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Agarose Gel as a Soil Analogue for Novel Ground Improvement Applications

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Extended Abstract

Biological agents can be used to mitigate construction problems – such as poor-quality soils – in a more sustainable manner. For instance, [1] developed an environmentally-friendly bio-mediated soil reinforcement method which improves the properties of sandy soils using bacteria as the trigger for calcite precipitation.
Furthermore, recently, a new multidisciplinary field has emerged called Synthetic Biology, based on Genetic Engineering of microorganisms, which attempts to engineer biological systems in such a way that their properties and response to external stimulus from their environment can be controlled [2]. For instance, [3] proposes a system in which bacteria cells are engineered to respond to pressure changes and synthesize bio-cement through Microbially-Induced Calcite Precipitation for ground improvement purposes. Further, Synthetic Biology could also have an impact on the development of low-cost and harmless soil bioremediation techniques [4].
However, the implementation of genetically modified organisms (GMOs) on civil infrastructure systems is far from realistic due to the constraints involved when manipulating this type of living organisms outside a controlled environment. Therefore, a method is needed in which GMOs can be cultured in a high controllable material with appropriate mechanical properties and tested under different physical and chemical conditions.

Thus, this abstract introduces the concept of agarose gel as a soil analogue for engineered bacteria testing. An experimental investigation is performed to analyse the mechanical properties of agarose gels and describe their similarities to saturated cohesive soils. Scanning Electron Microscope (SEM) inspection showed that agarose gels have a fibre-pore honeycomb microstructure, with pore sizes ranging *0.2-1 μm* in diameter, depending on the agarose concentration – values somewhat similar to those present in clayey soils. Further, mechanical tests (Unconfined Compression and Unconsolidated Undrained Triaxial) have been performed, indicating 6% w/w concentration gels have a comparable shear strength to soft-firm cohesive soils. Further tests are being performed to characterise the consolidation behaviour and their effect on the permeability due to the high compressibility of the gels. Therefore, if the results show that agarose gels can be a valuable soil analogue, their implementation could contribute to the development of novel bacteria-based ground improvement methods.

References

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