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## PERCEPTION OF WASTE MANAGEMENT BY CONSTRUCTION COMPANIES

### POSTRZEGANIE GOSPODARKI ODPADAMI PRZEZ FIRMY BUDOWLANE

#### Abstract

The responsible waste management is an integral part of a sustainable construction process which is based on managing of waste stream on site, waste minimization, waste registry, waste disposal (reusing, recycling, landfilling, ...) on construction site, but also the policies and regulations in this field. Currently, many opportunities have arisen for the beneficial reduction and recovery of construction material that would otherwise be destined for the disposal as construction waste. The scope of use of these opportunities is related to the perception of waste management by construction companies, especially by contractors. The submitted paper presents the importance of on site waste management in terms of construction of buildings. The research was carried out through a questionnaire survey in Slovakia. It was focused on finding construction companies' approach to the issues of waste management on building sites and problems in the field of construction waste registry. The first part of the paper is focused on attitudes to waste disposal depending on company size (using chi-squared test) and the second part is focused on attitudes to meeting waste legislation.

*Keywords:* waste management, waste disposal, construction industry, construction company, constructor, questionnaire

#### Streszczenie

Odpowiedzialna gospodarka odpadami jest integralną częścią zrównoważonego procesu budowlanego, który opiera się na zarządzaniu strumieniem odpadów na miejscu, minimalizacją, rejestrem, utylizacją odpadów (ponowne wykorzystanie, recykling, składowanie...) na budowie, ale także polityki i przepisów w tej dziedzinie. Obecnie pojawiło się wiele możliwości korzystnych dla redukcji i odzysku materiałów budowlanych, które w przeciwnym razie byłyby przeznaczone do usunięcia jako odpady budowlane. Zakres wykorzystania tych możliwości jest związany z postrzeganiem gospodarki odpadami przez firmy budowlane, zwłaszcza przez wykonawców. Przedstawiono znaczenie gospodarki odpadami na miejscu w zakresie budowy budynków. Badania przeprowadzono za pomocą badań ankietowych na Słowacji. Koncentrują się na poszukiwaniu firm budowlanych zajmujących się kwestią gospodarowania odpadami na budowach i problemami w dziedzinie rejestru odpadów budowlanych. Pierwsza część artykułu koncentruje się na postawach unieszkodliwiania odpadów w zależności od wielkości firmy (za pomocą testu chi-kwadrat), a druga na podejściu do spełniania przepisów

*Słowa kluczowe:* gospodarka odpadami, utylizacja odpadów, budownictwo, firma budowlana, konstruktor, kwestionariusz

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## 1. Introduction

The construction industry affects our society not only at local but also at national and global level. The construction industry is considered one of the largest producers of solid wastes globally. The huge amount of construction and demolition wastes (CDW) has been generated from increasing the building of new structures, renovation, rebuilding, repair, demolition works and infrastructure development projects. Large quantities of construction and demolition waste harmfully affects the environment if it is not managed in a proper manner. As such, huge amounts of waste needs to be properly managed [1, 2].

The assessment of the local impact of the construction industry is based on the assessment of sustainability for particular building. The assessment of building sustainability is performed through the assessment systems (e.g. BREEAM, LEED, SBToolCZ, DGNB etc.). There economic, social and environmental criteria are assessed. The weight of importance for environmental criteria is usually more than 20% (e.g. assessment system DGNB – 22,5%) [3, 4]. The environmental criteria is divided into three groups – energy and emission, water and waste. The criterion “waste” is aimed on the assessment of the solid waste, hazardous waste to disposal and waste management which is presented in a part of the project documentation [5].

On the other hand, waste management of construction and demolition waste is also important to solve at national and global level. According to Eurostat, the construction and demolition waste, which is produced by the construction process, presents 33% of the total waste stream in the European Union (EU) [6]. CDW has been identified as a priority waste stream of the EU. However, CDW can be easily recycled through the existing technological methods and processes.

The issue of construction and demolition waste management needs to be solved not only at national but also local level. However, the initial step of waste management solution is the attitude of waste producer to this issue. The producers of construction and demolition are the constructors, usually construction companies.

## 2. Waste management in construction

Waste management is defined by legislative framework. The Directive 2008/98/EC on waste [7] (Waste Framework Directive) sets basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products. The Directive lays down some basic waste management principles.

Different definitions are applied throughout the EU. In Slovakia, the construction and demolition waste is defined by Act 223/2011 Coll. of Waste act as a waste from activities such as construction of buildings and civil infrastructure, total or partial demolition of buildings and civil infrastructure, road planning and maintenance. The construction and demolition waste consists of numerous materials, including concrete, bricks, gypsum, wood, glass, metals, plastic, solvents, asbestos and excavated soil, many of which can be recycled.

Waste legislation and policy of the EU member states shall apply as a priority order the following waste management hierarchy within the waste management. The waste management hierarchy is divided into five levels – prevention, preparing for re-use, recycling, recovery and disposal. There is a high potential for recycling and re-use of CDW, since some of its components have high resource value. In particular, there is a re-use market for aggregates derived from CDW waste in roads, drainage and other construction projects. Technology for separation and recovery of construction and demolition waste is well established, easily accessible and, in general, inexpensive.

One of the objectives of the Waste Framework Directive is to provide a framework for high level of resource efficiency. In particular, member states shall take the necessary measures designed to achieve that by 2020 a minimum of 70% (by weight) of non-hazardous construction and demolition waste shall be prepared for re-use, recycled or undergo other material recovery.

According to the Enviroportal [8], the current situation in the waste management on national level in Slovakia is worse. In the analysed period (years 2005–2013), the amount of waste generated by the construction sector in Slovakia amounted to average 2.776 million tonnes, what presents 26.2% of the total amount of waste which is lower than the EU average (33%). The relatively lower waste level can be related to lower construction intensity than in other European countries. The lower waste level is not a signal of more effective construction waste management. This is also confirmed by the level of waste disposal. In the analysed period (years 2005–2013), the amount of construction waste disposal presents 57.8% and construction waste recovery 42.2%. Some European countries (the Netherlands, Denmark, and Belgium) have their reuse and recycling rates higher than 80%, but Malta, Romania and Bulgaria present these rates at lower than 10%.

In this context of target volume of waste recovery (70%) by 2020, it is important to deploy initiatives that contribute to an effective waste management scenario reaching high CDW recovery rates. It can be achieved only through active and appropriate attitude of each constructor, at particular construction site, to waste management.

### **3. Approaches of constructors to waste management**

The perception of construction waste management by constructors (construction companies) can be divided into two groups:

- attitudes to waste disposal,
- attitudes to meet waste legislation regulations.

Both aspects are interconnected. The positive approach to waste disposal (recovery preference) means positive approach to meet waste legislation regulations (legislative rates target).

The level of waste management perception by construction companies was found out by a questionnaire survey performed by Institute of Construction Technology and Management at the Faculty of Civil Engineering, Technical University in Kosice in 2014. The basic method of research is a questionnaire. Respondents (experts) were asked by personal questioning to answer questions relating to waste management perception in Slovak construction companies.

Thirty-seven respondents from small-sized, thirty-six respondents from medium-sized and twenty-nine respondents from large-sized companies were interviewed.

The aim of this paper is to present partial results from the above mentioned research. The first part is focused on attitudes to waste disposal depending on each company size and the second part is focused on attitudes to meet waste legislation regulations.

Respondents were asked three questions to find out attitudes to waste disposal:

- Q1: How is the construction waste disposal used at particular building site?
- Q2: To whom is the construction waste given?
- Q3: Is the recycling of construction waste significant in financial terms?

The respondents had a scale of possible answers and the share of answers (in percent) for all three questions depending on company size as shown in Figure 1.

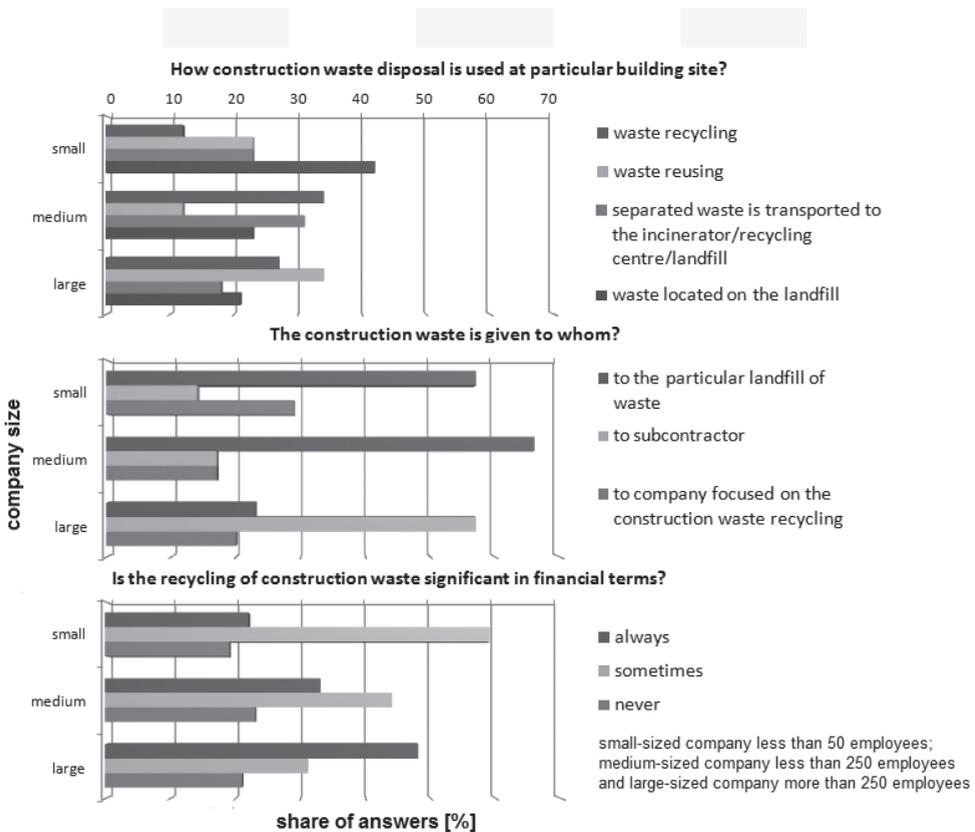


Fig. 1. Share of answers for questions Q1, Q2, Q3 depending on company size

Using chi-squared test (significance level  $\alpha = 0.05$ ) there influence of the company size to attitudes to waste disposal was investigated. A null hypothesis was: The attitude of constructor to waste disposal is independent on the company size. The share of answers (in percent) for all three questions depending on company size is shown in Table 1. Consequently chi-squared test was performed and the results are shown in Table 2.

Table 1

**Shares of answers for questions Q1, Q2, Q3 [%]**

Company size	Q1 [%]				Q2 [%]			Q3 [%]		
	Ans1	Ans2	Ans3	Ans4	Ans1	Ans2	Ans3	Ans1	Ans2	Ans3
Small	12	23	23	42	57	14	29	22	59	19
Medium	34	12	31	23	66	17	17	33	44	23
Large	27	34	18	21	23	57	20	48	31	21

Table 2

**Results of chi-squared test**

	p-value
Q1	< 0.0001
Q2	< 0.0001
Q3	0.00753

As we can see in Table 2, p-value of chi-squared test is significantly lower than significance level  $\alpha = 0.05$ , therefore we reject null hypothesis and accept alternative hypothesis: The attitude of constructor to waste disposal is dependent on the company size. The large-sized construction companies prefer waste reusing while small-sized companies locate the construction waste mainly on landfills. This approach is understandable, because large-sized companies declare the financial significance of recycling and reusing

The second part of a questionnaire survey was focused on the attitudes of companies to meet waste legislation regulations. One of the legislation requirements is keeping the waste registry. The producer, as well as the waste holder, is legally obligated to keep the construction and demolition waste registry. All information about the waste type, the amounts and disposal ways has to be reported to the authority of waste management. The initial step of the registry presents identification of the generated waste type according to European waste list in Notice of the Ministry of the Environment No. 283/2001. The next step is the quantification of waste producer during the construction works. This step can be considered as the most critical point of the whole waste registry process since there is no uniform and simple method for the registry of CDW volume. The final step is the determination of CDW disposal waste considering the waste characteristics, economic and transport possibilities of waste producers and the principles of waste management hierarchy.

We assumed that the declared volume of originated waste was not identical to the real waste volume. The respondents confirm this assumption (68%) and identified potential causes: common additional changes in the constructions projects, the inability to quantify waste in the preparation phase of the construction project, unforeseen waste especially during reconstruction work. The construction companies expressed their willingness to comply with the legal requirements, but due to the difficulties in quantifying waste that is not always possible. They emphasize the need of legislative support in the field of waste quantification.

#### 4. Conclusions

The proper approach to waste management by construction companies is essential for solving the construction waste issues at local, national and global level. The submitted paper presented the partial results of a questionnaire survey focused on attitudes to waste disposal and attitudes to meet waste legislation regulations by construction companies. The research confirmed that the attitude of constructor to waste disposal is dependent on the company size. The large-sized construction companies prefer waste reusing while small-sized companies prefer waste landfilling. At the same time, the construction companies see the need of legislative support in the field of waste quantification which identified as the most critical point of the whole waste registry process.

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#### References

- [1] Marzouk M., Azab S., *Environmental and economic impact assessment of construction and demolition waste disposal using system dynamics*, Resources, conservation and recycling, 82, 2014, 41–49.
- [2] Liyin S., Hong Y., Griffith A., *Improving environmental performance by means of empowerment of constructors*, Management of envir. quality, 17, 2006, 242–257.
- [3] Kozlovska M., Strukova Z., Tazikova A., *Integrated assessment of buildings quality in the context of sustainable development principles*, Quality innovation prosperity, 18, 2014, 110–115.
- [4] Sirochmanova L., Baskova R., *Criteria for assessing the apartment buildings*, Young Scientist, Kosice 2015, 1–8.
- [5] Juszczyk M., Kozik R., Leśniak A., Plebankiewicz E., Zima K., *Errors in the preparation of design documentation in public procurement in Poland*, Procedia Engineering Creative Construction Conference, Elsevier Ltd., 2014, 283–292.
- [6] European commission, <http://epp.eurostat.ec.europa.eu> [online: 26.08.2015].
- [7] Directive 2008/98/EC on waste.
- [8] Waste production and waste management in Slovakia, <http://cms.enviroportal.sk/odpady/verejne-informacie.php> [online: 26.08.2015].