# Mechanical properties and durability of a sand cemented by microbially-induced calcite precipitation (MICP)

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**Résumé**

Microbially-induced calcite precipitation (MICP) is a recent technique which represents a promising tool for soil improvement and remediation mediated by bacterial activity. More specifically bio-induced precipitation of calcium carbonate (CaCO3) can be used to transform a non-cohesive sand into a cohesive medium, creating CaCO3 crystal bridges between the sand grains(1). This application of MICP presents many advantages compared to the commonly used soil-reinforcement techniques that may involve high carbon footprint, use of toxic materials and high-energy consumption. On the contrary, bio-cementation would represent an environmentally friendly solution.

The mechanical properties of bio-cemented sands have been extensively characterized at the macroscale and microscale in our group. Synchrotron X-ray microtomography measurements (2) and triaxial tests on bio-cemented column samples permitted to understand that the macroscopic mechanical response of bio-cemented samples mostly depends on the micromechanical properties of the cohesive contact, the percentage of these cohesive contacts and their surface area distribution (3). Then, micromechanical characterization (4) (tensile and shear strength) of single agglomerates of two cemented sand grains have been performed in order to obtained input parameters in computation using D.E.M. (Discrete Elements Method) to predict the mechanical behaviour of bio-cemented samples (5).

In the optic of the application of bio-cemented materials, the durability becomes a key point. When exposed to aggressive environments, such as weakly acidic water, CaCO3 crystals dissolve triggering the degradation of the bio-cemented material and its potential strength decrease (6). The variation of pH and concentration of the solution influences the dissolution behaviour of CaCO3 crystals resulting in changes also on the morphology and contact properties of the crystals. Microfluidics represent a promising tool to study the behaviour of dissolution of CaCO3 crystals. In particular, it permits the possibility to perform in-situ experiments monitoring several parameters, such as flow rate, pH and concentration

*Intervenant

of the solution simultaneously.

The understanding on the evolution of the cemented contact surface areas measured at the local scale in the 2D porous media will be integrated in the D.E.M. model to gain multi-scale insights on the evolution of the mechanical properties of bio-cemented materials when exposed to acidic conditions.

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