

Biocalcis[®]



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Soil consolidation
by biocalcification



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This innovative biotechnology emulates natural calcification processes to cement soil in situ while maintaining its initial porosity.

- ⊕ A number of bacteria present in the natural environment are known to precipitate a variety of calcium carbonate minerals that build up over centuries to form **calcareous concretions with excellent mechanical properties**. A representative and spectacular example of this phenomenon is **the formation of stromatolites in shallow high-saline water** in Australia.
- ⊕ These observations suggested the idea of using **biomimicry** of these biogeochemical reactions to improve the soil via in-situ biocalcification.

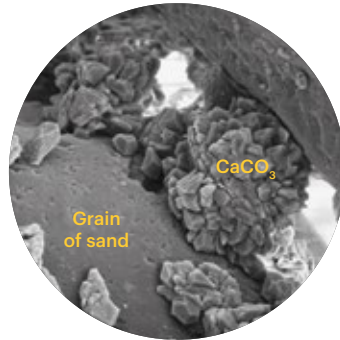


A natural phenomenon

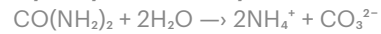


Use of the phenomenon to create a biocalcification injection process

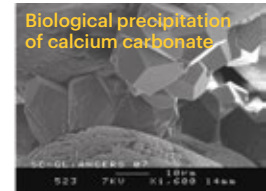
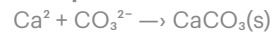
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+ Hydrolysis of urea by the bacteria

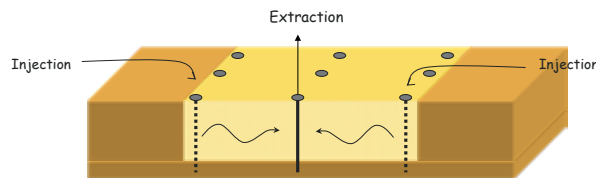


+ Precipitation of calcite



Sporosarcina pasteurii bacteria are non-pathogenic and environmentally harmless. They are cultivated using an industrial protocol developed by Soletanche Bachy. Calcite precipitation achieved by causing the bacteria to react with a calcifying nutrient solution.

Protocol

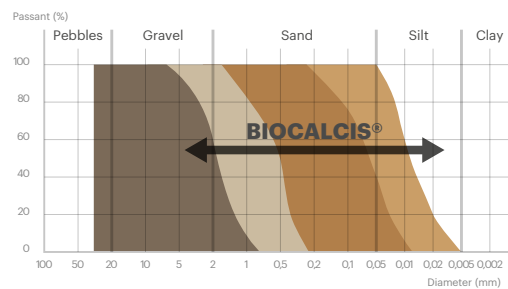


Inject insuccessive phases

1. Inject bacteria
2. Wait several hours to fix the bacteria in the soil
3. Inject the calcifying solution (urea/CaCl₂)
4. Exposure time required for biocalcification (several hours)
5. Final flush

Types of soil

Soil in which the various injection products can be used



Characteristics

- + The bacteria – a few microns in length – are small enough to be injected into fine-grained soils $K < 10^{-5}$ m/s
- + The viscosity of the bacterial suspension and the calcifying solution is close to that of water
- + No pressure increase during injection
- + Rapid reaction time: final mechanical strength is obtained within a few hours
- + Pores remain open after treatment – permeability does not change
- + Range of UCS values possible, from 0.1 MPa to several MPa

Applications



- + Restoration of reinforced soil retaining walls
- + Mitigation of soil liquefaction
- + Treatment to prevent internal erosion of embankments and slopes
- + Deepening of quay walls
- + Stiffening of soils under structures sensitive to vibrations
- + Artwork of stone & historical monuments restoration

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SOLETANCHE BACHY

Soletanche Bachy is a world leader in foundations and soil technologies, operating in 60 countries via a network of 80 subsidiaries and branches. The Group delivers the full range of geotechnical processes and provides innovative, effective solutions as either a lead or specialist contractor for turnkey projects with a geotechnical focus or specialist works.



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