Engineering With Nature
Project Fact Sheet

Application of Microbial Induced Calcite Precipitation (MICP) for Improved Wildfire-Altered Soil Performance

Background

Each year, thousands of square miles of land are destroyed by wildfires that can erupt at any time of the year from a variety of causes, including drought, heat, or lightening. Past USACE and ERDC research on wildfires focused on physical measures to control debris flow and sediment management as post-wildfire best management practices, however, they did not address the soils of fire-affected sites. Intense wildfires have detrimental effects on soil physical properties and soil structure by consuming the soil organic matter (SOM) resulting in an increased bulk density and decreased water storage capacity. On natural or engineered slopes, these degraded soil properties can significantly accelerate erosion, sloughing, and slope instability, which in turn can lead to flooding or excessive in-stream sediment loads downstream of the wildfires. There is a critical need to improve the physical characteristics and properties of burnt soils to reduce these harmful effects. This project will assess a treatment for wildfire-altered soils that aims to improve soil erodibility, infiltration, and strength properties by using microorganisms or bacteria that naturally exist in soils. This treatment is called *Microbial Induced Calcite Precipitation* (MICP).

Objectives

The primary technical objective of this project is to provide a sustainable, nature-based, and cost-effective soil treatment technology for treatment of wildfire-altered soils. The current common practice in soil improvement includes mixing of mostly synthetic materials (like recycled glass fibers and tires), chemical grouting or mechanically constructed stone columns. These techniques require substantial energy for their production and installation. MICP is a biologically driven calcium carbonate (calcite or $CaCO_3$) precipitation technology that is sustainable, does not introduce contaminants into the soil, and is not a high-energy process. Successful MICP treatment has been achieved in the field using enrichment medium containing natural materials like molasses, urea, and yeast extract.

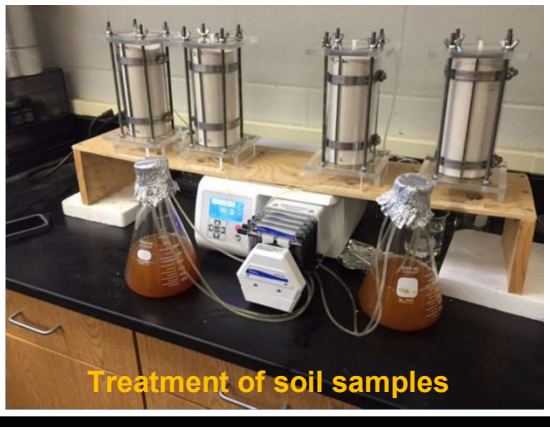
Approach

In order to achieve the above objective, the project team will:

- Conduct a literature review of MICP treatment.
- Investigate MICP treatment using wildfire-altered soils in the lab and in situ. Soils samples will be collected from three different sites.
- Investigate MICP treatment using different bacteria species, feeding media, and treatment times.
- Assess the effectiveness of treatment by measuring the improvement in soil properties (e.g.: resistance to erodibility, shear strength and reduction in infiltration).

Outcomes

This study will investigate the effectiveness of MICP treatment to revitalize soils subjected to wildfire. The outcomes of this study will be useful to inform the cost-effective, large-scale applications of MICP. MICP treatment has potential for broad applications and benefits that go beyond post-wildfire applications. The treatment increases water content of the soil, which deters erosion, slows runoff, and reduces flash flooding, and therefore MICP treatment could in theory also be used to stabilize a highway embankment or natural slope, or lessen the drying effects of drought on soils.


Treatment of soil samples

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