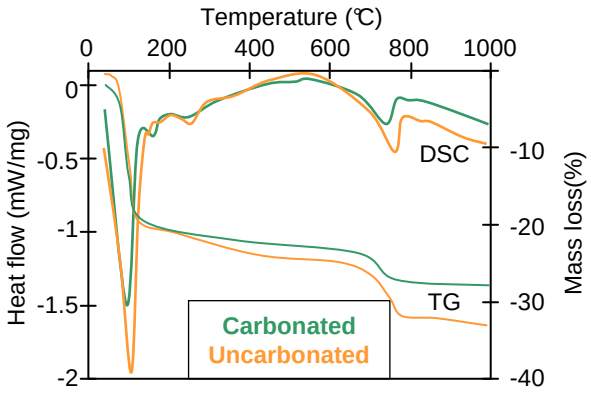
Carbonation of bottom ash

Reference: Carbon dioxide sequestration in municipal solid waste incinerator (MSWI) bottom ash, E. Rendek, G. Ducom, P. Germain, Journal of Hazardous Materials B128 (2006) 73–79

Introduction: The incineration of municipal solid waste generates solid residues, bottom ash and fly ash, as well as atmospheric emissions containing about 12% of CO_2, this last being completely released with the atmosphere. In France, for 64% of MSWI bottom ash, a period of weathering, several months, is required before reuse as, for example, a secondary building material or in road sub-bases. However, it has been proved that the natural carbonation process can be accelerated, using different sources of CO_2 as atmospheric CO_2. This process could both help reducing the greenhouse effect and reducing bottom ash storage duration by accelerating weathering reactions.

TG/DSC curves of uncarbonated and carbonated bottom ash as a function of temperature.



Experimental

Simultaneous TG/DSC was used before and after a complete carbonation to investigate calcite formation resulting from accelerated carbonation.

Experiments were carried out in a Labsys TG-DSC at a heating of 10K/min to 1000°C under an inert atmosphere of argon. For these analyses, a mass of about 20 mg of the uncarbonated or carbonated bottom ash was placed inside an alumina crucible.

The temperature of the sample and reference were recorded by a platinum/rhodium thermocouple (type S), and a high-precision balance registered the potential weight loss due to evaporation/decomposition of the sample.

For more details ask for publication A0787

Results

TG/DSC curves of uncarbonated and carbonated bottom ash are represented in the figure.

The first endothermic effect at 90°C accompanied by a mass loss of about 20% corresponds to the sample dehydration.

Between 200°C and 600°C TG/DSC curves show a slight decrease and an exothermic phenomenon, which is attributed to the pyrolysis of the 1.5% of organic matter.

Then, DSC curves present a small endothermic peak from 600°C to 750°C due to the dissociation of carbonates according to the following dissociation equation:

$CaCO_{3\,(s)} \rightarrow CaO_{\,(s)} + CO_{2\,(g)}$

It is accompanied by a mass loss of 3.3% and 6.2% for respectively fresh and carbonated bottom.

The mass difference is about 2.9%. This value is in agreement with the one obtained on the accelerated ageing set up, where the gain of mass was about 3.2%. It confirms that the gain of weight of samples was really due to a chemical carbonation and not to physical adsorption of CO_2.

LABSYS evo TG-DSC
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