The 2018 World Congress on
Advances in Civil, Environmental, & Materials Research (ACEM18)
Songdo Convensia, Incheon, Korea, August 27 - 31, 2018

Use of crude urease for the biocementation of silty sand

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ABSTRACT

Silty sand is widespread in natural conditions. It is also often prone to liquefaction in earthquake events. The appicability of biocement into silty sand is challenging. In this study, we tested a new method that applies biocement to silty sand. In this method, crude urease was used for the soil treatment instead of using live bacteria. The crude urease was obtained from cell lysis. Triaxial tests and calcite content measurement were conducted on the soil samples treated by urease or live bacteria. Silty sand samples treated by urease had higher shear strengths and more dilative responses during the undrained shear, as compared to the samples treated by live bacteria. The calcite in the urease-treated samples was more uniformly dsitributed than the bacteria-treated samples.

1. INTRODUCTION

Biocement, or microbially induced calcite precipitation (MICP), can be used for soil improvement. This method has been receiving a lot of research efforts recently (Ivanov and Chu 2008; Dejong et al. 2010; Dejong et al. 2013; Dhami et al. 2013). However, the applicability of this method is difficult in the treatment of fine particle soils, for example silty sand, silt, or clay. In natural conditions, silty sand is widespread. Silty sand is usually more susceptible to liquefaction than clean sand in earthquakes (Kokusho 2016). Silty sand has much smaller pores that hinder the movement of bacteria in soil pores. In addition, bacterial cells have strong tendency to adhere to solid surfaces, and thus fine particle soils with much larger specific surface areas can hinder the movement of bacteria (Harkes et al. 2010).

Urease, the urea-hydrolyzing enzyme, can be adopted for calcite precipitation in lieu of live bacteria. Commercial purified urease was used to induce biocementation effect previously (Neupane 2013; Zhao et al. 2014; Neupane et al. 2015; Jiang et al. 2016; Hamdan et al. 2016). Crude urease was obtained through the cell lysis of

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*Note: Paper to be submitted to
"Geomechanics and Engineering, An International Journal" for the purpose of Special Issue.