2023_28_ESE_Brito Parada: Coupling Life Cycle Assessment and modelling tools to inform the sustainable processing of critical raw materials

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The need for decarbonisation cannot be decoupled from an increase in demand for critical metals and minerals required for the green energy transition. The mining sector is, however, a major user of scarce resources, i.e. water and energy. Important environmental aspects must therefore be carefully considered to ensure mineral beneficiation processes adhere to sustainability principles. Life Cycle Assessment (LCA) is a well developed tool to assess environmental impact, but challenges remain regarding its application in mining and mineral processing operations. While the importance of coupling process simulators with LCA has been highlighted in the literature, applications of such an approach in mineral processing are scarce. Indeed, the limited use of LCA in the mining industry contrasts with its wide applicability in other industrial sectors. In particular, adequate inventory information required for LCA studies is usually not readily available.

The aim of this project is to develop further the coupling between process simulation and Life Cycle Assessment (LCA) in order to support well-informed design of mineral processing chains, towards optimized technical, economic and environmental performances. The newly developed approach will be integrated into an existing process simulation software for application to several case studies, as a support to the design of resource efficient and environmentally optimized small-scale mining operations in Europe (targeting critical metals, and in particular antimony). The approach will account for variabilities in the mineralogy of the mined ores and in plant performance (with uncertainty propagation). Results will be provided to process developers both by use of a number of diverse indicators and in an aggregated manner, supported by the coupling of LCA and Multi-Criteria Decision-Making methods. Moreover, the use of process simulation will support the accounting of dissipative flows in Life Cycle Inventories (LCI) of mineral processing chains, and therefore the consideration of more meaningful resource indicators in LCA. Finally, this PhD project will enable to complement existing (and widely used) LCI databases, through the integration of new datasets associated with a number of process chains currently not represented in these databases.

The PhD student working on this project will join a vibrant and multidisciplinary research group in the Department of Earth Science and Engineering at Imperial College and will work closely with colleagues at the French Geological Survey (BRGM), where they will have the opportunity to spend time during their PhD.

Interested candidates should follow the application guidelines published by the SSCP DTP and send a CV, a short statement, and any questions to Dr Pablo Brito-Parada (p.brito-parada@imperial.ac.uk).

For more information on how to apply to us please visit: https://www.imperial.ac.uk/grantham/education