



18th International Conference on Rehabilitation and Reconstruction of Buildings 2016, CRRB
2016

The laboratory examination of cement matrix with inbuilt hazardous waste

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Abstract

This paper deals with laboratory examination of cement matrix with inbuilt hazardous waste of its different contents. The paper examines the influence of waste content on the properties of cement matrix using the verification the physic-mechanical properties. These properties will be examined also at different time periods to examine the durability of designed cement matrices.

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Peer-review under responsibility of the organizing committee of the 18th International Conference on Rehabilitation and Reconstruction of Buildings 2016

Keywords: solidification, stabilisation, cement, leaching test, strength test, durability.

1. Introduction

Nowadays the waste disposal technologies are among the fastest growing branches of the Czech Republic national economy and the development of this area is mainly stimulated by the permanent increasing of environmental protection requirements. The cement based S/S process is also one of the most progressive methods of physic-chemical treatment of waste that currently cannot otherwise be effectively used and that can significantly contribute to the effectiveness of the waste disposal. It is also the one of the most often used technologies for waste disposal around the world if we do not count landfilling. S/S processes are characterized by the decrease of the

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waste surface, but the content of hazardous substances remains. A barrier is being formed between the hazardous substances and surrounding environment and the contaminants are chemically bounded to the matrix consisting of organic or inorganic inert substances. Since the cement based S/S process does not reduce the amount of pollutants contained in waste, but it rather creates the physical and chemical barriers that prevent these pollutants to from getting into the environment, it is necessary to examine the stability of the cement matrix with inbuilt waste.

Above all a frequent reason for utilization of cementation process is the simplicity of the process. However, this advantage is on the other side not fully compensated by significant disadvantage which means quite high cost of this type of binder and also the ecological aspect cannot be forgotten - high CO₂ emissions associated with cement production. [1 – 3]

The advantage of cementation process is that the process itself takes place under normal temperature. This process is particularly suitable for inorganic materials (ashes and dehydrated sludge from industrial wastewater treatment plants), and also for mere solidification of waste going to landfill. Currently a wide range of combinations of different types of binders is being used.

The current Czech legislation is very weak from the perspective of further use of treated waste as well because the evaluation of the durability, which is not verified, but is very important for the further use of S/S product. A fundamental document in the field of waste management in Czech Republic is Government Regulation No. 197/2003 Coll., The Waste Management Plan which establishes basic principles and measures for all relevant aspects of this branch. In connection with the current trend, when efforts to prevent waste generation or its minimization are dominating, there are also set out some precautions to encourage changes in production processes and in this context it is also recommended to work out life cycle analysis of products, etc. Significant space in the Plan is also devoted to hazardous wastes - to the possibility of preventing their production as well as to the treatment with them.

Another important document overarching the field of waste management is the State Environmental Policy of the Czech Republic (SEP CR), which is based on fundamental precautions of The Waste Management Plan. The area of wastes falls under the Chapter "Sustainable Use of Natural Resources, Material Flows and Waste Management". The need to prevent the use of primary source material and vice versa to deal more effectively with secondary via their reuse is emphasized. In terms of European legislation a key document is the European Parliament and the Council Directive No. 2008/98/EC on waste, which specifies the requirements for waste management rather on a general level, a specific solution is always determined by national legislation. The implementation of these requirements of the European Directive was implemented through an amendment to Act No. 185/2001 Coll., on waste from year 2010; however, other amendments occurred in following years.

The trend of waste recovery is encouraged by the legislation as well. International law of EU and OECD countries respects the requirements of a large international market with secondary raw materials and it adapts gradually the mode of regulation, control and monitoring. Established modes are introduced for the Czech Republic as a member country of the OECD and EU and are regulated by the Act on Waste No. 185/2001 Coll. Insufficient use of secondary raw materials and wastes in the Czech Republic in recent years primarily stems from the low price for waste disposal to landfill as compared with the costs of their recycling. However this price is now increasing every year.

The research conducted within the scope of this paper is a part of solved project. The aim of the solved project is for the representative of hazardous waste that was identified as a hazardous waste with the most critical production within the Czech Republic to study and find the optimal composition of the cement matrix that will ensure maximum content disposal of chosen hazardous waste. Properties of the cement matrix with incorporated waste at various content of hazardous waste and at different composition cement matrix will be verified by the set of suitably designed tests those will enable the study of the inbuilt hazardous waste impact on the cement matrix properties and those will prove the effectiveness of the formula.

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