



Experimental Studies of Dynamic Effects on Soil Water Retention Curve for Drainage-Imbibition Cycles

TingXin Pan (1) and YungChia Chiu (2)

(1) Institute of Applied Geosciences, National Taiwan Ocean University, Keelung, Taiwan (pandonna83@gmail.com), (2) Institute of Applied Geosciences, National Taiwan Ocean University, Keelung, Taiwan (yungchiachiu@gmail.com)

Unsaturated zone is a multiphase system in which the mechanisms of groundwater flow and solute transport are complicated. These mechanisms are mainly dominated by the relative hydraulic conductivity and the estimate of the hydraulic conductivity can be accomplished with the soil water retention curve (SWRC). Traditionally, SWRCs are usually obtained under equilibrium or steady-state water flow condition and the dynamic effects are not considered. However, the real system always changes, and the SWRC obtained under equilibrium condition cannot completely represent the variations of the system and the estimated hydraulic conductivity remains skeptical. Therefore, the objective of this study is to understand the influence of dynamic effects on the unsaturated soil and to quantify its relations to the capillary pressure and saturation. A series of sandbox experiments are conducted under different flow rates and boundary conditions, and the magnitude of dynamic coefficient and redistribution time are calculated. Experimental results show that capillary pressures are significantly affected by different flow rates and the depicted SWRCs are dissimilar. At the given pressure, the saturation under the dynamic condition is higher than that under the steady state during the drainage; on the contrary, the saturation under the dynamic condition is lower than that under the steady state during the imbibition. The calculated dynamic coefficients and estimated redistribution times increase with the decrease of saturation during the drainage and vary with different particle size distributions. According to these results, we can conclude that although the mechanisms of dynamic effects are still unclear, their effect on estimate of hydraulic parameters cannot be ignored.

Keywords: unsaturated zone, saturation, capillary pressure, soil water retention curve, dynamic effect, sandbox experiment.