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Isolation and Characterization of Ureolytic Bacteria from Landslide-Prone Areas in Sri Lanka for the Stabilization of Unstable Slope Surface by Bio-Cementation

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Abstract

Landslides are natural disaster, long-existing as one of the geotechnical threats in the central region of Sri Lanka. During the monsoon period of every year, number of human lives are lost due to the landslides. Therefore, early recognition of the potential areas and implementing landslide mitigative measure are essential to prevent the damages. Portland cement and chemical grouts are typically used to enable a protective cover over the slope surface. However, these approaches are recognized environmentally detrimental and expensive. The use of bio-grouting materials is a new proposal to stabilize the slope surface, disclosing the likelihood of eco-friendliness and sustainability. Among various bio-grouting techniques, microbial induced carbonate precipitation (MICP) has gained much attention recently. MICP is a process that triggers the precipitation of calcium carbonate using the metabolic aid of ureolytic bacteria. This paper presents the initial works carried out to isolate and characterize urease-producing bacteria that are competent for the application of MICP-based stabilization of Sri Lanka's unstable slopes. Few landslide-prone areas were identified in Matale district (of Sri Lanka) with the support of National Building and Research Organization. From each location, soil samples were obtained in sterile centrifuge tubes and transported to the laboratory. After a series dilution, soil samples were plated on trypticase soy broth agar medium and incubated at room temperature for two days. Grown-colonies were then carefully separated on new agar plates. Initial screening of potential bacteria was carried out using phenol red pH indicator. The growth and urease activity of identified bacteria were then measured over time. A set of test tube precipitation tests was also performed to verify the applicability of the bacteria. The results indicated that most of the identified bacteria exhibited adequate growth and urease activity during the second and third days of the culturing. The test tube test revealed that the natively-isolated bacteria were highly potential to produce $CaCO_3$, thus disclosed the potential for MICP application. Based on the preliminary results, laboratory-scale slope model tests and field-trails are to be performed in the subsequent phase of this work.

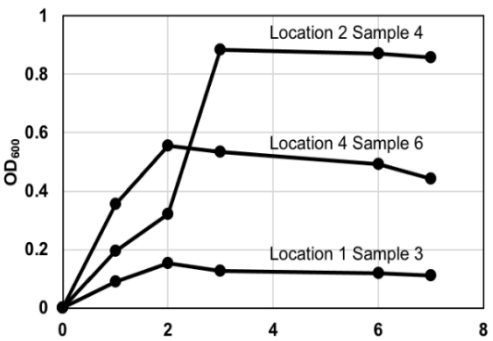

Figure 1 Variation of the growth of bacteria (OD_{600}) with time

Keywords: Unstable slopes; bio-cementation; microbial induced carbonate precipitation (MICP); native ureolytic bacteria; urease activity