

unLIMEted – Closed-loop recycling and reuse of lime-based masonry waste through thermal reactivation

Summary

Currently, the construction industry faces significant environmental challenges, including the rapid depletion of natural resources, the emission of greenhouse gases from binder production, and the generation of vast amounts of construction and demolition waste (CDW). Indeed, CDW constitutes the largest waste stream within the European Union, with an annual generation estimated between 450 and 500 million tonnes. Recognising its environmental impact, resource value, and recycling potential, the EU has designated CDW as a priority waste stream within its circular economy and waste management policies, aiming to enhance recovery, recycling, and the sustainable use of resources. Nevertheless, certain types of CDW remain largely underexplored in terms of valorisation. One example is lime-based masonry waste.

Lime was the most common binder in construction until the 20th century. Due to its historical prevalence, masonry buildings incorporating lime mortar as a joint material or surface finish are abundant worldwide. In Portugal alone, a substantial part of the more than 1.5 million existing masonry buildings (out of a total building stock of 3 million) were constructed using lime mortars. Consequently, this waste stream represents a significant portion of all CDW generated—yet one that could be fully recycled. Since lime mortars are relatively weak, they can be easily separated from masonry blocks, which can themselves be reused. Lime mortars can then be thermally reactivated (based on the lime cycle), and the resulting lime and aggregate used to produce new materials. At their end of life, materials made with recycled lime can potentially be recycled again, creating a zero-waste, closed-loop system.

Despite its potential and the high volumes involved, the valorisation of lime masonry waste from the demolition, collapse, or restoration of old buildings has been largely overlooked. This project, therefore, aims to develop an efficient process for recycling and reusing lime from masonry waste through thermal reactivation, to produce new construction materials with added value. The process will allow not only obtaining recycled lime but also recycled fine aggregates—particularly important given the current shortage of natural sand.

The project will make a relevant contribution to the technical and scientific community by: (i) defining a methodology for the thermal reactivation of lime; (ii) characterising the properties of recycled lime, recycled aggregates, and the materials produced with them; and (iii) identifying ways to reuse these recycled materials in construction (e.g., in new mortars, premixed products, or as fillers).

Furthermore, the project aligns strongly with the UN 2030 Agenda Goals 9, 12, and 13, as well as EU environmental and waste management targets, by promoting circularity and sustainability in the construction sector through: (i) significant reductions in the generation of CDW and extraction of new raw materials; (ii) the valorisation and reuse of waste; (iii) reductions in energy consumption and in greenhouse gas emissions associated with the manufacture of new masonry blocks and binders (as lime reactivation requires lower calcination temperatures than new lime production); and (iv) increased use of lime-based materials, which can capture up to five times more CO₂ than cement-based alternatives, thereby contributing more effectively to the EU's target of net-zero greenhouse gas emissions by 2050.

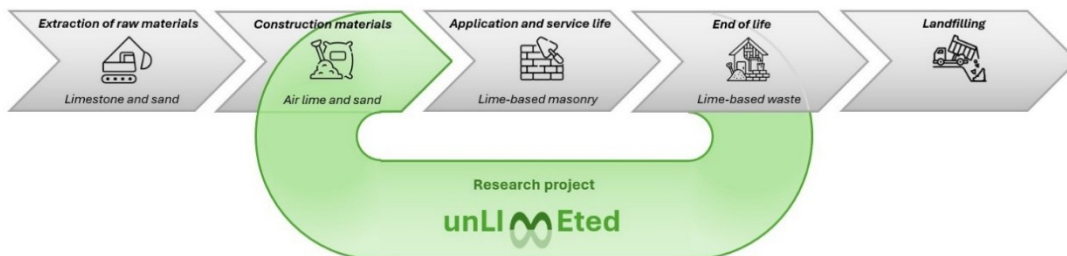


Figure 1. Objective of the project.



Project Reference

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Leading Institution

IST-ID – Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (Portugal)

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CERIS

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Project website

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