Analysis of pore structure for different textured soils by Micro-focus X-ray CT system

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Understanding mass transport properties in soils is important to develop techniques. The mass transport properties can be controlled by soil pore structure. The many analyses by visualization techniques for soil pore structure including a micro-focus X-ray CT system were carried out. However, few reports are available on the examinations of correlations between pore structure parameters and mass transport parameters. In this study, we visualized pore network for different textured soils by using Micro Focus X-ray CT system (inspeXio SMX-90CT, Shimadzu Corporation, Japan) and analyzed pore structure parameters (mean effective pore radius(r_{eff}), pore coordination number(N), and pore tortuosity(T_{zz})). Moreover, we measured gas diffusivity(D_p/D_0) and air permeability(k_a) as mass transport parameters. Different textured soils including sand, loam, and silty clay loam were used. The sand samples with different particle shape were packed at different densities. Similar to sand samples, the loam samples were packed. Undisturbed silty clay loam soils were collected from two different positions of an apple orchard, and two conditions (field water content and air dried after freeze drying) was used.
As a result, gas diffusivity increased with decreasing effective pore radius for the all dry samples. Correlations between effective pore radius and mean particle size have been reported. Thus, this results suggest that gas diffusivity is controlled by mean particle size. On the other hand, the gas diffusivity values of moist silty clay loam taken from alley area in apple orchard are lower than these of dry samples. Blocking by water in soil occurs the degradation of gas diffusion ability.

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