Time Domain Reflectometry and Water Level Measurement in Porous Media
Jessica L. Pippard

Abstract - Time domain reflectometry (TDR) is a measurement technique that makes use of the time it takes for an electrical impulse to reflect back to a source. The reflected signal (waveform) may be correlated to a variety of soil properties, including moisture content and conductivity. This project studied the potential for the application of TDR technology to the measurement of landfill leachate levels. There are a number of factors that could impact the use of TDR for leachate level measurement, including the media surrounding the probe, the conductivity of the liquid, and the probe configuration. This project evaluated the impact of the size of the media surrounding the TDR probe. The TDR probe used in this study consisted of a 30.5-cm long, 5.08-cm diameter PVC well screen with 0.51-cm slots surrounded by a stainless steel mesh with a stainless steel rod running through the center. The outer stainless steel mesh was soldered to the outer braid (shield) of a co-axial cable while the center rod was soldered to the conductor of the co-axial cable. The TDR measurement was taken via a Campbell Scientific TDR 100.

Experiments were conducted by placing the probe in a large cylinder with tubes attached for draining of the cylinder and reading of the water level within the cylinder. The cylinder was filled with water at ~2cm intervals to a depth of 25cm and then completely drained at intervals of ~2cm. TDR waveforms were taken for each water level. The data was then manipulated to identify the correlation between the waveforms and the water depths. These experiments were conducted with the probe standing in open water and then surrounded by small, medium, and large gravel.

The evaluation of the data consisted of identifying a distinct change in the TDR waveform which could be correlated to the air-water interface. This point on the TDR waveform was then plotted against the water depth in the column. The relationship was found to be linear with a correlation coefficient of 0.9935 for the experiment with only water, 0.9854 for the small rock media, 0.9973 for the medium rock media, and 0.9967 for the large rock media. These results indicated that the TDR waveforms can be used to accurately measure water depth in a variety of porous mediums. The next phase of this project will be to evaluate the impact of liquid conductivity on the waveform measurement.

1 Mercer University – School of Engineering, jessica.pippard@student.mercer.edu