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Reduction of acid rock drainage using alkali phosphate treatment: a column test

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Acid rock drainage (ARD) at construction sites in Korea has been an environmental concern due to its high acidity and high concentration of toxic element. We tested the feasibility of the alkali phosphate treatment for the ARD reduction using a column test. A Mesozoic andesite with a high ARD generation potential indicated by 6.9% of S and NAG pH 2.32 was collected from the railway embankment site, where the contamination of surface water and soil by ARD occurred in two years after the completion of construction work. The collected rock sample was crushed to be less than 3/8 inches in diameter using a jaw crusher. The 40 cm height column of the mixture of the crushed rock (15 kg) and sand (7 kg) was constructed in an acryl tube with 20 cm in diameter and 80 cm in height. The columns were incubated with the wet and dry rotational repeat by a periodic addition of distilled water for 2 weeks. After the incubation, two treatments for the ARD reduction were conducted with duplicate columns: 1) the addition of 10mM KH_2PO_4_3% $NaHCO_3$ and 2) the addition of 10mM KH_2PO_4_3% $NaHCO_3$ and ordinary portland cement (OPC) on the top of the column. After the treatments, 500 ml of distilled water added to each column for every one week for 3 weeks and then the columns were flushed with 1,500 ml of distilled water in the 4^{th} week. The incubation and flushing were conducted for 4 months and will be continued in the future. The pH, electrical conductivity (EC), concentrations of anions and cations of the leachates were determined. The pH of the leachates from the untreated column showed 2.1 - 3.7 but the leachates from the columns treated with the alkali phosphate solution with or without the OPC addition showed pH 7.5 – 8.9. The leachates from the treated columns had much lower concentrations of SO_4^{2-} and toxic elements such as Al, Mn, Fe and heavy metals than those from the untreated columns. However, the leachates from the treated columns had a higher As concentration than those from the treated columns. There was no significant chemical difference between the leachates from the treated columns with and without the OPC addition. The chemistry of leachates indicates that the alkali phosphate treatment decreased the oxidation of sulfide and neutralized the acidic pore water. No significant effect of the OPC addition on the leachate chemistry has shown during 4 month experiment. However, we expect a positive effect of the OPC addition on the reduction of ARD generation in terms of long period. According to the results of this experiment, the alkali phosphate treatment of sulfide rich rock can be a promising technology for the ARD reduction.