Florida Department of Transportation Research

Application of Microbial Induced Calcite Precipitation to Stabilize Florida High-Organic Matter Soils for Roadway Construction

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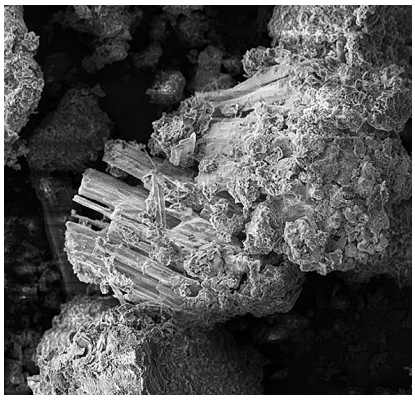
Current Situation

Florida is well known for its lush greenery. This abundant plant life results in soils that are rich in organic matter. That's good in a garden, but not as good for carrying roads. Decay of organic material in soils makes the soils more compressible and, thus, poorer as foundations for structures like roads. The decomposition of the organic matter can create underlying soils with a very large void composition, resulting in large settlements under the road that cause depressions and cracking in the road surface. The greater the percentage of organic material in soil, the greater the potential problem. Soils that are high in organic matter can be stabilized by the addition of calcium-containing materials like lime or cement. One method of doing this involves causing the mineral calcite (calcium carbonate) to form through chemical reactions in the soil to bond particles together and strengthen the soil.



MICP calcite crystals appear in this scanning electron micrograph of a soil sample treated in this project.

Research Objectives

Researchers from the University of North Florida and the University of Florida studied methods of stabilizing high organic-matter soils using microbially induced calcite precipitation (MICP).

Project Activities

In outline form, the procedure used in this project involves applying a solution containing a specific type of microbe, *Sporosarcina pasteurii*, to the soil. In the presence of urea and calcium, this microbe helps produce calcium carbonate (calcite) and has been used to strengthen sandy soils. Challenges of applying MICP to soils with organic matter include uniform distribution in the soil volume and the unpredictable nature of chemistry conducted in a highly variable medium like soil, especially organic soils. Early trials encountered problems with uniform distribution. The researchers tried a pre-mixing technique, but found that it was only slightly more effective and only with soils with lower organic content.

The researchers investigated the role played by a chemical called exopolysaccharide (EPS) in MICP. An EPS is a long chain of sugar molecules secreted by microbes which appears to be essential to successful MICP. However, the formation of EPS appeared to be inhibited by organic matter in soil.

Sodium dodecyl sulfate (SDS), a soap-like chemical often found in cleaning products, was added to the procedure to aid in the calcite precipitation process. Results were promising, but calcium reacted with SDS to produce calcium dodecyl sulfate. This new chemical was highly insoluble and resulted in stronger soil samples. This suggests a new approach using SDS to stabilize Florida soils, which, while beyond the scope of this project, warrants further investigation.

Project Benefits

Methods of stabilizing Florida soils, which often contain high amounts of organic matter, are valuable because they can improve the construction process and the durability of roads. Natural stabilization agents investigated by this study offer a greener solution compared to traditional methods using agents such as cement.

For more information, please see www.fdot.gov/research/.