Sewage Sludge Ash in Reinforced Concrete

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The production of cement is responsible for 5 % of the global CO2-emissions (Development, International Energy Agency and World Business Council for Sustainable, 2009). It is thereby desirable to reduce the amount of cement used by replacing it, or part of it, with another material. Today the concrete industry is experienced in using fly ash from coal combustion. This project investigates how addition of incinerated sewage sludge ash (ISSA) to concrete affects the corrosion environment for reinforcement bars.
This project used ISSA from Lynetten treatment plant. Relevant properties of the ISSA are investigated such as pH, Water Solubility, Water content, Content of organic materials, Electrical conductivity, and particle size. Furthermore the content of heavy metals and soluble anions in the ISSA was investigated. Tests were carried out on mortar samples as the mortar has smaller aggregates (<4mm) and therefore is more homogeneous than concrete. The castings were carried out according to the recipe from DS/EN 196:2005 (w/c-ratio: 0.5). Three types of mortar samples were used: Reference samples, samples where 10 % of the cement were replaced, and samples where 5 % of the sand was replaced. The mortar samples were investigated for changes in diffusion of chlorides, capillary suction, density, porosity, and samples with reinforcement were placed in an air-saltwater-cycle for investigating changes in chloride-induced corrosion. Generally the lab-test did not indicate critical properties for the ISSA from Lynetten. There was however found a content of heavy metals, which compared to the demands in the Danish legislation 1662 (Danish Ministry of the Environment, 2010), falls in category 2 hence its use is restricted for certain civil works. The properties of ISSAs generally seemed to vary between different batches from the same sewage sludge plant. Most of which can possible be explained by differences in the efficiency of the combustion. The test on the mortar samples yielded the following conclusions. The tests regarding density and diffusion of chlorides did not indicate any changes. The porosity indicated a little tendency that replacing cement with ISSA might lower it slightly. The tests for capillary suction showed an increase when cement was replaced. Visual inspection of the samples with reinforcement did not show signs of corrosion after 2 months in the air-saltwater-cycle. Potential measurements suggested at first that the samples with ISSA would corrode faster. After 20 days this was however no longer evident.
This project has not found critical evidence that addition of ISSA to concrete will increase the risk of corrosion significantly. However there was found a high content of heavy metals and a significant variation between batches of ISSA from the same treatment plant. This needs to be handled before commercial use. However if handled, there is found no arguments against replacing cement with ISSA in this project. Thereby the cement industry is a possible consumer of waste from the sewage treatment plants and it is at the same time possible to reduce the CO2- emissions from the cement production.

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