Comparison of Solute Diffusivity between Volcanic Ash Soils and Normal Mineral Soils

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Accurate description of solute diffusion coefficient, Ds and its dependency on physical factor as soil-water content and soil dry bulk density for a given soil are essential as input parameters in numerical simulation studies in order to evaluate the extent of contamination from polluted soil sites where the transport of contaminant in the soil-liquid phase is mainly controlled by diffusion. Further, since the solute diffusion coefficient highly depends on the soil type, it is important to investigate the solute diffusivity (Ds/Do, Do is solute diffusion coefficient for water) in different type of soil, especially for soil with different behavior which spread in large quantity such as volcanic ash soils (Andisols).

In this study we investigated the special behavior of solute diffusion in volcanic ash soils with comparing the solute diffusivity data of volcanic ash soils with sandy, loamy and clayey types of soils.

The diffusion coefficients of chloride were measured in volcanic ash soils taken at Nishi-Tokyo (at three different bulk densities) and Hokkaido (at one bulk density) in Japan, over wide range of volumetric water contents.Diffusion coefficients for loamy soil (from Hokkaido) and two types of sandy soils (Hokkaido and Toyoura) were also measured to identify the special behavior of volcanic ash soils with compared to other soil types. Half-cell method was used to measure Ds where the source and sink half cells (each cell of 10-cm length and 4.9 cm in diameter) were joined together and the concentration profile was analyzed after a substantial time to determine Ds.

Results showed that measured Ds/Do values for volcanic ash soils, decreased with decreasing watre content with inflection points at around pF 2.8 and those Ds/Do values were comparatively lower than other types of soils. Furthermore volcanic ash soils showed different solute diffusion behavior under changing bulk density with compared to other soil types, as its pore size distribution was significantly affected by the bulk density variation. At higher soil-water contents (pF ? 3.5) the magnitude of Ds/Do considerably decreased with increasing dry bulk density and at low water content values (pF ? 3.5) it increased with increasing dry bulk density.

Based on these experimental evidences, a descriptive model for predicting Ds/Do was developed taking the linear relationships of slope (at impedance factor (Ds/(Do(volumetric water content))) variation with volumetric watre content) and threshold water content with dry bulk density into account. The new model performed well in the model tests and is recommended for predicting Ds/Do for volcanic ash soils.

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