

Integrated economic and environmental assessment as driver for innovation of metallurgical systems for the recovery of metals from low grade input materials

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Keywords: LCA, Risk Assessment, Metallurgy

Low-grade primary ores and secondary industrial residues often yield significant amounts of (critical) metals. As Europe doesn't possess easily accessible deposits of raw materials, these low-grade resources could serve as a reliable sources of metals. Traditional pyro- and hydrometallurgical methods don't suffice to exploit metals from these resources. Within the METRGROW+ project the main aim is to valorise the low-grade resources by implementing novel methodologies in a metallurgical system, with a zero waste approach in which valorisation of all outputs of the raw materials is achieved. In order to reach that aim, an integrated Life Cycle, Risk and Techno-Economical Assessment (LCA-RA-TEA) will be performed. Importantly for the LCA-RA-TEA is to align the goal and scope of the studies. The goal of the integrated LCA-RA-TEA is to quantify the environmental impacts, environmental risks and economic impacts of the metallurgical systems that consist of the novel unit operations that are developed during the course of the project and tested for 4 different material streams (laterites, fayalitic slags, iron rich sludges and fine grained poly-metallic sludges). Impacts from the complete metallurgical systems will be assessed by combining results for the different unit processes. Many unit processes are still in an experimental phase, and impacts will be assessed based on outcomes of the different unit processes modelled to industrial scale. For the LCA-RA-TAE study a gate-to-gate approach will be used. The system boundaries of the studied metallurgical systems comprise the pre-treatment and the smelting-refining steps of the raw materials to the production of refined metals and matrix products. Downstream activities of the matrix products will be included in the system boundaries, as these will comprise novel products/uses/risks and could be different for the metallurgical systems investigated. The material management perspective is chosen to define the functional unit as the treatment of 1 tonne raw input material for the recovery of valuable metals (e.g. Cr, Ni, Zn & Co) and matrix products. This also highlights the zero waste concept that is key to the METGROW+ project. The product environmental footprint (PEF) guidelines will be used as base for the LCA impact analysis. The outcome of the LCA-RA-TEA will allow to select the most cost-effective and environmentally-friendly flow sheet for a given low-grade resource.