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Turning mine waste into a ceramic resource: Plombières mine tailing case

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Mining and quarrying waste is considered the second largest waste stream in Europe. According to Eurostat, in 2018, this extractive waste accounted for over a quarter of all the EU-27 waste output (26.2%). The accumulation of this type of waste in tailing dams or waste rock piles, with no end-use, can pose as a significant environmental and health hazard as well as a resource loss. Sulphidic mine waste processing residues (tailings) pose a large challenge, as their content in hazardous metalloids and sulphates tend to become more chemically available, leading to the generation of acid mine drainage. Apart from the hazardous metalloids and sulphates, these mine tailings contain valuable base, precious and critical metals which can be used in different technological applications. Moreover, silicates and clay minerals are amongst the most common and abundant minerals in sulphidic mine tailings, which indicates that after pre-treatment, if necessary, they can be used in different ceramic building applications (e.g. roof tiles and blocks) for an increasing world's population.

Plombières Zn-Pb inactive mine (Eastern Belgium), was exploiting an ore deposit between 1844-1882 and after closure of the mine, imported ores were smelted at the Plombières site until 1922. The dumped material from the mining operations consist of mainly mine waste and metallurgical waste, such as tailings and slags, from the processing plants. The goal of the present study is to evaluate the potential use of (uncleaned) Plombières tailing material in 3 different ceramic products (roof tiles, blocks and pavers), with different compositions and firing temperatures, taking into account production parameters, product quality and environmental compliance in Flanders (Belgium).

After a detailed physical, mineralogical, chemical, thermal and environmental characterisation of the Plombières mine tailing material, as well as of the replaced raw materials, one company-specific blend has been modified on a lab scale for each ceramic product, by partly or totally replacing some primary raw materials (mainly clay and sand) by 5%, 10% and 20% of Plombières fine tailing material. The shaping, drying and firing behaviour of lab test pieces was assessed and compared to the standard, as well as the required technical, aesthetical and chemical properties of each ceramic product. Furthermore, environmental compliance tests (column leaching test) were

performed on the fired test pieces of all the ceramic products. The column leaching test is performed considering a 2nd life scenario where shaped building products are demolished and can be recycled as granulates (non-shaped building products).