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Recycling of sewage sludge incineration ashes as construction material

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Highlights:

- Production of construction material from sewage sludge ash without using cement
- The convenience of sewage sludge ash with marble sludge and fly ash for geopolymerization
- No heavy metal leaching problem with the sludge ash-originated construction materials, no hazardous characteristics of the products

Keywords:

- Stabilization / Solidification,
- Geopolymerization,
- Compressive Strength,
- TCLP,
- Eluate test

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Graphical/Tabular Abstract

Incineration is a commonly preferred method in sewage sludge management because of its high volume reduction capacity. However, a waste, namely sludge ash is being generated in considerable amounts as a result of incineration. It is being estimated that the global annual sewage sludge ash generation accounts to approximately 1.7 million tons, and it is likely to increase in the future. Sewage sludges that are originating from the municipal wastewater treatment plants of Bursa city have been incinerated with a fluidized bed reactor since 2017. Each month, on an average, 615 tons of ash is generated as a waste of the incineration process, which needs disposal.

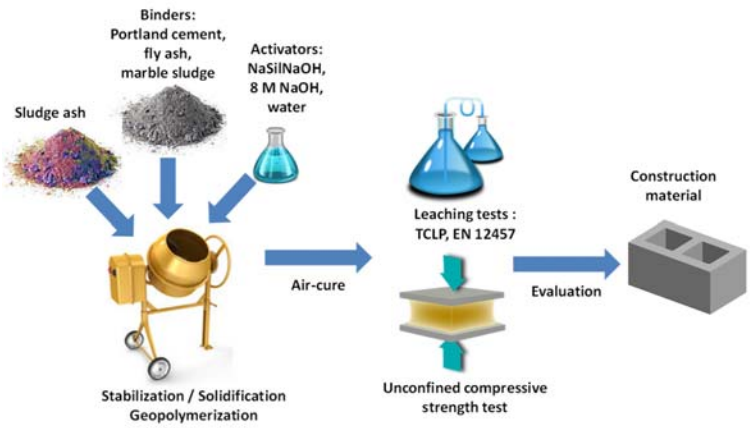

Figure A. Conceptual model for the experimental study

Purpose: The purpose of this study was to investigate if the sludge incinerator ash can be recycled as a construction material.

Theory and Methods:
Stabilization/solidification (S/S) and geopolymerization technologies were applied to the sludge ash to convert the waste material into construction material. Portland cement, fly ash from a coal-fired power plant, and marble sludge were used as binders. S/S samples were activated with water, while geopolymer samples were activated with 8MNaOH and NaSilNaOH solutions. The prepared paste samples were air-cured for 28 days and analyzed for compressive strength and heavy metals leaching.

Results:
S/S samples containing sludge ash yielded a compressive strength level of 21.8 MPa, while geopolymer samples resulted in a compressive strength level of 50.0 MPa. Higher compressive strength levels of several samples containing waste sludge ash than that of the control samples without waste were noticed. Leaching tests showed that heavy metals leaching from the samples prepared with sludge ash were much lower than the legal limit values for toxicity.

Conclusion:
The results of the experiments showed that sewage sludge ash, which is generated as a waste material at the end of the sludge incineration process, has the potential to be considered as a construction material when combined with other materials such as marble sludge and coal-fired power plant fly ash.