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Feasibility study on bioclogging by bacterial fermentation using bioaugmentation and biostimulation methods

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ABSTRACT

Bioclogging can be induced by *in situ* accumulation of biopolymer produced by bacteria in soils. The bioclogging can be achieved either by bioaugmentation or biostimulation strategies. A preliminary study was conducted to examine the feasibility of bioaugmentation and biostimulation methods to induce fermentation-base bioclogging effect in sands. In experiments, the model bacterium, *Leuconostoc mesenteroides*, and a consortium of indigenous soil bacteria from an embankment were examined for bioaugmentation and biostimulation, respectively, where *in situ* production of bacterial biopolymer through microbial fermentation was stimulated while monitoring reduction in hydraulic conductivity of sands for more than 40 days. The results revealed that both strategies can reduce the hydraulic conductivity of sands by 1–2 orders of magnitude. It was concluded that a biostimulation method using sucrose-rich growth media was applicable to induce fermentation-base bioclogging in the embankment site that the soil bacteria were sampled.

1. INTRODUCTION

Microorganisms produce variety of biomass that can modify the physical properties of soils, including stiffness, shear strength, permeability, and erosion resistance (DeJong *et al*. 2010, Ham *et al.* 2018). Bioclogging can be caused by the production of biopolymer, which can be formed as a result of fermentation. Fermentation is a kind of metabolic process that consumes sugar in the absences of oxygen. Many kinds of bacteria, which dwell in soil, can get energy from this metabolism. Recently, several studies have investigated bioclogging mechanisms by bacterial biopolymers, not only because of its possible application as an eco-friendly and cost-competitive alternative to traditional crack-sealing methods but also due to the possibility of field monitoring using seismic techniques (Kwon *et al.* 2013, Noh *et al.* 2016). With discovery of many natural bacterial biopolymers, there are also growing interests in identifying properties of soft gel-like biopolymers, including mechanical and viscoelastic properties to predict

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