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Sewage Sludge Ash in Concrete – Studies of Usability

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ABSTRACT

Of both environmental and economic reasons, the usability of ash from sewage sludge, sludge ash, is interesting to examine. If sludge ash can be used as a substitute for cement or sand, in the manufacture of concrete, both the environmental impact from transport and deposit of sludge ashes in other countries can be eliminated. Furthermore the reduced need for cement, which is a heavy environmental cost, means a cleaner concrete and can save the concrete manufacturer material costs. Earlier waste products as coal fly ash and microsilica, which came from power plants and as a byproduct from metal alloying, are now used in concrete in order to optimize it. This means that they have changed status from a waste product, which is an environmental impact, into a useful product which improves the properties of the concrete.

The characteristic qualities of sewage sludge ashes must be determined because, the content of salt, and the quantity of heavy metals are really important as the salt might cause corrosion in a reinforced concrete structure and heavy metals might be dangerous and therefore harmful to the neighboring environment. . Earlier studies have showed that the sludge ash in some cases acts like a pozzolane. In addition to the ordinary aggregates in concrete, pozzolanes can be added and this might have an impact on the strength, the degree of packing and the water/cement ratio.

In order to determine the content of heavy metals and chlorides were an Ion Coupled Plasma (ICP) apparatus and an Ionchromograph (IC) used. The sludge ash impact on the strength development was tested according to DS/EN 196-1. Several mortar speciments with different content of sludge ash were tested. Some specimens had milled sludge ash added in order to investigate the improvement of the packing of the concrete, if any.

The chloride content in the sludge ash was measured to 96.53 mg/kg. This means that the mortar specimens with the highest amount of sludge ash had a chloride content of 0.003 %, which was below the limits given in DS/EN 206-1 at 0.1-1.0 % for armed concrete. The amounts of heavy metal were determined to be in usage category 2 according to the Danish Environmental Protection Agency (DEPA). This means that the sludge ash has limited usage within construction.
The strength development shows that by replacing up to 10 % of the sand with the milled sludge ash, the compressive strength increases by approximately 25 % after 28 days of hardening compared to a reference mortar. By replacing 10 % of the cement with the milled sludge ash, the mortar specimen achieves the same compressive strength as the reference mortar after 28 days of hardening.

The sludge ash meets the requirements for usage category 2, from DEPA, regarding the heavy metal content. The chloride content for the sludge ash complies the requirements from DS/EN 206-1 regarding armed concrete.
By replacing cement or sand with milled sludge ash was the compressive strength at the same level or approximately 25 % above the reference. This could indicate that the milled ash increases the degree of packing or has a pozzolanic effect. This study shows that the sludge ash could be the next waste product used in concrete.