A Life Cycle-Based, Sustainability-Driven Innovation Approach in the Minerals Industry: Application to a Large-scale Granitic Quarry in Rio de Janeiro

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Abstract

Sustainability in mining must be envisioned from a more comprehensive perspective that involves the management of primary and secondary resources and that prioritizes the adoption of innovation beyond a techno-economic mindset. The holistic Life Cycle Assessment (LCA) methodology is useful to diagnose the environmental profile of mining operations seeking a greater contribution to sustainability. This work proposes an enhanced life cycle-based approach for the minerals industry, which is supported by mine-to-product process simulation, scenario analysis, and a comprehensive and context-specific data collection involving the life cycles of the product and the mining project. The convenience of this approach in terms of reducing epistemic uncertainty is demonstrated with a Brazilian case study of a large-scale granitic quarry operation. It is shown that mining can contribute to sustainability by adopting sustainability-driven innovation and circularity principles. The proposed methodology can be applied to other mineral commodities and geographic contexts.

Keywords: Minerals industry; Life cycle assessment (LCA); Process simulation; Innovation; Circularity; Aggregates