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The "Theisenschlamm" challenge: exploring the potential and limits of valorizing a stockpiled flue dust slurry by mixing it with other environmentally toxic waste streams.

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Theisenschlamm is an industrial waste product from the copper smelting of Kupferschiefer from the Mansfeld region (Germany). It is a slurry of flue dust that was fed into the lead smelting process until the 1970s and stockpiled after the lead smelter was closed. With the cessation of Kupferschiefer mining and the closure of the associated metallurgical plants in 1990, a total of 220,000 tons of "Theisenschlamm" were amassed into one tailing and safely stored.

"Theisenschlamm" is characterised by elevated concentrations of Pb and Zn, as well as accumulations of strategically significant trace metals, including Re, Ag, and Ge. Its mineralogical composition is complex. In addition to sulfide, sulfate and silicate minerals, high organic carbon concentrations with toxic biphenyls, dibenzofurans and polyaromatics are found.

Alongside the safe storage, extensive investigations were carried out into the possible use of this valuable resource, which, however, could not be technically implemented till today. The main focus was on the extraction of individual metals by hydro- or pyrometallurgical means. As part of the FINEST project, a novel circular economy approach was developed that encompasses the pyrometallurgical extraction of a wide range of metals using a plasma furnace, in addition to the production of a non-classified slag that could be utilised as a building material or disposed of without long-term surveillance costs. This approach involves the mixture of the "Theisenschlamm" with materials from the wastewater treatment of the surrounding tailings and reducing agents from other waste streams.

The results of the metallurgical experiments are presented, as well as the possibilities and limitations of this circular economy approach, particularly with regard to the geochemical material balance will be discussed in details. This will be sustainable legacy industrial wastes and resources management, to implement circular economy in practice using advanced geochemical and mineralogical understanding.

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