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A second life of waste products for a responsible and ethical use of natural resources: evaluations of the use of ashes produced by waste-to-energy plants as aggregated materials

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In many geographical contexts, the availability of natural mineral resources is not always able to meet the demands and often the supply is carried out at high energetic and environmental costs. This may not only concern fossil fuels but also raw materials used for the production of aggregates. It is one of the consequences of the growth of the living standard that involves the construction of an increasing number of infrastructures.
For this reason the figures called to solve the problems of supplying raw materials and their use, as geologists and engineers, are necessarily faced with problems different from the normal supply of natural resources, increasingly rare and insufficient to cover the demand, thus shifting the scope of research and its application to materials considered as waste or waste resulting from an industrial process.
With regard to sustainability, the use of residues from waste-to-energy plants for urban waste is included: after moderate treatments, they can find a role of raw material-second in the construction of works, reducing the need to find additional natural resources and related problems for their disposal or storage.
The aim of the present study is to characterize the bottom ashes of a plant present in northern Italy by means of a multidisciplinary approach and on the basis of the results we have defined the quotas of material available for re-entry into the "portfolio" of raw materials. We have also tested some inertization techniques to reduce polluting substances release in the environment as natural and accelerated carbonation. The carbonation process involves the absorption of carbon dioxide by an alkaline material, as bottom ash, decreasing pH and making calcite precipitate. The interaction of carbon dioxide with municipal solid waste incinerator (MSWI) bottom ash has been studied to investigate the resulting changes in pH and bottom ash mineralogy and the impact that these changes have on the mobility of dangerous substances, especially heavy metals. This process can be natural, in an open environment, or accelerated, using laboratories reactors to study the variation of time, temperature and humidity to maximize the carbonation process. We have compared this two methods to evaluate the possibility of a reuse of bottom ashes, respecting the European legislation threshold limits.