

Laboratory study of unfrozen water content of diesel contaminated frozen sandy soil using time domain reflectometry (tdr) cable tester

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The results presented in this paper are part of a laboratory investigation of unfrozen water content changes due to diesel contamination using the Time Domain Reflectometry (TDR) cable tester. This laboratory investigation is part of an ongoing study of the mobility of petroleum oil lubricants as contaminants in permafrost, carried out at the geotechnical laboratory of the Royal Military College of Canada. The unfrozen water content is one of the most important parameters governing contaminant movement in frozen soils. The use of TDR to determine the unfrozen water content of clean and contaminated soil is achieved by measuring the dielectric properties of the solids-water-ice mix and solids-water-ice-diesel mix. Five clean and six contaminated soil columns (poorly graded sand) have been prepared: 3 clean columns at 12% fluid content; 2 clean columns at 20% fluid content and 6 columns at 20% and different diesel contents of 2%, 7%, 12%, 17%, 25%, 50%. Temperature profiles and dielectric signals were taken at three levels within each column: Top, middle and bottom. The equation of Roth et al. (1990) was used to convert the dielectric signals to unfrozen water content values. Both the dielectric constant and unfrozen water content were plotted against temperatures for each test (Chenaf and Hadj-Rabia, 2000)*. These results allowed the determination of the influence of diesel content on temperature diffusion and therefore on ice phase, dielectric properties and unfrozen water content in frozen soil.

* Chenaf, D. and Hadj-Rabia, K. (2000). Petroleum Oil Lubricant Mobility in Permafrost: laboratory study of unfrozen water content of diesel contaminated soil using time domain reflectometry cable tester. Research progress report submitted to DGE-DND, 120 p.

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