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SECONDARY MATERIALS MANAGEMENT SYSTEM FOR THE ROAD INFRASTRUCTURE IN THE CZECH REPUBLIC

Dusan Stehlik[1], Petr Hyzl[1], Michal Varaus[1], Jan Valentin[2], Petr Mondschein[2]
1 Brno University of Technology, Faculty of Civil Engineering, Institute of Road Structures, Brno
2 Czech Technical University in Prague, Faculty of Civil Engineering, Department of Road Structures

Abstract

The article gives the information about the research project for the Ministry of Transportation "Secondary materials management system for the roads in Czech Republic". The results of this project should complete the knowledge and revise some of the today technological directives about these materials and further tries to simplify the access to the knowing on their use for the road constructions at the regional level.

Keywords: secondary material, waste material, recycled material to roads, pavement, waste management system,

1 Introduction

In 2007, with the help of the Ministry of Transportation of the Czech Republic, the project CG712-043-910 titled as "Secondary Materials Management System for the Road Infrastructure in the Czech Republic" was initiated. The main purpose of the project is to establish and maintain the information system for the management of secondary materials that are potentially appropriate for use in the development of road communications. Attention is especially paid to secondary materials available in huge amounts for the road constructions in all regions of the Czech Republic. The most significant secondary materials (in terms of the volume) are construction-demolition waste that is treated and converted to recycled demolition material – based on the latest researches this material represents about 85 % of the total production of secondary materials. Also there is waste from industrial production, such as ash from power plants, foundry sand, waste rock, slag, etc. The use of these materials for the road constructions may represent a significant relief to environment, both as a reduction of construction waste generation and the decrease of the volume of exploited primary mineral resources.

2 Current secondary materials management issues in the Czech Republic

Recently we face a boom of development projects especially aimed at almost uncontrolled deposition of building and demolition waste. We often see various landscape recultivation or reclaiming projects consuming thousands of tons of this waste. In this respect the waste producers often rank (due to a lack of qualification or intentionally) premium material suitable for production of recycled concrete, mixed walling or used mortar material to the category referred to as "excavated soil" – this is a consequence of rather benevolent approach and

indolence by some state authorities. Such incorrectly declared waste that is deposited in the backfill material is not traceable anymore. This procedure is not only advantageous for the waste producer, but especially for the project investor. With at least a minimum level of discipline and rational approach by the involved parties, the sorted and treated material from demolitions may be used as a suitable material for development of road communications and not disposed thoughtlessly. Moreover, when such a material is introduced (in a backfill) in some "undefined" ground construction, the basic technological adaptations are often not performed (such as moistening of material to optimum humidity, maximum consolidation, etc.). A big disadvantage is impossibility to develop such area (with improper backfilling) for decades and also there is a risk of deposition of hazardous waste that may contaminate surrounding soils and underground water. [1]

One of the key issues experienced in relation to processing of construction-demolition waste is the presence of hazardous waste due to technological mistakes during processing and especially sorting of demolition material. Such hazardous waste may - amongst others – include old roofing (fibrocement roof tiles or waved roof panels) containing asbestos – in case of their rupture and exposure of their core, human health may be considerably jeopardized. Also older building constructions impregnated by tar insulation materials, etc. Monitoring of tar presence in the construction-demolition waste may considerably reduce risks related to the use of the uncontrolled demolition waste as an "excavated soil".

Currently there is no special legislation in the Czech Republic that would deal with hazardous substances in building materials. In future it should be based on the EU legislation that is currently in process of preparation. The existing European regulations contain generally binding obligations for the waste producers to mitigate health risks (both risks to public health and the occupational health). These regulations were adapted to Czech legislation too; however they are often not followed.

Management of demolition waste is covered in the methodical guideline of the Waste Department of the Ministry of Environment, concerning handling waste coming from construction activities and waste from reconstructions and demolitions of structures. The guideline contains measures and recommendations aimed at mitigation of risks of contamination or jeopardy to environment and human health, resulting from improper handling and management of construction and demolition waste. One of the recommendations is to carry out a detailed survey of the construction prior to demolition by some authorized expert. Such expert should determine possible risks of hazardous attributes of future waste, take samples and recommend the most appropriate and efficient way for demolition of the hazardous sections of the construction step by step. Such hazardous sections shall be always removed separately and the resulting waste sorted right in the construction site. Then the waste should be handed over to some authorized company for further processing or disposal. [2]

Another issue are the technologies for the conversion of construction-demolition waste to a usable recycled material – because of a lack of awareness of the environmental benefits, waste disposal in dumping places is still the preferred and cheaper way than its recycling. The price of the recycled material is then comparable with the exploited material. Considering the geometric, physical, mechanical and other attributes, the use of recycled material is comparable with the use of primary natural resources of lower quality, despite the available testing procedures. In the current building practice it is very hard to enforce more extensive use of the recycled materials in construction parts of road communications. Recycled materials are then often produced with a stress on the lowest possible price and finally they end up as inferior backfilling materials - nevertheless many completed tests, especially those aimed at the modern functional attributes of the mixtures of sorted and treated recycled material from demolitions, proved how good recycled materials are. As recycled materials produced from walling, concrete, asphalt layers or recycled aggregate from road sub-layer have their specific attributes that may be utilized in these constructions (e.g. great compression capacity, etc.). It would be appropriate to prepare a generally binding regulation for evaluation and asses-

sment of quality of recycled materials. These are the proposed technical conditions aimed at verification of usability of secondary materials in the road infrastructure development as well as determining their important building-technical parameters. Such technical conditions covered in the above mentioned project are based on the valid EN standards for the proposal and evaluation of mixtures of such materials. Moreover, they resolve the issues of technological processing and application of layers of such materials in more details. [3]

3 Methodology and main goals of the project

Project implementation was divided into two parts. The first part is focused on monitoring and testing of the most exposed construction-demolition and industrial wastes and a successive revision of the particular technical conditions for the use of products developed by processing/ adaptation of these waste materials. Another part of the research project is aimed at establishment of the information system for the management of secondary materials suitable for the development of road infrastructure. Such information system should provide technical information on the usable secondary materials that are suitable for development of road communications in the territory of particular districts and regions. It should improve the level of knowing on the usability of such materials for petty investors and general vocational public as well as facilitate the communication amongst project designers, investors and implementing companies who make use of local resources of such secondary materials. The output of this second part should be a brief and transparent catalogue of secondary materials usable for road infrastructures with particular catalogue (material data) sheets (see figure 1).

A significant part of the information system for the management of secondary materials for road communications development is the use of waste and some other already used materials in road engineering with regard to REACH directive and the obligations/ requirements related to waste at pre-registration and a subsequent registration.

At the moment the information on the use of secondary materials in other countries of the European Union as well as in Czech Republic is being collected. The information mainly pertains to legislative conditions for the use of construction-demolition wastes, capacity data, financial flows and basic technical parameters of recycling lines. In details the issue of usability of secondary materials with a certain tart content or tar binder is resolved/ assessed. In the next years of the implementation the revisions of the actually valid technical conditions for the use of slag aggregates, waste rock powder, etc. should be executed.

Important is also the assessment of the tested secondary materials in mixtures (e.g. with natural rock aggregates, etc.) by monitoring and reviewing the functional attributes of these materials. Simulation of specific conditions of load of the suggested mixtures (layers of road communication) in laboratory environment is necessary to verify the usability of the materials. Such functional testing is carried out in the excellently equipped road laboratories of two universities (Brno University of Technology and Czech Technical University in Prague) fitted with a complex system of functional testing of road construction materials in accordance with the latest European standards.

Catalogue sheet

Secondary material	**Foundry sand**
Reg. No.	123456/369
Region	Moravskoslezský

Originator	**Sand Team s.r.o.**
Address	Sadová 224
	Ostrava
	765 02
ID No./ VAT No.	255 266 255
ID No./ VAT No.	CZ 255 266 255
Contact person	Ing. Josef Kropáček
Phone	606 111 222

Map	**Detail**
	

Production (years)	2004	2005	2006	2007	2008
tons	89000	99000	105000	52000	65000

Environmental aspects of secondary material	
Are there any environmental issues connected to the material?	yes
If yes, please, specify in details?	Risk of phenol leaching in case of organic foundry sands

Application in road constructions	
a) subbase of pavement	Note: only inorganic sands with the required grain size may be used
b)	Note:
c)	Note:

Secondary material technical parameters

Unit grain size (mm)	
Treated material grain size	
Fraction	
0/2	No
0/4	Yes
4/8	No
8/11	No
8/16	No
16/22	No

Material photo documentation

Figure 1 Example of the secondary material catalogue (material data) sheet

4 Some frequently discussed issues related to the use of secondary materials for road communications

For the more frequent use of recycled materials in road communications a common consensus amongst representatives of building industry and environmental protection is necessary. A common goal should be the maximum use of these materials in the suggested building mixtures and compounds as well as in building parts of line constructions that would not mean such a risk to environment as brings deposition of the same materials in open dumps (the most frequent way of disposal of construction-demolition wastes and other waste or treated secondary materials in the Czech Republic). For this purpose it is of course also necessary to eliminate some problematic aspects and eliminate the related risks, such as:

Presence of tar or asphalt-tar binders in recycled material

Roads with some layers containing tar binder are governed by the methodical guideline MDS-OPK, ref. No. 30011/99/120 by the Ministry of Transport of the Czech Republic, dated November 20th, 1999, determining the conditions for registration of roads with tar or asphalt-tar binders. In accordance with the Act No. 185/2001 Coll., (Waste Act), as amended by the Act No. 188/2004 Coll., Act No. 7/2005 Coll., Act No. 314/2006 Coll. and Act No. 34/2008 Coll., including the implementing regulations, especially the ministerial regulation No. 351/2008 Coll., on the details of waste handling, as amended and based on the valid waste catalogue (regulation No. 381/2001 Coll.), the material obtained from the road that contains tar binders shall be classified as hazardous waste (No. 17 03 01). Registration of the roads with tar binders shall be assured by the administrators of particular road communications within the area of their responsibility.

As for the use of the exploited material from the road constructions that contains tar or asphalt-tar binder, it is necessary to assure that the contractor/ builder is authorized to dispose and handle with the material in accordance with the terms and conditions set by the above mentioned regulations and legislation. In case that this material is managed as a recycled material and intended to be used for road communication development, such use is only possible if the material is processed in the site and the appropriate technology of cold recycling (see the technical conditions for the cold recycling of construction layers of non-rigid road communications, 2009) is applied – this procedure will assure an adequate immunization of hazardous substances contained in tar binder that are considered as harmful to environment and human health. In this respect "immunization" especially means encasement of grains with tar binder by appropriate asphalt emulsion or reinforced asphalt. Such material may be processed by similar technologies in the suitable stirring unit. In case of necessity of transport from the place of origin (milling or demolition of old road communication), the material must be handled in accordance with the regulation No. 374/2008 Coll. on waste transport.

Use of the material recovered from the old road communications with tar content or asphalt-tar binder by means of hot technologies is not allowed because of the risk of emissions of contaminants and hazardous substances.

The issue of recycling of road layers with tar content or asphalt-tar binders will be subject of the revised technical conditions (TC) 150.

Use of recycled material from demolitions (such as aggregate) in asphalt layers

As for the use of recycled aggregate from demolitions in asphalt mixtures, most often the premium recycled concrete, the definition of the remark to the subject of the European Standard ČSN EN 13043 - Aggregate for asphalt mixtures and surface layers of road communications, airports and other transport surfaces (2003) is unclear. It says that "some recycled aggregates or aggregates obtained from some industrial side products that should fulfill all requirements set by this EN standard, may have other characteristics that do not correspond to the mandate M 125. This EN document from 1998 determines – besides the standard geometric and physical-mechanical tests, such as testing of granularity, shape index and volumetric weight – the appropriate micro-texture for the most efficient adhesion to asphalt, resistance

against crushing, resistance to drop of temperature, good resistance to temperature shocks, volumetric stability, constantly low level of sulphur, minerals sensitive to humidity fluctuations, etc. Special requirements must be determined for recycled aggregates from experimental building materials such as foam-silicate bricks that are known because of rather high content of radioactive substances – in this case the level of radioactivity in the aggregates must be determined as well as the content of heavy metals, poly-aromatic hydrocarbons, etc.
Therefore it is important to know what materials is the recycled aggregates made of, respectively to know the composition of the constructions of demolished road constructions.
Use of slag aggregates in construction layers of roads and sub-layers of road communications
The revision of TC138 should be focused on the suitable chemical composition of blast furnace slag intended to be used in the sub-layer of road communications and construction layers of roads. The revised technical conditions (TC) should especially adjust the composition of SiO_2 and CaO in accordance with the new production outlets and slag aggregates application. It is expected that for the use of the slag aggregates, especially for the sub-layers of road communications, the range of use of the above mentioned compounds will be adjusted (extended).
Revised TC138 shall be then linked to the valid EN standards, especially in terms of use of the secondary materials in unbounded or bounded sub-layers of road communications.

5 Application of results in practice

One of the planned outputs of the project (until 2011), as indicated by the article, is the preparation of new technical conditions (TC) or the revision of the existing ones, aimed at the use of secondary materials in road communications, particularly:

- TC 210 Recycled construction-demolition materials for road communications (new);
- Revision of TC 150 Permanent maintenance and repairs of road communications containing tar binders;
- Revision of TC 105 Handling of waste produced by technologies using tar-free asphalt emulsion;
- Revision of TC 138 Use of slag aggregates for road communications development;
- Revision of TC 176 Waste rock powder in the road communication body;

and the related methodological guideline of the Ministry of Transport of the Czech Republic.
By creation of catalogue of the usable secondary materials with a brief specification of their attributes and possibility of their use in construction parts of road communications in form of catalogue sheets (see the example in figure 1), the particular regions and especially the industrial areas in the Czech Republic would be better informed on their use and methods of application.

6 Conclusion

By determining technical and legislative conditions for effective use of secondary materials in constructions of road communications, including their classification (in form of catalogue), drafting of sample solutions of road compositions (layers) and by creating new/revising the existing technical regulations, the relevant information will become available to general vocational public which may help to more purposeful and economic management of secondary materials at development of road communications.

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