Ground Improvement Studies on Problematic Soils: Innovative Materials with Sustainable Applications

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Chemical stabilization of problematic sulfate-rich soils is a considerable cause of concern even to this day for geotechnical and transportation engineering practitioners. With the advent of innovative materials and technologies, researchers have tried to incorporate them into ground stabilization practices. However, the application of novel materials is often met with apprehension when the concept of long-term durability and sustainability of construction is weighed upon. The researchers at Texas A&M University have been studying innovative stabilization methods to address some of the prevailing problems of traditional stabilization methods. Application of metakaolin-based Geopolymers and novel silica-based admixtures with Ca-based treatments to improve problematic soil properties are presented in this paper. Micro-mechanical behavior of the stabilized soils was investigated using both engineering and mineralogical studies. Engineering studies included, strength, stiffness, moisture susceptible durability and free swell strain tests. Additionally, X-ray diffraction studies and scanning electron microscope imaging were performed to understand the microstructural behavior of the treated geomaterials. Sustainability benefits of the stabilizers were assessed using a unified framework, which subsumed the effects of embodied energy for production, environmental impacts, and socio-economic impacts of the treatment. The engineering and microstructural studies showed that the new stabilization methods provided more durable geomaterials as compared to traditional treatments. Sustainability assessments showed that new stabilization methods could be considered as a potential alternative if the cost of the production is significantly reduced. Overall, this paper provides new insights into the innovative stabilization methods, which may be of enormous benefit to geotechnical and transportation engineering practitioners.

Keywords: stabilization; ettringite; durability; crystalline silica; geopolymer, sustainability