ESStab: Eco-Friendly Soil Stabilizing Powder

Pratueangsukpong, Narawit (School: Kamnoetvidya Science Academy)
Srijomkwan, Ek-amon (School: Kamnoetvidya Science Academy)
Puanglumyai, Pojarpa (School: Kamnoetvidya Science Academy)

Soil erosion is a natural process that negatively impacts agriculture as it wears away top fertile soil. To prevent soil erosion, Microbial Induced Calcite Precipitation (MICP) is one of the most cost-effective, easy-to-use, and sustainable methods. The process utilizes the urease enzyme from bacteria to hydrolyze urea into Ammonium ion and Urea, which can be crystallized into Calcium carbonate, linking soil particles. However, its drawback is the Ammonium byproduct, which could contaminate in runoff and become toxic to life. This project aims to eliminate this flaw, utilizing soil-dwelling nitrifying bacteria to oxidize Ammonium to Nitrate, its non-hazardous counterpart, before culminating into a powder product readily in use. Potassium hydrogen phosphate, a natural enhancer of nitrification, was added with the MICP reactants into soil-filled tubes at different concentrations. The soil in each tube was assayed for ammonium ion concentrations. Each soil column is pulled apart to investigate the maximum shear force it can resist. The study showed that Potassium hydrogen phosphate at a concentration of 2.7 ppt is the most successful in eliminating ammonium ion with no statistical difference in its strength. Finally, the design and production of the powder product upon the collected data were accomplished. The product comprises 3 components: the endospores of bacteria with added Potassium hydrogen phosphate, the fixation powder, and the MICP powder. All powders should be dissolved into solutions at particular concentrations according to the user manual. The endospores solution and the fixation solution is to be applied once, followed by three applications of the MICP solution instantaneously, 2 hours later, and 24 hours later.

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