

The effect of permeable geobarrier using gravel bean and silty clay for remediation of PCE contaminated groundwater

(자연지질매체를 이용한 PCE로 오염된 지하수 정화)

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<Abstract>

The objective of this study was to examine the effect of proposed permeable geobarrier system for removal of PCE from groundwater. The materials used for the natural geobarrier are gravel bean and silty clay. In addition, the effect of Pyeongtaek soil on PRB assessed in this experiments. It was observed that the adsorption of PCE in natural geobarrier system is eligible for real site. However, natural geobarrier system has various factors based on using materials. Therefore, more laboratory work is needed to study about permeable geobarrier.

Key word : Remediation, PCE, Permeable reactive barrier, Groundwater

1. Introduction

The contamination of groundwater by PCE (perchloroethylene) is a environmental concern because PCE is known to be a carcinogenic substance. PCE is widely used as a degreasing agent for metalworking, machine and electronic industries. Also, PCE is regarded as priority pollutants because of its toxicity in environment at low concentrations. DNAPL can be persisted as a long-term source of contaminating groundwater due to its low aqueous solubility and slow rates of dissolution.

Permeable reactive barrier system (PRB) is used in many processes for treatment of groundwater. It provides a convenient technology for removing a broad range of organic pollutants, which are generally of concern because of their toxicity to human health. In recent years, various treatment techniques of PRB were suggested. Tracing the history of the study of remediation using PRB, introduced the method of iron PRBs technology by

many reports. It reported that a PRB effectively removed some heavy metals. Many researchers examined the feasibility for the use of geo-materials on PRB. They reported that properly designed remediation system can reduce the levels of many contaminants to regulate cleanup goals. Therefore, the objective of this study is to examine the effect of proposed PRB for removal of PCE from groundwater.

2. Materials and Methods

2.1. Chemical selection

All chemicals used in this study were analytical-grade reagents. PCE (>99% purity) is purchased from Merck Chemical, USA. N-hexane was used as a solvent to calibrate a quantitative analysis of gas chromatography. N-hexane was purchased from Daejung Chemical, Korea.

2.2. Materials

Pyeongtaek soil was selected for this study. Soil properties are presented in Table 1. Also, gravel bean and silty clay obtained from Ottawa Company, IL, USA.

Table 1. Characteristics of the used soil

Classification	Value
Sand (%)	62.3
Silt (%)	31.5
Clay (%)	0.8
Organic C contents (%)	<0.03
pH	6.4
Cation Exchange Capacity (meq/100g)	17
Surface Area (m ² /g)	33

2.3. Column experiments

The column experiments used deionized water that distilled with Milli-Q distillation system. Column experiments in this study were performed to consider the effect of proposed PRB systems. The photography of column experiments is shown in Figure 1. The column remained in a vertical orientation during the course of experiments. PCE (1ppm) solution was added into the column. The columns were placed in a constant room temperature. A HP 6890 series gas chromatography (Agilent technologies) equipped with electron capture detector (ECD) was used for GC-ECD analysis. Helium was used as the

carrier gas. All of the sample vials (25ml) were sealed with Teflon sheets to minimize and keep in a refrigerator.

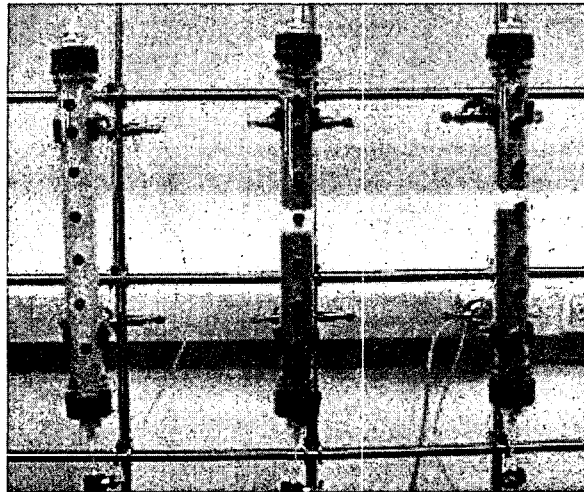


Figure 1. The photography of column setup.

3. Results and Conclusion

Much greater effectiveness was observed in using the proposed PRB system by column tests (Figure 2). In adsorption of PCE for long term, double layers of proposed PRB system is more effective than that of single layer (Figure 2). However, there are no difference during the short time, namely less than 2 months, between two layers. These results suggest that the proposed PRB system can be a good candidate for removal of PCE from groundwater.

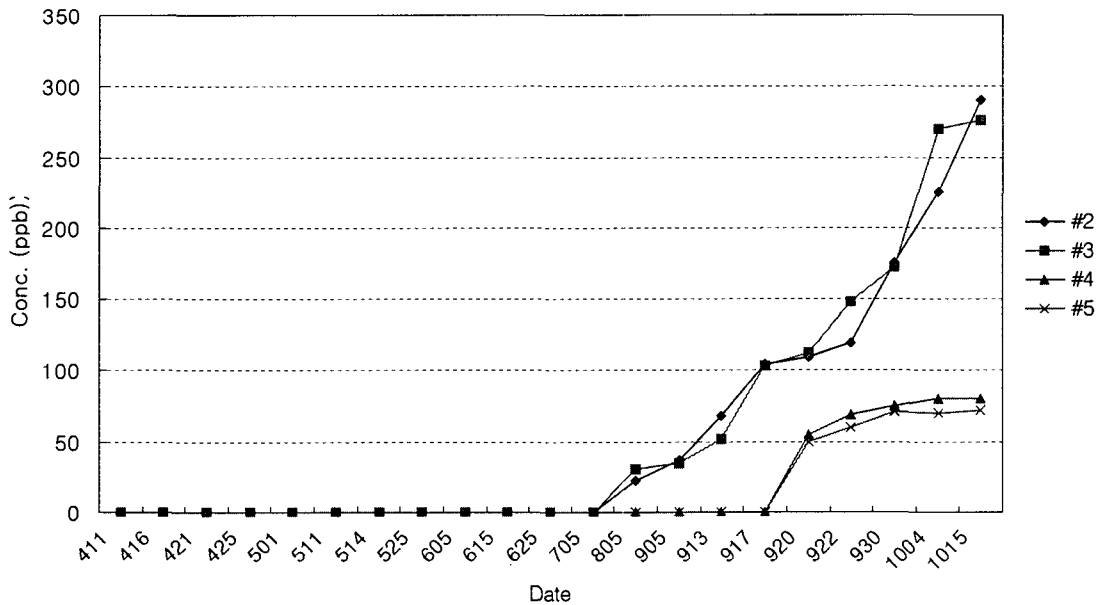


Figure 2. Observed PCE concentration in outlet sample

4. Reference

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