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Laboratory and Field Investigations of Dynamic Effects in Soil Water Retention Curve

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The unsaturated soil is a multi-phase system and the embedded physical mechanisms and chemical reactions are very complicated. The characteristics of groundwater flow and mechanisms of mass transport are still ambiguous so far. In order to fully understand the flow and transport in the unsaturated zone, the soil water retention curve plays an important role in description of water flow. However, the measurements and calculations of soil water retention curve are usually obtained under the static condition or steady state (equilibrium), in which the dynamic effects (non-equilibrium) are not considered, and the obtained relationship between capillary pressure and saturation is skeptical. Therefore, the sandbox experiments and field tests will be conducted to discuss the dynamic effects in the soil water retention curve and hysteresis effect in this study. In the laboratory, the relations between capillary pressure, saturation, the rate of change of water content, and dynamic constant are evaluated through different setting of boundary conditions and different sizes of particles. In the field, the tests are conducted to describe the soil water retention curve through the rain simulator and artificial evaporation. Besides, the dynamic dewpoint potentiameter is used to analyze the hysteresis effect of soil samples, and its results are compared with the results obtained from sandbox and field experiments. Finally, through a series of experiments, the relationship between capillary pressure and saturation under the dynamic effects is established, and the associated theories and mechanisms are discussed. The works developed in this study can provide as reference tools for the hydrogeological investigation and contaminated site remediation in the future.

Keywords: capillary pressure, saturation, soil water retention curve, hysteresis, sandbox experiment, field test