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Original scientific paper

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ANALYSIS OF WASTE MANAGEMENT IN THE REPUBLIKA SRPSKA AND SERBIA WITH REFERENCE TO SOME EUROPEAN COUNTRIES

Summary: *Waste management is an important component of sustainable development of a country. Formation of waste causes changes in the environment, has a degrading effect on wildlife and ecosystems as a whole. The correct management of waste is therefore important in order to reduce the harmful impact on the environment. This paper analyzes the process of development of waste management in the Republika Srpska, but also presents a comparison of municipal waste management in Republika Srpska and Serbia and some EU countries (Greece, Germany, Great Britain). The established average specific amount of municipal waste generated in the Republika Srpska is around 279kg of municipal waste per capita per year. In Serbia, this quantity is 359kg per capita annually. While in Greece, this amount is around 457kg, 587kg Germany and Britain 526kg per capita annually. The conclusion is that Republika Srpska per capita generates the smallest amount of waste in relation to the analyzed countries. Problem in Republika Srpska is the fact that there is still lack of harmonized legislation with EU regulations.*

Key words: *waste management, municipal waste, environment*

JEL Classification: *Q 53, Q 56,*

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INTRODUCTION

Urbanization is one of the global changes at the global level. Population growth in urban areas is directly related to the increase in the quantity of waste that, despite the impact on the environment, has the other numerous negative impacts on people. Environmental degradation, as well as the concept of sustainable development, has presented waste management as the top goal of a society. Waste is any substance or object that is discarded or intended to discard. Basic classification of waste is to:

- municipal waste (household waste);
- commercial waste
- industrial waste.

Waste management is an important item of the concept of sustainable development, in which many aspects are being considered: environmental, economic, legal, political, technical and social (Chang et al. 2011, 1551). Each activity of the anthropogenic factor will result in formation of waste that causes changes in the environment, endangering wildlife and ecosystems as a whole. Therefore, it is important to properly manage waste, which would ultimately result in reduction of the harm continuously being done to environment and in conservation of the natural resources. Waste management is one of the many aspects of sustainable development of a country (Nikolić 2016).

Waste management is an activity of general interest, which includes the implementation of a series of prescribed measures for waste treatment. These include the collection, transport, storage and disposal of waste, including waste management. Waste management should be performed with minimal risk to human health and the environment. Constant monitoring is considered to be very important of the following items:

- Pollution of water, air and soil,
- Danger to flora and fauna,
- Danger of explosion or fire,
- Negative impacts on regions and natural resources of special value and
- The level of noise and odors (Law on Waste Management of Republika Srpska, 2013).

In Republika Srpska waste management is still the final stage of planning. For this purpose, following documents are about to be enacted: Waste management strategy, plans for specific waste streams, common waste management plan, local waste management plan and waste management plan in the plant for which the environmental permit needs to be issued. The aim of this paper is to analyze the process of development and degree of implementation of waste management in Republika Srpska and comparison of the amount of municipal waste between the Republika Srpska, Serbia and some European countries.

1. MATERIAL AND METHODS

In the course of the study inductive-deductive method, analysis and synthesis methods, with the application of relevant procedures of knowledge based on the international experience, as well as the comparative method were used. Analysis of the development of waste management in Republika Srpska was carried out through examination of the issued legal documents, as well as those that are still in the process of preparation. In accordance with the Law on Waste Management, the line ministry conducts activities on the development of the waste management strategy in the Republika Srpska, which is at this point still in the draft.

The aim is to analyze the process of development of waste management in Republika Srpska. This includes establishing baseline data on waste and assessing the situation, setting future goals, developing the plans for integrated waste management and their implementation, and all that in accordance with the principles of reducing the negative environmental impact. The tasks of this research are also the comparative analysis of the management of municipal waste in the Republika Srpska in comparison with Serbia and some EU countries (Greece, Germany, and Great Britain).

2. RESULTS WITH DISCUSSION

The waste, according to the waste catalog, is classified into twenty groups. The categorization was made on the basis of the place of origin and the source. This brochure forms part of the Rules on categories, testing and classification of waste from the Waste Catalogue from the year 2010. This

catalogue is fully compliant with the Waste Catalogue of the European Union that created a clear system for the classification of waste within the European Union. The catalogue is the basis for all the obligations related to waste management permit, for a national database on waste and for the waste transportation. Waste Catalogue with an indexed number is given in Table 1.

Table 1. Waste Catalogue (Regulations on categories, testing and classification of waste “Official Gazette of RS”, No.56 / 2010, article 14)

Index number	Place and origin of waste
01	Wastes resulting from exploration, mining, quarrying, and physical and chemical treatment of minerals
02	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
03	Wastes from wood processing and the production of paper, cardboard, pulp, panels and furniture
04	Wastes from the leather, fur and textile industries
05	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
06	Wastes from inorganic chemical processes
07	Wastes from organic chemical processes
08	Wastes from the manufacture, formulation, supply and use of coatings (paints, varnishes and vitreous enamels), glues, sealants and printing inks
09	Wastes from the photographic industry
10	Wastes from thermal processes
11	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydrometallurgy
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13	Oil wastes and wastes of liquid fuels (except edible oils, and those in groups 05, 12 and 19)
14	Wastes from organic solvents, coolants and propellant gases (except 07 and 08)

15	Packaging wastes; absorbents, wiping cloths, filter materials and protective fabrics
16	Wastes not specified in the list
17	Construction waste and demolition wastes (including excavated soil from contaminated sites)
18	Wastes from facilities that provide health care for humans and animals and / or where related research is conducted (except from the waste from the kitchen and restaurant wastes not arising from immediate health care)
19	Wastes from waste treatment facilities, facilities for treatment of water off formation site and reparation of water for human consumption and industrial use
20	Municipal wastes (household waste and similar commercial and industrial wastes) including separately collected fractions

All aspects of solid waste management should be analyzed and viewed as a whole, because all the parts are connected with each other and the development of a segment directly or indirectly influences the practices and activities of other segments (Pires et al. 2011, 1037).

2.1. EU legislation on waste management

Framework of the European waste management policy consists of a number of Directives. Here are just a few:

- Directive 2008/98 / EC of the European Parliament and of the Council on waste and repealing of the certain directives in 2008;
- Directive 2010/75 / EC of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) from 2010.
- Council Directive 1999/31 / EC of the deposit of waste from 1999.
- Directive 2009/31 / EC of the European Parliament and of the Council on the geological storage of carbon dioxide and on amendments to Council Directive 85/337 / EEC,

- Directive of the European Parliament and Council Directive 2006/60 / EC, 2001/80 / EC, 2004/35 / EC, 2006/12 / EC, 2008/1 / EC and Regulation (EC e) No. 1013/2006 from 2009.

With that Directive, there are a number of the Regulation and the Decision of the Council of the European Union and the European Commission, which provide: a framework for waste management, way to handle the special categories of waste, shipments, imports and exports and facilities for treatment and disposal of waste (Draft Waste Management Strategy in Republika Srpska for the period 2016-2025, 2016.).

2.1.1. Analysis of Municipal waste in Republika Srpska

Based on the review of the data, the average specific amount of municipal waste generated in Republika Srpska is about 0,76kg municipal waste per capita per day (values range from 0.23 to 1.08 kg / capita / day, depending on the development of the municipality and the waste collection service coverage), or about 279kg of municipal waste per capita per year. In table you can the morphological composition of municipal waste in Republika Srpska.

Table 2. Review of morphological composition of municipal waste in Republika Srpska (Analysis of the morphological composition of waste and elemental analysis of the individual components of waste brought to the Ramići landfill)

Waste type	Share (%)
Organic waste	34,2
Wood	4,1
Textiles	1,3
Glass	4,9
Construction waste	5,7
Waste of animal origin	3,8
Electronic waste	0,2

Paper and cardboard	10,8
Metal	4,5
Cans	2,1
Plastic	7,8
Gum	0,9
Foil	9,4
PET	5,1
Other	5,3

According to the waste composition largest single share of municipal solid waste has an organic waste from kitchen and garden (one-third), about 56% of municipal waste have components that can be recycled, and about 10% have the other mixed components, and components which need special rework (animal, electronic waste, etc.).

If we look at this situation from the economic aspect, arranging waste management system, according to the Waste Management Strategy of Republika Srpska for the period 2016-2025., the estimated total amount of investment into the measures to achieve the objectives in this segment is approximately 191.9 million Euros. Approximately 80.5% of the funds are planned to be realized in the activities and work until the end of 2020. It requires, therefore, a great investment in the future, so that the system of waste management in Republika Srpska can reach a satisfactory level. We can conclude that the current situation is not at the level of European countries and that Republika Srpska, in this segment, is still developing. This is supported by the research results of the regional Ramići landfill (Kalamanda et al. 2015, 282). Their research shows that the Ramići landfill has a number of drawbacks, such as high living layers of waste, while at the same landfill does not have a perforated pipe for the evacuation of gases. This leads to degradation because the gases spread uncontrollably in the air, but also cause fires. One of the risks due to improper waste management system is the danger of explosion.

2.1.2. Analysis of municipal waste in Republika Srpska

In Serbia, one of the main problems in the field of environmental protection is inadequate waste management. Increasing amount of waste is being generated and without special pre-treatment is being disposed in landfills. This practice threatens the environment and human health, prevents exploitation of energy resources from waste. In table 3, an overview of the amount of municipal waste generated by municipalities in Serbia is provided.

Table 3. Overview of the amount of municipal waste generated in the municipalities of Serbia (Vujic et al. 2010)

Municipality	Amount of generated waste			
	Daily		Yearly	
	t	kg/capita	t	kg/capita
Indija	52	1,05	18 890	383
Sombor	38,5	0,67	13 966	246
Novi Kneževac	5,7	0,59	2063	214
Šabac	66	0,59	25 794	209
Topola	7,3	0,29	2761	105
Kragujevac	128	0,7	47 099	252
Bor	17,8	0,32	6507	114
Niš	176	0,73	63 937	266
Novi Sad	366	1,16	133 104	424
Beograd	1 484	1,08	548 513	394

Determination of morphological composition of municipal waste is an important part in the collection of relevant data that defines the segment of waste management system in a particular territory. Table 4 shows the morphological composition of municipal waste in 5 cities of the Republic of Serbia, expressed in percentage for 16 fractions of municipal waste (Vujic et al. 2010, 1026).

Table 4. Morphological composition of municipal waste in 5 cities of the Republic of Serbia (%) (Vujic et al., 2010.)

Waste category	Belgrade	Niš	Kragujevac	Topola	Novi Sad
Garden waste	6,68	10,00	11,29	16,16	13,37
Other biodegradable	30,93	30,56	27,34	36,32	30,17
Paper	10,78	7,90	8,07	4,72	5,25
Glass	6,84	4,74	5,04	2,95	5,07
Cardboard	8,97	6,12	11,13	4,25	6,13
Cardboard-wax	1,74	0,71	0,80	0,46	0,71
Cardboard-aluminium	1,20	0,62	1,24	0,54	0,65
Metal-packaging and other	1,98	1,38	1,09	1,00	1,64
Metal-aluminium cans	0,40	0,57	0,68	0,33	0,15
Plastic packaging	4,58	3,01	4,78	3,17	3,71
Plastic bags	5,61	9,18	8,45	6,24	6,40
Hard plastic	4,73	5,77	3,68	2,88	5,04
Textiles	5,31	5,67	3,68	4,45	7,49
Leather	0,61	0,36	0,41	0,50	1,04
Diapers	3,67	4,08	3,72	4,15	4,48
Fine elements	5,98	9,32	8,61	11,88	8,70

A review of a number of analysis it can be concluded that one of the major environmental problems in the Republic of Serbia is the inadequate waste management. A huge problem is the unregulated landfills on which the municipal waste is often disposed. Greater risk of the foregoing for the environment is illegal dumps. A significant problem is the creation of large quantities of hazardous industrial and medical waste. Hazardous waste is often inadequately stored, sometimes without specific controls and, as such disposed in municipal or wild landfills. Thus, the problems in this area are really numerous. By adopting the National Waste Management Strategy

2010-2019 (Official Gazette of the Republic of Serbia 29/2010) with a program of approaching the EU, a framework which provides conditions for the rational and sustainable waste management in the Republic of Serbia is clearly set. By The Law on Waste Management enactment (Official Gazette of the Republic of Serbia 36/2009 and 88/2010), the way of adequate waste management, from its formation through the collection, transport, storage, treatment, up to the final disposal (Jovanović 2015) is clearly prescribed.

2.1.3. Analysis of municipal waste in some European countries

Waste management in Germany, the UK and Greece is very different in comparison to Republika Srpska and Serbia. This is primarily related to: disposal and waste collection, legislation, economic level, habits of citizens and others. Some parallels can be made, however, when you take into account that developing countries have far less waste, but do not have sufficient funds to take care of that waste, while developed countries have other problems, and these other problems are primarily numerous obstacles to achieve the ideal waste management in order to reduce its quantity (Nikolić 2016). The total amount of waste in the aforementioned countries is in the range from 359 kg to 526 kg per capita per year (Table 5). The table below presents the data for the total waste generated and the mean annual quantity of waste generated per capita, where Serbia is compared with the following European countries (Eurostat 2012 a, b).

Table 5. The amount of generated municipal waste and waste in kg per capita in one year (2010) (Source: Eurostat 2012 a, b)

	The total amount of municipal waste (1000t)	Average annual quantity waste (kg / capita)
Serbia	2 650	359
Greece	67 523	457
Germany	367 256	587
Great Britain	316 991	526

Table 5 shows that Serbia annually generates significantly less amount of waste from countries with which it is compared. The amount of waste per

capita is lower for around 100 to 200kg in average, compared to Germany, the UK and Greece.

CONCLUSION

From a review of the relevant literature, policy documents and presented data on waste management in Republika Srpska and Serbia, it can be concluded that there are numerous shortcomings in the waste management system, which is characterized by:

- insufficient reliable data on the quantities and composition of waste at all landfills,
- underdeveloped system of collection and systematization of data and flow of all types of waste,
- the inability of the organization of separate collection of recyclable waste from households,
- failure to implement a program of environmental monitoring concerning emissions from landfills, to the necessary extent,
- the lack of facilities for processing and utilization of waste,
- disposal of hazardous waste along with the municipal waste,
- The phenomenon of unregulated and illegal landfills.

Average specific amount of municipal waste generated in the Republic of Serbian is around 279kg of municipal waste per capita per year. In Serbia, that is 359kg per capita annually. While in some European countries, this amount is as follows: Greece 457kg, 587kg, Germany and the United Kingdom 526kg per capita annually. We can conclude that Republika Srpska generates the smallest amount of waste per capita when compared to the analyzed countries. The main problem related to this issue in Republika Srpska represents the fact that there is still lack of coordinated legislation with EU regulations. At this point Republika Srpska is in the stage of final enactment of the long-term Waste management strategy. Serbia has already enacted this and many other documents and coordinate them with the regulations of the European countries.

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