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

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Low-grade primary ores and secondary industrial residues often yield significant amounts of (critical) metals. As Europe doesn't have easily accessible deposits of raw materials, these low-grade resources could serve as reliable sources of metals. Traditional pyro- and hydrometallurgical methods do not suffice to exploit metals from these resources. Within the METRGROW+ project the aim is to valorise low-grade resources (laterites, fayalitic slags, iron rich sludges and fine grained poly-metallic sludges) by implementing novel methodologies, with a zero-waste approach. To aid in the development of the novel unit processes, an interative integrated Life Cycle, Risk and Techno-Economical Assessment (LCA-RA-TEA) will be performed, quantifying environmental impacts, environmental risks and economic impacts. This to enable practitioners to select the most cost-effective and environmentally friendly option. The impacts related to the whole metallurgical systems will be assessed by combining results for the different unit processes. 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 until the production of refined metals and matrix products. Downstream activities (processes and uses) 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 functional unit is defined 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. In the first iteration, most unit processes are still in the experimental phase. Therefore the collected process data is modelled to an industrial scale using HSC Chemistry. This upscaled data is used as input for the LCA-RA-TAE, allowing to make meaningful estimates on the environmental and economic impacts of the individual unit processes. By using a multi-criteria analysis based on the outcomes of the LCA-RA-TEA, the aim is to select the most cost-effective and environmentally-friendly flowsheet for a given low-grade resource and providing decision support for the extractive metallurgy industrial stakeholders. First results methodology shows us the value and pitfalls and points of attention for the second iteration.