FUNDAMENTAL STUDY ON PERMEABILITY CONTROL OF THE SAND AQUIFER USINGBIOPOLYMER PRODUCING BACTERIUM

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1. INTRODUCTION

In situ remediation for contaminated aquifer often employs washing technologies by which the contaminants are removed by continuous injection of water with or without chemical agents into the source zone and its recovery by pumping. In this remediation process, there is a possibility for injected liquids to be transferred out of the designated zone unintentionally through a highly permeable layer. Thus, there have been potential needs to develop a cost-effective and environment-friendly technique to reduce the hydraulic conductivity of a high-permeable aquifer temporally. These days, applicability of microbial induced products generated in soil pores as ground improvement techniques is widely studied in the fields of geotechnical and earth resource engineering. This study employs *Enterobacter sp.* strain CJF-002 (hereafter referred to as CJF-002), which was introduced in the MEOR (Microbial Enhanced Oil Recovery) project in China[1)], to reduce the hydraulic conductivity of the sand aquifer by plugging the high-permeable zones with the water-insoluble polymer produced by this strain. Factors affecting the bio polymer production and related plugging effect, such as pH, chemical concentrations in the medium, etc., were evaluated by conducting a series of in-vitro tests and column tests.

2. OUTLINE OF THE EXPERIMENTS

Activity of the CJF-002 has been ensured mainly under anaerobic condition, since this bacterium had been employed in the MEOR field. Firstly, a series of in-vitro tests were conducted to evaluate the status of biopolymer production in the polysaccharide production medium (PPM) under both anaerobic and aerobic conditions. In addition, pH effect on the activity were also evaluated by using the PPM with or without the calcium carbonate acting as acid buffer.

Secondarily, hydraulic conductivity tests were conducted for the cylindrical sand columns with and without cultivation of strain CJF-002 to assess whether the biopolymer production can effectively reduce the permeability of the sand. Effects of pH and PPM concentration in the soil pore water were mainly examined.

3. MAIN ACHIEVEMENTS

1) Growth of strain CJF-002 was successfully enhanced under aerobic condition. Accordingly, stable production of the biopolymer was observed within a few days.
2) Hydraulic conductivity of the sand column cultivated with strain CJF-002 decreased by one order of magnitude only in three days due to plugging effect by the biopolymer generated in the pore space, as shown in Figure 1. However, pH control by the acid buffer solution was essential to maintain the biopolymer production.
3) Effect of the PPM dilution in the soil pore water was examined. Under 10% concentration of the standard PPM in the porewater, hydraulic conductivity was successfully lowered by 60%. However, 1% concentration of the standard PPM was unable to activate CFJ-002 and reduce the hydraulic conductivity accordingly.

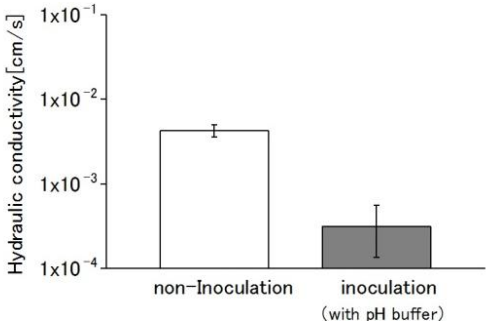

Figure 1: Change in hydraulic conductivity of the sand column due to the polymer production by CFJ-002.

REFERENCES

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