Monitoring of an Ethanol Released into Gasoline Residuals Using High Frequency Ground Penetrating Radar

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As ethanol becomes increasing produced and utilized as an alternative fuel source and clean technology, its potential to interact with a previously gasoline contaminated site also increases. The interaction of these two contaminates must be investigated and understood, as ethanol has the ability to remobilize existing residual gasoline. High frequency (450 & 900 MHz) Ground Penetrating Radar (GPR) was utilized in a controlled field experiment to monitor the effects of an ethanol released over existing gasoline residuals. In September 2009, 185L of E95 (95% ethanol and 5% gasoline) was released at CFB Borden into an unconfined sand aquifer, directly above an area of gasoline residuals previously established by a release of E10 (10% ethanol). The initial GPR images following the E95 release indicated a zone of strong EM wave scattering which expanded laterally in all directions throughout the next 30 days. The strength of the electromagnetic scattering decreased with time indicating a thinning of the ethanol contaminated zone, consistent with spreading and ethanol dissolution into the capillary fringe. Two-way travel times to an underlying clay reflector show a clear velocity “pull-up” effect resulting from the ethanol, and further characterizing lateral and vertical extent. Beyond the initial expansion, very little change in the GPR signature was seen until winter and the development of frozen soil. The interpretation of the geophysical response has indicated that ethanol in the vadose zone inhibited the freezing of pore water in the contaminated zone. This effect was confirmed by direct physical measurement of the increased depth to the frozen zone.

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