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Reuse of waste material for civil application: a study of municipal incinerator bottom ash composition aimed to inertization and recycling.

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The production of building materials usually requires raw materials obtained through extractive activities that often imply different environmental impacts. Moreover, the growing sensitivity towards a responsible use of natural resources has led to greater attention to materials considered as waste; among these, the waste from the municipal waste-to-energy plants is located.
The disposal of municipal waste in landfills is now considered unsustainable in most of the countries where environmental protection regulations have been consolidated and in recent decades the waste-to-energy process has been consolidated, thanks to an increasing differentiation of waste and technologies able to Reducing emissions is widespread, resulting in a large production of waste.
In this study, therefore, the bottom ash of a waste-to-energy plant have been characterized with a multidisciplinary approach in order to evaluate its use as geomaterial for the production of aggregates for civil infrastructures.
A characterization of the bottom ash coming from a municipal waste incinerator plant in the Northern part of Italy to analyze its composition, leaching behavior in water, with a particular attention to heavy metals release in the environmental matrices after leaching processes, in order to improve the reuse of it and to study possible ways of inertization; for example, heavy metals release and the high content of chloride and sulfate ions are the main factor that limit the reuse of bottom ash as secondary material.
Different methods were applied for a complete characterization, to determine the size features, the physical-chemical composition and the behavior at different temperature conditions (200-1000 °C). Micro-XRF, ICP-OES, SEM-EDS, Ion Chromatography and X-ray powder diffraction were used to investigate bottom ashes and leachates before and after the treatments. Bottom ashes are mainly constituted by an amorphous phase, around 66-97 wt%, regardless of particle size; the remaining phases are quartz, calcite, Fe-oxides, melilite and other minor crystalline materials. The amorphous phase exhibits a relevant dependence on particle size, and undergoes dissolution in water up to 20 wt%, thus being the most important component in affecting chemical species release. Bottom ashes' particle size is fundamental to discriminate the material composition, in fact the finer the particle size the more the heavy metals (major species: Zn, Cu, Ti, Pb) and calcium contents increase, whereas silicon's decreases. Electrolytic conductivity during observations during the leaching tests in combination with phase/chemical composition and metals release as a function of particle size, suggest a bottom ashes partitioning into two main classes, i.e. >=1 and < 1 mm, aimed at inertization purposes.