Clean up performance of a stearic acid-based bio-barrier for denitrification of nitrate

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1. INTRODUCTION

Nitrate and nitrite contamination of groundwater is a highly recognized issue in Japan because it usually exceeds the environmental quality standard (10 mg/L in groundwater). Previous studies [1)] have developed a bio-barrier which uses stearic acid as hydrogen donor to purify the nitrate that penetrates from soil surface to groundwater. However, long-term performance of bio-barrier is not clear. So, considering that the bio-barrier uses stearic acid, three important points were evaluated in this study; ①testing on aerobic and anaerobic conditions that provides a good performance, ②application of stearic acid to inhibit excess elution of organic carbon into groundwater and ensure longer performance, ③purification capacity of stearic acid remanent in the bio-barrier.

2. METHOD

Column test was conducted to estimate if specific surface areas of stearic acids affect denitrification and elution of organic carbons. Three types of stearic acid that are, fine powder, powder and beads, were used. Reactor test was carried out to estimate whether denitirification was affected by aerobic and anaerobic condition, the number of initial microbes and the amount of stearic acid mixed into the bio-barrier.

3. DISCCUSION

In the column test, all types of stearic acid reduced the nitrate concentrations to 10 mg/L values. But, in the case of beads type stearic acid, higher nitrate concentration was observed compared to other stearic acids cases. When beads type stearic acid was used as substrate, ratio calculation of consuming rate between beads and fine powder, and beads and powder was about 0.07 and 0.05, respectively, under the same outlet flow condition. Therefore, it was estimated that beads type stearic acid is better in order to obtain long-term performance. In the reactor test, denitrification reaction under anaerobic condition was faster than the one under aerobic condition. There was a strong relationship between denitrification rate and microbe activity, which was reflected in the rate of inorganic carbon generation. However, it was not possible to confirm if the quantities of soil affect the microbe activity and denitrification rate in the reactor. In addition, it was observed that after nitrate concentration decreased, concentration of total organic carbon and inorganic carbon increased. It was also found that concentration of total organic carbon continued increasing even after the concentration of nitrate and inorganic carbon sopped changing. The amount of stearic acid mixed with soil in reactor affected denitrification rates. Denitrification rates were 2.1-2.3 mg/L/hour for 2 % stearic acid、0.7-1.2 mg/L/hour for 0.5 % stearic acid、0.5-0.7 mg/L/hour for0.2 % stearic acid, respectively (Figure 1). When 0.02 % of stearic acid was used, denitrification was not always occurred. The lower the quantity of stearic acid mixed, the less denitrification rate was observed. So, in order to have a stable denitrification reaction, the lowest amount of stearic acid was found to be 0.2%. It was found that 0.2% stearic acid was the lowest necessary amount that should be mixed into the bio-barrier to guarantee denitrification.

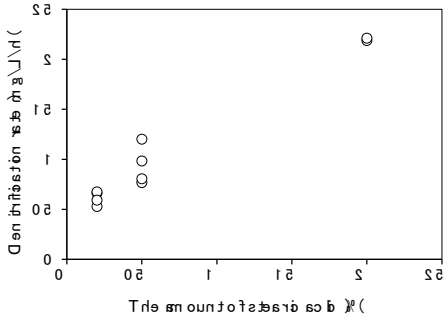

Figure1 relationship between denitrification rate and addtional amount of stearic acid

REFERENCE

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