Doctoral Dissertation Defense Announcement

AQUEOUS BASED PROCESS FOR ENHANCED DISSOLUTION AND DISPLACEMENT/REMOVAL OF NAPLs

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Friday, August 3, 2018 (11 AM - 1 PM)

Conference Room, Civil and Environmental Engineering

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Abstract

This dissertation addresses the aqueous-based processes associated with alcohol fuel releases and treatment of hydrocarbon impacted soils. It is comprised of two parts. In Part A, the effects of alcohols (methanol, ethanol, and isobutanol) on the aqueous solubility of benzene, toluene, m-xylene (BTX) and 1,2,4-trimethylbenzene (TMB) from a synthetic gasoline in contact with water were evaluated through equilibrium partitioning experiments. Enhancements in the aqueous solubility of aromatic hydrocarbons were measured over a wide range of aqueous concentrations (0 to ~60 vol.% alcohol). Enhancements in BTX and TMB were observed to be greater for ethanol vs. methanol on a volume fraction of alcohol in aqueous solution basis. Enhancements with isobutanol were greater than those for ethanol and methanol over the range of miscibility of isobutanol in water (0 to ~8 vol.%). Experimental enhancements were compared with predictions using activity coefficient models (UNIQUAC, 2- and 3-suffix Margules) using independently measured binary interaction parameters. In separate experiments, pore water concentrations of alcohols and aromatic hydrocarbons were measured in continuous flow column experiments to determine the pore water impacts of spills with ethanol, methanol, and isobutanol for varying alcohol content (3%, 15 %, and 25 vol.% alcohol) fuels. Visualization studies were also conducted to examine how the non-aqueous phase liquid (NAPL) sources are generated from these spills and how the alcohols are released for these different fuels. Observed enhancements in hydrocarbon pore water concentrations were consistent with the equilibrium partitioning measurements. Alcohol pore water concentrations for higher fuel contents for methanol and ethanol fuels were characterized by an increase in mass transfer limitations that was also indicated by the visualization studies. Maximum pore water alcohol concentrations for the high alcohol content isobutanol spills were limited by the solubility of isobutanol in water. In Part B, a bench scale physico-chemical aqueous-based separation technique was developed to treat hydrocarbon impacted soils. The primary objective of Part B was the removal of residual NAPL from soils to environmentally acceptable levels either as a single treatment process or as a preliminary step in a treatment train.