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Geotechnical behavior of a beta-1,3/1,6-glucan biopolymer-treated residual soil

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Abstract. Biopolymers, polymers produced by living organisms, are used in various fields (e.g., medical, food, cosmetic, medicine) due to their beneficial properties. Recently, biopolymers have been used for control of soil erosion, stabilization of aggregate, and to enhance drilling. However, the inter-particle behavior of such polymers on soil behavior are poorly understood. In this study, an artificial biopolymer (β-1,3/1,6-glucan) was used as an engineered soil additive for Korean residual soil (i.e., *hwangtoh*). The geotechnical behavior of the Korean residual soil, after treatment with β-1,3/1,6-glucan, were measured through a series of laboratory approaches and then analyzed. As the biopolymer content in soil increased, so did its compactibility, Atterberg limits, plasticity index, swelling index, and shear modulus. However, the treatment had no effect on the compressional stiffness of the residual soil, and the polymer induced bio-clogging of the soil's pore spaces while resulting in a decrease in hydraulic conductivity.

Keywords: beta-1,3/1,6-glucan; biopolymer; Korean residual soil; geotechnical behavior; elastic wave

1. Introduction

Soil is a natural material consisting of multiple phases that differ from the morphological, physical, chemical, and mineralogical characteristics of their parent minerals. Moreover, soil is a mixture of inorganic minerals and organic constituents that exist in solid, aqueous, and gaseous states (Paul 2007). Geotechnical engineering focuses mainly on the physical and mechanical behaviors of soil, whereas geochemical and biological influences are considered as minor concerns. Nowadays, unusual geotechnical phenomena (e.g., quick clay, underground waste/pollutant remediation, bio-fouling) have raised the necessity for, and importance of, more holistic consideration of the chemical and biological factors affecting geotechnical engineering (Mitchell and Santamarina 2005, Soga and Jefferis 2008). Organic compounds in the soil has been reported to increase the inter-particle binding forces and incremental cohesion (DeJong *et al*. 2010, Piccolo and Mbagwu 1999) and the elastic modulus of soil (Nason 1987), according to the reinforcement by biological fibers (Soane 1990) and variation of electrical charge in pore fluids (Brown and

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