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## Solidification of hazardous waste with the aim of material utilization of solidification products

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### Abstract

In order to reduce the amount of hazardous waste this work deals with the possibility of using solidification technology to transform the hazardous waste with the aim to achieve the material utilization of solidification products. For this purpose, it is necessary to determine a suitable solidification formula for solidification product made of the chosen hazardous waste – neutralization sludge. Particular solidification formula is chosen on the basis of advanced experimental examination of solidification products. Solidification products have to comply with the environmental requirements and physical and mechanical properties arising from their suitable further use in building industry or for land rehabilitation processes.

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### 1. Introduction

Due to the continuous production of neutralization sludge (NS) in industry and in the context of the necessary remediation of old ecological burdens in The Czech Republic (removal and remediation of substandard and unsecured landfills, which contain such neutralization sludge (NS)), it is necessary to find a suitable technology to solve this problem. The technology of solidification seems to be the most suitable way, through which the hazardous waste (HW) can be reprocessed to a new usable product – solidification product. In order to use the

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treated waste in the most efficient way, primarily as a replacement for primary sources of raw materials, it should have required properties resulting from its further use.

Meeting of the requirements resulting from the future use of solidification product is achieved mainly by selecting the appropriate neutralization sludge and economical-efficient solidification binders. At first, it is therefore necessary to design and then examine large amount of solidification formulas.

The suitability of various solidification recipes need to be checked first on a laboratory scale and then subsequently the most technologically and economically acceptable option must be chosen. After the thorough examination of the properties of solidification products, this new material may be used in practice. To prevent any release of contaminants from solidification product resulting in environmental pollution, it is inevitable to monitor the long-term durability of the solidification product (steady required properties at any time on the place of its use).

The trend of waste maximum utilization is also provided in national legislation. Waste Act No. 185/2001 in force is based on Directive of the European Parliament and Council No. 98/2008/ES and states hierarchy of waste management, which emphasizes the prevention of the waste production. The waste disposal (landfill without further use) is in this hierarchy of waste management in the last place.

For the possibility of further use of solidification product it is necessary to maintain certification (conformity assessment). Government Directive No. 163/2002 offers the possibility how to make the conformity assessment or it can be through a voluntary certification (used in building within the meaning of Act No. 183/2006), while it would be possible to use it only in the Czech Republic. Because of currently missing standards or other technical regulations in the Czech Republic dealing with the possibilities of use solidification products, the building technical certificate (BTC) has to be provided at first. BTC provide technical determining of the product properties by the authorized person. When the BTC is drafted it can be based on standards and technical regulations developed for a similar type of material (e.g. a stabilized fly ash). Authorized person on the basis of BTC defines the technical characteristics associated with the basic requirements and also determines their levels due to the intended use of solidification product in construction. When BTC is released, the certification of solidification product can be processed. After release of the certificate, solidification product can be used for its intended use, which is specified in the relevant technical documents.

## **2. Future applications of solidification product and optimal testing methodology**

The use of solidification products (SPs) should have predominantly ecological benefits - environmental protection. The most of possible future applications of solidification product result from technical manuals that have been developed mainly for the product group - ashes and mixes with fly ash, while defined use is closest to the appropriate application of the solidification product. Vacenovska et al. [1] discovered that a possibility of application of this product, which contains HW is closely related with the technology of its production. It is mostly produced on solidification lines, in form of granules, so the principal possibility of its utilization are various dustings, backfill material, base layers, material shaping the terrain and especially as material for landfill reclamation and remediation of old ecological burdens. The use of the product as a building material in common earthwork is unlikely due to the usual high pollutant content in dry matter, which is not permitted by applicable strict standards.

Based on the selected optimum application of solidification product, the optimal testing methodology was created. The proposed testing results mainly from the requirements arising from the aforementioned technical manuals. The tests can be divided, as shown in Figure below, into physical and mechanical tests – for detecting and defining the technical characteristics of the product and the ecological tests – dealing with the protection the environment and human and animal health. Recent results from Al-Tabbaa and Perera [2] indicate that the final physical and mechanical properties of solidification product (SP) influence also the future suitable technology of

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