EVALUATING BY LCA THE ENVIRONMENTAL IMPACT SAVINGS RELATED TO THE USE OF WASTE INCINERATION BOTTOM ASH IN PORCELAIN TILES MANUFACTURING: THE ROLE OF METALS RECOVERY

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The implementation of circular economy concepts in industrial manufacturing is being promoted in many Countries, in particular by the EU. The evaluation of the economic and environmental savings related to the decrease of the amounts of waste sent to final disposal and also of the impacts of the extraction of raw materials, are of particular relevance to companies. In particular, Life Cycle Assessment (LCA) and footprint analysis are being increasingly applied with the aim of attaining Environmental Product Declarations (EPDs) to prove to potential customers how “greener” the products achieved employing circular routes are compared to those attained via traditional linear processes. It should be noted however, that the environmental advantages that can be achieved can vary significantly according to the specific characteristics of the system in question, such as the current strategies applied for managing the waste, the types and amounts of raw materials that are replaced and the distance of supply of each type of material (both for the waste and raw materials).
A type of waste material that is currently being increasingly used outside of landfills is waste incineration bottom ash. This material is employed as aggregates or sand substitutes in concrete or asphalt mixtures, as aggregates in unbound applications, or as raw material in cement or recently also ceramics manufacturing. In any case, the bottom ash is first treated to recover ferrous and non-ferrous metals and may undergo different treatments such as particle size separation, crushing, washing, natural weathering and/or binder addition, in view of the intended application.
In this study, we focused on the relevance of some of the input parameters and assumptions on the environmental impacts resulting for a cradle to gate LCA case study concerning a manufacturing process employing waste incineration bottom ash. Specifically, data from a company in Central Italy that has started a production line of porcelain stoneware tiles using waste incineration bottom ash in partial replacement of feldspar sands was employed to evaluate the environmental impacts related to the manufacturing of the new product, comparing them to those of the same type of tiles produced using only quarried material.
From the comparison of the environmental performances related to the production of the two types of products (stoneware tiles with and without bottom ash) assessed employing the EPD 2018 method and Simapro 9.1.1 software, the production of the tile containing the bottom ash compared to that obtained by the traditional process would in particular involve a significant decrease of the following impacts: mineral consumption and eutrophication (70%), photochemical smog and acidification (40-45%) and climate change (25%). In particular, the results showed that the reduction of the impacts is not so much linked to the impacts avoided for the extraction and transport of feldspar replaced by bottom ash, as to the recovery of ferrous and non-ferrous metals from the bottom ash implemented in the tiles manufacturing plant. It is evident hence that the results are strongly dependent on the assumptions made regarding the amounts of iron and aluminum that can be recovered and the processes assumed for their recovery. In particular, the substitution of primary steel and aluminum production were considered, although the impacts related to secondary steel and aluminum production were accounted for and substitution ratios lower than 1 were considered.
It should be highlighted that for the analyzed case study it was considered that the bottom ash would be treated for metal recovery at the plant and would be diverted from landfills. If instead pre-treated bottom ash intended for reuse as aggregates were employed in the tile production process, the potential environmental benefits that could be achieved would be significantly lower.
At the Conference the results of the study, and in particular the effects of the assumptions made on ferrous and non-ferrous metals recovery, with regard to amounts, quality and utilization/substitution scenarios, as well as of the management options for the bottom ash and transport distances, will be assessed in terms of their overall effect on the environmental impact savings of the examined circular economy process.