Summary

As discussed in the Introduction, this book is the sixth ASTM Special Technical Publication (STP) on the subject of new test methods to assess and control the handling of hazardous and industrial solid wastes. Sound testing methods are needed to complement the range of engineering practices being developed in the solid waste management area.

Contaminant and Leaching Assessment

Tests of wastes are required to predict the tendency of toxic constituents to leach. Results are used to guide the selection of safe disposal practices.

Philipp, Endell, Raguin, and Dechelette describe an eight-laboratory study under the auspices of the International Iron and Steel Institute that compared the results of standard leaching tests of nine countries with two types of slag, one sludge and three dusts. One interesting finding was that lead extracted from blast furnace slag by the U.S. Environmental Protection Agency (EPA) test was over 50 times in excess of the standard, whereas it was more than 100 times below the standard imposed for the French and Japanese tests.

Ham, Boyle, and Blaha compare laboratory leach tests of foundry wastes with actual landfill leachate quality. The U.S. EPA acetic acid leaching procedure was marginally more useful than a similar procedure using deionized water in predicting the presence or absence of problem constituents in landfill leachate; neither was able to predict accurately parameter concentrations. Leach tests on auger samples of buried wastes were more accurate than leach tests on raw wastes.

Pilot-scale leaching tests developed by Pohland and Gould showed that heavy metal sludge could be assimilated within a landfill when it is disposed with municipal refuse down to a ratio of 1:13 and exposed to the influence of leachate containment and recycle.

Instead of applying a standard leach test with its one set of environmental conditions to a waste, Cote, Briddle, and Benedek surveyed and described the intrinsic properties of a solidified waste that relates to leachability under any set of environmental conditions.

Brown, Bishop, and Gress used up-flow column leaching tests to study the release patterns of heavy metals from stabilized/solidified heavy metal sludges. Particle size was found to be important, primarily because of the loss of alkalinity, which allowed metal release.

The selection/specification of parameters to reduce variability in the ASTM batch leach tests is presented by Jackson. The ASTM column leach test is described by Miner, Maltby, and Dell.

Ground-Water and Contaminant Migration Assessments

Chemical interaction and advection/diffusion modeling of leachate constituents from a landfill overlying clay are described by Quigley and Rowe (Canada). DeVille and Malloy developed a management system for handling ground-water monitoring data with emphasis on error checks and quality assurance.

The effect of pH and soil organic carbon content on adsorption of pentachlorophenol is described by Banerji, Piontek, and O'Connor; 84% of the adsorption was reversible. The rate and extent of adsorption of mixed dichlorobenzene and dichlorophenol was determined by Uchrin and Katz; the two-solute system showed enhanced adsorption by some soils.

Design and operating factors that affect bioreclamation of ground water at the surface and *in situ* are identified and discussed by Parkin and Calabria; means are described to select proper environmental conditions and to provide adequate contact between the bacteria and the contaminants.

ASTM guides for sampling ground-water monitoring wells and for pore water sampling in the Vadose Zone are described by Bone and Morrison. Sampling devices, flushing procedures, and sample preservation are emphasized.

Incineration of Hazardous Waste

Performance assessments of thermal systems for destroying hazardous waste are described by Oppelt. Parameters monitored are SO_x, NO_x, particulates, hydrochloric acid (HCl), carbon monoxide (CO), carbon dioxide (CO_2), oxide (O_2), metals, total hydrocarbons, and specific organic compounds of concern; these are related to process operating variables. Particulate emissions turned out to be the most difficult standard to attain for incinerators.

Liner Assessments

An overview of the manufacturing, properties, installation, and compatibility testing of flexible membrane liners is presented by *Koerner*. Improved accelerated aging tests, field seam test methods, and leak location methods are needed.

The use of *in-situ* soil as part of a clay liner was studied by Yong, Warith, and Boonsinsuk; heavy metals tended to be significantly attenuated most likely through coprecipitation and fixation. The effect of pore fluid pH on the dynamic shear modulus of clay-sand mixture was described by Du,

Mikroudis, and Fang, for acidic fluids the modulus of the kaolinite samples increased as the pH decreased, the opposite was the case for bentonite.

Site Monitoring and Assessment

An array of remote methods for assessing waste sites is described by Wruble, van Ee, and McMillion. These are classified as airborne, ground surface, and subsurface or down hole. Airborne techniques include infrared photography and multispectral scanning. Surface methods are seismology, magnetometry, ground-penetrating radar, resistivity, and electromagnetic induction. Subsurface approaches include induction logging, gamma profiles, and optical fibers tipped with optrodes for laser-induced fluorescence detection of contaminants.

ASTM guidelines for sampling solid wastes from point sources and impoundments are described by Holcombe, Johnson, and Lorenzen; methods for determining the required number of samples are included.

A single probe that combines the functions of a tensiometer and a lysimeter is applied in an ASTM method by Morrison and Mioduszewski for use in monitoring leaks from underground storage tanks and impoundments.

Waste Testing

The analysis of waste with complex chemical matrices is described by Rohlik. In this paper he discusses separation and preparation of samples, implications of oxidation and reduction, adaptation of simple matrix methods and the use of modeling, waste background information and process analytical tools in solving the complex chemical matrix problem.

Katz and Jennis reviewed and evaluated procedures being used for the determination of micro-nutrients, macro-nutrients, and some toxic elements in sewage sludge. Inductively coupled plasma spectroscopy (ICPS) analysis seems to be an extremely useful analytical tool considering speed, sensitivity, and selectivity.

Waste Treatment Alternatives

Cement-based grouts were used by Gilliam, Dole, and McDaniel for the immobilization for four simulated waste streams. Grout formulations were compared and leach tests were performed. All wastes, including the organics were suited for this type of treatment. Tittlebaum, Eaton, Cartledge, Walsh, and Chalasani employed the use of scanning electron microscopy, energy dispersive X-ray analysis, electron probe analysis, and X-ray powder diffraction to study cement-based solidified/stabilized wastes. The use of these short-term testing techniques when combined properly provide a method for identi-

fying mechanisms of waste stabilization. They were found particularly useful for evaluating the solidification of organics.

Biological treatment of toxic or inhibitory wastes were reviewed and collated by Rozich and Gaudy. The use of standard aerobic treatment processes were evaluated in light of the inhibitory nature of toxic wastes and were found to be easily adapted to the treatment of these wastes.

ASTM Test Method Development

Some of the work of Committee D-34 on Waste Disposal was presented at a one-day symposium in Colorado Springs, CO, before the international symposium in Alexandria, and is contained in this STP.

Bone discusses standards that have been developed for sampling ground-water monitoring wells and for the analysis of ground water. The procedures for sampling ground-water monitoring wells assumes that the wells have been properly installed and developed, and the analysis of ground water is limited to evaluation of EPA's Method 8600 proposed in EPA Manual SW-846. Soil moisture monitoring and techniques for sampling of pore water in the vadose zone are given a comprehensive and detailed review by Morrison and Mioduszewski. Application of these techniques to underground storage tanks and surface impoundments are described.

Guidance for collecting representative samples of wastes from point discharges and impoundments is described by Holcombe, Johnson, and Lorenzen. Safety procedures, design considerations, equipment, and sampling procedures are outlined.

Jackson describes the history and development of the first standard leaching test for solid waste. Comparisons with the EPA Toxic Extraction Procedure were also made. Another group in ASTM is attempting to develop a column leaching method for solid waste. This group's efforts are presented by Miner, Maltby, and Dell.

The development of a standard test for comparing the adsorption properties of various soil materials is described by Griffin, Sack, Roy, Ainsworth, and Krapac. The test presents an initial and a 24-h solution concentration as a distribution ratio between solutes and soil materials. This method should prove particularly useful to consultants and regulators alike in assessing attenuation potential of soils.

Rinaldo-Lee evaluated the use of a paint filter test proposed by EPA to determine the free liquid content of waste. Six laboratories participated in the testing of four different waste samples as part of this study. Two major problems were identified concerning the usefulness of this test: (1) separation of the mesh from the cardboard filter holder and (2) differences in filter design.

Although generally small in quantity, chemical laboratories generate a large number of diverse waste streams. McKee describes the committee's

work on the development of a currently improved guide for the disposal and handling of laboratory chemicals and samples.

Warner, Frick, Lovejoy, and Burns present a new classification scheme to facilitate the storage of hazardous materials and waste. Seventy-seven hazard storage compatibility groups were identified for which specific storage requirements are to be developed.

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