Sustainable Soil Stabilisation via Biocementation Using Microbially Induced Calcite Precipitation and Cow Dung as a Low-Cost Organic Bio-Agent

Geetanjali Tiwari
Delhi Technological University, New Delhi, India

Kashish
Delhi Technological University, New Delhi, India

Tanuj Kumar
Delhi Technological University, New Delhi, India

Prof. A. Trivedi
Delhi Technological University, New Delhi, India

Abstract

Microbial calcite precipitation (MICP) has become an all-in-one, environmentally conscious, and sustainable solution as an alternative soil stabilization technique to conventional chemical methods. However, bringing this technology from the laboratory to production is not straightforward. The practical use of MICP has always been hampered by real-world field ap-plications, particularly the high expense of laboratory-cultivated urease-producing bacteria and the special nutrient media they require. This paper describes a workable and inexpensive bio-cementation system that utilizes cow dung, an abundant and inexpensive agricultural byproduct, as a convenient source of both urease-producing microorganisms and necessary enzymes.

We demonstrate that a simple bio-slurry made from cow dung can be effectively used to stabilize weak soils. Laboratory tests showed remarkable gains in soil strength and a substantial decrease in permeability. Interestingly, a significant density-strength paradox emerged: although the modified soil was lighter and less dense, its load-bearing capacity increased significantly. Analysis of soil microstructure and soil-water interaction, initial density, urease activity, and the non-uniform distribution of precipitated calcite revealed new insights. Overall, cow-dung-assisted MICP provides a realistic and scalable framework for large-scale bio-mediated ground improvement that meets stability and resilience requirements while achieving significant cost savings in materials.

Keywords

Biocementation, Microbially Induced Calcite Pre-cipitation, Soil Stabilisation, Cow Dung, Sustainable Engineering, Density-Strength Paradox.