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Remediation of Heavy Metal Contaminated Groundwater Originated from Abandoned Mines by Using Lime and Calcium Carbonate

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ABSTRACT

Chemical treatment by using lime ($Ca(OH)_2$) and calcium carbonate ($CaCO_3$) was applied to remove heavy metals from groundwater in laboratory scale. Heavy metals were separated from groundwater by coagulation and precipitation processes of lime and calcium carbonate. As coagulants, powdered lime and calcium carbonate were used for batch tests and granulated lime and calcium carbonate were used for column tests.

From results of batch tests, by the addition of 0.5 wt.% lime, more than 95% of As and Mn were removed and 74-90% of Cd and Zn were removed. The removal efficiency of Pb with lime addition was lower than 30%. For 0.5 wt.% of calcium carbonate, almost all Pb were removed and more than 88% of Cd were removed. However, removal efficiencies of As, Mn, and Zn were lower than 50% with the calcium carbonate addition. Removal efficiencies of heavy metals were diverse with a different kind of coagulants, suggesting that the available coagulant should be applied to remediate groundwater according to a kind of heavy metals in groundwater.

Column experiments were performed to investigate the removal efficiency of lime and calcium carbonate on the continuous groundwater treatment condition. Heavy metal contaminated groundwater around two abandoned mines, Korea was used for the column experiment. Granulated lime or calcium carbonate was packed in a glass column (10cm in length and 5cm in diameter) and contaminated groundwater was injected from the bottom of the column at a constant velocity. Drained water from the top of the

column was gathered into a flask and was analyzed on ICP/MS for heavy metal concentration. Both lime and calcium carbonate (1:1 wt.% ratio) were packed in a column and the experiment was duplicated.

By using granulated calcium carbonate, more than 97% of Ni and Zn were removed for 15 liter of groundwater flushing in the column experiment. However, the removal efficiency of As maintained lower than 50% (Fig. 1). For the column experiment with granulated lime, almost all As were removed and more than 98% of Ni were removed for 11 liter of groundwater flushing (Fig.2). The removal efficiency of Zn maintained over 90% for 5 liter of groundwater flushing and then decreased to 75% after 11 liter flushing. For the column experiment with lime and calcium carbonate mixed at 1:1 ratio, removal efficiencies of As and Ni were very similar to those of column experiment used only granulated lime (Fig.3). The removal efficiency of Zn ranged from 82% to 50% for 12 liter of groundwater flushing. Results from both batch and column experiments investigate that the chemical treatment process by using lime and calcium carbonate has a great possibility to remove heavy metals from contaminated groundwater.

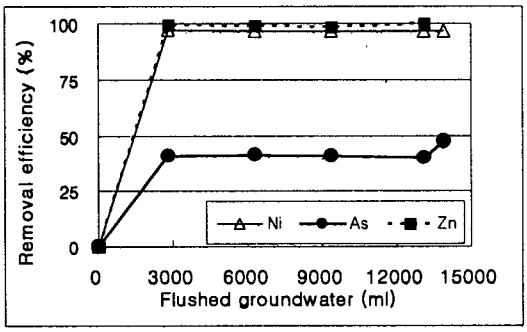

Fig.1. Results of calcium carbonate column experiment.

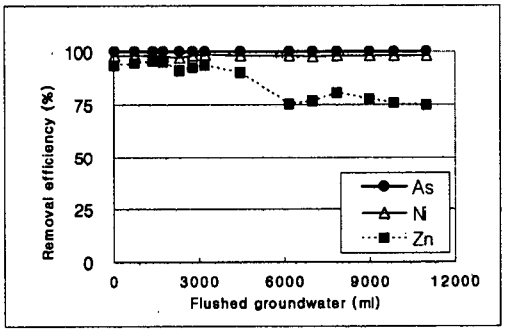

Fig.2. Results of lime column experiment.

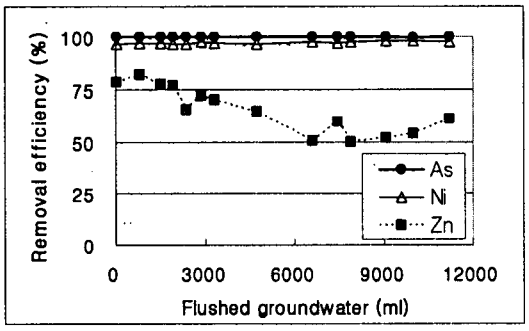

Fig. 3. Results of mixed lime and calcium carbonate column experiment.

Key words: lime treatment, coagulation, contaminated groundwater, heavy metal, calcium carbonate.