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Bio-Grouting Applications in Caprock Sealing for Geological CO2 Storage

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Abstract : Geological CO2 storage has been regarded as a promising strategy to mitigate the emission of greenhouse gas generated from traditional power stations and energy-intensive industry. Caprocks with very low permeability and ultra-fine pores create viscous and capillary barriers to guarantee CO2 sealing efficiency. However, caprock fractures, either naturally existing or artificially induced due to injection, could provide preferential paths for CO_2 escaping. Seeking an efficient technique to seal and strengthen caprock fractures is crucial. We apply microbial-induced-calcite-precipitation (MICP) technique for sealing and strengthening caprock fractures in the laboratory scale. The MICP bio-grouting technique has several advantages over conventional cement grouting methods, including its low viscosity, micron-size microbes (accessible to fine apertures), and low carbon footprint, among others. Different injection strategies are tested to achieve relatively homogenous calcite precipitation along the fractures, which is monitored dynamically based on laser ultrasonic technique. The MICP process in caprock fractures, which integrates the coupled flow and bio-chemical precipitation, is also modeled and validated through the experiment. The study could provide an effective bio-mediated grouting strategy for caprock sealing and thus ensuring a long-term safe geological CO2 storage.

Keywords : caprock sealing, geological CO2 storage, grouting strategy, microbial induced calcite precipitation
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