ammonia in conjunction with extraction-enhancing anionic ligands such as acetate and EDTA.

Extensive screening tests were performed at 43 °C and 250 psig (18.5 bar) using a pressurized stainless steel Soxhlet extractor to rapidly evaluate the anhydrous ammonia extraction concept. A typical test involved spiking and aging prior to Soxhlet extraction for 2-hours with 30 extraction/siphon cycles. When extracting soils that were soaked with metal nitrate solutions prior to drying and aging, the metal removals were 73% for copper and cadmium, 64% for zinc, and 26% for mercury when the metal-nitrate spiking concentrations ranged from 20,000 to 50,000 mg/kg. Only 8% lead removal was observed using ammonia under these conditions. Furthermore, poor extraction efficiency was uniformly observed for all metals when extracting soil samples with spiking concentration below 2,000 mg/kg.

When enhancing ligands were added prior to ammonia extraction, lead removals greatly improved. For example, 95% removal was achieved from $Pb(NO_3)_2$-spiked soil previously soaked in disodium EDTA solution and dried prior to extraction. When using dry-mixed enhancing ligands such as powdered sodium acetate or disodium EDTA, 75% to 87% lead removal was achieved on $PbSO_4$-, $PbCO_3$-, PbO- or Pb^0-spiked soil samples during ammonia extraction. Similar extraction results were obtained for lead-contaminated Superfund soil treated with solution-mixed or dry-mixed enhancing ligands prior to ammonia extraction.

A commercially available Supercritical Fluid Extraction (SCE) Screening System has been used under subcritical conditions (110 psig or 8.5 bar, 23 °C) to further evaluate the anhydrous ammonia extraction concept. The limited SCE experimental results obtained to date are confirming the Soxhlet extraction data for copper removal from $Cu(NO_3)_2$-spiked soil. Eventually the SCE will be modified to incorporate a mechanically-stirred extraction reactor in place of the fixed-bed extractor now in use. The modified SCE will more closely simulate the extraction mixing conditions in a full-scale soil extractor.

The feasibility of *in situ* treatment of soil to promote desorption of hazardous wastes, thus permitting capture and treatment

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Abstract

Hazardous wastes are frequently immobilized on soil particles by adsorp-

tion. This project is investigating altering, *in situ*, either the surface chemistry of the soil particle or the nature of the sorbed organic compounds, such that the organic compounds will be desorbed and then be ready for transport and treatment.

Two approaches were investigated so far, to alter the soil–sorbate bond; (1) the addition of H_2O_2 to make the sorbate more oxygenated (more polar), (2) the addition of NaOH to alter the surface properties of the soil at high pH. Soil specimens contaminated in the laboratory with phenol were placed in the flexible-wall permeameter apparatus. In duplicate, contaminated specimens were permeated with 120 mg/L solution of H_2O_2. A 77% recovery of the contaminant was measured, whereas in duplicate contaminated specimens permeated with NaOH solution at pH 10 a 87% recovery was measured. To allow a comparison of the treatment processes to simple flushing, triplicate contaminated specimens were permeated with deionized water and a 61% recovery of the contaminant was measured.

A hazardous substance project management system

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Abstract

Disposal of the ever-increasing amounts of hazardous substances is a critical concern in our society. Vast amounts of resources are necessary to conduct research into the most efficient and effective means to treat these wastes. Officials of the Federal and State Governments and in Industry are involved in the planning and allocation of financial resources to combat this problem. Im-