APPLICATION OF MICROFOCUS X-RAY COMPUTED TOMOGRAPGY TO OBTAIN PORE STRUCTURAL PARAMETERS FOR DIFFERENTLY COMPACTED SOILS

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Mass transport in soils occurs through the soil pore network, which is highly influence by soil pore structure parameters such as pore size distribution, pore radius, pore tortuosity and pore coordination number. Micro-focus X-ray computed tomography (CT) has emerged as a powerful non-destructive tool for the direct visualization and better understand soil pore network structure. However, there are a limited number of studies on visualization and quantification of soil pore network for highly compacted soil like final cover soil. The study aimed to identify the effects of scanning resolution (voxel) and volume (region of interest) on pore structure parameters for compacted sandy loam soils. In this study, soil samples from an earthen solid waste landfill site located in Saitama prefecture, Japan were used. Soil samples of particle size (d<2mm) with air dry and moisture content (9%) were packed with different dry bulk densities, 1.40, 1.50 and 1.65 g/cm^3 by hand compaction. The packed samples were used for characterizing soil pore networking and structure using a microfocus X-ray computed tomography (MFXCT) system. Soil samples were scanned by MFXCT system with different scanning resolution (voxel) 12,30 and 50 μm/voxels. Then, by using software of Exfact VR 2.1, different interest of regions (50, 100, 200 and 300 voxels) were selected and 3-dimensional models were reconstructed. Finally, using software of EXFact Analysis for Porous Particles (Nihon Visual Science, Inc.), the soil pore-structural parameter such as effective pore radius, coordination number, and tortuosity in z direction were analyzed. For pore structure parameters, effect of the scanning resolution (voxel) and analysis of volume (region of interest) were examined.

Based on the results from the tested conditions, effective pore radius is highly affected by the resolution size as compared to tortuosity and coordination number. Low resolution size results low effective pore radius but effect of ROIs on pore structure parameters is not significant. On the other hand, 300 voxels are enough volume for evaluating pore network structure. For all tested scanning resolutions and ROIs, mean pore radius and pore tortuosity becomes smaller and pore coordination number becomes larger with increasing dry bulk densities. Future, measured pore structural parameters will corelate with mass transport parameters such as soil-gas diffusion, air permeability and hydraulic conductivity.

Keywords: Microfocus X-ray Computed Tomography (MFXCT), Soil pore network, Pore structural parameters

