39/2016
Huber, F.; Purgar, A.; Blasenbauer, D.; Mallow, O.; Winter, F. (2016) „Addition of fly ash to the fuel of a rotary kiln used for hazardous waste incineration”, In: Proceeding “5th International Conference on industrial & hazardous waste management”, 27-30 Sept., Crete, Greece, TU of Crete, p. 155-156, ISBN 978-960-8475-24-3

ADDITION OF FLY ASH TO THE FUEL OF A ROTARY KILN USED FOR HAZARDOUS WASTE INCINERATION

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Keywords: waste incineration, fly ash, MSWI residue, hazardous waste

Incineration reduces the volume of waste by 90 % and prevents organic degradation processes at landfills which are associated with polluting leachate and gas emissions. Bottom ash, the major solid residue of waste incineration, can safely be disposed of at non-hazardous waste landfills. However, fly ash, the second residue arising during waste combustion, is classified as hazardous waste, and hence has to be disposed of at hazardous waste landfills or has be stabilized/treated prior to disposal at non-hazardous waste sites. The current practice of fly ash management in the many countries (including Austria) consists of stabilization with cement, which is not only associated with significant greenhouse gas emissions (during cement production) but also costly. Therefore, the feasibility of an alternative treatment (thermal co-treatment together with combustible hazardous waste in an existing rotary kiln) was investigated in a field scale experiment.

Fly ash was mixed with water in a ration of 1:0.16 to avoid dust emissions. For every t of hazardous waste combusted, 240 kg of wet fly ash were inserted into rotary kiln 1. Rotary kiln 2 was fed with hazardous waste only and no fly ash in order to serve as a reference. Bottom ash, fly ash, wet deasher water and scrubber water were sampled in regular intervals and their composition was analysed. Additionally, the mass of generated bottom and fly ash was determined and the concentrations of CO, NO_x and SO_2 in the flue gas were monitored during the experiment.

A detailed mass balance for the inorganic matter was established for the field scale trial based on the determined masses. The results of this balance are illustrated in Fig. 1. Transfer coefficients from hazardous waste to bottom ash and fly ash were calculated based on the mass balance of inorganic matter for rotary kiln 2 (no fly ash addition). These transfer coefficients were subsequently applied to rotary kiln 1 (fly ash addition) and the difference between the amount of bottom ash observed and the bottom ash mass theoretically arising from hazardous waste combustion only was calculated as bottom ash mass derived from inserted wet fly ash. The same calculation was applied to generated fly ash. The ash content of solvents and light fuel oil is assumed to be 0. However, the mass of fly ash generated in rotary kiln 1 during the experiment was lower compared to rotary kiln 2.

Based on the results presented in Figure 1 it can be concluded that a major part of inserted fly ash generated additional bottom ash and only a minor part was transferred to new fly ash. The amount of fly ash recovered in form of additional bottom ash is lower than the dry matter of the fly ash inserted into the kiln. Due to the relatively short experimental time it cannot be precluded that part of the inserted wet fly ash was still in the air pollution control system of the incinerator at the end of the test. Another likely explanation for the discrepancy in input and output flows of inert matter are unavoidable differences in the hazardous waste composition (with regards to their ash content) between rotary kiln 1 and rotary kiln 2.

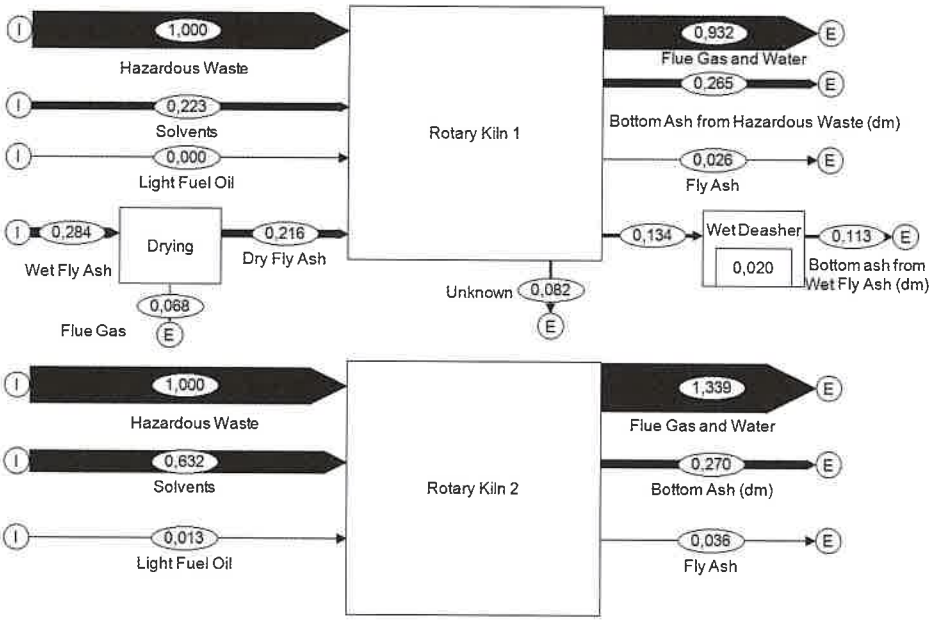

Fig. 1. Mass Balance for inorganic matter of the field scale experiment (given in kg per kg hazardous waste combusted)

With regard to the composition fly ash generated in rotary kiln 1 showed slightly higher concentration of K, Cd, Zn and Pb compared to rotary kiln 2. The concentration of total dissolved solids in the wet deasher water was increased by about 20 % after the insertion of wet fly ash. The flue gas composition did not change significantly during or after the experiment. However, the concentrations of Cl and Hg in the first scrubber stage of rotary kiln 1 were increased by approximately 50 % and 200 %, respectively. This effect is a desired way to transfer Hg contained in the inserted fly ash into the filter cake generated at the on-site wastewater treatment plant.

The results of the chemical analyses indicate that the quality of the bottom ash (with regard to leachate composition) generated at kiln 1 was not negatively affected by the treatment of wet fly ash. No significant difference between the leachability of heavy metals was observable for the bottom ash of both lines. A comparison of the averaged contents to the limits values for landfilling at non-hazardous waste landfills indicate that the bottom ash of both lines may be disposed of at non-hazardous waste landfills. However, it need to be kept in mind that for the decision about the deposition of a certain incineration residue the leachate of a weekly composite bottom ash sample instead of only considering three random samples is relevant. Therefore, long time trials are necessary to assess the bottom ash quality in detail. As it was not possible to retrieve all of the inserted fly ash in the output streams of the rotary kilns, it is also suggested to address the issue of closing the mass balance in further trials, in which the addition of fly ash to the fuel of the rotary kilns is conducted for a prolonged period of time.