

Remediation of TCE contaminated groundwater by pretreated granular activated carbon

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<Abstract>

The objective of this study was to clarify the possibility of adsorption trichloroethylene (TCE) of pretreated granular activated carbon (GAC). The chemical solution used for the acidic treatment was phosphoric acid. In addition, the effect of ultrasound on GAC assessed in this experiments. It was observed that the adsorption of TCE were different based on pH value of pretreated GAC. However, natural water such as groundwater has various factors like ionic strength and hardness etc. Therefore, more laboratory work is needed to study about pretreated GAC..

Key word : Remediation, TCE, pretreatment, granular activated carbon, groundwater

1. Introduction

Groundwater contributes about 15% of the total water supply and contamination of groundwater by tichloroethylene (TCE) is a environmental issue, because TCE is known to be a carcinogenic substance. TCE is widely used as a degreasing agent for metalworking, machine and electronic industries. Soil and groundwater of industrial areas were found to be contaminated by TCE with a higher concentration than the environmental quality standard. Also, TCE is regarded as priority pollutants because of its toxicity in environment at low concentrations. Many of them have been classified as hazardous pollutants because of their potential harm to human health. Many reports published on the study of remediation dealt with such problems.

Granular activated carbon (GAC) is used in many processes for treatment of drinking water and industrial wastewater. 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 GAC were suggested. Tracing the history of the study of remediation using GAC, introduced the method of acidic

treatment GAC by many reports (Gullon et al., 2004; Park et al., 2004). It reported that a GAC effectively removed some heavy metals (Chen et al., 2000). It also reported that effect of ultrasound on GAC was studied (Hamdaoui et al., 2003). Lim and Okada (2005) examined the feasibility for the use of ultrasound on TCE from GAC. In addition, natural water such as groundwater has various hydrogeochemical factors like a ions. Therefore, more laboratory work is needed to study about pretreated GAC.

2. Materials and Methods

2.1. Chemical selection

All chemicals used in this study were analytical-grade reagents. TCE (>99% purity) is purchased from Merck Chemical, USA. Phosphoric acid was purchased from Daejung Chemical, Korea. Granular activated carbon was purchased from Samchully, Korea and GAC (SLS-100) with size of 8-30 mesh was used for this study.

2.2. Methods

Pretreatment was conducted in titration method (Park et at. 2004). A deionized water with the appropriate amount of reagent is mixed with GAC in glass bottle. The bottle was placed on a shaker table set at a rate of 150 shake/min to ensure adequate mixing. After pretreatment, feed solution was then drained and rinsed with deionized water. The GAC was treated in a 20 kHz Misonix XL 2020 with a power of 24 W during 1 hour. This treatment was conducted at room temperature. The diameter of the plate tip was 15 mm. After sonication, the pretreated GAC was drained of water and dried oven for 24 hours. All GAC samples were stored under dried oven in 110 °C. The pH values of GAC are shown in Table 1.

Table 1. pH of granular activated carbons.

Name	pH
GAC rinsed with deionized water (GAC)	9.81
GAC of pretreated with H ₃ PO ₄ (A-GAC)	6.52
GAC of pretreated with ultrasound (U-GAC))	9.40
GAc of pretreated with ultrasound, H ₃ PO ₄ (U,A-GAC)	6.03

2.3 Batch experiments

The batch experiments used deionized water that distilled with Milli-Q distillation system. Batch experiments in this study were performed to consider the effect of pretreated GAC. The GAC of 1g was precisely weighed and set in 1000ml glass bottle. The photography of batch experiments were shown in Figure 1. 5ppm of TCE solution was added into the bottle and sealed with Teflon sheet. The bottles were placed in a constant room temperature. Then solutions were placed in shaker table.



Figure 1. The photography of TCE (5 ppm) solutions and sample vial (25ml).

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.

3. Results and Conclusions

The effectiveness of the granular activated carbons and pretreated GAC for removing TCE was evaluated. In remediation of TCE for short term, pretreated GACs is more effective than rowed GAC (Figure 2.)

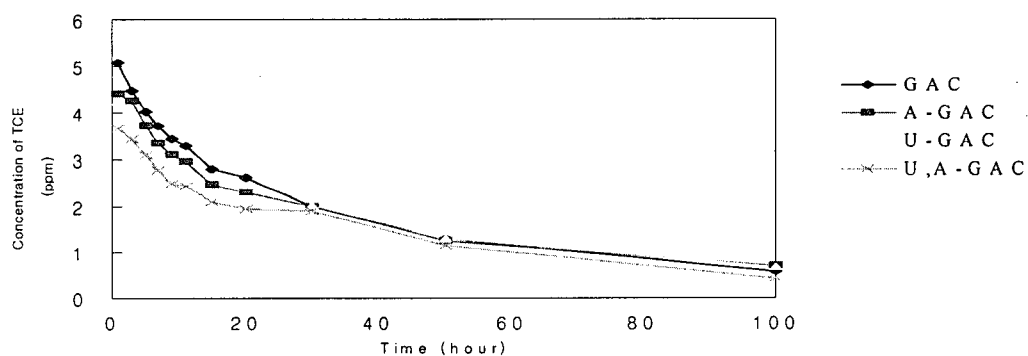


Figure 2. The variation of TCE recovery rate by GAC

This result is comparable to other studies when similar amounts of contaminants were removed by GACs. In addition, the mechanism of the TCE remediation in natural system is the product of complexly combined factors. For example, each groundwater samples have the difference of ionic distribution. The possibility for using and effectiveness of pretreated

GAC are showed during short term remediation (Figure 2). Also, used materials for GAC selection may be very useful and are essential for reducing cost and time.

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