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Use of microorganisms to improve the cementation of granular structures. Applications in the restoration of monuments

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This researching work focuses on the development of new procedures to be applied in heritage rehabilitation, through the implementation of low-cost biotechnological processes in the realm of engineering and architecture. In doing so, it explores the possibilities of MICP (Microbially Induced Calcite Precipitation), which is a biomineralization process applied to improve the engineering properties of granular structures.
This is a novelty approach at present, as there are few researches putting together knowledge in biotechnology and mineralogy to by applied in architecture and engineer. Some authors propose the bacteria use to generate habitable structures that reduce desertification (Magnus Larsson 2008). Innovative research teams led by De Jong and the University of California UC Davis (XXXX) study how cement or stabilize soils to prevent landslides, improving the foundation injecting populations of Bacillus pasteurii in the field. Bacterially induced mineralization has emerged as a method for protecting and consolidating decayed ornamental stone, which offers noticeable advantages compared to traditional restoration procedures (Tiano et al., 1999). Castanier et al. (2000) found that Bacillus cereus was able to induce extracellular precipitation of calcium carbonate on decayed limestones. Rodriguez-Navarro et al. (2003) tested the ability of Myxococcus xanthus to induce calcium carbonate precipitation. Current studies are evaluating the potential of bacteria as self-healing agents for the autonomous decrease of permeability of concrete upon crack formation (De Muynck, et al 2010)
In the urban area of Seville, most historical buildings are constructed with calcarenites, limestones, sandstones and bricks, the weathering forms associated to this building materials often are granular disintegration, so the proposed technology has a huge potential to be applied to these materials for possible restoration.
This research is mainly grounded on laboratory work, which focuses on finding out the best conditions to cultivate populations of bacterias Bacillus pasteurii and Myxococcus xanthus and the suitable proportions of the mixing of urea, with building material, calcium chloride; to come out with structural components interesting for the civil engineering. Trials with some stone materials with alteration problems (granular disintegration) have been carried out to assess their application to the restoration of monuments. Porosity and petrographical characterization has been analyzed before and after the process.