ANALYSIS OF THE STATE OF CONSTRUCTION WASTE MANAGEMENT IN REPUBLIC OF SERBIA

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Abstract

Construction waste includes waste generated during construction, reconstruction, maintenance or demolition of existing buildings, as well as waste generated from excavated material, which cannot be used without prior treatment. It is estimated that about 1 million tones of construction and demolition waste is produced in the Republic of Serbia annually. Construction waste in Serbia ends up at municipal waste landfills and utilize as an inert material for covering of waste at the landfills. This kind of approach has a negative impact on the environment and human health. Therefore, the purpose of this paper is to present analysis of the state of construction waste management in the Republic of Serbia. The research results show that there is no consolidated data of the specific composition of construction waste that is being disposed of at landfills at any level. Additionally, it's necessary to establish control of construction and demolition waste quantity, composition and stream, which would meet requirements for designing a system of collection, transport, recycling, reuse and disposal of the waste.

Key words

by-product; construction waste; landfills; recycling; waste management

To cite this paper: *Stanojlovic, D., Spasojevic-Santic, T., Trivunic, M. (2016). Analysis of the state of construction waste management in Republic of Serbia , In conference proceedings of People, Buildings and Environment 2016, an international scientific conference, vol. 4, Luhačovice, Czech Republic, pp. 221-229, ISSN: 1805-6784.*

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1 INTRODUCTION

In the context of environmental protection, waste management involves waste generation, accumulation, storage, transportation, treatment, recycling, use and disposal of secondary raw materials, harmful and hazardous substances. Construction waste belongs to industrial waste type, and depending on how it affects human health and the environment, it can be inert, hazardous or non-hazardous. According to the different stages of construction it is generated in, construction waste can be classified as construction, renovation or demolition waste [1,2].

Construction waste includes waste generated during the construction of buildings, reconstruction, maintenance or demolition of existing buildings, as well as waste generated from excavated material, which cannot be used without prior treatment. On average, construction waste contains: excavated soil 75%, waste from construction and demolition (waste ceramics, concrete, iron, steel, plastic, etc.) 15-25%, as well as waste asphalt and concrete 5-10%. According to the Waste Catalogue, construction waste is classified under the group with waste index number 17 00 00 [1, 2].

The composition and quantity of construction waste generated on sites depend on the construction methods and materials used during construction activities [3]. Many methods of measuring the generation of construction waste have been mentioned in the literature. The methods applied to measure the generation of construction waste with the aim of predicting the quantity of generated waste show significant discrepancies due to the large number of variables affecting the construction process and to the different contexts in which assessment methods are applied [4, 5].

Within the European Union (EU) regulatory framework and planning documents, waste reduction has been actively promoted, which would reduce the waste problem at the source. However, there are significant differences in the application of this principle in EU member states. Waste recycling rates range from 10 to 65%, and waste disposal to landfill rates from 10% to 90% [1].

Construction waste that is generated during the various stages of a construction process life cycle should be, in the first place, measured and classified in order to utilize these data in terms of disposal, recycling and reuse planning, as well as for planning of future projects. During construction works and all other stages of realization of a construction, waste is generated gradually over a long period of time, thereby directly hinders its measurement and classification [4].

2 METHODOLOGY

The research is based on a review of the relevant European directives, laws and bylaws that define the legal framework in the field of waste management in the Republic of Serbia.

Documentary research method has been used for analyzing the structure and the state of construction waste management in the Republic of Serbia. The data presented in the study are based on the official reports of state institutions (The Serbian Environmental Protection Agency and The Statistical Office of the Republic of Serbia).

The basic findings about the current state of construction waste management in the Republic of Serbia are presented through analysis and synthesis of the obtained data.

3 RESULTS AND DISCUSSION

3.1 The Legal Framework for Waste Management in the Republic of Serbia

The Waste Management Strategy of the Republic of Serbia is the core document that defines and directs the long-term waste management strategy. It is based on the analysis of the existing situation and the objectives of waste management and determines the measures to improve waste management (preparation for reuse, recycling, reuse, disposal and other methods of waste treatment) in the Republic of Serbia.

The legal framework for waste management was established through the adoption of laws in the field of environmental protection in 2004, including new laws governing waste management, and packaging and packaging waste in 2009. These laws provide the conditions for the establishment and development of an integrated waste management system [6].

The Serbian Environmental Protection Agency maintains and updates the database on waste management in the information system of environmental protection in accordance with the law governing the environmental protection. In the context of specific waste streams, the Agency collects data from entities engaged in the collection, storage and treatment of all waste categories from this group in accordance with the law [2,6].

Professional organizations for waste testing perform tests for the classification of waste for transboundary movements, treatment and disposal of waste, according to the scope of tests for which they are accredited, and issue reports on waste testing. Other participants in the waste management are manufacturers or importers of products that become waste after use, waste owners or waste generators, waste transporters, as well as operators of waste collection and waste treatment facilities, and landfill operators [6].

3.2 Review and Analysis of the Current State of Waste Management

There is no systematically organized separate collection, sorting and recycling of waste in the Republic of Serbia. The current level of recycling and utilization of waste is insufficient. Although the primary recycling is prescribed by law and provides for the separation of paper, glass and metal in specially marked containers, recycling is not applied in practice.

3.3 Data on Hazardous Waste Quantities

In Republic of Serbia, there are no reliable data on the amount of hazardous waste generated by industry sectors.

Data for the Integrated Cadastre of Polluters (Register of Pollution Sources), conducted by the Serbian Environmental Protection Agency, were submitted by over 600 companies. The establishing of an information system that will enable the efficient collection and analysis of data collected by different parameters and by data availability to the public is underway. Although there is a legal obligation of submitting data on waste, there is still no response from all polluters [1].

There is no location for the disposal of hazardous waste in the Republic of Serbia. Overall, there are no authorized facilities or operators who have a license for the thermal and physico-chemical treatment of hazardous waste from the competent authority. Lately, procedures of solidification and bioremediation of hazardous waste have been used.

There is no permanent hazardous waste storage facility in the territory of the Republic of Serbia. In such circumstances, hazardous waste generators store hazardous waste in temporary storage facilities at their own locations, and some of that waste has been staying there for more than 20 years. Transport of waste is subject to the permit-to-work system, in accordance with the Law on Ratification of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the Law on Environmental Protection and the Law on Waste Management [2, 6, 7].

3.4 Data on Non-hazardous Waste Quantities

Data on quantities of non-hazardous waste are also insufficiently precise. In 2007, the quantity of waste produced by commercial entities that are subject to fees for manufactured and disposed non-hazardous industrial waste amounted to 598 160 t of non-hazardous industrial waste. On the basis of other data, it is estimated that the real amount is up to 700,000 t / year [1].

3.5 Data on Construction Waste Quantities

The main prerequisite for the analysis of waste management is adequate collection of data. In accordance with law and regulations - Regulations on Methodology for the Preparation of National and Local Register of Pollution Sources and Methodology for the Types, Methods and Terms of Data Collection ("Official Gazette of RS", No. 91/10 and 10/13), the companies that generate waste during their manufacturing activities, as well as the companies that take over the waste for treatment, disposal or exportation, have to submit reports on type and quantity of waste to the Serbian Environmental Protection Agency [8].

Table 1 shows the recorded quantities of construction waste and demolition waste based on the official reports of the Serbian Environmental Protection Agency.

Table 1: Recorded quantities of construction waste and demolition waste

Year	The amount of non-hazardous waste (t)	The amount of hazardous waste (t)	Total (t)	Waste generators	Source
2009.	2,505.511	143.28	2,648.79	Companies that report in accordance with the E PRTR Protocol*	[9]
	1,610.67	1.50	1,612.17	Other companies	
2010.	24,077.77	114.25	24,192.02	Companies that report in accordance with the E PRTR Protocol	[10]
	6,565.60	740.30	7,305.9	Other companies	
2011.	170,363.83	133.38	170,497.21	Companies that report in accordance with the E PRTR Protocol	[11]
	100,019.56	82.20	100,101.76	Other companies	
2012.	21,755.84	141.96	21,897.80	Companies that report in accordance with the E PRTR Protocol	[12]
	1,091,571.24	811.25	1,092,382.49	Other companies	
2013.	62,410.25	11,623.84	74,034.09	Companies that report in accordance with the E PRTR Protocol	[13]
2014.	207,993.00	2,299.00	210,292.00	Companies that report in accordance with the E PRTR Protocol	[14]

**PRTR Protocol -The Protocol on Pollutant Release and Transfer Register of the Aarhus Convention.*

3.6. Existing Infrastructure for Hazardous Waste Management

The lack of infrastructure for the treatment and disposal of hazardous waste presents a particular problem. In the territory of the Republic of Serbia, there are no facilities for treatment of hazardous industrial waste, nor a location set-up for hazardous waste disposal, nor central storage facilities. Hazardous waste is stored in inadequate storage facilities, some of which are decades old, or in factory dumpsites. Analyses indicate that 62% of hazardous waste temporary storage facilities do not meet the prescribed requirements, and that only 5% of hazardous waste is temporarily stored in a prescribed manner [1].

Spatial plans in the Republic of Serbia do not specify locations for the construction of hazardous waste management facilities, and so far there are no approved locations for hazardous waste landfill in the Republic of Serbia. Lack of infrastructure for waste treatment in the Republic of Serbia has left export to authorized and registered treatment plants in the EU (incinerators, facilities for physico-chemical treatment, etc.) as the only option for the final disposal of waste.

3.7. Recording of Specific Waste Streams

In Serbia, companies and entrepreneurs who produce or import products which become special wastes after use are obliged to keep daily records and submit an annual report on quantity and type of produced and imported products becoming separate waste streams after use. The annual report on specific waste streams is submitted to the Serbian Environmental Protection Agency. These companies and entrepreneurs fall into taxpayers category paying fees for specific waste streams [15].

Construction and demolition waste may contain hazardous materials in the form of various insulation materials and plastic door and window frames. One of these hazardous materials is asbestos. In the Republic of Serbia, the problem of disposal of the asbestos-containing waste has not been solved.

One of the long-term goals of waste management for the period 2015-2019 defined in the Waste Management Strategy is to establish a system for managing construction waste and asbestos-containing waste. Regulations on the Treatment of Asbestos-containing Waste ("Official Gazette of RS", No.75/2010) set the criteria for the management of asbestos-containing waste and other measures to prevent dispersion of asbestos fibers and dust into the environment [16,17].

Table 2 shows data on the amounts of asbestos in the specific waste streams. According to the Serbian Environmental Protection Agency, there were no exports, imports nor treatments of asbestos waste (surface hardening process, solidification or destruction of asbestos fibers) in 2014. The quantity of products containing asbestos which were placed on the market in the same year amounted to 0.01t. [17].

Table. 2: Data on quantities of asbestos in the specific waste streams [17]

Year	Waste Generated (t)	Waste Disposed (t)	Waste Treated (t)	Waste Exported (t)	Waste Imported (t)
2011	141.00	/	310.00	/	/
2012	240.24	306.00	17.00	/	/
2013	191.83	279.00	30.47	/	/
2014	1,542.20	1.647.07	/	/	/

3.8. Statistical Classification of Waste

Statistical Classification of waste (EWC-Stat) was created for easy publishing of data on waste collected according to the European List of Waste (LoW), which gives the legal basis for the European control and monitoring of waste.

In the Republic of Serbia, the Statistical Office of the Republic of Serbia was the first to conduct a study on waste in mining sector, processing industry and electricity, gas and steam supply sector, which referred to 2008 and was done in cooperation with Swedish statistics experts within the project "Partnership in Statistics", which was funded by the Swedish International Development Cooperation Agency - SIDA [18].

The study is conducted on the basis of the Law on Official Statistics ("Official Gazette", No. 104/09) and the Official Statistics Programme in the period 2011-2015. ("Official Gazette", No. 23/11), and in compliance with the Waste Statistics Regulation (EC) No 2150 / 2002, which had several implementations, and was revised in 2010 [19, 20].

The results of statistical surveys on waste carried out by Statistical Office of the Republic of Serbia in 2010-2013 show that the amount of waste generated is on the increase. Table 3 shows the share of individual economic activities in the total amount of waste generated per year. The largest increase in the quantity of waste generated compared to the previous year was recorded in 2011, and it was 45.8%.

Although in 2012 and 2013 the scope of the research was expanded, the largest increase in the quantity of waste generated compared to the previous year still was in 2011. It is important to emphasize that the first data on the quantities of waste generated in the Construction sector were recorded in 2012 [21].

Table 3: The quantities of waste generated by sectors [21]

Sectors	**Year**			
	2010 (t)	**2011 (t)**	**2012 (t)**	**2013 (t)**
Mining	26,460,274.00	41,522, 482.00	47,896,363.00	50,807,563.00
Processing Industry	1,135,357.00	1,126,609.00	759,832.00	821,286.00
Electricity, Gas and Steam Supply	6,020,287.00	6,355,668.00	5,744,350.00	6,199,079.00
Watter Supply and Wastewater Management	-	-	-	33,106.00
Construction	-	-	**363,706.00**	**328,235.00**
Service Industry	-	-	238,336.00	199,132.00
Total	33,615,918.00	49,004,760.00	55,002, 585.00	58,388,403.00

3.9. Construction Sector Waste in the Republic of Serbia in the 2012-2013

According to data of the Statistical Business Register, Construction sector is one of the sectors with the highest number of registered business entities. The structure of the reporting units for the year 2012 shows that 70% of the total number of businesses are those with unknown number of employees and with number of employees from 1 to 9. A large number of businesses in the construction sector, especially in the field of KD 43 - Specialized construction works, perform their activity with a small number of craft labourers on site [21].

Table 4 shows the structure of the waste generated in the construction industry by type of waste. Mineral waste from construction and demolition was the dominant type of hazardous

waste in 2012 (with 93.5%), while soil was dominant type of non-hazardous waste in this sector (with 63.8%).

Table 4: Structure of waste generated by type of waste EWC-Sat (%) [21]

EWC-Stat-Hazardous Waste	**Construction Industry (2012)**
Mineral waste from construction and demolition	93.5
Used oil	3.9
Other Waste	2.6
EWC-Stat- Hazardous Waste	**Construction Industry (2013)**
Discarded Vehicles	46.3
Used oil	35.4
Other Waste	18.3
EWC-Stat- Non-hazardous Waste	**Construction Industry (2012)**
Soil	63.8
Mineral waste from construction and demolition	23.0
Metallic Waste, Iron	6.1
Household Waste and Similar Waste	5.4
Other Waste	1.7
EWC-Stat-Non-hazardous Waste	**Construction Industry (2013)**
Soil	74.8
Mineral waste from construction and demolition	20.2
Metallic Waste, Iron	3.4
Other Waste	1.6

Discarded vehicles (with 46.3%) and used oil with (35.4%) were the most dominant types of hazardous waste in 2013, while the soil (with 74%) was the dominant type of non-hazardous waste in this sector, same as in 2012 [21].

4 CONCLUSION

The Waste Management Strategy of the Republic of Serbia clearly underlines the need for preventing uncontrolled disposal of construction and demolition waste that can cause water, air and soil pollution, directly affecting human health. The legal framework for adequate waste management have been created, but its implementation by the competent institutions is still sporadic and insufficient financing hinders the realization of the set goals.

Since there is no consolidated data on the specific composition of construction waste disposed of at landfills, it can be concluded that the first and essential step in the construction waste management is to design efficient and accurate methods of quantifying and sorting of construction and demolition waste. Without knowledge of the exact quantities and types of waste generated, it is difficult to plan its management.

Additionally, at the beginning of 2016, the Law on Amendments and Additions to the Waste Management Law was adopted, which should provide financial control of waste management trends, as well as engagement and categorization of those involved in waste management. Also, the new law defines the types of waste that cease to be considered waste and specifies the conditions on handling the waste materials and by-products.

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ACKNOWLEDGEMENTS

The work presented in this paper constitutes a part of the research project TR 36017 "Utilization of By-products And Recycled Waste Materials in Concrete Composites in the Scope of Sustainable Construction Development in Serbia: Research And Environmental Assessment of Possible Applications", supported by the Ministry of Science and Technology of Republic of Serbia. The authors gratefully acknowledge support of the Ministry.