SUBLime
Sustainable Building Lime Applications via Circular Economy and Biomimetic Approaches

Marie Skłodowska-Curie Actions

OPEN PhD POSITION in European Training Network

We are looking for a dedicated and highly motivated Early Stage Researcher (ESR), who will join our team to craft the future of lime mortars/plasters in new construction and conservation of the built heritage.

SUBLime description (4 years ETN project starting February 2021)

Lime is one of the earliest industrial commodities known to man and it continues to be one of the essential building blocks of modern Society. The global lime market is anticipated to approach the value of 44 Billion Euros by the end of 2026 and resulting in various growth opportunities for key players. The SUBLime network aims to develop the most advanced technology in lime-based materials modelling and characterization for industrial use that will go beyond the limitations of existing solutions in new construction and conservation in the built heritage. It is dedicated to recruit and train fifteen PhD students in multiple scientific and engineering fields towards a better understanding and development of sustainable innovations in both added functionalities and sustainability aspects in lime mortars and plasters, strongly based on novel biomimetic and closed loop recycling approaches. The cross-disciplinary approach throughout the SUBLime value chain, leveraging the knowledge of the academic (6) and industrial members (11), such as lime producers, mortar/plaster/block producers, and end-users for the prioritization of industrial needs, will dramatically increase the transfer of scientific knowledge to the lime-consuming industries in the EU.

ESR4 – UGR

New CO2 capture solutions on lime-based mortars

Objectives: Lime-based mortars and plasters naturally set and harden by carbonation, contributing to the long-term effective mineral sequestration of atmospheric CO_2. However, little is known on the mechanisms and kinetics of this process. This precludes the design and implementation of effective methods to speed up this setting reaction and to optimize CO_2 mineral capture. Here we plan to conduct a detailed research of the mechanisms and rate-controlling steps of lime carbonation. For this task we also will explore the possibilities of using lime-rich industrial waste materials (e.g., carbide lime or other alkaline wastes such as bottom - or fly-ash from carbon power plants) as a binder and/or additive (with pozzolanic activity) for CO_2 capture and utilization. Means to accelerate the carbonation process will also be explored by using a biomimetic approach. Overall, the main objectives are: (a) Gain a better understanding on mechanisms and kinetics of lime-binders carbonation; (b) Evaluate the possibility of using waste lime (e.g., carbide lime) and other industrial Ca-rich alkaline wastes as an alternative to hydrated lime for the design and application of lime-based mortars and plaster with the added-value of enhanced CO_2-capture and utilization; (c) Gain insight on the mechanisms and effects of natural enzymes such as carbonic anhydrase for the acceleration of the carbonation (setting via CO2 mineral capture) of lime-based materials; (d) Explore the possible application of Zn-based MOFs as a biomimetic strategy for the accelerated CO_2 capture and setting via carbonation of lime-mortars and plasters.

Expected Results: The research results will lead to a better understanding of mechanisms and kinetic of carbonation of lime-based binders used in mortars and plasters. They will also contribute to the recycling and utilization as building materials of lime-rich industrial wastes that are currently stockpiled or disposed in ponds or landfills (e.g., case of carbide lime) posing an environmental risk and being an economic burden. We also expect to gain an insight into the effect that natural and artificial (biomimetric) metal-enzymes play on the acceleration of lime mortars and plasters carbonation. Ultimately, we strive to develop an economic biomimetic strategy for accelerated lime-binders setting via CO_2 capture.

Keywords: lime mortars carbonation, kinetics, CO_2 capture, carbonic anhydrase, biomimetics, MOFs, Ca-rich alkaline industrial wastes.

Applicant Profile: Master level in Geology, Physics, Chemistry or related field, ideally with background in experimental research. Excellent communication skills (both written and oral) in English.

PhD main locations: The recruited ESR is given the opportunity to conduct 3 years of PhD studies at Unit of Research Excellence "Carbonates", located at the Dept. Mineralogy and Petrology in the University of Granada, but also to visit other network partners for secondments (Lhoist, Technical University Delft , and Carbon8), and to attend the training events of the network.

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More details about SUBLime project, requirements for the candidates and recruitment procedure: www.sublime-etn.eu/jobs/