ABSTRACT

Jung, Sochan. Ph.D., Purdue University, 2011. Alternative Methodology for Soil-Type Identification and Characterization using Electromagnetic Waves. Major Professor: Vincent P. Drnevich

Engineering properties of geomaterials used in fills and backfills predominantly influence the performance of earth structures such as roads, retaining walls and embankments. In order to assess adequate strength and compressibility of fill materials, specifications call for a minimum acceptable dry density and water content within a defined range. Field compaction control is a check on whether or not the geomaterials meet the specifications. Therefore, the dry density and water content of the fill materials need to be obtained in the field. The Time Domain Reflectometry (TDR) method is a leading electromagnetic wave method that has been widely used as field compaction control. The main objective of this research is to develop the next generation of TDR methodology for use in compaction quality control by: developing new calibration equation(s) to replace the existing relationship of the soil bulk electrical conductivity (EC_b) and water content from ASTM D 6780-05; checking the effects of compaction energy, temperature, pore fluid conductivity, and probe geometry on the performance of the newly proposed calibration equation(s); investigating the applicability of the calibration coefficients obtained from the controlled laboratory tests to be used in the field; validating the newly proposed calibration equation(s) with determining the apparent dielectric constant (K_a) in lossy soils; exploring the potential for the self-calibrated TDR system. The newly proposed method and parameters are validated with a variety of laboratory and field tests from ASTM Reference Soils and other soils. The results in this research suggest that the newly proposed method should replace the relationships in ASTM D 6780-05. Furthermore, it suggests future direction for implementing the self-calibrated TDR system.