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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 thus an increased amount of APC residues. High mobility of metals in such APC residues and tightening EC legislation for their disposal requires research in the field of ash stabilisation.
This work presents the part of investigations on the possibilities for a stabilisation of refuse derived fuel (RDF) ashes.

Research Questions

- To which extent is it possible to mechanically stabilise RDF fly ash with water? What factors influence that process?

Material

Fly ash from incineration of sorted industrial waste (wood, paper, cardboard, plastic, gypsum, mill peat *etc.*)

Methods

1. **Experimental design**

A 2^3 full factorial design with centre points was applied to examine the impact of different factors on the process of stabilisation and mechanical strength. The impact of three factors was investigated: **water addition** to the fly ash – water mixture, **temperature** at which samples have been dried and **time** of drying (table)

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

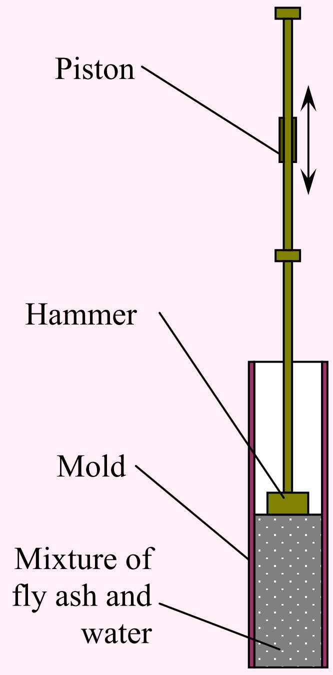
The experiment was replicated two times, with one centre point per each basic design set.

2. **Modified Proctor packing**

The Proctor packing was modified for the production of test pieces 10 *cm* high and 5 *cm* in diameter. A manual hammer was used (figure) to assure that the same work was used for compaction of all samples.

3. **Uniaxial compression test**

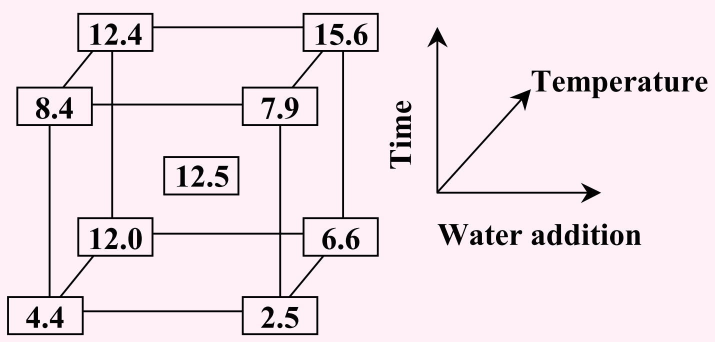
Test pieces were broken by putting force on their bases. The force affecting the sample was recorded electronically.



Results

- The statistical evaluation of the results showed a significant impact of the factors: time, temperature, one second-order interaction (water addition + time) and a third order interaction (water addition + time + temperature). **The factors time and temperature had the major influence on mechanical strength.** The effect of water addition depended on the level chosen for time. This effect was minor comparing to the effects of time and temperature.

- Both the third order interaction and the lack-of-fit test indicating the presence of curvature in the model were significant on 5% significance level.



The cube plot shows the average of highest forces that can be hold by the samples (in kN). Samples with all factors set on high level had the highest mechanical strength.

Conclusions

- The results of mechanical testing showed that samples made with **all three factors set on high level** had the highest mechanical strength.

- Samples representing **centre point** treatment had a satisfactory level of mechanical strength, with lower energy and time consumption. The mixture was easier to handle, resulting in better-defined geometry. Samples for the further investigation will be made with levels set on centre points.

- The statistical analysis showed the **presence of curvature** in the model. It is of interest to further investigate the curvature and the second order model by applying *central composite design*.

- The investigation of mechanical stabilisation gives a good basis for **future research**. Some questions that should be answered are:

  a. Does mechanical stabilisation with water effect metal mobility in RDF fly ash?
  b. Does this kind of stabilisation give new possibilities for a safe disposal of RDF fly ash?

  Future research will be based on results obtained from **different leaching tests** such as diffusion and availability tests.