Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

AGE030-P14 Room:コンベンションホール Time: May 26 17:15-18:30

Gas Dispersion in Variably Saturated and Differenly Textured Porous Media

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Abstract
Measurements of Gas Dispersion in Variably Saturated and differentially Textured Porous Media
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The transport, fate and emission of gases in the soil are governed by gas advection, diffusion and dispersion phenomena. Among three gas transport phenomenas, gas dispersion is the least understood especially how it is correlated with flow velocity, scale of the experiment, particle size distribution, particle shape and variable moisture conditions.

In this study, the Unified measurement system (UMS) made of soil column of 15 cm diameter and 100 cm length was used for the sequential measurements of gas dispersion coefficient, gas diffusion coefficient, and air permeability. Oxygen concentration was monitored at multiple points along the soil column length and air pressure was monitored at inlet and middle of soil column. Using Narita sand (0.25-0.425mm) at dry bulk density of 1.35 g/cm3, 1.52 g/cm3 and moisture contents 0, 5, 10 and 15%, the effects of variable moisture conditions, level of compaction and scale dependency were studied, comparing to the measured datasets by Hamamoto et al. (2009).

Test results shows that measured values of dispersivity varied from 0.19 to 1.10 cm on varying air filled porosity from 0.49 to 0.22. The values of air permeability varied from 6 to 62 microm2 and gas diffusivity (measured gas diffusion coefficient divided by the gas diffusion coefficient in free air) from 0.05 to 0.33 depending on air filled porosities from 0.22 to 0.49. The measured dispersivities did not show any significant variations along the soil column at different distances from the inlet. Compared to measured dispersivities by the soil column length with dimensions of 6 0cm in length and 5cm in diameter (Hamamoto et al., 2009), there were no distinct differences except those at much lesser values of air filled porosity

Keywords: Scale dependency on Gas dispersion