

defects such as desiccation cracks, fissures and fractures in laboratory clay specimens are totally or partly responsible for the discrepancies in the reported results. Since field tests are expensive, time-consuming and in many instances impractical, it is essential to develop reliable laboratory permeability tests where the field conditions are closely modelled. Effect of cracks on the hydraulic conductivity of clays and various treatment techniques to reduce the hydraulic conductivity of cracked clays and permeable soils (clay-sand mixture) have been investigated.

A field clay (obtained from Houston area) and kaolinite clay (commercially processed clay) were selected for this study with methanol and acetic acid as the organic permeants. In this laboratory study a reliable testing procedure for simulating cracked clays has been developed. The hydraulic conductivity of clays, compacted at optimum moisture content, ( $< 3 \times 10^{-8}$  cm/s) was increased above the EPA limit of  $10^{-7}$  cm/s in a controlled manner using syringe needles of various sizes to simulate cracked clay specimens. Relationships between hydraulic conductivity of clays and crack parameters (crack length, size and density) have been developed. The interactive nature of cracks and hazardous organic permeants on the hydraulic conductivity of clays have also been evaluated. The hydraulic conductivity of the cracked clays ( $> 10^{-7}$  cm/s) and permeable soils ( $> 10^{-5}$  cm/s) were restored to that of the uncracked clays ( $< 3 \times 10^{-8}$  cm/s) using various colloidal solutions such as sodium silicate, cement, lime and bentonite or their mixtures thereof. These findings will improve the current repair practice for leaking clay barriers in waste disposal sites and deep aquifers. Preliminary results on treating contaminated soils are also very encouraging.

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## Investigation of equilibrium and kinetic parameters for air stripping of volatile and semi volatile organic contaminants from soil by dynamic experiments

C. Erkey and A. Akgerman

*Department of Chemical Engineering, Texas A&M University, College Station, TX 77843-3136 (USA)*

### Abstract

An experimental technique has been developed for simultaneous measurement of adsorption equilibrium and rate parameters for air stripping of con-

taminants from soil through adsorption and desorption breakthrough curves. The parameters for sorption of toluene, trichloroethane, heptane and carbon tetrachloride from sand and soil with an organic content of 25 have been determined. The adsorption isotherms obtained for these systems are successfully represented by a Langmuir formula. The desorption profiles have also been obtained using moist air. The removal rates of contaminants were found to increase significantly in the presence of water. This was attributed to the effect of water on the thermodynamic equilibrium between the soil and the contaminant. The experimental technique developed is fast, accurate and can be used for quantification of soil contamination from soil gas analysis as well as yielding the necessary equilibrium and mass transport relationships for air stripping as a remediation technique.

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## Modelling of deep well oxidation of aqueous hazardous wastes under supercritical conditions

Susan Kodra, Marianne E. Lovo and Bemuri Balakotaiah

*Department of Chemical Engineering, University of Houston, 4800 Calhoun Road, Houston, TX 77204-4791 (USA)*

### Abstract

Deep well oxidation is a novel process that has been developed recently for oxidizing suspended and dissolved organics from aqueous waste streams. The process employs wet oxidation methods and is carried out in a deep well reactor buried in the ground. The reactor consists of concentric tubes of length 1,500–3,000 meters suspended within a conventionally drilled and cased well. During the oxidation process, the waste stream and oxygen are brought together in a mixture at high pressure and elevated temperature. Oxidation of organics is initiated spontaneously at these conditions. The heat of combustion is used to heat up the incoming feed to the required temperature and the hydrostatic head provides the required pressure. The temperature and pressure within the reactor can be above or below the critical temperature and pressure for water and the process can be accordingly treated as supercritical or subcritical deep well oxidation, respectively.