lead (up to 50%) is absorbed from the children's digestive tract compared to adults, a higher percentage of lead which is in the blood circulation travels to the children's brain and the developing nervous system and is far more vulnerable to lead's toxic effects than the mature brain.

Absorbed lead is eliminated by the kidneys through urine while unabsorbed lead is eliminated through feces, although secondary paths of elimination are possible. After absorption, lead is distributed to all organs by blood. The liver and kidneys have the highest concentrations of lead from the soft tissues. To some extent, lead crosses the blood-brain barrier and is distributed through the nervous system. Taking into account other organs lead affects the gonads, deposits in the placenta and fetus, and much is incorporated in the skeletal system. The half-life of lead in the blood is approximately 35 days, in the brain two years, and can stay in bones for decades. The level of lead in the blood is the most common and primary indicator of children exposure and indicates recent exposure. However, the concentration of lead in the blood may remain elevated for a relatively long time period after the exposure due to the mobility of internal deposits.

Lead is not an essential metal, but when it enters the organism it can be found in almost all tissues and organs. As a metal with a cumulative effect it is competitive with essential metals (iron, calcium, copper and zinc) for their numerous functions in the body, especially proteins and enzymes. According to the physico-chemical properties, Pb^{2+} can easily replace Ca^{2+} in calcified tissues (bones and teeth) and a variety of soluble complexes with metal bioligands in biological fluids and tissues. Lead in the bones contributes to the development of osteoporosis and inhibits certain stages in the synthesis of heme. Also, this metal reduces the antioxidant defense in the body and causes disorders in the exchange of ions through the electrolyte membrane. Lead exposure is a common environmental health problem for children in the United States, and many federal agencies study and monitor lead exposure. Elevated blood lead levels can affect behavior, hearing, and learning, and can slow the child's growth.

The aim of the paper was to discuss the current knowledge state concerning the neurotoxicity of lead in children.

RESULTS AND DISCUSSION

A large number of important brain functions, including the development of the nervous system in children may be damaged as a result of lead exposure. The mechanisms by which this damage occurs involve apoptosis, reduced energy production in mitochondria, impaired transport of oxygen due to the impact of lead on heme synthesis, increased oxidative stress, changes in gene expression and consequently transcription (4).

Studies carried out on young people showed that early lead exposure reduces the volume of several brain regions, as well as the metabolism in several regions of gray and white matter (5).

These changes in the structure and function of neurons are followed by permanent behavioral damage. International pooled analysis of seven prospective studies, which included 1.333 children, showed that the blood levels of lead are inversely associated with IQ in childhood (6). The explanation for this, somewhat surprising fact, can be that the blood levels in childhood are a significant predictor of IQ levels in later stages of life e.g. thirtieth year of life.

Surkan et al. (7) have found that children with lead blood values of 50-100 μg/l in comparison to children with lead blood values of 10-20 μg/l achieved a significantly worse score on tests of reading and math, even when results were compared to full custom children's IQ score scale. This suggests that even among children with a similar score on the children's complete IQ scale, those with higher lead blood values tackled the set tasks with greater difficulties. This discordance between talent (i.e. IQ) and capacity (i.e. academic performance) is the characteristic of a specific learning disorder. In addition, children that are more exposed to lead have less success in meeting goals related to the mental school demands. Also, it is shown that the effect of lead is more expressed in children who have other risk factors for the development of mental disorders.

For decades it has been known that higher lead exposure is linked to ADHD, including increased absentmindedness, poor persistence, greater disorganization and an inability to follow commands. According to data from a recent study using information from the national research carried out in the USA 1999-2002. Braun et al. (8) observed that the degree of probability of reporting ADHD by parents of children whose blood lead values were greater than 20 μg/l was 4 times probable, wherein the reference group consisted of children with blood lead values below 8 μg/l. Similar results on higher risks for developing attention deficit disorder in children who where highly exposed to lead was found in other studies.

A recent approach to research involves exploring possible connections between significant early lead exposure and aggression, including the tendency towards criminal behavior. Studies support the possibility that one effect of lead poisoning is the "loss of normal inhibitory functions" and the emphasis on inadequate social behavior. Needleman et al. (9) report that children who are 11 years old and with higher values of lead in the bones where marked on a scale of aggression and delinquency on the test of children's behavior by both parents and teachers with greater disorder. The researchers further compared the values of lead in the bones of adolescents convicted of juvenile delinquency, with the lead values in the control group. Among boys and girls measurable values of lead in bone were significantly more common in delinquents than among controls.

The strongest epidemiological evidence on the connection between early lead exposure and crime comes from prospective studies conducted by Wrajt et al. (10) on the group of 250 socio-economically disadvantaged people, aged 19-24 years, where the level of lead in the blood was measured several times between gestation and 6 years of age. The mean value of blood lead in the fifth year was 123 μg/dl (range 60-263). The researchers then collected data from the state criminal justice system on the number of arrests of study participants from their 18-years of age. This study determined the number of index values for lead levels, including prenatal, average childhood index and index in the sixth year of life. A connection was found for every 50μg/dl rise in lead levels in blood.

In support of this research is the recent evidence of neurological disease in children related to early in life lead exposure that results in a cascade of effects that include deficits in IQ, executive functions, impulse control, ability to delay satisfaction and adverse outcomes such as poor academic achievement, higher probability of dropping out of school, disorders such as ADHD, conduct disorder, antisocial behavior, and even substance abuse (11). It is important to take into account a complex model where lead exposure is more of a predictor than the outcome of behavior.

Current, but a relatively unexplored area is the study of individual susceptibility to the development of neurotoxicity in children exposed to lead. In several studies it was observed that children of lower socio-economic status disproportionately respond to exposure to lead. As this status is complex and involves a variety of factors that can affect brain development in children, considerable effort has been made to investigate and identify components of SES that affect children's response after exposure. The major components include medical state (including exposure to other toxic substances), genotype, environment while growing up, stress, access to healthcare, quality of schools, the characteristics of the local environment and nutrition.

Animal studies have shown that there is a reduction in the deficit of learning in rats exposed to lead if they are kept with other rats, given more space, and more toys. Animals raised with the use of any ban despite their exposure to lead and stressful procedures show greater learning deficits and altered response to stress.

Also, researches conducted on monkeys have shown permanent changes in behavior during playing even after stopping daily exposure of 1 mg of lead in their first year of life. They found that exposure to this metal leads to inadequate social interactions among animals that hinder social integration and reduce reproductive success.

Studies using rats indicate a reduced capacity to recover after a trauma in adult animals, if they were in their youth exposed to lead. Also, there is evidence that exposure to this metal during development of animals can lead to developing neurodegenerative diseases in adulthood. The most striking changes are seen in the frontal cortex (12).

It is believed that the basic level of lead in the blood, which does not depend on its anthropogenic sources, is about 10-30 μg/l. However, any concentration of lead in children's blood is a risk, especially those values over 10 μg/l. Although there have not yet been established safe values of lead in the blood, there is evidence to show that the values under 10mg/dl can cause adverse effects on the behavioral and cognitive development. It is estimated that 1 μg Pb m^3 air leads to the concentration of lead in the blood of about 50 μg/l.

There are still no established procedures to detect lead poisoning. In some regions screening methods are used for the detection of toxic levels of lead in the blood of children, while in others only those children who live in residential areas built before 1978. are tested. However, an additional problem is the half-life of lead in the blood which is a couple of weeks, so that the period for detection of lead poisoning can be much shorter than its toxic effects on the child's brain. Consequently, even after the decline of the value of lead in blood, lead deposited in the brain continues to cause adverse effects because its half-life in the brain is approximately 2 years, leading to the conclusion that the only way to prevent lead poisoning is to prevent any exposure of children to this metal in childhood. Also, there is data to suggest that genetic factors and other so far unidentified factors influence individual susceptibility to the toxic effects of lead, because of which it is necessary to conduct additional research to identify these factors.

The potential role of nutrition in altering susceptibility to lead exposure and toxicity has long been recognized (13). One general belief is that the many effects of lead toxicity are related to similar structural properties between lead and calcium. Some research gives credence to the theory of lead displacing calcium in biochemical reactions and physiological processes within the body in the context of emerging research. The report also acknowledges that iron deficiency is associated with increased blood lead levels. Adequate iron and calcium stores may decrease lead absorption and vitamin C may increase renal excretion. Children with elevated blood lead levels are often at risk for poor nutrition, and both calcium and vitamin C have been identified as shortfall nutrients for US children in general by the Dietary Guidelines Advisory Committee (14).For the potentially lead exposed child, an eating pattern of regular meals and snacks consistent with the 2010 Dietary Guidelines is appropriate. The committee states that it is imperative that nutrition education be provided to the caregivers of potentially lead exposed children to ensure that these children obtain a well-balanced and age-appropriate diet. Nutrition research in this area continues, and a recently published study suggests that regularly eating breakfast may reduce the risk of lead poisoning in children (15).

CONCLUSION

In the last decade, an extraordinary number of new studies have illustrated that "the problem" of lead in children remains. Certain genetic and environmental factors can increase the detrimental effects of lead on neural development, thereby rendering certain children more vulnerable to lead neurotoxicity. Children's intelligence has traditionally been considered to be the most sensitive endpoint and used as the basis for risk assessment. Lowering the lead exposure in childhood continues to be an important public health objective in many countries. Moreover, children in undeveloped counties are more at risk.

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OUTDOOR AIR POLLUTION AND RESPIRATORY HEALTH

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ABSTRACT

The aim of this research was to assess the prevalence of respiratory symptoms and diseases in women exposed to significantly different quantities of outdoor air pollutants. The survey was conducted at 298 women, aged 35.88± 5.0 from two areas with different levels of sulfur dioxide and black smoke.Concentrations of sulfur dioxide were analyzed by spectrophotometry, while concentrations of black smoke were analyzed by reflectometry. The questionnaire was adapted from the American Thoracic Society questionnaires validated for Serbian language. Statistical significance is determined for cough with colds, congestion and/ or phlegm with cold and sinus trouble which were higher in women from residential area.

Key words: outdoor air pollution, respiratory symptoms, respiratory diseases,women,black smoke.

INTRODUCTION

Outdoor air pollution can be defined as the presence of solids, liquids, or gases in outdoor air in amounts that are injurious or detrimental to human health and/or the environment; or that which unreasonably interferes with the comfortable enjoyment of life and/or property.

Sources of outdoor or ambient air pollution are varied and include both natural and anthropogenic ones. Natural pollution is all around us all of the time. The most common source of anthropogenic air pollution outdoors is the burning of fossil fuels, such as coal, oil and gas, in power stations, industries, homes and road vehicles. Both primary and secondary pollutants are, to a greater or lesser extent, detrimental to human health, depending on their concentration in the air, and the sensitivity of the individual (1).

Sulphur dioxide (SO_2) is a colourless, nonflammable gas with a penetrating odour that irritates the eyes and air passages. The main anthropogenic source of SO_2 is the burning of sulfur-containing fossil fuels for domestic heating, power generation and motor vehicles. Sulphur dioxide pollution is considered more harmful when particulate and other pollution concentrations are high (2).

Particulate matter is a complex mixture of organic and inorganic substances, present in the atmosphere as both liquids and solids. Particulate matter is emitted from a wide range of anthropogenic sources, the most significant primary sources being road transport , non-combustion processes, industrial combustion plants and processes, commercial and residential combustion and public power generation. The extent to which particulates are considered harmful depends largely on their composition (3).

The aim of this research was to assess the prevalence of respiratory symptoms and diseases in women exposed to significantly different quantities of outdoor air pollutants.

SUBJECTS AND METHODS

The measurement of outdoor air pollutants was carried out at two measuring locations in Nis. The first place of measurement was in residential area, while the second one of measurement was located in suburban area**.**

Concentrations of outdoor air pollutants sulphur dioxide and black smoke, were measured for 24 hours a day during the period from 2004 to 2008. The sampling protocol was carried out by well trained personnel. Laboratory examination of sulfur dioxide and black smoke was done according to the Regulation of Guideline Values of Immission (Official Register Republic of Serbia 54/92) (4). Concentrations of sulfur dioxide (SO_2) were analyzed by spectrophotometry, while concentrations of black smoke (BS) were analyzed by reflectometry.

The survey was conducted at 298 women, aged 35.88± 5.0 from two areas with different levels of common outdoor air pollutants (sulfur dioxide and black smoke). One group of them (142)live in residential area, another group (156) live in suburban area. Women of both groups had been no smokers and they were not professionally exposed to air pollution,and they have lived for at least five year on those locations.

The questionnaire was adapted from the American Thoracic Society questionnaires validated for Serbian language (5). Training physicians filled out questionnaires during the interview with women. Investigation was carried out in April 2009. Questionnaire includes questions about prevalence of respiratory symptoms (cough- with/apart from colds, congestion and/or phlegm- with/apart from cold, runny nose longer then three mounts, wheezing) and respiratory diseases (sinusitis, bronchitis, asthma, pneumonia) which were diagnosed by physicians in women in the past 12 months.

All collected data were processed with a software system. Interview data were analyzed using programs Epiinfo 6 and Microsoft Excel. Levels of statistical significance of the measured sulfur dioxide and black smoke concentration were determined by Mann-Whitney U test, and differences at the level of $p<0.01$ were taken to be statistically significant. Statistical significance of difference was established by Pearson Chi–Squared test. The Odds Ratio and 95% confidence interval were calculated to evaluate the presence of associations between all respiratory symptoms and diseases in women and environmental variables.

RESULTS

Outdoor air pollutants, sulfur dioxide and black smoke, were monitored at two measuring locations, in residential and suburban area.Analyzed and measured of these pollutants in the studied period are given in Table 1.

Table 1. Pollutant concentrations at the measuring points in the period of 2004- 2008 (g/m3)

Parametar	Measuring points			
	Residential area		Suburban area	
	SO_2	Black smoke	SO_2	Black smoke
$\overline{X}$ ±SD	14.18±6.79	37.11±2.44	4.17±2.04	1.03±1.69
Min	0	0	0	0
C_{50}	11	18	2	0
Max	75	223	43	21
C_{98}	51	164	22	11

The average annual concentrations of sulfur dioxide and black smoke at both measuring locations do not show higher concentrations than allowed maximums in the corresponding year according to the Regulation Book of Serbia (50 $\mu g/m^3$). The average levels of the pollutants also remained below the current WHO Guidelines. However, one should notice that both measured pollutants values in suburban area are significantly lower in reference to the same measured values in residential area (tables 2).

Table 2. Statistics differences in the concentrations of pollutants between two areas

Pollutant	Statistics	
	Mann-Whitney U test	p-value
SO_2	16.67	p<0.01
Black smoke	17.88	p<0.01

Of the total number of women 47.65% live in residential area and 52.35% live in suburban area. Homogeneity of the group's satisfactory since the average age among women compared to the residence there is no statistical significance ($t = 0.998$, $p > 0.05$).

In the table 3 was shown prevalence of respiratory symptoms and diseases at examined women. As can be seen, the prevalence of respiratory symptoms is higher among women who are exposed to outdoor air pollution, but statistical significance is determined only for the symptoms such as cough with colds (OR=2.58; 95% CI=1.22-6.89) and congestion and/ or phlegm with cold (OR=14.96; 95% CI=1.89-10.96).

Table 3. Prevalence of respiratory symptoms and diseases and exposure to outdoor air pollution

Respiratory symptoms and diseases	Prevalence		χ^2	OR	CI
	Residential area	Suburban area			
Cough with colds	10.35	8.36	7.16*	2.58	1.22-6.89
Cough apart from colds	4.94	3.43	2.28	0.11	0.41-1.52
Congestion and/ or phlegm with cold	45.83	26.34	14.96*	4.49	1.89-10.96
Congestion and/or phlegm apart from cold	20.81	19.21	2.30	3.01	0.59-1.07
Runny nose longer then three mounts	12.91	11.68	3.80	1.43	0.57-0.98
Wheezing	9.71	10.18	2.43	0.97	0.97-1.15
Sinus trouble	27.69	8.09	10.46*	3.03	1.62-10.08
Bronchitis	17.63	18.57	5.26	1.39	0.40-2.90
Pneumonia	15.83	14.80	0.26	1.16	0.63-2.13
Asthma	8.94	7.43	3.28	0.17	0.01-1.62

* $p < 0.01$

Prevalence of sinus trouble (OR=3.03; 95% CI=1.62-10.08) is the only respiratory disease which was statistic significantly higher in women from residential area. We didn't find connection between high outdoor pollutant concentrations and appearance of bronchitis, pneumonia and asthma.

DISCUSSION

Exposure to air pollutants is largely beyond the control of individuals and requires action by public authorities at the national, regional and even international levels.Air pollution may possibly harm populations in ways so subtle or slow that they have not yet been detected. For that reason research is now under way to assess the long-term effects of chronic exposure to low levels of air pollution,what most people experience,as well as to determine how air pollutants interact with one another in the body and with other physical factors (6).

Health effects are now known to be associated with much lower levels of outdoor pollutants than previously believed.The respiratory system has various defensive mechanisms which prevent or alleviate air pollutants` effects, since the respiratory system is the primary place where the negative influence of the air pollutants stands out. The most important defensive mechanisms of the respiratory tract are cleaning and filtrating air by upper bronchial tubes, bronchial secretion of immunoglobin, lyssossms, sneezing and coughing reflexes, presence of antioxidants in mucus which covers lung's surface, etc.(7).

The previous researches in the world follow the acute exposure of the people to the high concentrations of pollutants in the air. It is established that being acute exposed to the air pollutants can provoke higher incidence of symptoms and diseases of the respiratory system. There is less information about chronic effect of lower concentration of the pollutants. It is assumed that being chronically exposed can provoke disease symptoms and diseases of the respiratory system because of lung functions` disorder.

The concentration of sulphur dioxide and soot during our research didn't exceed values which are allowed by the regulations, as well as references of the WHO. Being exposed to the low concentration of sulphur dioxide, the group of women which were examined had statistically significant prevalence of some respiratory symptoms and diseases.

In the Swiss study (8) living within 20 m of a main street increased the risks of regular phlegm by 15% (95% confidence interval: 0, 31) and wheezing with breathing problems by 34% (95% confidence interval: 0, 79) in never smokers. There are several good examples of how there have been improvements in public health after policy interventions resulting in a reduction in ambient air pollution. Thus, air quality improvements brought about less symptoms of chronic cough and phlegm, or wheezing with breathlessness, and a decline in new onset of asthma in adults with a mean decline of PM_{10} (9). Whereas it is accepted that reducing air pollution is associated with beneficial effects for the traditional pollutants from stationary sources, there is now also evidence that control of traffic related pollution may have equally beneficial effects (10).

CONCLUSION

This study shows that among women long-term exposure to low concentration of outdoor air pollutant is associated with prevalence of some respiratory symptoms and diseases. Government action to improve air quality is important because of the evidence of negative health effects and environmental damage caused by air pollutants.

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DIRECT IMPACT OF CLIMATE CHANGE ON ARBOVIRAL DESEASES TRANSMISSION IN HUMANS

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ABSTRACT

Climate is a major factor contributing to i.a. geographical and temporal distribution of arthropods, their life cycle, their spread to vertebrates and the evolution of arboviruses. Under the influens of rising temperatures and rainfalls, as well as changes in natural cycles that stabilize the climate, arboviruses may emerge on entirely new territories. This review summarises the direct impact of climate change on Arboviralinfections and their transmission in humans, as well as the prevention of serious consequences on human health.

Key words: Climate change, direct impact, Arboviral diseases, transmission in humans, prevention.

INTRODUCTION

Climate is a key determinant of health. Currently a phenomenon of gradual global warming caused by increasing greenhouse gas emissions has been observed. The main effects of warming on health could be thermal stress, extreme weather events, and infectiousdiseases changing in their location or frequency. A more global approach has to take into account difficulties in food yields, social, demographic and economic imbalances, which could favour emerging infectious pathogens.

Climate constrains the range of infectious diseases, while weather affects the timing and intensity of outbreaks (1). A longterm warming trend is encouraging the geographic expansion of several important infections (2), while extreme weather events are spawning 'clusters' of disease outbreaks and sparking a series of 'surprises' (3, 4). Ecological changes and economic inequities strongly influence disease patterns. But a warming and unstable climate is playing an ever-increasing role in driving the global emergence, resurgence and redistribution of infectious diseases (5, 6).

The aim of this review is to summarise the direct impact of climate change on Arboviralinfections and their transmission in humans, as well as the prevention of serious consequences on human health.

MATERIAL AND METHODS

We usedrelevant literature evidence on climate change andits direct impact on Arboviral diseases and their transmission in humans. The preventive measures of serious consequences of climate change on infectious diseases and human health were than discussed.

RESULTS

Higher temperatures at earth's surface will provoke an increase in global average rainfall, although some mid latitude will become drier. Rainfall can promote transmission ofvector-borne pathologies by creating ground pools and other breeding sites for insects. Moreover, drought may cause flowing water to stagnate; drought may also stimulate peopleto store water in cisterns, and containers that also serve as breeding sites for mosquitoes. Elsewhere, one can assume that massive clearance of the forests exposed to warmingclimates could allow contacts between non immune humans with dangerous viral infectious cycles and their corresponding reservoirs from the forests (7, 8).

As a global consequence, the spread of viruses restricted to tropical areas until now could occur in the future. It is commonly admitted by experts in vectors cycles that mosquito-related diseases, especially arboviruses in virology field, able to cause very serious haemorrhagic fevers, could thus emerge in case of climate warming. Thus, the spread of "exotic" viruses could be observed in Europe and North America. Emerging arboviruses (Arthropod-Borne viruses) such as Dengue virus, Chikungunyavirus, West Nile virus, Tick-Borne Encephalitis virus, Rift Valley Fever virus, Japanese encephalitis virus, Crimean-Congo haemorrhagic fever virus could be reported and virusesfrom the forests could threaten humans, such as Yellow Fever Virus (9-13).

Dengue Virus

This Flavivirus (types 1, 2, 3, 4), transmitted by Aedes aegypti and Aedes albopictus, is observed in the equatorial areas of America, Africa and Asia with increasing reports of epidemics in the recent years. The corresponding health concern is estimated as 50-100 000 000 cases a year,with 250,000 haemorrhagic forms (9, 10). Dengue virus can provoke fever, pains, rash and, in about 10% of the cases, serious haemorrhagic syndromes, especially in Asia and in children. The severity of secondary infections has to be underlined. Thus, reinfection by a viral type different from the primary infection could be more serious, maybe by production of "facilitating" antibodies, which are not protective but deleterious. In the absence of any effective vaccine, the prevention consists in mosquito control.

Yellow Fever

This Flavivirus is principally transmitted by *Aedes aegypti* in forest and urban locations. It is largely observed in the equatorial areas of Africa and America. The estimation of the related public health concern is approximately 200,000 cases a year, with 30,000 fatal cases. The severecases consist of asthenia, alterations in kidney, liver, and heart function with diffuse aemorrhagic signs.

The prevention corresponds to the control of mosquitoes. Moreover, the use of a very effective vaccine, obligatory for foreign travellers in endemic countries would be crucial to bedeveloped in case of increasing incidence of the disease. Elsewhere, climate warming could alter forests and favour contact between non immune humans and certain forest transmission cycles. Indeed, highly dangerous viruses, leaving the forest, could then provoke epidemics in humans. This concern could involve Yellow Fever virus.

West Nile Virus

West Nile Virus (WNV), another Flavivirus, is transmitted to birds and transferred by *Culex* mosquitoes. Humans and horses are incidental hosts for the viruses. WNV fever appears mostly at the end of the summer, able to provoke fatal human meningitidis or encephalitis in elderly patients. WNV is endemic in Africa, south-western Asia, eastern and southern Europe and in the Mediterranean basin. It was also frequently detected in North, Central and South America andin the Caribbean.

Paz and Albersheim (13) analyzed the correlation between weather conditions (especially air temperature) and *Culex pipiens* mosquito abundance, and WNV fever frequency in humans between 2001 and 2005 in Israel. Israel is a major stopover for huge flocks of migrating birds, the reservoir of WNV. In 2000, a large outbreak of 429 cases (35 deaths) occurred in Israel with very hot previous summer and long heat waves, comparably to the outbreaks previously reported in Romania (1996) and in New York city (1999). There was a recent tendency for temperature increase in the hot season in Israel. These positive anomalies of the temperature appear to have increased the quantity of mosquitoes and the disease in humans. Most of the WNV fevers occurred in the Tel Aviv metropolis, where the risk is very intense due to the combination of high temperatures, a high level of air humidity, and a high population density. In the context of future uncertainty on climate change, WNV has to be considered as an important health concern.

Tick-Borne Encephalitis Virus

Tick-borne encephalitis virus (TBE) is transmitted by *Ixodes* ticks in an area from western Europe to the eastern cost of Japan. TBE virus causes acute meningoencephalitis, more or less severe, with or without myelitis. Morbidity is age dependent, and is highest in adults of whom half develop encephalitis. A third of patients have longlasting sequelae, frequently with cognitive dysfunction and substantial impairment in quality of life.

The disease arises in patchy endemic foci in Europe, with climatic and ecological conditions suitable for circulation of the virus. Climate change is partly responsible for increased incidence of the disease in Europe. TBE virus was shown to circulate at increasing altitudes in Czech Republic; in Sweden, a northward expansion of *I. Ricinus* is seen, and mild winters and early springs are associated with more frequent disease (14).

Climate change and leisure habits expose more people to tick-bites and have contributed to the increase in number of cases despite availability of effective vaccines. The serological diagnosis is usually straightforward. No specific treatment for the disease exists, and immunisation is the main preventive measure.

DISCUSSION

The global climate system has been stable for centuries due to heterogeneous interactions between the atmosphere, oceans, ice core, biosphere and total energy (15). Currently a phenomenon of gradual global warming caused by increasing greenhouse gas emissions has been observed. During the 20th century, the global surface temperature increased by approximately 0.3-0.6 ^{0}C, which proves the anthropogenic origin of these changes (16).

In recent years, an increase in human exposure to vector-borne diseases has been observed. Due to increases in global temperature, tropical insects can expand their territories to further (northern or southern) latitudes and find living conditions at higher altitudes that affect the transmission of local viral pathogens (17).

During the past 50 years patterns of the emergence of arbovirus diseases have changed significantly. Climate is a major factor contributing to i.a. geographical and temporal distribution of arthropods, their life cycle, their spread to vertebrates and the evolution of arboviruses. Under the influens of rising temperatures and rainfalls, as well as changes in natural cycles that stabilize the climate, arboviruses may emerge on entirely new territories (18).

We have to be ready, in case of climate change, to take into account the potential increase in mosquito-borne viral infections and in diseases which are facilitated by close contacts between humans, humans and animals, humans and spoiled water.

CONCLUSION

Experts in climate changes, which are complex and increasing, are crucially needed. Healthy networks, able to survey the distribution and circulation of emerging infectious pathogens are essential.

The prevention of serious consequences of climate change on infectious diseases and human health will consist in first, the control of mosquito spreading, second, the control of people displacements; third, water quality will be crucial to be preserved in case of disruption of social organisations provoked by climate events. At last, production of vaccines and specific treatments, if developed by scientists, should be drastically increased by the pharmaceutical industry in case of epidemics.

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THE ROLE OF ENVIRONMENT AND FOREST IN REDUCING OBESITY - RISK HEALTH FACTOR OF URBAN POPULATION

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ABSTRACT

The link between population health and environment is not direct, but it is very important, especially by the recommendation of the World Health Organization about the importance of regular physical activity in forest, during a day. Belgrade is a good place with nice urban forest for recreation. Modern conditions of life in the developed technical environment has a lack of physical activity. Health statistics data for Belgrade are alarming and indicate that there is an epidemic of obesity: 57.60 percent of the population of Belgrade is overweight and obesity affects the cardiovascular, renal, cerebrovascular and other diseases.

Key words: Obesity, high-quality environment, way of life.

INTRODUCTION

The environment is important for every individual regardless of age, sex and interest of working. State of the environment on the Planet, and that means in Serbia including the state of water and water resources, air, biodiversity, land and forests.

About the environment must be careful to take care of various experts, and people. This concern for the environment is characteristic of Belgrade. Environmental quality of capital town is largely dependent on its forests. Belgrade has eleven forests, 66 parks, three protected areas and four hunting areas.

Everything in nature is closely linked with each other. The man, who is himself a part of nature, is also linked with the environment that surrounds it: the land, rivers, air and living organisms from all around. Science helps us to examine and clarify these complex interconnections. Scientists around the world have raised the alarm. They proved that it is necessary to think hard about every man's impact on nature. Nature protection must all be mindful, as will our descendants will need clean water, animals and the beauty of our country provides[1].

One must behave hospitable to reasonably use the natural resources that are necessary to feed him and the industry-land, forests, fish, birds, wild animals. One must help the living nature is renewed. Everyone should be clear that we are all intimately connected with nature and each of us is responsible for their actions to the present and the future.

The link between population health and of the environment is not straightforward, because there are other factors that affect human health. It is noted, however, that a number of factors that determine the health status of the population, the environmental factor ranks high, along with the heritage, lifestyle and accessibility of health services.

Man spends each day, often more than 10 hours, in the preparation of business plans, creates new jobs, but not everyone has made their own life plan, that is the philosophy of healthy living, and it is easy to read as follows: To live in harmony with nature. The philosophy of life on Earth in close connection with the forest management[2].

Modern conditions of life in the developed technical environment has a high energy intake above requirement and lack of physical activity of urban population. Belgrade is a metropolis that offers an excellent opportunity to stay in the forest area recreation for all who wants it. The city government made bike paths and fitness oasis in the parks, and SE "Srbijasume" produce oxygen for the Belgrade population in urban and suburban forests, and professional work of rangers in protected areas create a pleasant recreational centers in nature. SE "Srbijasume" within their regular activities, deals with education of the population. Statistical data for the urban population of capital town are not satisfactory in health and lifestyle [1], [2].

MATERIAL AND METHODS OF WORK

In our study were analyzed and synthesized the results of our own study "Obesity and way of life" (SE "Srbijasume" in collaboration with the Health Primary Centers of Belgrade), data from Annual Reports of the City Institute of Public Health Belgrade, Institute of Occupational Medicine and Radiological Health "Dr Dragomir Karajovic" and the Institute of Public Health of Serbia "Dr Batut". We analyzed studies of the international conventions, strategies and directives related to nature and the environment, in the field of prevention, protection and improvement of human health.

The study "Obesity and lifestyle", SE"Srbijasume" and the Health Primary Centers of Belgrade, covers a period of 6 months, and in this study we included 450 Belgrade citizens of both sexes, who are extremely obese, who are prepared and motivated to reduce body weight, with no health problems 220 women and 230 men from the group of working-age population of Belgrade, from age 30 to 39 years, who do not smoke, do not drink. All have increased body weight: male BMI (26.87-29.41) kg/m2, and BMI in women (26.64-29.03) kg/m2.

Body mass index BMI is calculated as the mass of person expressed in kg divided by the square of his height in m. Optimal-permissible values of BMI is from 18.5 to 25. All persons-subjects in our study were given advice on lifestyle changes: three meals and two snacks during the day without eating sweets, fatty foods and artificial drinks, along with regular physical activity, daily walking 6 km in the urban forest. Walking is an organized group by SE"Srbijasume": weekdays in the afternoon and on weekends during the morning daylight, in accordance with the recommendations of the WHO World Health Organization: ambient-forest; time- during the daylight.

Atmospheric conditions were not significant with adequate comfortable shoes and clothing. This is an organized hike took place at three locations in Belgrade:Protected natural area forests Miljakovac, Landscape of Outstanding Features "Kosmaj", Site of Outstanding Natural Beauty "Avala"[3].

RESULTS AND DISCUSSION OF RESULTS

All participants in the study: the working-age population in Belgrade, age from 30 to 39 years, 220 women and 230 men followed up advice on lifestyle changes, along with regular physical activity, daily walking 6 km through the town forest and reached a satisfactory results in own health. In fact, after 6 months there was a reduction of obesity, ie. decreased body mass index-BMI. In men BMI reduced 6.2% to 6.8% compared to the initial value, BMI in females 7.2% to 7.8% compared to the initial value, which means that women are more disciplined applied the advice in whom achieved slightly better results.

The results indicate that the employed urban population must continue to compliance hygienic-dietary way to achieve ideal BMI value, which reduces the risk factors for the disease [3], [4].

All participants in the study said that they would continue individual recreation in the forest, because their six-month walking with SE"Srbijasume" was pleasant to feel better, faster concentrate at work and sleep better with a visible loss in body weight

Good results indicate that we must continue to improve the care of forest and of the environment of Belgrade and a constant reminder-education of the population that can change way of life. Obesity, the World Health Organization classified in serious health problems, and for a decade, they are an economic problem on a global level.

Belgrade forest

In Belgrade, the national forests occupy 16913.06 ha and looked after FE "Belgrade" (Table 1), which operates within SE "Srbijasume". The Belgrade Forest has the highest ash, oak, beech, maple and black locust. FE "Belgrade"- SE "Srbijasume" apart from the core business, every day, fight against forest degradation, illegal construction on account of the reduction of forests against illegal logging.Forest management that are narrower in urban areas is a specific problem of today's forestry, but also a challenge for experts of different profiles, local government, city and state governments, because of the special use of these forests and the complex factors that affect their survival and stability.Belgrade forest with recreational and health function, contribute to the regeneration of the psychological and physical abilities of the population. Well-maintained public forest provides visitors freshness and relaxation, develop a sense of aesthetic nature, creates a microclimate and beautify the environment. Landscaped recreational areas in urban and suburban forests allow the inhabitants of Belgrade pleasant and healthful recreation. Belgrade forest are nice and beautiful, as is the position of Belgrade interesting. Belgrade lies at the confluence of the Sava and the Danube River in southeastern Europe, on the Balkan Peninsula, on the slope between two alluvial planes. The river waters surround it from three sides and therefore, from the beginning, the guardian of river passages. Because of its position it was properly called "the gate" of the Balkans and the "door" to Central Europe. Belgrade is the crossroads of Eastern and Western Europe, which Morava-Vardar and Nishava-Marica valley to the shores of the Aegean Sea, to Asia and the Middle East [1], [2].

Table 1. BASIC DATA for FE "Belgrade"

FE "Belgrade" - BASIC DATA	
State Forests	**16.913,06 ha**
Total Timber Volume	**2.603.845 m^3**
Average	**194,7 m^3/ha**
Increment	**89.817 m^3**
Average	**6,7 m^3/ha**
Planned Productivity	**92.041 m^3**
Professional-technical activities in privately-owned forests	**15.636 ha**

Ecological importance of forests

Forests, the most complex ecosystem, have a particularly important role in the environmental protection. Forests play a leading role in the storage of solar energy, forests positively affect the forming of soil, increasing its fertility, protect the soil from erosion and prevent landslides, water and wind erosion. Forests protect against sediment farmland, streams, reservoirs and lakes. Forests affect climate - mitigating climate change.

Forests have a positive impact on the reduction of runoff, improve water quality, preserve water and water sources (springs and curative), but kept us from flooding. Forest has a large number of plant and animal species and forests are a critical factor in the preservation of biodiversity and genetic resources.

Forests are the controller balance between oxygen and carbon dioxide in the air. Impact on the prevention of air pollution, protection of solid particles, harmful gases and radiation[5].

Environment and environmental activities

The modern way of life and bustle of professional successes give rise to a risk factor for morbidity of various diseases of modern society. Professionals in today's have an obligation to find ways to reduce the influence of risk factors.In line with the Millennium Development Goals and the United Nations document entitled "Sport for Development and Peace: Towards achieving the Millennium Development Goals," SE "SRBIJASUME" started the implementation of the project of education and recreation, urban youth "Living in harmony with nature in Serbia", which is a continuation of own studies "Obesity and way of life". This project includes the education of the urban population, information-propagandistic work, presentation and popularization of the forestry profession, as well as expansion of partnerships with governmental and non-governmental sectors including health and sports activities, environmental education and raising awareness of saving forests and mobilization of society as a whole at the national, regional and local level for the protection of forest. Education of children and youth in the protection of forest is a priority in the principles of the European Union, and the National Strategy for Serbia.Strategy of the Republic of Serbia in the field of environmental protection and sustainable development means improving the quality of life by providing desired environmental conditions and conservation of natural resources in such a way as to ensure their availability for future generations. The Government of the Republic of Serbia adopted the National Strategy for Sustainable Development (2007), which defined national priorities: the protection, conservation and enhancement of biodiversity in Serbia, increasing the area under protection to 10% (by 2010), expanding the network of protected areas, establishment of ecological corridors and a network of environmentally significant areas and others.Spatial Plan of the Republic of Serbia, for the period 2010.- 2020th year, envisages an increase in the total area under protection to 12% of the territory of the Republic of Serbia (2014. year).The concept of protection, development and utilization of natural heritage is based on increasing the protected area, the establishment of a national ecological network and identify areas for European ecological network Natura 2000, and the building of an effective system of management areas under ecological networks.Our country is a signatory to many international documents (conventions, resolutions, strategies) that are concerned with the preservation and improvement of the environment, forests and protected areas.In Serbia there is the Regional Environmental Center for Central and Eastern Europe (REC). REC Country Office Serbia is part of a network of national offices that word has in the 15 countries of Central and Eastern Europe and Turkey. The role of the REC is to assist in solving environmental problems, the promotion of inter-sectoral cooperation of non-governmental organizations, governments, businesses and other partners in the field of environmental protection, information sharing and support public participation in decisions that are important to the environment and human health [6], [7], [8].

CONCLUSION

Forests contribute to alleviating climate change by storing carbon in forest biomass (trunks, branches, leaves, roots as well as soil) and by producing oxygen. They reduce increasing global warming.

Serbian forests are managed sustainably, in a way and to an extent enabling permanent maintenance and enhancement of their production capacity, biodiversity, regenerative ability and vitality, which in both present and future makes possible the fulfillment of economic, environmental and social functions of forests whileas the surrounding ecosystems are not harmed.

A significant part of the activities of SE "Srbijašume" is aimed at raising people's consciousness about the necessity to increase the growing stock and game population and the protection level concerning natural environment as national richness can be preserved only by mutual strength. Join us, come with us to the World of Health!

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CADMIUM AND NICKEL IN SEVERAL MEDICINAL PLANTS ON SERPENTINE SOILS IN THE WESTERN PART OF REPUBLIC OF SRPSKA

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ABSTRACT

In this paper the content of heavy metals (Cd and Ni) in medicinal plants*Thymus serpyllum*, *Fragaria vesca* and *Potentillaerecta*was investigated at five locations with serpentine soilsin the western part of Republic of Srpska. The results indicatedthat the Cd content in the dry plant weight of mentioned plant species was below the detection limitor below the limit recommended by the WHO. Ni content in dry plant weight at all investigated sites was far above the level recommended by FAO and WHO and moderate to high compared with plants that do not grow on serpentine soils.

Key words: heavy metals, medicinal plants, serpentine soils.

INTRODUCTION

The use of plants in healingoriginates from the distant past. Over the last decade many of them, that have been successfully used for centuries in traditional therapy represent important raw materials in medicine, the pharmaceutical industry, as well as for human consumption (Saric, 1989; Skoula et al., 2003). According to the World Health Organization (WHO), about 80% of the human population uses different medicinal plants (WHO, 2002). However, the plant material may be contaminated with various heavy metals during the growth, cultivation, processing and further distribution. Such toxic plant material causes negative effects on human health (Naeem et al., 2009; Maobe et al., 2012). WHO provides guidelines for qualitative and quantitative analysis of toxic metals in plant raw materials (WHO, 2005).

Peridotite and serpentinite soils are characterized by high variability of properties such as: low Ca: Mg ratio, lack of essential macronutrients, increased concentrations of heavy metals low water holding capacity (Gordon and Lipman, 1926; Walker, 1954; Proctor and Woodell, 1975; Brooks, 1987; Kay et al., 2011).

Cadmium is a relatively rare metal, with a lowamountinthe Earth's crust, about 0,1 mg/kg. It is toxic to plants and represents one of the most dangerous environmental pollutants. Phytotoxic concentrations ranging from 5 to 10 ppm (dry weight) for sensitive plants, while concentrations of 10 to 20 ppm (dry weight) are critical. The highest concentration of Cd is always found in the roots and leaves of plants (Kastori et al., 1997; Kabata-Pendias and Pendias, 2001). Nickel belongs to the iron triad. Represents one of the essential trace elements as a component of enzymes, but at higher concentrations have a toxic effect on growth. Ni content in plants ranges from 1 to 15 ppm, but there are plants known for their great tolerance and accumulation of Ni, especially the plants that grow on serpentine soils (Kastori, 1983, Palacios et al., 2005; Bogdanović et al., 1997; Kabata-Pendias and Pendias, 2001).

Cadmium and nickel have toxic impac on humans. Cadmium causes acute poisoning, kidney damage, anemia, enteropathy, heart diseases. Nickel causes changes in the respiratory tract, skin, cardiovascular organs, cancer. These heavy metals in significant amounts are entered into the human body through food and water (Vapa and Vapa, 1997). For these reasons, in this paper, the content of Cd and Ni in three medicinal plants *Thymusserpyllum*, *Fragariavesca* and *Potentillaerecta*, collected from five locations of serpentine soil of the western part of the Republic of Serbian is investigated, in order to assess level of plant contamination with these heavy metals.

MATERIAL AND METHODS

Herbal material of plant species *Thymus serpyllum*, *Fragaria vesca* and *Potentillaerecta*is sampled from five sites of serpentine soil of the western part of the Republic of Srpska during 2012, from the location from which the local population collects herbs. Samples were first dried at room temperature in the dark, then in an oven at 105°C. After that, amples were ground, homogenized and analyzed. For the destruction of dry plant material was used procedure of moist mineralization with nitrogen and perchloric acid. Cd and Ni content in those samples is determined by flame atomic absorption spectrophotometry.

Herbeljekovitih biljnih vrsta*Thymus serpyllum*, *Fragaria vesca* and *Potentillaerecta*sakupljene su sa pet lokaliteta serpentinskih zemljišta zapadnog dijela Republike Srpske2012. godine, sa lokaliteta sa kojih i lokalno stanovništvo sakuplja ljekovite biljke. Uzorcisu prvo sušeni na sobnoj temperaturi na tamnom mjestu, a zatim u sušnici na 105°C. Nakon toga uzorci su samljeveni, homogenizovanii analizirani. Za razaranje suvog biljnog materijala korišten je postupak vlažne mineralizacije azotnom i perhlornom kiselinom.Sadržaj Cd i Ni u tako pripremljenim biljnim uzorcima određen je metodomplamene atomske apsorpcione spektrofotometrije. Contents of Ni and Cd in the soil of the study sites is also determined by atomic absorption spectrophotometry, for the whole soil profile.

RESULTS AND DISCUSSION

The results are presented in tabular and graphic form.

Cd content in analyzed profiles on serpentine soils was below the detection limit of the applied method (Table 1).

Nickel is a chemical element which amount is highest in basic and ultrabasic rocks. The average concentration of nickel in the soil is about 40 mg/kg. Serpentine soils can contain 100-7000 mg/kg of nickel (Kastori, 1997). In our soil samples, the concentration of nickel increased with depth and differed significantly between profiles. Nickel has the highest concentration in profile 1, in Pribinić, at lowest concentration in profile 5 (Mlinska Rijeka, Table 1).

Table1. Concentrations of Cd i Ni in serpentine soils of the western part of the Republic of Srpska

Soil profile nr.	Site	Soil type	Depth (cm)	CONCENTRATION (mg/kg)	
				Cd	Ni
1	Pribinić	ranker	0-10	<d. l.	1447.22
			10-20	< d. l.	2332.92
2	Pribinić	eutric cambisol	0-10	< d. l.	675.09
			10-20	< d. l.	760.43
3	Brestovo	stagnosol	0-10	< d. l.	215.36
			10-20	< d. l.	197.60
			10-20	< d. l.	825.06
4	Brestovo	ranker	0-10	< d. l.	1586.46
			10-20	< d. l.	1479.98
5	Mlinska Rijeka	stagnosol	0-10	< d. l.	178.36
			10-20	< d. l.	213.06

d.l. – detection limit

Table 2. Concentrations of Cd i Ni (mg/kg) in medicinal plantsThymus serpyllum, Fragaria vesca and Potentilla erecta on serpentine soils

Site/Area	Plant species	Cd (mg/kg)	Ni (mg/kg)
Site nr.1/ Pribinić	*Thymus serpyllum*	0,00	60
Site nr. 2/ Pribinić	*Potentilla erecta*	0,00	15
Site nr. 3/ Brestovo	*Thymus serpyllum*	0,00	36
Site nr. 3/ Brestovo	*Fragaria vesca*	0,12	41
Site nr. 4/ Brestovo	*Thymus serpyllum*	0,00	11
Site nr. 5/ Mlinska rijeka	*Thymus serpyllum*	0,10	62
Site nr. 5/ Mlinska rijeka	*Fragaria vesca*	0,23	45
Site nr. 5/ Mlinska rijeka	*Potentilla erecta*	0,11	81

Concentration of Cd in herbal material of*Thymus serpyllum* sampled from four sites was in the range of 0,00 to 0,10 mg/kg of dry biomass, for the *Fragaria vesca* in the range 0,12 to 0,23 mg / kg of dry biomass , while for the*Potentilla erecta* concentration was in the range of 0,00 to 0,11 mg/kg of dry biomass. According to WHO, the recommended concentration of Cd in dry plant material is 0,3 mg/kg (0,3 ppm), but the regulation of our country does not give limit values for Cd in dry plant material. Cd content in dry herbalmaterial of sampled species in four of the five sites was below the detection limit, while on the three sites relatively low concentrations are detected,below recommended limits stated by the WHO (Table 2, Diagram 1).

Nickel was detected in dry herbal material of sampled species at all investigated sites. Ni concentration in plant dry weight at all sites was far above the level recommended by FAO and WHO (1,63 mg/kg for edible plants) and also moderate to very high (11-81 mg/kg dry weight) compared to plants that do not grow on serpentine soils (0,5-1 mg / kg dry weight) (Table 2, Diagram 1).

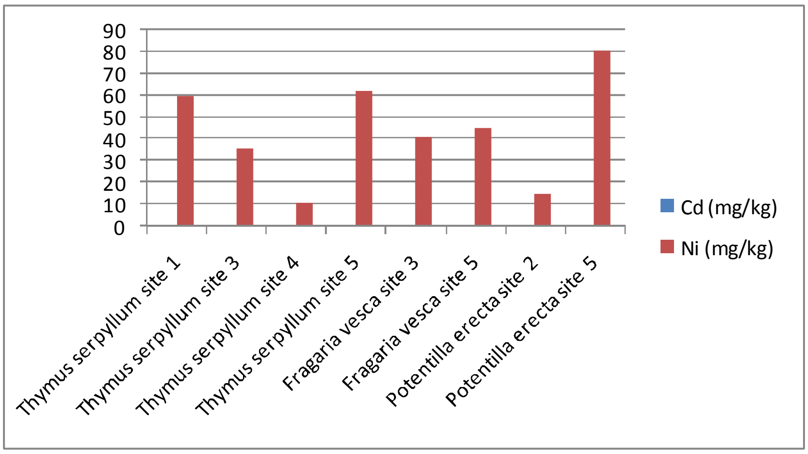

Diagram 1. Concentrations of Cd i Ni (mg/kg) in medicinal plants Thymus serpyllum, Fragaria vesca and Potentilla erecta on serpentine soils

The presence of cadmium and nickel, as heavy metals in the soil, is the result of pedogenetic processes, but also from human activities. Sources of these heavy metals in soils are numbered: agricultural materials, fertilizers, atmospheric deposits, waste sludge and many other. They are concentrated in surface horizons of soil profile as a result of recycling through the vegetation, atmospheric residues and absorption by soil organic matter (Kast, 1997). Physico-chemical characteristics of serpentine habitats are unfavorable to the development of many plant species. Serpentine soil is naturally characterized by an increased concentration of Ni, and Cd in them primarily originate from anthropogenic sources. According to some researches, the total content of Ni in serpentine soils ranges from 500 to 600 ppm (Ubavić et al., 1993, Reeves et al., 1999).

The increased concentration of Cd in the environment has a negative impact on medicinal plants: on the content of active substances, the quality and safe use of products and raw materials. In many studies of medicinal plants material, especially in the neighboring countries,the increased content of Cd in dry herbs and leaves was determined, compared with the limit level of 0,3 mg/kg recommended by WHO (Radanović et al, 2007; Obratov-Petković et al. 2008; Đukic-Ćosic et al, 2011; Kostić et al, 2011). However, in our study, there is no significant increase in the level of Cd in dry herbal material of investigated species, compared to the limit recommended by the WHO, which indicates that the investigated sites are not contaminated with these heavy metals.

Nickel, which amounts in the serpentine soils are naturally high, is also found in increased concentrations in dry herbal material of analyzed plants. Concentration of this heavy metal in plant material was above the level recommended by FAO and WHO. These results suggest that sampled species have a moderate ability to accumulate Ni. The degree of contamination of the investigated sites with nickel is moderately significant, although these sites are not contaminated with industrial activity. Differences in Cd and Ni concentrations in investigated species can be explained by the different soil profiles on sites and also the genetic properties of species.

CONCLUSIONS

The content of heavy metals in plants depends mainly on the concentration and form of heavy metals in the soil solution, the movement of heavy metals from the soil solid phase to the root system and transport to the aboveground plant parts, the genetic constitution of plants, as well as the characteristics of the root system (Alloway, 2005). Measured Cd concentrations in sampled plant materials were low or below detection limits, while in the soil profiles were below the detection limit. Ni content was moderately increased in the soil and in plants, at all studied sites. According to the analysis of Ni concentrations in tested plants can be concluded that the *Thymus serpyllum*, *Fragaria vesca* and *Potentillaerecta*are mostly tolerant species for this heavy metal, which is accumulated in their biomass. Therefore it is not recommended collecting these species on the studied sites. Also, the results of this study indicate the need for systematic control of toxic metals contents and to determine their maximum allowable concentrations in medicinal plants. This especially applies to soils that are naturally characterized by elevated concentrations of heavy metals, such as serpentine soils.

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HORTICULTURE THERAPY – FIELDS AND METHODS OF APPLICATION

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ABSTRACT

This paper examinates fields and methods of horticulture therapy. There are described concepts and different methods of treatment, which could be applied by a large range of patients. Some of the primary fields of application are: physiological area, cognitive area, psycho - emotional area, social area, self image and relations with oneself. Methods of application depends on the type of disease, condition and age of person. Horticulture therapy is an activity that can be adapted to different needs in the treatment and rehabilitation. It can provide benefits for users (the elderly, people with disabilities, unemployed, victims of violence, chronic ill).

Key words: horticultural therapy, rehabilitation, people-plant relation.

INTRODUCTION

Horticultural therapy is a process that uses plants, horticultural activities and the natural world in order to increase awareness and well-being by improving the body, mind and spirit. It establishes a people-plant relationship through garden activities and has a strong positive impact on human development. It is a non-pharmacological therapy used for a number of physical and mental health outcomes. Horticultural therapy is a process that uses plants and plant-related activities through which participants strive to improve their well-being, either through active or passive involvement (1).

Horticulture therapy offers a variety of treatment methods and has a large application area (figure 1). It is used worldwide in hospitals, health and social rehabilitation centers, nursing homes, parks, botanical gardens and arboreta, schools, farms, horticultural centers, prisons, centers for the homeless and abandoned children. This form of therapy stimulates memory, social activity, provides sensory stimulation and exercise, lowers stress and tension, anger and reducts agresivness (2).

Figure 1. A. Socialization; B. Improvement of motor skills; C. Therapy for all ages
(Source: A. http://www.pacificquest.org/2012/11/the-growing-edge-of-wilderness-therapy/ B. http://careerwatch.wordpress.com/2010/03/09/what-is-a-horticultural-therapist/ C. http://www.arboretum.umn.edu/horticultural_therapy.aspx)

Horticultural therapy uses physical and psychological benefits offered by working in the garden to help the large number of users in the treatment and rehabilitation (3). Users are groups who were diagnosed different disorders, different abilities and ages, with a variety of physical, psychological and developmental disabilities (mental patients, drug addicts, the disabled, the chronically ill, people with learning and development disabilities, with social problems, unemployed, victims of violence and war, the elderly, people who suffered of serious diseases, such as heart attack or stroke).

MATERIAL AND METHOD

In this paper the analysis of fields of application of horticulture therapy, as well as the concepts and different methods of therapeutic treatment was made. Relevant data were collected by analyzing and studying the available professional international and national literature. By comparison of various written sources, the basic concepts were defined. Previous results of the work have been synthesized in the context of possible operationalization and determined how this knowledge can be used for the purposes of the application of different methods of horticulture therapy. Through the synthesis of the results, the main conclusions were made.

RESULTS AND DISSCATION

Areas of application of horticulture therapy - Horticultural therapy is used in a variety of areas: psychiatry, geriatrics, mental illness, physical and sensory impairments, social deviation. Some of the primary fields of application are:

physiological area, cognitive area, psycho - emotional area, physical area, social area, self image and relations with oneself.

Physical fields of application - Spending time outdoors in the beautiful gardens on the fresh air gives a lot of opportunities to develop and improve the user's needs for physical therapy. Horticultural therapy has been used in physical rehabilitation through training muscles, increase coordination, balance, strength, improvement and maintenance of motor skills. Patients are more willing to work physical therapy outdoors in the garden than indoors.

Cognitive fields of application - Horticulture therapy entails people interacting with plants, in the case to improve the cognitive function (5). Using different methods of horticultural therapy following advantages in this field are achieved: speech enhancement, improve memory, learning new skills, follow the specific instructions, solving problems, maintenance attention. Giving information about plants that were used in the garden, such as their names and origin, is one approach that improves the therapy program. Orientation in time and space can be facilitated through horticultural therapy program including the monitoring of the process of planting and plant growth.

Emotional fields of application - Horticultural therapy program may help patient to create a stronger sense of itself. In situations where people think they can not continue and have not enought strength to fight in life, well-organized horticulture therapy can provide a safe way to get positive feelings back into their lives. Through the care of plants, the patient learns to be caring for others. Horticultural therapists can design a program that will affect overcoming anger and aggression. The excess energy that some person manifested through anger and aggression is directed at productivity, eg. digging, removing weeds, collecting leaves, substrate preparation, washing garden tools. To change negative outlook on life, the patient is involved in programs where is encouraged to observe changes in plant growth from day to day and week to week. This can be achieved by monitoring growing plants from seed.

Social fields of application - Horticulture therapy programs can provide social benefits in different ways. According to Ó Nualláin (6) gardening can offer strides in the development of social and intellectual skills, especially those required for social inclusion or rehabilitation. Gardening involves personal initiative and effectiveness, and nurturing responsibility to living things. Socialization is done in the following ways: frequent family visits to the garden, creating projects through the season, talking to other people while working in the garden. The other side of socialisation is making some skills for recreation in free time. Gardening, whether it is a new skill or favorite hobby, is a great leisure activity, which helps to motivate people to leave their solitary lifestyle.

Interactions in the environment - Gardening is one of the most common leisure activities and therefore there is a possibility that customers join some communities through horticulture. This includes tours of horticultural facilities, participation in local gardening clubs and participation in trade fairs. Horticulture can provide business opportunities in the green industry, for people with basic horticultural skills such as watering, digging, planting. Thus, it is possible to employ people with disabilities, because they are the most common users of horticulture therapy programs.

Methods and techniques of horticulture therapy

Methods of application of horticultural therapy depend on the type of disease, person's condition and of his age. Depending on whether they are children or adults, persons with disabilities, psychiatric patients or some other group of people, based on these criteria it can be determinate the program of rehabilitation. In all types of training program, therapist teaches individuals or groups.

Group therapy - The first step is to classify clients according to the groups of different sizes of three to fifteen or more individual (figure 2). Then, it is necessary to adjust program to an individual, for which a team of experts is working - biologists, horticulturist, physical therapists, physicians, psychologists, social workers etc. In group therapy, individuals also need to fulfill their needs through interaction with other people - members of the group, with the therapist, plants, insect pests living on them or insects visiting plants (4). Groups can be classified as active groups or support groups, or a combination of these two. Active groups are focusing on tasks and duties or socialization. Their goal is to improve concentration, cooperation, creativity, learning new skills, are the main goals, and at the same time, participants are motivated to discuss, collaborate, and have fun. Support groups, on the other hand, focus on communication and psychotherapy. In these groups, participants shared experiences, directing to the response and reactions, interpersonal skills, express their feelings. In addition to learning gardening skills, participants can socialize and have fun, talk and in this way provide each other support.

Figure 2. Group therapy

(Source: A. http://designforgenerations.com/uncategorized/horticultural-therapy-week/ B. http://thehort.org/horttherapy_htp.html)

Individual therapy - In individual therapy (figure 3) connection established between the patient and the therapist is the most important element in the healing process. The main components of horticultural therapy programs are plants and the environment, the patient and therapist. The development of the patient's goals and activities with the plant are the basis of the program. The role of the therapist is very important in this process and should not be ignored.

Figure 3. Individual therapy
(Source: A. http://www.horticulturaltherapy.info/
B. http://www.healinglandscapes.org/blog/category/horticultural-therapy/
C. http://horticulture.oregonstate.edu/content/therapeutic-horticulture)

The role of the therapist - I In order for therapy to be successful, the therapist has to take therapy program in the proper way. The therapist should act as a teacher, trainer, motivator in the way to establish a leadership that will lead to the better development and progress of the participants. The therapist should use effective communication techniques, encouraging satisfying relationships, provide psychological support, and help the client to understand themselves and to understand the therapeutic process. He is responsible for creating the environment that will be enjoyable for all participants of therapy, which is achieved by showing respect, compassion, honesty and trust. He must have patience to create an uncritical atmosphere and quickly to connect with the client through a relationship that is honest and open. It is also important a verbal and non-verbal communication that includes facial expression, posture and tone.

Apart from the good communication techniques, the therapist must have a good understanding of the task or activity that sets the participants, which is achieved through a detailed analysis of both, participants and the activities in the garden. The process of tasks and activities analysis, takes into account materials, equipment and possible adaptation and modification of materials or the environment, as well as the skills needed to perform the task. It is also important that the task is corresponding to certain people eg. by age or physical capabilities of the patient. During the implementation of the task, therapist should follow the participants and to observe thoughts and feelings that occur in a patient, physical and cognitive ability and emotional response after completion of a task. If he decides that the task does not match the client abilities, activities can be modified - for example change of material, the number of steps and time required to perform the task.

CONCLUSION

Therapeutic garden stimulate and engage all of our senses and feelings, give emotional satisfaction, develop physical and intellectual skills, have positive psychological impact and affect on social inclusion and rehabilitation. Through an interaction with the environment, horticultural therapy focuses on clients and treatment activities and can serve physical and physiological health. Garden activities improve cognitive skills and provide benefits to the physical, mental and emotional wellbeing. It can be concluded that horticultural therapy through various methods of treatment has a wide range of application and healing potential and effects to the people with different abilities.

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TOXIC EFFECTS OF CADMIUM IN THE METALWORKING PROCESSES

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ABSTRACT

Occupational cadmium intoxication solely chronic character, which has the task to study its toxic effects. Given that exposure to low levels of cadmium in biological materials is an important indicator of the toxicological risk, performed the statistical analysis of the association of age and length of service and cadmium concentrations. We used data from the annual reports of social services and medical statistics, medical records and the specific primary health care staff and expert findings of the Public Health Nis. The concentration of cadmium in biological samples were determined by spectrophotometric methods. Statistical analysis was performed software packages Excel, Matlab and SPSS19.0. Research has shown that low levels of cadmium exposure leads to adverse health effects, which is an important indicator of the toxicological risk.

Key words: cadmium, chronic exposure toxicity.

INTRODUCTION

Cadmium, common occupation and environmental pollutant [1], is used in the process of corrosion protection because it shows better corrosion properties of nickel and chromium. Cadmium are particularly exposed workers during the autogenous cutting and heat treatment of metal structures that are protected from corrosion by cadmium. Utilization of cadmium as an ingredient of paint metal resources, the technological processes of metal is 7% of the total industrial use [2]. Nineties and the beginning of this century, it was announced a few epidemiological studies that have described adverse health effects of exposure to low levels of cadmium in four groups in Japan, China, Europe and the United States. The results of these studies indicate that very low levels of exposure to cadmium can cause kidney dysfunction. Usuda et al. [3] provided an overview that describes the typical indicators of toxicity of cadmium to the potential health risks that can lead to kidney dysfunction, skeletal and respiratory diseases. Chronic poisoning professionally can occur after long-term exposure to cadmium by inhalation or orally, and the systematic effects of cadmium exposure leads to increased excretion of calcium, an increased risk of stone formation in the kidney and bone damage [4]. Cadmium directly affects the lungs, liver, kidneys and testes after acute intoxication and causes nephrotoxicity, immunotoxicity and ostetoxicity and tumors after long-term exposure [5]. During occupational exposure, the total amount of cadmium in the body by the liver is between 15 and 20%. After cadmium exposure gradually from the depot to the liver in renal depot. During this process, by glomerular filtration cadmium complexes with metallothionein [6], these complexes appear in the primary urine and reabsorbed in the proximal renal tubule. Cadmium is eliminating from the body through the gastrointestinal tract and the urine in the form of complexes with metallothionein.

In moderate continuous cadmium exposure, if there is no saturation of renal binding of cadmium, its concentration in urine is a relatively good indicator of exposure. Based on the previous study, the reference dose concentration of cadmium in the urine, which is in the range of 0.005 to 0.010 mmol/g creatinine (from 0.6 to 1.2 mg/g creatinine) [7], and recent studies indicate that the concentration cadmium lower than 0.002 mmol /g creatinine (0.2 mg/g creatinine) nephrotoxic [8]. Also, recent research has found that the twofold increase in the concentration of cadmium in the urine, the relative risk of mortality increases 17% [9]. Exposure is very high concentrations of cadmium, due to irritation and damage to the alveolar epithelium, leading to the development of pulmonary edema. The appearance of pulmonary emphysema in patients exposed to long-term cadmium is associated with its inhibitory effect on the activity of α_1-antitrypsin in serum [10].

The research indicates the importance of the toxic effects of cadmium on the exposed population and suggest establishing statistical correlations cadmium concentrations, age and length of service.

MATHERIALS AND METHODS

Biomonitoring is based on the determination of the concentration of cadmium in biological samples (blood and urine) exposed and control groups of patients. The applied analytical method type of retrospective epidemiological cohort study, covering the period since 2001. until 2010. year. Exposed cohort consisted of respondents employed in "NISSAL" ad respondents were male, mean age 45.4 years, who were in the period worked at least one year in the metalworking processes. The control cohort consisted of respondents reference technology systems, male, average age 44.1 years, which was the period of administrative work.

We used data from the annual reports of social services and medical statistics, data from medical records and the specific primary health care professional is employed and the Institute for Health Workers and the Public Health Institute in Nis.

Analysis of biological material exposed and control group, were analyzed in Office of Public Health workers in Nis, the Public Health Institute in Nis and the Military Medical Academy in Belgrade.

Using atomic absorption spectrometry, graphite furnace technique, the analysis of the concentration of cadmium in biological material exposed and control groups of patients.

The results cadmium concentrations in biological samples were analyzed using standard statistical methods: descriptive statistics technique (mean and standard deviation, frequency, percentage) to determine the severity of basic research variables, correlation techniques to determine the direction and degree of association between the variables, the Student's t statistic for a major independent samples and the chi-square test for differences in frequency.

Statistical sample size is determined by the statistical methodology, while providing the basic principle of representativeness. Statistical analysis and presentation of the results was performed software packages Excel, Matlab, SPSS19.0 (Statistical Package for the Social Sciences), and StatCalc EduStat.

RESULTS AND DISCUSSION

In the statistical analysis of biological material, we started from the analysis of the expression of cadmium-exposed and control groups, as shown in Table 1.

Table 1. The magnitude of the level of cadmium in biological material exposed and control groups

The measured parameter	Group	Min	Max	AS	SD	Mod	DNV
Cadmium (blood), μmol/dm^3	Exposed	0,005	0,196	0,061	0,053	0,023	0,089-0,267
	Control	0,003	0,102	0,022	0,017	0,032	
Cadmium (urine), μmol/dm^3	Exposed	0,000	0,058	0,022	0,015	0,021	0,089
	Control	0,004	0,038	0,019	0,009	0,006	

Min - minimum value; **Max** - maximum value; **AS** - mean; **SD** - standard deviation; **Mode** - the most frequent value; **DNV** - allowed normal value

The average concentration of cadmium in the presence of blood is 0,053 μmol/dm^3, which is relatively low, given the measured maximum value of 0.196 μmol/dm^3, while the most frequent value of 0,023 μmol/dm^3. The mean value of the concentration of cadmium in urine is relatively low 0,015 μmol/dm^3 , compared to the maximum value of 0,058 μmol/dm^3. If we take into account that the most common value of the concentration of cadmium in urine is lower than the allowed amount, and 0,021 μmol/dm^3, it is concluded that an intermediate level of representation.

Pearson's correlation coefficient was estimated correlation age structure and length of service exposed and control groups, and cadmium concentrations in biological samples. Based on the results showed a statistically significant correlation between the concentration of cadmium in biological material and the age and length of service. These correlations are positive and indicate that with increasing age and length of service increases and the concentration of cadmium in biological material, as a result of many years of exposure. The value of the correlation coefficient is above 0.60, which indicates the high correlation age and cadmium concentrations in biological samples, with statistical significance at the 0.01 level.

Correlation and age structure of service-exposed group and cadmium concentrations in biological samples is shown in Table 2.

Table 2. Connection between age and length of service and the group exposed to cadmium concentrations

Cadmium (blood), $\mu mol/dm^3$	Age	r	0,722**
		p	**0,000**
		N	60
	Length of service	r	0,806**
		p	**0,000**
		N	60
Cadmium (urine), $\mu mol/dm^3$	Age	r	0,656**
		p	**0,000**
		N	50
	Length of service	r	0,705**
		p	**0,000**
		N	50

r - correlation coefficient, **p** - statistical significance, **N** - sample size.
** *Statistical significance at the 0.01 level*

Dependence of the concentration of cadmium in biological materials by the age of the plant Nisal done in MATLAB and is shown in Figure 1.

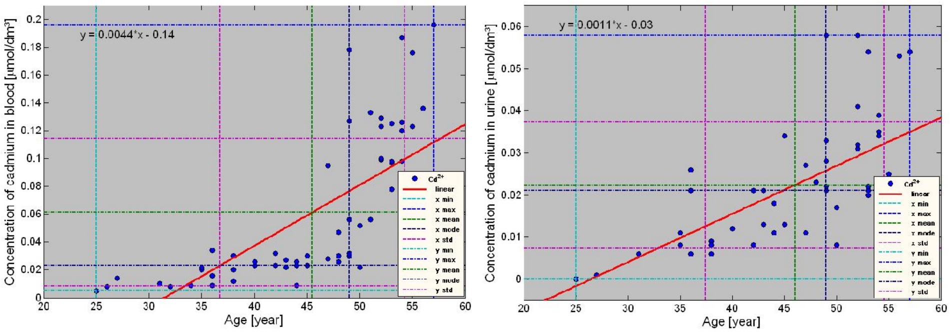

Figure 1. Dependence of the concentration of cadmium in blood and urine of age

Linear dependence of the concentration of cadmium in blood and urine of exposed age groups, are shown in Figure 1 are of the form: i, which means that the increase retirement limits for one year, increase concentration, an average of 0.0044 and 0.0011 mol/dm ^{3}, respectively.

Dependence of concentration of cadmium in biological material exposed by years of work in the factory Nisal done in MATLAB and is shown in Figure 2.

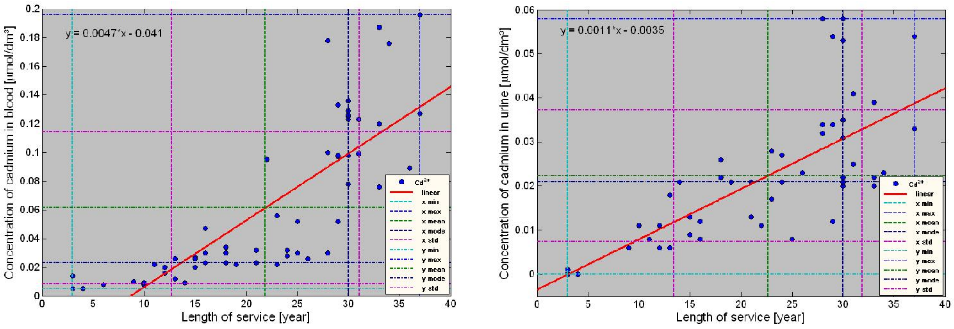

Figure 2. Dependence of the concentration of cadmium in blood and urine of length of service

Approximate linear dependence on the concentration of cadmium in blood and urine of exposed length of service exposed groups of patients, are shown in Figure 2, the linear form: and it was found that with the increase of service exposed for one year, increase concentration, an average of 0,047 and 0,011 µmol/dm^3, respectively.

DISCUSSION

The average concentration of cadmium in the presence of blood-exposed group was 0.053 µmol/dm^3, which is relatively low, given the measured maximum, 0,196 µmol/dm^3 and limit (0.089 to 0.267 µmol/dm^3). The maximum allowed value of cadmium in blood professionally exposed population, for example, according to German law, µmol/dm^3 0,133 (15 µg/dm^3), which is much lower compared to the maximum permissible value according to our regulations 0,267 µmol/dm^3. In comparison, among non-smokers, the average concentration of cadmium in the blood of 0,004 µmol/dm^3 [11]. The mean value of the concentration of cadmium in urine is relatively low, µmol/dm^3 0,015, compared to the maximum value of 0,058 µmol/dm^3. Taking into account that the most common value of the concentration of cadmium in urine is less than allowed 0,089 µmol/dm^3, amounting to 0,021 µmol/dm^3, it is concluded that an intermediate level of representation. The concentration of cadmium in blood is a reliable indicator of recent cadmium exposure, while urinary concentrations showed earlier exposure [12].

Comparison of mean values of cadmium in the blood of exposed µmol/dm^3 0,061 and control 0,022 µmol/dm^3 group of respondents indicate statistical significance at $p<0,05$. Comparison of average values of cadmium in urine-exposed and control group received a slight difference, so there is no statistical significance.

During long-term exposure, the concentration of cadmium in urine above 0.089 mmol/g creatinine (10 mg/g creatinine), indicating actual or impending renal tubular damage. Cadmium concentrations lower than 0.004 µmol/100g (0.5 µg/100g) whole blood do not cause damage during long-term exposure, while in the blood cadmium values above 0,080 µmol/dm^3 a significant exposure to cadmium [13].

The level of cadmium in blood and urine of exposed groups during the study period was positively correlated with age retirement (r=0,722, p<0,01 i r=0,656, p<0,01, respectively), which coincides with the results of Lauwerys [14], who found that the burden of cadmium, particularly in the kidneys, mainly to increase linearly with age, up to 60 age, after which the level of cadmium in the kidney remains constant or decreases very slightly. Grinyer et al. [15] also found that the content of this cumulative toxin increases linearly up to the age of fifty, according to the authorities which has a strong affinity, and then remains constant or slightly decreases.

Determined by the high correlation between the concentration of cadmium in blood and urine and the exposed length of service in exposed subjects during the time of study, (r=0,806, p<0,01 i r=0,705, p<0,01, respectively). Correlation is high and positive, which indicates the significance of the relationship.

CONCLUSION

A retrospective cohort epidemiological study showed that the systematic effects of cadmium exposure results in an increase of its concentration in biological material, confirming the hypothesis of high toxicological risk. The level of cadmium in blood and urine of exposed groups during the study period was positively correlated with age, and the exposed length of service. These data confirm the association between occupational exposure to cadmium as well as the age and length of service exposed and pointing to a response to the effects of harmful effects.

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THEORY OF HIERARCHY AND DYNAMICS IN LANDSCAPE ECOLOGY ON EXAMPLE OF RITOPEK LANDSCAPE IN BELGRADE

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ABSTRACT

A large number of complex systems, especially ecosystems among which includes the landscape are characterized by lower or higher spatial arrangement, high functionality, flexibility and stability. Basically the occurrence of these organizations and a significant number of other self-organization in nature, there is a principle of spontaneous hierarchical order. This general principle of self-regulation characteristic of many complex systems is referred to as hierarchies. This paper deals with the ecological organization units on the level of minimum landscape area, across the landscape element to the landscape scale on the example of the landscape Ritopek in Belgrade.

Key words: hierarchy, region, system, landscape element, Ritopek.

INTRODUCTION

The work involves the examination of landscape features such Ritopeklandscape hierarchy level properties, lower and higher systems, horizontal and vertical integration of hierarchical levels, examine the origin of the structure, function, dynamics and balance in the landscape Ritopek. Main goal is to use the settings hierarchy theory in the study of the origin and ways of functioning, development, and acquisition stability of the landscape and its neighboring levels of the organization on the example of the Ritopek landscape.

This work presents the theoretical basis which is a prerequisite for successful practice in the field of hierarchy and mechanism approach in landscape ecology that needs to be much more involved and it can be instrument for ecological planning. Goal is to prove the need and necessity of knowing the hierarchical approach into landscape ecology and the mechanisms of action in the landscape area of policy for the further development of the landscape but in this case on example of Ritopek landscape[1]. .

MATERIALS AND METHODS

Literal material that is used for this paper is professional literature in the field of landscape ecology which deals with the interrelationships and hierarchical setting in the landscape.

Methodsthat is used in the analysis of the Ritopeklandscape combines ascendant and descending flaccid-analysis approach in landscape. It consists of the original boundary separating regions of larger spatial units, according to the criteria of geomorphic and geologic units and human activities, and lower hierarchical systems-functional landscape elements. After analyzing the structure and typology of landscape elements, considered their spatial hierarchical collection - mosaics and the spatial configuration, hierarchical and functional addition - interactions and mechanisms that connect landscape elements combiningthem into a higher system - landscape. In addition to factors that originate from the lower levels of the factors considered and the higher levels - geographical region, which also contribute to the functioning of the landscape as a whole [2].

RESULTS

Aftertriedical observation hierarchy structure we can conclude that Ritopek landscape belongs to the Belgrade region, it is to act as cultivated landscape with subtype of traditional agriculture and landscape elements in Ritopeklandscpeare: discontinuous urban fabric (an area of 4,75 km^2), dump sites(area of 4,50 km^2), complex cultivation patterns (area of 22,25 km^2), landprincipally occupied by agriculture (an area of 12,50 km^2), agro-forest area (area of 1,75 km^2) andbroadleaved forest (area of 1,50 km^2) and they have acting forces dynamism in the region. The area of Ritopek landscape covers an area of 47,25 km^2 and is situated on the right bank of the Danube river near the suburban area of the Belgrade. To find the source of the dynamics with the analysis of spatial patterns, interactions between the landscape elements and identification of origin of the strongest influences, their character, range and bearing spread through the region.During the period of the intersection of the landscape, the existing structure of the most common surface reflects the current dominant influences and conditions the future dynamics. The majority of landscape elements in the observed region have anthropogenic origin and are therefore conclude that the set of influences that control the dynamics of the human form of activity. There are twoinfluences that operate in the area of Ritopek landscape, and they are:

<u>Anthropogenic influence in shaping the structure through:</u>

- Removal of indigenous vegetation and the resulting erosion processes,
- Planting and plant cultivation,
- Creating land reticular form field hedges and belts,
- Construction of residential buildings,
- Construction of the infrastructure of roads, water and sewer maintenance structure constant

Anthropogenic influences in the functioning of the landscapethrough:

- Input-grown plants and animals, introduced pests and diseases control their growth,
- Input of materials - fertilizers, pesticides, herbicides, waste as a product of industry and housing, combustion products of fossil fuel,
- Input of energy - heat from the heating

In contrast to anthropogenic structures that are a constant disturbance in the area, remains a source of natural vegetation succession and stops once impact a man they assume the role of the dominant factors. In certain locations in the monitored area are noticed signs of regenerating or the establishment of natural regulatory mechanisms where nature took control of the dynamics, aiming at establishing a homogeneous structure[3]. .

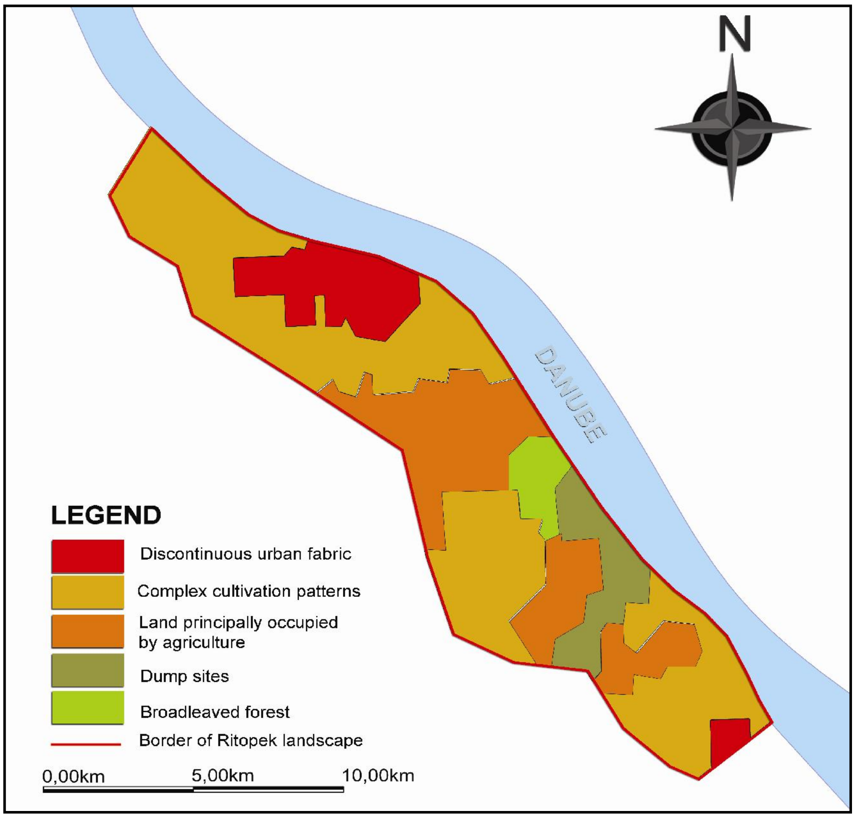

Figure 1.Map of landscape elements distribution in Ritopek landscape

Areas under agriculture and housing cover most of the Ritopek landscape and between them there are small areas of original forests and belts. These microstructures pervade the landscape elements (except dump sites and broadleaved forests themselves), making a sort of "connective" tissue regions. There are active forces in the area represented by the forces of nature: climate, geomorphological and biological forces, and human effects; induced disorders man forces - changes in natural conditions, structures and processes, introducing species, matter and energy. To form an integrated whole landscape is required spatial and temporal continuity factors, structures and processes.

In such conditions, it is possible to continuously and rhythmically and smoothly effects on dominant forces that results in stable operation and dynamic balance of the whole landscape. Due to occasional or frequent changes of the relevant factors, the structure and process, the volatile influence of man, space-time continuity of the landscape is more difficult to define and set up the human activity flows by highly variable effects. This results in uneven rhythms and dynamics often creates a short-lived metastable structures. Entire landscape dynamics depends on the degree of human influence and therefore the character of the landscape as a whole conditional right of man.

Secondarily, the functional scope of the landscape is based on geomorphological unit which is the spatial-temporal continuity elsewhere but they are subject that are changing during periodic of landsliderhythmic. Importance of climate trends is much higher because they are constant, and as such, in terms of longevity, only provide a stable, continuous functional scope of landscape dynamics.

Man has changed the character of the landscape so that the trend continues dynamic balance is being influenced by the interaction of man and nature. The assumption is that if there is a weakening of the influence of man, (as has been observed in some parts of the landscape around the area) natural flows will be restored and act in the direction of the prevalence of the natural character of the landscape. If man continues to act, human effects will tend to further urbanization that will act in the direction of reshaping the landscape of cultivated into suburban landscape.

DISCUSSION

The scale of human activity is measured from a few meters to several million square kilometers. Distribution and diversity of the human impact has led to partial or complete changes of the environment and the ways of its self-regulation. The set of natural factors and mechanisms that influence the self-organization of ecological systems has been replaced by a set of disorders that reflect housing, agriculture, industry, transport. Way of establishing a hierarchical order of anthropogenic structure differs slightly from natural mechanisms. During the analysis of theRitopek landscape there has been expression of these specificities and is hereinafter referred to briefly reviews hierarchy created by human influences[4,5]. Accordingly, there are three hierarchical levels of influence and level of organization that man creates by his actions, and they are:

1) **Anthropogenic ecosystem**

   They changes the nature motivated by the satisfaction of human needs (resource), because people perceive nature in terms of effects (if nature provides benefits to a man because he wants to change itfor his needs) and to eliminate the threat and danger.

   Artificial, man made environment which applies the same rule of mutual dependence and interdependence of living things and the environment, as well as other ecosystems, is referred to as anthropogenic ecosystem. One, the primary anthropogenic ecosystem (residence) causes formation of all the other (of pastures, farmland, orchards, vineyards, and so on.).

2) **Anthropogenic landscape**
This landscape depends on the presence of certain structures and the dominant influence of the origin, natural or man-made forces. For the definition of landscape types Forman and Godron used as the main criterion level of human action. When the representation of man's influence and impact caused the structure to overcome the natural, anthropogenic landscape emerges. Anthropogenic landscapes appear and operate within mutually conditioned,and opposing influences of man and nature.

3) **Anthropogenic region**
Human activities reached recently the domain of macro-scale. Complex ecological mechanisms and the interdependence of living and inanimate environment at the micro-scale subordinate to the needs of numerous people. Set of spontaneous natural elements replaced by a set of established and controlled disorder.

CONCLUSION

The observed Ritopek landscapes created by human activity are observed on the following properties:

- Scale-natural mechanism that defines the landscape and the landscape element to natural levels of the organization and the scale of anthropogenic mechanisms that cause the occurrence of anthropogenic environmental matching systems are not equal;
- Violation divided system - hierarchical dynamics of anthropogenic level tends to equalize at all scales of operation. Large-scale systems can be just as fast as the lower dynamics systems;
- Integration level of anthropogenic creation does not follow defined scale and box holons;
- A high degree of heterogeneity at the micro-level subsystems according to the principle of self-similarity maps to multiple systems observed;
- Integrity of cultivated areas of traditional agriculture which is the region of Ritopek, is based on a set of changed environmental factors and anthropogenic - introduced mechanisms that are related to inpatient housing and agriculture. The effects of these factors exceeds the characteristic scale natural influences and spatial pattern-structure and function are determined by the intensity of the use and maintenance of the parts of the landscape different purposes. The center analyzed the influence of anthropogenic landscape is a village whose development is driven by economic, business and social policy more pronounced at the level of physical sites - Belgrade region.

Landscape elements such as lower levels of the organization are a source of initial conditions and mechanisms for the formation of the holelandscape system. In order to understand a set of factors and mechanisms that operate at this level of analysis it is necessary to descend to an even lower level - the plot. Heterogeneity and variability of factors at the lowest level are very high due to the diverse usage and the scale of development shifted to natural ecosystems, the pace accelerated and the number of functional states is much higher. Adjacent parcels with different annual and perennial crops, operate under different rhythms operation and maintenance which leads to non-compliance of their dynamics. Coherence dynamics of neighboring spatial units causes the frequency of interacting and interdependence.

Sustainability levels of the organization depends on the degree to which the interaction of subsystems are supported in relation to the degree to which the organization is destroyed. Degree of interacting elements of the landscape and their relationship is uneven in parts of the landscape to the diverse origins (broadleaved forests and dump sites). On the other hand, low contrast and greater structural landscape connectivity related to elemants (complex cultivation patterns, agro-forestry areas and land principally occupied by agriculture) occurs, because of the similarity in the dynamics and frequent interaction.

This is due to anthropogenic influences unimodality usage so that the structural configuration parts of Ritopek landscape resembles the pattern of adjacent areas, but within a given landscape.

From the above, it is concluded that Ritopek landscape with a very small impact of man's will able to become suburban landscape or with the proper input to hierarchy elements, the development of the condition can be redirected to the maintenance of the current type of landscape which is cultivated landscape with subtype of traditional agriculture.

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ANALYSIS OF WORK "RECYCLING CENTER" PUBLIC UTILITY COMPANY POZAREVAC

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ABSTRACT

Systematic collection of PET bottles, cardboard and paper at the end of December 2007. has begun forming a recycling center by the PUC "Public Utility Services" Požarevac. The goal of Recycling Center is to collecting and providing the opportunities to recycle all municipal and industrial waste, for which may be found appropriate strategic partner, which is registered in the Serbian Agency for recycling. In the 2012. year analyses were done for the potential and already exiting raw materials which are processed at the center.

Key words: recycling, communal waste, industrial waste, analysis.

INTRODUCTION

The problem of environmental pollution is constantly increasing. The causes are, on the one side in continuous increase in the number of people on Earth, and in the other side in continuous increasing needs for natural resources for such a numerously population. At the same time people reject the increasing amount different kind of waste. Collection and disposal of large quantities of waste represents a huge environmental problem. From the time when people will start to think about their environment, how to guard him and to feel like his part, when they will start to wake up a conscience, which turns into an ecologic ethics, morale, we can talk about the environment protection. Theoretically, the environment protection includes a set of different proceedings and measures which prevent endangering the environment in order to maintain of biological balance. The use of modern technology leads to the general progress of society, but the technology must be accompanied by appropriate measures of prevention, ie. removing potentially harmful consequences.

Waste management is the implementation of measures prescribed for the treatment of waste in within the collection, transportation, storage, treatment and disposal of waste, including the supervision of such activities and taking care waste management facilities. Waste and waste management public has recognized as a problem, however, it is not perceived as their own problem, than a problem for which someone else is responsible-state, local government, industry, and so on. Disappointing data is that in Serbia practically the only way to manage waste is disposal at a local landfill, which with very few exceptions, does not meet even basic sanitary and technical conditions, and besides, some existing landfills are almost full.

The term recycling mean converting waste materials into new products which will re-use and which contributing to the reduction of environmental pollution, save energy and natural resources (water, land, flora and fauna). Recycling is the process of collecting waste that can be recycled (plastic, aluminum, glass, paper, metal, etc.), then separation of other types of waste and sorting into subgroups. This technology greatly reduces the amount of waste which going to landfill, and therefore its expansion, guarding the natural Resources and energy, and helps protect the environment.

Recycling urban centers are areas in which the separately collected waste is properly stored and prepared for transport and recycling. They are the basic infrastructure for the development of primary and secondary waste selection and provide a steady flow of raw materials for the recycling industry, which has been extensively developed.

Defining the problem

The research problem is based on the fact that "Recycling Center" PUC Požarevac, is not running at full power capacity, which is a consequence of an insufficient number of machines and equipment, as well as the work of many small, private recycling centers, which use waste landfill in Požarevac for recycling.

Subject of research

The subject of research concerns the analysis of work "Recycling Center" Public Utility Company Požarevac.

The aim of research

Improvement of work "Recycling Center" Public Utility Company Požarevac.

Research instruments

As a research instrument was used documentation of quantitative and qualitative mandatory records of waste "Recycling Center" Public Utility Company Požarevac.

WORK OF "RECYCLING CENTER"

Work of "Recycling Center" in Požarevac can be seen through the processing of PET, nylon and other PCB products, cardboard and paper. Also, in further work center plans there is possibility processing tires, lead and lead-acid battery (accumulator), plastic, metal and non-ferrous metals, spent catalysts, wooden packaging, and recycling of electrical and electronic equipment, polymers of ethylene and styrene and polypropylene.

The collection of raw materials "Recycling center" is done in two ways:

1. Systematic collection container chassis for the collection of raw materials;
2. Collecting on an ad-hoc basis of principle from the known sources of raw materials.

The "Recycling Center" currently features the following raw materials:

1. PET;
2. PCB and nylon products;
3. Aluminum packaging;
4. Cardboard, kraft paper and other waste paper;
5. White paper and archival raw materials.

Cooperation with "Recycling Center" is performed by three strategic partners:

1. FHB Belgrade Umka
2. Dani PET Merošina
3. AD-system Radinac

Collected raw materials are processed (baling), with pressure in the hydraulic press brake ORWAK 5070 HDC with compression force of 100 kN (10t), or by force of 2.9 kg/cm^2, and ORWAK 5040 STD with compression force of 60 kN (6t). Baled materials are delivered to the agreed quantities of 100-150 bales per delivery. Systematic collection involves systematic placing vessels for collection of materials. PET packaging is collected with help of 123 special container chassis, 1 m^3 which are placed at 106 locations in Požarevac, and 17 locations in Kostolac. Monitoring PET containers, there was a need increase the number of them.

Cardboard and paper are collected with the help of three special plastic containers which are placed in the central zone of Požarevac, and a wired container sizes 3x2 m is located in Sinđelićeva street. The white papers are collected using 164 cardboard boxes. Cardboard and white paper are collected in cooperation with public and private companies, tour the city streets and by dint of calls from the public and other companies.

ANALYSIS OF WORK "RECYCLING CENTER"

In 2012. year, ie. for 12 months work of the "Recycling Center" processed and baled 3231 bale (113 819 kg) of which:

1. PET colorful bottles 1367 pieces - 26 530 kg
2. Baled nylon 149 bales - 4564 kg
3. Baled cardboard 1338 bales - 97 070 kg

During the 2012. year in the "Recycling Center" was came 20 new wire containers from Merušina, 480 boxes of white paper from Mladenovac and 60 new container of 1m^3.

The current state of container on 31.12.2012. in the "Recycling Center" was:

1. Container 1m^3 - 94 pieces
2. Container 5m^3 (open) - 12 pieces

3. PET container - 0
4. Trash cans from 120 liters - 81 piece
5. Concrete trash cans - 9 pieces

On the same day the stock of raw materials in the "Recycling Center" was:

1. PET - 323 bales (5895 kg)
2. Cardboard packaging - 20 bales (1167 kg)
3. Nylon - 6 bales (124 kg)

Table 1. The annual report of delivered PET of packaging, cardboard, and nylon in the period from 01.01.2012. - 31.12.2012.

Month	Delivered PET of packaging/kg	Delivered cardboard/kg	Delivered nylon/kg
January	0	9320	960
February	0	0	0
March	3760	31470	0
April	3660	5820	444
May	3480	9080	0
June	0	7430	0
July	4320	5630	0
August	0	5280	0
September	0	7140	0
October	3430	5790	0
November	0	6360	3160
December	2040	3750	0
In total	20690	97070	4564
Σ = 122 324 kg			

Table 2. The annual report baled PET packaging, cardboard packaging, and nylon in the period from 01.01.2012. - 31.12.2012.

Month	Baled PET packaging /kg	Baled cardboard/kg	Baled nylon/kg
January	2187	5685	240
February	1227	4300	159
March	2063	13410	320
April	2279	9040	289
May	2939	8775	289
June	2136	8810	392
July	2760	5435	307
August	2450	6620	394
September	2372	5510	228
October	2451	5330	360
November	1994	5380	312
December	1663	5287	417
In total	26530	83582	3707
Σ = 113 819 kg			

SUGGESTIONS FOR IMPROVEMENT OF WORK "RECYCLING CENTER"

Some of the conditions that should be fulfilled, and which apply to enhance of work in the recycling center are as follows:

- Purchase a minimum of 20 containers which were placed at the busiest locations in Požarevac;
- Purchase of newer and larger machines - trucks (recycling center uses trucks which are older than 36 years);
- During discussions with communal police (which responds to remarks about taking care of cardboard and nylon in the city), as well as with the owners of retail shops and citizens Požarevac, we found that the town of Požarevac needs minimum 10 wire containers of 3 x 1 m, for disposal cardboard and waste paper, which will be posted in the town center, the city's markets places and in the central city area. It should be noted that the supply of wire containers more economical than purchasing plastic containers for the disposal of paper and cardboard;
- Public companies , primary and secondary schools as well as private firms have needs to obtaining boxes for white paper and white computer paper;
- It is necessary to introduce a collecting of PET packaging into the district, which would introduce second shift and eventually opened the way for new jobs;
- Better cooperation with the city administration and public enterprises, because the advent of private companies which collected PET and carton packaging, reduced the amount of collected materials that are processed in a "Recycling center".

CONCLUSION

The number of people on the planet has reached 7 billion people. In proportion to the increase in the population on the Earth, increases the amount of waste which being creates every day in households and businesses. More and more landfills used to dispose of waste, which degrades the soil, reduce the area of arable land and becomes a potential source of infection for humans and animals.

Recycling significantly reduces the amount of waste which are going to landfill, thereby preventing its expansion. At the same time recycling reduces the emission of methane gas which is produced in landfills and reduce greenhouse effect and reduces harmful climate change on Earth. Recycling saves energy and raw material resources, and contributes to environmental protection.

In Požarevac people are still very interested for giving a cardboard and PET packaging. It is very important to work on further information to citizens and businesses through electronic media, newspapers and printed materials, and "Mail" letters.

Table 3. Total packagings delivered to strategic partners for 48 months of work "Recycling Center" Požarevac

Type of baled packaging	Bale	Tonnes (t)
Baled PET packing	4083	118,845
Baled cardboard packing	7083	358,740
Al baled packaging	24	0,333
Baled nylon	758	16,815
Baled white paper	58	3,020
Σ	**12006 bales**	**494,736 t**

It is important to note that with the amount of goods 494.736 t during 48 months of operation in the „Recycling Center", the city dump in Požarevac largely preserved by repletion from carton and PET packaging.

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SPATIAL PLANNING OF THE BOULEVARD OF EUROPE IN NOVI SAD AND ITS CONNETCTION TO THE SYSTEM OF GREEN

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ABSTRACT

There are various definitions of such wide boulevards:beautiful streets planted with trees of the promenade and walkways;greenery along the road planted trees,shrubs, grass, etc [1].The word Boulevard basically has multiple meanings.Given the basic feature boulevards,and that is its complexity, therefore it represents a specific,linear,effective green area,with a large weight in the sanitary-hygienic view [2].Novi Sad has more boulevards.Lately their number increases and the success of urban development that relies on physical surroundings.Boulevard of Europe is one of the newest.

Key words:boulevard,landscaping,urban ecology.

INTRODUCTION

Boulevard of Europe is a new,modern road,which is located on the territory of Vojvodina,in the municipality of Novi Sad.It extends the route of between the Rumenačka road to the intersection of Sombor Boulevard in Liman and it is the longest boulevard Novi Sad has more boulevards and this is one of the newest.On the east side of the boulevard,zone is located multifamily housing. Villages that surround it are Avijatičarsko settlement Detelinara and part of the Novo naselje and Liman.From the west,is also located housing and part of the undeveloped areas with high grass and shrubs as part of the space occupied by the old station overgrown with grass and weed .On the north side,boulevard exits on the Rumenačka road and southern borders Futoška street and still connects with Sombor boulevard.Boulevard also partly runs through the former railway line from Subotica.Construction of the Boulevard of Europe began in 2009,and the construction of the boulevard ran in several phases of the traffic was soon opened. Boulevard has three lanes in both directions, separate island, pedestrian and bicycle paths,which is the ability to use the boulevard in the form of various activities and provide space for each.

METHODS AND MATERIALS OF WORK

Attendance boulevards of Europe is quite big,and besides roads connecting different directions,its users use it as a promenade and a place for recreation (walking,running,cycling).Since the realese of the boulevard in ransport is facilitated by connecting many parts of the city.Not only in the transport system and the system of green, its importance is also reflected in the creation of another public space for users.However,his organization does not fully correspond all the needs of its users.There are many empty and unused spaces around the boulevard,which could be converted into useful space.Also,on the boulevard there are very little street furniture.Europe Boulevard area is landscaped seedling trees and shrubs,but they are still young.As a basis between tracks is set up lawn.On both sides of the boulevard there are hiking and biking trails and each of them separate alleys.The area covered by the analysis and regulation in this work is the part of boulevard from the limit of the boulevard of Vojvode Stepe to the intersection with the Futoška Street,respectively the space around the boulevard between the buildings.


Figure 1.i 2. Current state-disordered surface around the analyzed area of the boulevard


Figure 3.i 4. Railway and old marshalling station

Figure 5. View at the old marshalling station

Figure 6. Unordered area around the boulevard

As discussed,you can find a large number of empty space around the boulevard but with many users of people who live near and people who come there to spend their time.Over time,the boulevard will become even more important part of the transportation system with more visitors and higher concentration of traffic,why should his organization devote even more atencion.Because of his name"Boulevard of Europe",its construction can be for the purpose of eco-tourism or environmental design.

RESULTS OF WORK

At the beginning of the analysis it can be done zoning map and land use map that can be a basis for further planning.

In this example,the zoning map is done as follows primarily determined by the surface area for detailed planning,in this case the segment I and II.Within blocks provided the block green as in other parts of the area that would connect with the corridors and green line and determination of the main points within all zones.One should constitute the main parts of zones in segments I and II, and also the rest of the green areas are connected to each other.Main points in segments I and II are the sub-zone arrangement,while in other parts they are some smaller green areas in urban gardens-part single-family housing and "urban pockets" in the fairgrounds mini plaza with seating facilities and a little playground.For the segment I and II is planed to merge into one common unit-urban park,which will consist of various activities designed for all users, regardless of age.

For the segment I is scheduled to be intended for recreation,and could be called as one big area of sport and recreation.

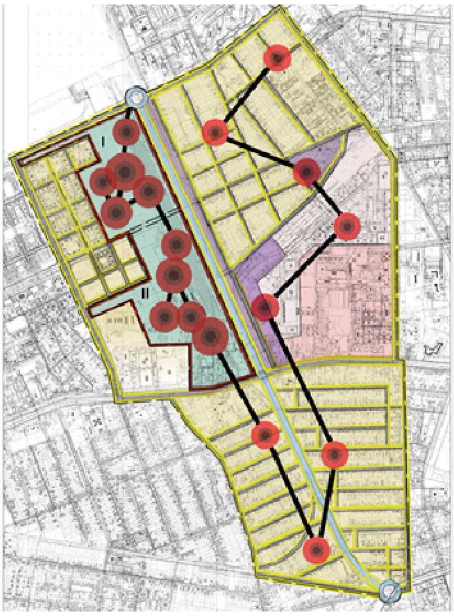

Figure 7. Zoning map development ideas for the area under study

Therefore,all content in segment I solely intended to sport.In this segmnet are planned the part of the outdoor swimming pool,a children space in the form of terraces with different installations and sports facilities-this zone is located around the existing nursery and close to residential buildings;portion of paintball zone,which is fenced off from other parts of the gym,outdoors, artificial hills which have a decorative function as a function of recreation that is climbing,sports area with plateaus that are mutually connected and within each there are sports facilities (courts, of table tennis).Additionally,a large part of the design include high ranges of the countryside which has the function of protection and decoration.

The segment II,which is as stated goes to the first segment,there are also various facilities.This segment represents the area of the park that is dedicated to culture,leisure and education.The part where the old marshalling station is planned museum and library (decorating station and turn it into a museum and library) with exhibits open in memory of former track and trains (rail and car parts) having a decorative and educational purposes (one of the locations on the night of the museum).It also provides seating and rest.In this segment are also part of the children's play-installation of the adult form of the pavilion,which would maintain a variety of workshops,part of the amphitheater for concerts and performances with round canopies to sit in front of,and part of the botanical garden in which to cultivated plant varieties and to serve the educational purpose.In this segment,too much of the design are ranges of green.

Figure 8. Map of the study area planned state-Segment I

Figure 9. Map of the study area planned state-Segment II

So,when planning primarily take account of the needs of all users and use of space in this way.Also and introducing a lot of greenery as the area of the boulevard in a negative environment in terms of climate conditions.Here are some 3d pictures of the regulation.

Figure 10. Artificial hills

Figure 11. Outdoor pools

Figure 12. Children's playground

Figure 13. Installation for children

Figure 14. Plateau seating

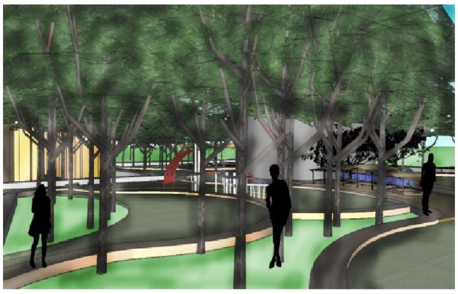

Figure 15. Range of green

Figure 16. Museum and library

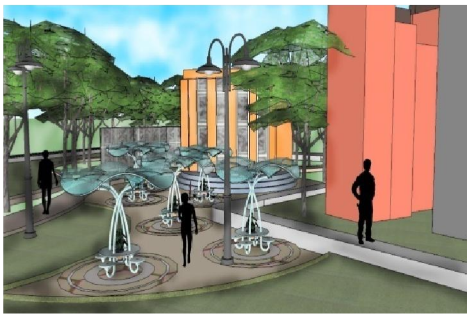

Figure 17. Amphitheater with seating facilities

CONCLUSION

This analysis served as an example of a green face self which is an integral part of the greenery of a city.The conclusion is that the boulevards are part of a comprehensive transportation system that is an important factor of social events.Inseparable companion of the development of modern society is today the most common form of mass and individual transportation due to the advantages it has in relation to other modes of transport [3].In addition boulevards also have great importance,which is reflected in the fact that plants are used for landscaping his protection from the negative impacts of traffic boulevard and the environment [4].Part of the Boulevard of Europe,which is included in the analysis is taken for an example of a boulevard,primarily because it is built in recent years,which joined existing boulevards in Novi Sad.It can serve as an example of a modern road,which meets the needs of the population,which properly designed and greened. residents who live close to the local populations as well as the arrangement may provide a useful and effective green space that is consistent with the principles of urban ecology.

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PHYSICO-CHEMICAL AND BIOLOGICAL CHARACTERISTICS OF WATERS FROM RIVERS CEROVO REKA AND VALJA MARE AS A RESULT OF ACTIVITIES IN COPPER MINE CEROVO

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ABSTRACT

Ore exploitation in Copper Mine Cerovo significantly has affected the environment, caused large area degradation and changes in surface water quality. River basin under the influence of mining activities in Cerovo consists of two rivers, namely Cerovo Reka and Valja Mare which flows into the river Kriveljka Reka. Analysis of physico-chemical and biological characteristics of waters from rivers Cerovo Reka and Valja Mare was performed on samples taken in September, 2009 and March, 2010. Water samples from eight sampling locations were analyzed on heavy metal content (Cu, Zn, Ni, Fe, As), pH, COD (Chemical Oxygen Demand), BOD (Biological Oxygen Demand) and content of coliform bacteria.Based on the results, increased level of copper, zinc, nickel and iron was recorded in most of the analyzed water samples. Analysis of microbiological parameters of water samples from rivers Cerovo Reka and Valja Mare (total number of coliform bacteria) does not indicate on increased pollution in catchment area of these rivers.

Key words: water quality, mining, heavy metals, coliform bacteria, environmental protection.

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