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Gas Transport Parameters in Permeable Reactive Barrier Materials using a Mixture of Molten Slag and Volcanic Ash Soil

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The Permeable Reactive Barriers (PRB) has been recognized as an efficient technique for the treatment of landfill leachate and contaminated groundwater. Recently, a mixture material of molten slag and volcanic ash soil has received an attention as PRB materials at landfill cover and intermediate layers due to the high water permeability and the high removal ability of contaminants. At the landfill site, not only contaminated leachate but also various types of gases (e.g., methane) produced from the waste are passing through the PRB materials. Therefore accurate understanding and knowledge of gas transport processes in the PRB materials are also essential to estimate emissions of landfill gases. However, only limited measurements and knowledge of gas transport parameters such as air permeability $k_a$and gas diffusion coefficient $D_p$in the PRB materials are available. In this study, the six compacted mixtures of molten slag and volcanic ash soil were used as PRB materials to measure $k_a$and D_p.

The average diameter of molten slag is 1.20 mm which is relatively coarser than volcanic ash soil (average diameter 0.04 mm). The volcanic ash soil was taken from Tsurugashima City, Saitama, Japan. Firstly, the volcanic ash soil was sieved with 2-mm mesh and was fully mixed with air dried molten slag. Two different moisture conditions of volcanic ash soil, air dry and field water content, were used for sample preparation. Next, the mixed samples were compacted using a standard proctor method with volume of 2120 cm^3, and were used for measurements of gas transport parameters ($k_a$and D_p).

Results showed that the measured $k_a$and $D_p$varied not only with the mixing ratio of molten slag and volcanic ash soil but also with the moisture conditions of volcanic ash soil. It was revealed that larger pore networks in the coarser testing materials with higher molten slag contents enhanced air advection, resulting in higher k_a. On the other hand, measured $D_p$was dominantly controlled by air filled porosity.