Stabilisation/solidification of refuse derived fuel (RDF) fly ash

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Introduction

The requirements for decreased emissions to air and water from waste incineration plants resulted in both, advancement of air pollution control (APC) equipment and processes and increased amount of APC residues. High metal mobility of metals in such APC residues and tightening EC legislation for their disposal, make further research in this field necessary.

This work presents the part of investigations on metal mobility in refuse derived fuel (RDF) ashes and the possibilities for the stabilisation of such residues.

Research Questions

- Is it possible to mechanically stabilise RDF fly ash with water? What factors influence that process?

Experimental

The first part of research included investigations on cemetitious properties and mechanical stabilisation potential of RDF fly ash. Cementitious properties were studied on the fly ash from Igelsta power plant located in the southern part of Sweden. A 2^3 factorial design was applied to examine the impact of the factors water addition, time and temperature (table 1) on the stabilisation and mechanical strength of specimens prepared using procedure similar to Proctor compaction. A laboratory procedure was designed to assure that all factors, except those being investigated, were kept at a constant level. Samples were tested using uniaxial compression test, recording the maximum force that can be hold by sample. Results were analysed using *Statgraphics Plus 5.0.*

Table 1. Factors and levels used in experimental design

Factor	Unit	Low level	Centre point	High level
Water addition	%	25	30	35
Temperature	°C	20	60	100
Time	days	1	15	29

The second part of research included investigation on suitable technique for production of solid samples. The results from investigations on mechanical stabilisation of RDF fly ash were used to produce cylindrical samples for further investigation of mobility of metals from the solid matrix.

Conclusions

Although process of mechanical stabilisation is primary influenced by origin and chemical structure of fly ash and as such differ for different fly ashes, investigation gave important data for further research.

Statistical evaluation of results showed statistically significant influence of next factors on process of solidification: time, temperature, one second-order interaction (water addition + time) and third order interaction. Factor water addition and other two second-order interactions were of minor influence. Third order interaction and lack-of-fit test, both indicating the presence of curvature in the model were significant on 5% significance level. In connection with presence of curvature it would be of interest to further investigate second order model and to apply *central composite design* in experiment. Results of mechanical testing showed that samples made with all three factors set on high level had the highest mechanical strength.

Investigation of mechanical stabilisation gives good basis for future research. Some questions that should be answered are:

- Does mechanical stabilisation with water affect metal mobility in RDF fly ash?
- Does this kind of stabilisation give new possibilities for safe disposal of RDF fly ash?

Future research will be based on results obtained from different leaching tests. To assess the availability of pollutants from both, untreated and stabilised fly ash the availability leaching test NT ENVIR 003 will be applied. The Dutch Leaching Test NEN 7345 is standardised procedure for testing of solid waste and building materials and it will be applied on solidified samples for investigation of diffusion transport.

Experimental design with combinations of different factors, beside the possibility to study their influence on response, also gave answers on how the fly ash and the mixture with water should be handled to make solid samples, which will be used in leaching tests. In accordance with that detailed lab procedure for making solidified fly ash samples was made. Samples showed good mechanical stability in water, and it is very likely that they are suitable for testing using batch diffusion leaching tests.