CERIS Civil Engineering Research and Innovation for Sustainability

Recovery of mining residues for ecoefficient mortar production

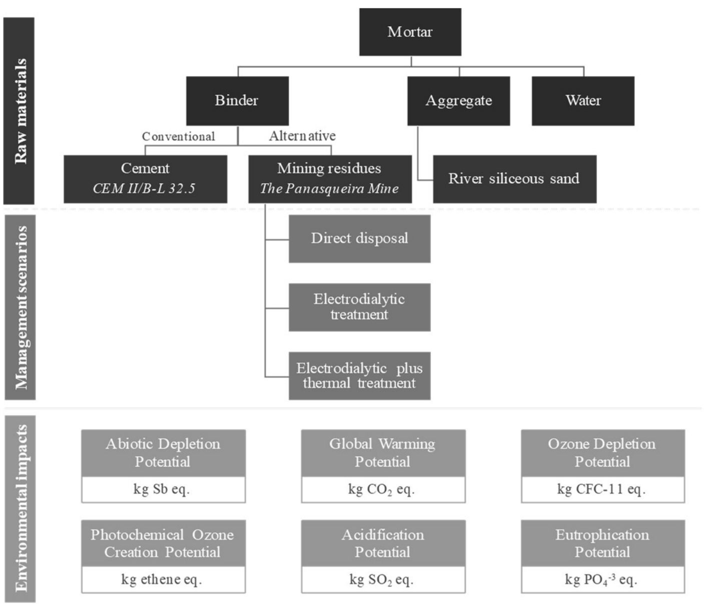
Summary

Raw materials are essential for human well-being, although their production, consumption and end-oflife are causing increasing environmental burdens. The Panasqueira mine has been operating for more than one century, being the main threat to its activity and for the surrounding ecosystem the disposal of significant amounts of old mining residues that contain substances of environmental concern. On the other hand, tungsten, considered a critical raw material, can be recovered from Panasqueira mining resources. In the construction sector, cement is one of the main contributors for greenhouse gas emissions and is the main binder used in mortar and concrete production. Hence, a partial replacement of this binder by secondary mining resources may bring economic, social, technical and environmental benefits. Efficient technologies to remove and recover elements from environmental matrices may promote safe storage and reuse. The electrodialytic (ED) treatment has demonstrated successful results on the removal of inorganic and/or organic contaminants from a wide range of resources. Thus, to address the challenges in climate change and environmental degradation issues, in both mining and construction sectors, the present work aimed at assessing the feasibility of applying the ED technology to mining residues for (1) the recovery of critical raw materials and the hydrogen that is inherently produced; (2) the removal of harmful compounds; (3) the production of a suitable matrix for further reuse in cementitious construction materials, and (4) the minimization of environmental impacts in the materials life cycle.

The main results of the work developed demonstrated that the reuse of mining residues can decrease the consumption of primary resources and promote improvements in the sustainability of the industries involved, without high investments. Through the ED treatment, tungsten could be recovered in 22%, while the removal of arsenic may achieve 63%. The hydrogen produced can be recovered with 74% of purity. The production of cement-based mortars, replacing cement by treated mining residues, revealed similar performances to conventional mortars. Although a higher cement substitution percentage (50% volume) have caused some deterioration in mechanical resistance, the mortars produced demonstrated compatibility with current applications, as bedding mortars and fired brick masonry walls. The life cycle analysis also proved that the mortars produced allow impact mitigation in several environmental categories, namely in global warming potential, supporting the circular economy of sustainable construction products.

Keywords

Mining residues, electrodialytic treatment, critical raw materials, construction materials, life cycle assessment, circular economy.



Life cycle analysis.

PhD student

Joana Saraiva Rocha de Almeida

PhD program

Civil Engineering (FCT, Nova University of Lisbon)

Supervisor

Paulina Faria (FCT, Nova University of Lisbon; CERIS, IST, University of Lisbon)

Co-supervisors

Alexandra Branco Ribeiro (FCT, Nova University of Lisbon) and António Santos Silva (LNEC)

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