Investigation of MSWI Fly Ash for Utilization in Mortar

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Fly ash from municipal solid waste incineration (MSWI) is classified as hazardous waste because of the high content of heavy metals and salts. It is currently being disposed of in Norway although it contains potential resources. In addition to disposing potential resources the disposing and transport of the MSWI fly ash is a costly and resource consuming affaire.
In this project it was investigated whether MSWI fly ash may partly substitute cement in Portland cement mortar after upgrading the MSWI fly ash by electrodialytical removal of metals and salts.
The main emphasis was laid on the workability, strength and heat evolution of the mortar with MSWI fly ash. This was carried out by using different methods for mixing the mortar and varying the content of MSWI fly ash. As references were used mortar without fly ash and mortar with fly ash from the coal industry which is a material commonly used in Portland cement mortar.
Before upgrading the MSWI fly ash was carbonized, and the fly ash was further carbonized during the electrodialysis. During electrodialysis metals, salts and water-soluble substances were removed from the MSWI fly ash. This removal resulted in an up-concentration of all metals investigated, except for barium. Leaching of metals was on the other hand reduced for all heavy metal. The results were compared to Danish legislation, (the limiting value for possible reuse of waste materials), and all the metals were below the permissible.
Utilization of MSWI fly ash in mortar showed no difference compared with the reference mortars as regard to the strength when substituting 15 % (weight) or less cement.
The high content of carbonate caused a low workability for the mortar however adding superplasticizer improved the workability essential, even when adding only a small amount (0.5 % of total cement and fly ash weight).
Heat evolution from mortar with MSWI fly ash was delayed and reduced causing a delayed strength development. After seven days of curing the strength was however at the same level as the reference mortars. The reason for the delayed and reduced heat evolution might be lime which is added during flue gas treatment at the incineration plant and which later forms gypsum. Gypsum slows the early rate hydration.
Leaching of salts showed a higher concentration of water-soluble sulfate which increases the risk for sulfate corrosion, the mortars investigated showed however no signs of sulfate corrosion.
Based on the results mentioned above it was concluded that utilization of MSWI fly ash is possible in mortar when substituting 15 % and adding superplasticizer. Since production of Portland cement contributes about 5 % of global total CO_2 emission it is clearly important to find ways to improve the production. The CO_2 emission from the concrete production is directly proportional to the cement content used in the concrete mix. A substitution by 15 % MSWI fly ash in a mortar will therefore reduce the emission of CO_2 caused by the cement production.