Hydrogen peroxide/visible-ultraviolet irradiation for oxidation of organic environmental contaminants is a promising treatment technology. This research uses a continuous flow tubular reactor to model the rate of disappearance of organic compounds (benzene, trichloroethylene, 1,4-dichlorobenzene, 1,1-dichloroethane, 1,1,1-trichloroethane, tetrachloroethylene, and carbon tetrachloride) at both leachate and contaminated groundwater concentration levels. The effects of process parameters includedi in the study are space velocity (contact time), oxidant to reactant ratio, and light intensity.

Hydrometallurgical treatment of hazardous waste for simultaneous detoxification and metal recovery

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Abstract

Many industrial processes generate hazardous solid wastes containing heavy metals such as lead and cadmium. Fly-ash from municipal solid waste (MSW) incinerators and waste molding sand from brass foundries are two examples. This material is currently disposed of in hazardous waste landfills. Investigations presented in this paper address a potential hydrometallurgical process for (1) chemical dissolution (leaching) of the metal values from the hazardous waste, and (2) recovery of the dissolved metals from the aqueous leaching solution which can then be recycled. The process is flexible and can be applied to various types of solid waste. Work during the previous year has been concentrated on MSW fly-ash.

The leaching of metal values from MSW fly-ash has been compared for various lixiviants, including HCl, H_2SO_4, acetic acid, NaCl and HCl+NaCl. The maximum extractions observed for Pb, Cd and Zn were 89%, 98% and 74%, respectively in 1 *M* HCl. Chemical dissolution of Pb, Cd and Zn can be accom-

plished quickly and effectively in both HCl and HCl + NaCl solutions. Optimization of leaching conditions for effective detoxification and subsequent metal recovery can be achieved by controlling the pH of the lixiviant and the ratio of fly-ash to lixiviant. Significantly, Toxicity Characteristic Leaching Procedure (TCLP) tests have been conducted which show that residues can be produced which meet the toxicity limit for Pb and Cd. Furthermore, lead and cadmium can be recovered from the leaching solution by cementation with zinc dust. Experiments have been performed to determine the effects of pH, particle size of the zinc dust used, quantity of zinc added, and dissolved impurities on the cementation kinetics. The final solution obtained after leaching and cementation yields a dissolved zinc concentration of approximately 15 g/L or higher, a level suitable for direct electrowinning of zinc. Electrochemical experiments have been performed which are aimed at determining the critical parameters which affect the cementation and electrowinning steps.

A flexible process flowsheet incorporating the material and water balances has also been developed which runs on Lotus 1-2-3 or Quattro Pro spreadsheets. The program is based on the data generated from experiments and includes many adjustable parameters. The flowsheet/spreadsheet program is currently being used to develop an economic analysis of the overall process. Progress so far suggests that such an approach for simultaneous detoxification of the solid wastes and recovery of the metals value is both technically and economically feasible.

In situ treatment for cracked and contaminated clays and permeable soils

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Abstract

There is increasing concern over leaking deep clay aquicludes resulting in contamination of aquifers. Also failure of primary or secondary clay barriers in existing hazardous waste storage and disposal facilities has drawn much attention recently. But very little is known about repairing leaking clay barriers *in situ* to reduce seepage of contaminants. Improper modeling of local