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Development of a Monitoring Method of Salinity Level in Lowland Swelling Heavy-Clays

Hideki Miyamoto [1], Masaaki Uemura [2], Ty P. A. Ferré [3]

[1] Saga University, [2] Graduate School of Agriculture, Saga University, [3] University of Arizona

Summary

Time domain transmissiometry (TDT), a method of measuring transmitted broadband signal in microwave frequency, has been drawing a lot of attention more than ever as an alternative method to monitor water content (w), salinity level, and void ratio (e) in heavy-clays.

To establish their coupled monitoring method by applying TDT, we measured TDT waveforms of step-pulse transmitted through fluid media, such as ethanol-water mixtures and NaCl solutions with different electrical conductivities, using digital TDT sensors with serial/digital interface at 1200 baud (SDI-12), and verified the response of travel time and amplitude of the step-pulse to apparent permittivity (ε_{TDT}) and electrical conductivity (σ_{TDT}) of the media. Although the determination of ε_{TDT} and σ_{TDT} of an extremely high-conductive media (≥ 5.0 dS m^{-1}) was not completed due to the inadmissible loss of the transmitted step-pulse, we successfully determined both properties by TDT in moderate-conductive media (≤ 5.0 dS m^{-1}).

The pre-established approach for the fluid media was applied to the measurement of ε_{TDT} and σ_{TDT} of kaolinite-water mixtures with different w. The ε_{TDT} and σ_{TDT} of the mixtures were quite sensitive to the changes in w and empirical expressions of ε_{TDT} vs. w and σ_{TDT} vs. w were demonstrated. Although further investigation on the estimation of e for various natural heavy-clays are required, we believe that the TDT would be a more convenient method than time domain reflectometry (TDR) to simultaneously monitor w, salinity level, and e in heavy-clays.