Valorisation of Greenlandic municipal solid waste incineration bottom ash as sand substitute in mortar

In Greenland waste has traditionally been dumped at open disposal sites combined with uncontrolled incineration. In the mid 1990s the first waste strategy was implemented and as a result, simple and small municipal solid waste incineration (MSWI) plants were taken into use in towns and settlements primarily to minimize the amount of waste at the disposal sites. Between 6,000 – 15,000 tons MSWI bottom ash is produced annually in Greenland and is disposed of at the open disposal sites without leachate collection or encapsulation. The MSWI bottom ash could have value as a secondary resource in construction work, as most construction materials are imported. This would contribute to solving the problem of disposal and possible related environmental problems in the vulnerable Greenlandic environment. This study investigated the use of incineration ash, particularly bottom ash, as a sand substitute in mortars. The ash was taken from two of Greenland’s six incinerator plants, located in the two biggest cities: Nuuk, the capital, and Sisimiut. Mortar samples with up to four different substitution percentages of sand (5%, 10%, 20%, 100%) were tested. The main properties studied were the compressive strength (curing time 7, 14, 28 and 90 days) and the leaching behaviour of the mortars containing ash, in comparison to a reference mix. The characteristics of the ash samples showed that the heavy metal content in the Sisimiut ash contained high amounts of lead and zinc, while the Nuuk ash contained high levels of copper and chromium and the resulting elevated leaching of these metals in the ashes. The compressive strength results after 28 days of curing showed that the mortar samples with 5 % sand replacement with bottom ash have a compressive strength 42-47 MPa compared to the reference (55 MPa). At higher percentages, comparing a replacement of 20% and 100% sand with Sisimiut bottom ash, no significant strength difference was found, while maintaining strength of almost 70% of the reference at 35 MPa. The early strength development was slower for the mortars containing bottom ash compared to the reference. The leaching results showed that the level of heavy metals in the eluate are significantly lower for the mortar samples, compared to those from tests done directly on the ashes, thus including them into a mortar matrix reduces the leaching significantly. In addition to this, the use of bottom ash as aggregate appears to have high potential in mortar, with strength values approaching those of the reference mixes and could have potential for use a local secondary resource.