

COMPARATIVE LIFE CYCLE ASSESSMENT (LCA) OF A NOVEL CEMENT BASED ON BAUXITE RESIDUE (BR)

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After water, concrete is the second most consumed material on earth, corresponding to 3 tonnes per year per human¹. Promising benefits of scale can be achieved by decreasing the environmental and human health impacts of concrete and its key ingredient cement. This work explores the use of bauxite residue (BR, a byproduct of alumina production) as a potentially low-environmental impact substitute for clinker within the cement. This work addresses the symbiotic value chain between the cement and alumina industries by a comparative cradle-to-grave custom LCA model (Figure 1). An Open LCA model was developed to compare Ordinary Portland Cement (OPC) and the novel cement including 30 wt% BR as a Supplementary Cementitious Material. The functional unit (FU) was selected as 1 m² of concrete structure in an average European building. Based on this FU, a life cycle inventory (LCI) has been established. The comparison was performed based on the Recipe Midpoint (H) impact assessment method. According to the results, BR addition to the OPC production would generate almost 20% less CO₂ than traditional OPC production, while other indicators showed similar results. This preliminary study provides a comprehensive quantitative assessment. Future efforts will concentrate on advanced and comprehensive fate, exposure, and damage modeling.

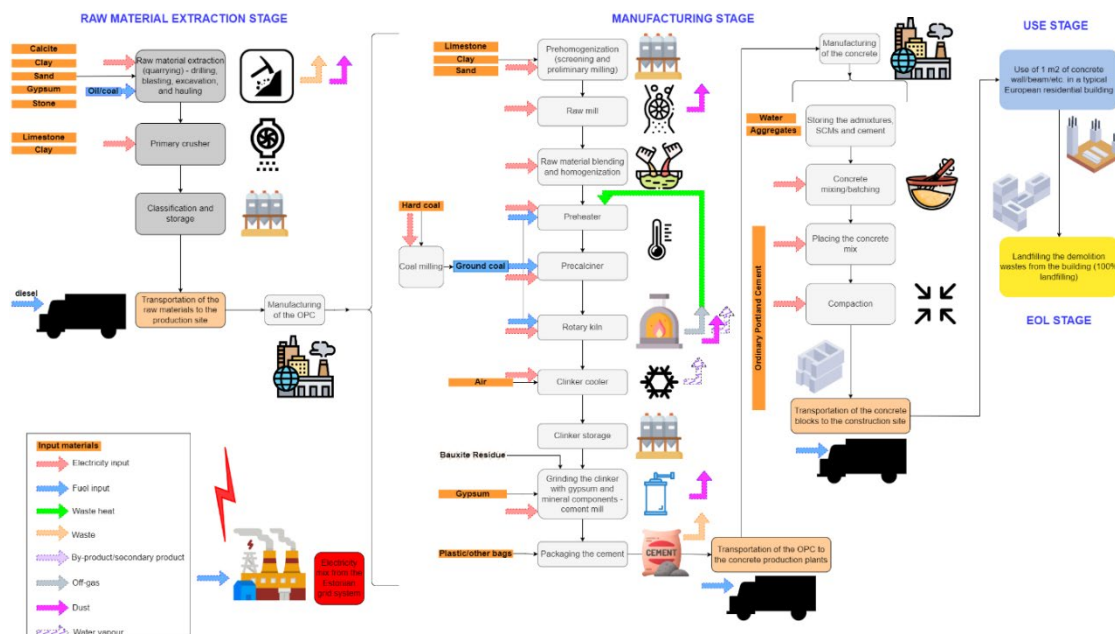


Figure 1. Life cycle stages model for cradle-to-grave LCA study of bauxite residue (BR) addition to Ordinary Portland Cement (OPC).

¹Gagg, C. R. (2014). Cement and concrete as an engineering material: An historic appraisal and case study analysis. *Engineering Failure Analysis*, 40, 114–140. <https://doi.org/10.1016/j.engfailanal.2014.02.004>



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