Stabilization and Solidification of

Hazardous, Radioactive, and Mixed Wastes

3rd Volume

T. Michael Gilliam and
Carlton C. Wiles, editors

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Foreword

This publication, *Stabilization and Solidification of Hazardous, Radioactive, and Mixed Wastes: 3rd Volume* contains papers presented at the symposium of the same name, held in Williamsburg, Virginia on 1-5 November 1993. The symposium was sponsored by ASTM Committee D-34 on Waste Management; Oak Ridge National Laboratory; U.S. Environmental Protection Agency; Hazardous Substance Management Research Center of the New Jersey Institute of Technology; Environmental Canada Wastewater Technology Center; and the Alberta Environmental Center. T. Michael Gilliam of the Oak Ridge National Laboratory in Oak Ridge, Tennessee and Carlton C. Wiles of the National Renewable Energy Lab in Golden, Colorado presided as symposium chairmen and are editors of the resulting publication.

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Overview

Stabilization and solidification (S/S) technologies have been used for decades as a final treatment step prior to the disposal of both radioactive and chemically hazardous wastes. Stabilization refers to the alteration of waste contaminants to a more chemically stable form (i.e., a form which results in a greater difficulty of contaminant release to the environment), thereby resulting in a more environmentally acceptable waste form. Solidification refers to the physical alteration of the waste to restrict water release from or access to the waste and thereby resulting in a more environmentally acceptable waste form. Typically, stabilization processes also involve some form of physical solidification.

This symposium series (scheduled once approximately every three years) provides a forum for technical exchange between researchers working with S/S technologies from both the low-level radioactive and chemically hazardous waste communities. Although the two scientific communities are faced with similar problems and basically work with the same technologies, this symposium series presents a unique forum for technical exchange between the two communities. This meeting is the second in the series. Papers from the second meeting in the series were published in STP 1123, *Stabilization and Solidification of Hazardous, Radioactive, and Mixed Wastes.*

Land disposal restrictions are becoming ever increasingly stringent, driven by technical, regulatory, and political considerations. To the largest extent practicable, alternatives to land disposal are desirable, such as waste minimization, recycling, and destruction (e.g., incineration). In many instances, however, these alternatives are unrealistic due to the physical nature or location of the waste, the type and concentration of contaminants that it contains, or technical and economic issues. In such cases, S/S technology is a viable technical option which has historically proven to be cost effective.

A wide variety of both radioactive and chemically hazardous wastes are amenable to S/S. These include liquids, sludges, filter cakes, contaminated soils, and ash. S/S technologies are often used with chemically hazardous wastes contaminated with metals (e.g., lead, nickel, chromium) and are routinely used with low-level radioactive wastes of all types. Clearly, S/S is not the preferred technology for organic-rich wastes, but research is increasingly focusing on its application to wastes containing trace levels of organic contaminants.

S/S technologies are often classified on the basis of the principal additives used to obtain a solid matrix. Various systems based on organic and inorganic additives are listed below:

Inorganic Based Systems	Organic Based Systems
portland cement	bitumen
soluble silicates-cement	urea formaldehyde
pozzolan-lime	polybutadiene
pozzolan-cement	polyester
clay-cement	epoxy
gypsum	polyethylene

The specific technology used is based on several factors including volume increase, performance requirements, economics, logistic constraints, and material availability.

Inorganic-based systems may involve both stabilization and solidification. They generally utilize a hydraulic binder which reacts with water to form a solid product. Portland cement is the most commonly used binder. Cement-based systems are widely used due to the availability of raw materials, compatibility with existing process equipment, and adaptability to a variety of process configurations and waste-form performance requirements. Pure cement systems are becoming increasingly rare. Additives such as fly ash, granulated blast furnace slag, and specialty clays are used to improve waste-form performance and to minimize the cost. Compared with a pure cement system, these additives can reduce the resulting volume increase, reduce porosity (and, thus, reduce leachability), and increase compressive strength.

Organic-based systems consist of encapsulating the waste in a matrix that is essentially impervious to water. As such, they are designated as solidification processes. Many of these systems require water removal from the waste prior to solidification and thus result in an overall volume decrease. Products from these systems require a container to provide the necessary structural integrity to support overburden pressure. Use of such systems has been limited to special types of high-hazard, relatively low-volume, radioactive wastes due to the increased costs generally associated with these systems.

The scientific community has been focusing attention on understanding and predicting the long-term containment prospects of waste treated with this technology. Consequently, the majority of papers presented in this publication address to some degree one or both of the two principal issues associated with long-term containment; leachability and durability. Leach-bility refers to the release of contaminants from the waste form upon exposure to an aqueous media. Durability refers to the ability of the waste form to maintain its structural integrity upon exposure to expected environmental conditions.

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