terials from accidental spills and land based handling operations has become increasingly apparent. Many of these hazardous materials contain volatile organic compounds (VOCs) that can volatilize into the air and/or sorb to the soil. To develop adequate treatment and control for volatile air emissions and to predict the fate of chemical constituents in soil, it is necessary to understand the fundamental processes and interactive mechanisms that occur in the unsaturated soil. In addition, such knowledge can be utilized both to provide criteria for designing soil decontamination projects such as soil vapor extraction and to evaluate the feasibility of alternative treatments for industrial vapors and exhaust gases.

It is commonly assumed that volatile compounds in the vapor phase pass unaffected through the soil and enter the atmosphere with no change in mass. This assumption impacts decisions on air emissions, transport and fate estimation, regulatory limits, on-site controls and treatment strategies. An evaluation of this assumption and the identification of removal mechanisms for mixtures of compounds in unsaturated soil is the focus of this research. The major mechanisms that have been identified are sorption, degradation, and vapor loss.

Data from batch reactors were collected for the vapor phase sorption of five compounds: benzene, ethylbenzene, trichloroethylene, toluene and o-xylene on unsaturated soil. These data were used to determine sorption and degradation coefficients for single compounds and sorption coefficients for mixtures of compounds. The results indicate VOCs are sorbed and then removed by degradation as they pass through soil in the vapor phase. Sorption coefficients for mixtures determined from laboratory data were compared with predictions obtained from an ideal adsorbed solution model (IAST).

Supercritical CO_2 extraction/catalytic oxidation of aromatics from contaminated aqueous streams

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Abstract

Distribution coefficients (K-values) between water and supercritical CO_2

have been measured for a series of typical aromatic contaminants (benzene, m-cresol, p-chlorophenol, phenol), both in the ternary system and in systems containing several aromatics. The results were accurately modeled using a perturbation theory- based equation of state of the Carnahan–Starling–DeSantis–Redlich–Kwong type. In some cases it was shown that pure component solubilities in supercritical CO_2 could be used as a basis for estimating distribution coefficients between water and CO_2.

The oxidation of supercritical mixtures containing extracted aromatics was also studied, by adding the necessary amount of air (equivalence ratios near 1) and contacting this mixture with various mixed-metal oxide catalysts. Typical reaction conditions were $P = 80$–200 bar and $T = 393$–573 K. Over this range both partial and total oxidation were possible. By holding temperature and composition constant, but varying pressure, it was determined that fluid-phase reactions do take place (as evidenced by measurement of an activation volume), but that the reactions are not diffusion-limited. Overall rates were enhanced by the catalysts, as was demonstrated by comparing Pt-based catalysts to those containing Ni, Co, or V. Rates comparable to oxidation in supercritical water can be obtained, but at lower temperature.

Technological innovation in hazardous waste treatment and disposal

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Abstract

Innovation is a highly desirable process in the field of hazardous wastes. The high cost of disposal with current technologies impedes the cleaning of old sites