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Effects of soil-water retention hysteresis on gas and heat transport parameters

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Knowledge of soil-gas and heat transport parameters is essential for understanding and simulating behaviors of greenhouse/toxic gases and changes in soil temperature at landfill sites. Degree of water-saturation at different water potentials (i.e., water retention characteristic) highly affects these gas and heat transport parameters. In this study, the effects of water retention hysteresis on the soil-gas diffusion coefficient (D_p), air permeability (k_a), and thermal conductivity (K_T) were investigated. Different sand particle size fractions with different particle shapes were used for measuring gas and heat transport parameters. The soil-water retention hysteresis highly affected the gas transport parameters, showing higher D_p and k_a values for the wetting processes than those for drying processes at the same air content. This suggests that the more continuous air-filled pore-networks in the wetting processes enhanced diffusive and advective gas transport. As compared to gas transport parameters, the effect of soil water retention hysteresis on the K_T was insignificant for all sand materials.

Keywords: soil-water retention hysteresis, gas transport parameter, heat transport parameter