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A Study on the Hydrochemical Effects of Particulate Matters on Soil and Groundwater in an Urban Area

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Atmospheric aerosols are drawing attention because they are repeatedly observed during winter and spring in Korea. In order to reduce the effects of airborne particles on air quality, many countries are planning to wash out toxic smog aerosols by using artificial rain or water sprinkling methods. As the final destination of particulate matters will be soil and groundwater owing to gravity and precipitation, this study try to characterize the hydrochemical properties of ambient aerosols in an urban area on soil and groundwater. The fallen total suspended particles (TSP) collected with precipitation during the winter season (November to December) and filtered rainwater were analyzed to specify the chemical ionic composition. The rainwater had a weak acidic pH range of 4.1 $\sim$ 6.3 and acidification ions such as SO4 and NO_3 were analyzed to be 1.8$\sim$8.2 mg/L and 2.0$\sim$16.0 mg/L, respectively. The water-soluble components of rainwater came in the following order: NO_3> nss-SO4> Cl> Na> nss-Ca. In addition, the non-sea salt (nss) ratios of SO4 and Ca were higher than 90%. Such findings resulted from the fact that the study site was located inland. The trace metals of Al, Fe, Zn and Mn were detected from all rainwater samples because of the TSP leaching.
Based on the hydrochemical data from precipitation, 96 hours of batch test was conducted to find out whether ionic component dissolves from the deposited TSP when acid rain event occurs in an urban site. The particulate matters of the test are two types of fly ashes – bituminous coal and wood pellet mixed with bituminous coal gained from a thermoelectric power plant representing black carbon aerosols as fossil fuel combustion. In comparison with fly ash, the ashes from charcoal kiln representing brown carbon aerosols as wildfire were used. The final solutions of the fly ashes had the acidic condition for pH 3.9 with bituminous coal and pH 4.5 with wood pellet mixed with bituminous coal but the ash from charcoal kiln had the neutral condition as pH 7.3. The final concentrations of SO4 were 31.2 mg/L for the bituminous coal, 29.6 mg/L for the wood pellet mixed bituminous coal, and 19.4 mg/L for the ash from charcoal kiln but NO_3 were almost 31.1 mg/L for all solutions. The pH values of batch solutions might be depended on SO4 concentrations. Based on the batch test results, the TSP has a potential to induce an acidification and leached metal contamination of soil and groundwater.