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Thermal Properties of Sands and Aggregated Volcanic Ash Soils: Effects of Particle Size and Shape, and Soil Structure

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Thermal properties including thermal conductivity and heat capacity are very important for understanding heat transport processes in landfill site cover soil to control the microbial processes in the cover soil.

Previous studies have shown effects of soil conditions such as moisture content and degree of compaction on the thermal properties for differently-textured soils. However, there are few studies on the relations between the thermal properties and micro-scale soil information such as particle size and shape although the size and shape of soil particles highly affect soil packing configuration. In addition, it is not fully understood that soil structure (i.e., aggregate structure) affects behaviors of thermal properties.

In this study, non-aggregated (sandy) and aggregated soils with different size fractions at variably-saturated conditions were used for measuring thermal properties. Micro-scale characterizations of soil-pore structure and soil particle configuration using a X-ray CT device were also performed for sandy soils. For sandy soils, the relation between measured thermal properties and mineral composition (i.e., quartz content), roundness/sphericity of soil particles, and particle size, and solid-phase tortuosity based on X-ray CT images, were investigated. For aggregated soils, the measured thermal conductivities at variably-saturated conditions were discussed based on the water retention characteristics and pore-size distribution in inter- and intra-aggregate pore regions.