Emerging Technologies in Hazardous Waste Management V

EDITED BY

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Foreword

THE ACS SYMPOSIUM SERIES was first published in 1974 to provide a mechanism for publishing symposia quickly in book form. The purpose of this series is to publish comprehensive books developed from symposia, which are usually "snapshots in time" of the current research being done on a topic, plus some review material on the topic. For this reason, it is necessary that the papers be published as quickly as possible.

Before a symposium-based book is put under contract, the proposed table of contents is reviewed for appropriateness to the topic and for comprehensiveness of the collection. Some papers are excluded at this point, and others are added to round out the scope of the volume. In addition, a draft of each paper is peer-reviewed prior to final acceptance or rejection. This anonymous review process is supervised by the organizer(s) of the symposium, who become the editor(s) of the book. The authors then revise their papers according to the recommendations of both the reviewers and the editors, prepare camera-ready copy, and submit the final papers to the editors, who check that all necessary revisions have been made.

As a rule, only original research papers and original review papers are included in the volumes. Verbatim reproductions of previously published papers are not accepted.

Preface

HAZARDOUS WASTE MANAGEMENT continues to be of great interest to scientists and engineers. The symposium on which this volume was based featured approximately 400 presentations during a three-day meeting. The final selection of the chapters included herein is based on peer review, scientific merit, the editors' perceptions of lasting value or innovative features, and the general applicability of either the technology itself or the scientific methods and scholarly details provided by the authors.

The volume continues a theme initiated in 1990. Its predecessors, *Emerging Technologies in Hazardous Waste Management,* ACS Symposium Series No. 422 (1990), *Emerging Technologies in Hazardous Waste Management II,* ACS Symposium Series No. 468 (1991), *Emerging Technologies in Hazardous Waste Management III,* ACS Symposium Series No. 518 (1993), and *Emerging Technologies in Hazardous Waste Management IV,* ACS Symposium Series No. 554 (1994), are related contributions on waste management, but each volume is essentially different. By inspection, the reader may quickly recognize this diversity, and also conclude that no single volume can do justice to the breadth and depth of technologies being developed and applied in practice.

The contributions presented in this volume are divided into six separate but complementary sections, including: Electrokinetic Soil Cleaning; Element Recovery and Recycle; Vitrification and Thermolysis; Chemical Oxidation and Catalysis; Extraction and Precipitation; and Biological Degradation.

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Chapter 1

Emerging Technologies in Hazardous Waste Management V

An Overview

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The process of development and application of many remedial alternatives has occurred largely in response to the mandates of "Superfund" (CERCLA and SARA), as well as other federal and state programs. Hence, an array of options have become available which can include an emerging concept with bench-scale testing, a field demonstration, a selection for site-specific remediation, and full-scale use and commercialization. For example, the state-of-technology development for options applicable to soils and ground waters has been described as indicated in Figure 1(1).

Both *ex situ* and *in situ* techniques are evident, with dependence on the biological, physical and chemical sciences and engineering, either in separate or combined processes. When arrayed according to source matrix, technology applications for soils and ground waters have been or are being developed to destroy/detoxify, separate/recover, and/or immobilize contaminants(1,2).

Although not as well developed, many of these same technologies may be similarly applied to sediments, sludges and dredge spoils. Whereas, *in situ* remediation may require augmentation and/or enhancement to optimize both biological and physical-chemical techniques, *in situ* immobilization may be but one consequence of an applied technology rather than the primary intent. Moreover, techniques for access, isolation or capture of contaminants, as well as their extraction and *ex situ* aqueous-phase treatment, may provide supplemental alternatives for an integrated remedial action approach.

New technologies continue to be developed for remedial applications(3), and the use of innovative options has already surpassed established or conventional alternatives for remediation at Superfund sites. There has been a significant trend toward innovation, as new technologies are demonstrated and applied for the remediation of contaminated ground waters, soils and sediments. Moreover, depending on site-specific circumstances, more than one technology or process may be needed to achieve remediation goals. Therefore, combinations of technologies are often necessary, and those already implemented at Superfund sites have included(4,5):

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- soil washing, followed by bioremediation, or incineration, or solidification/stabilization of soil fines;
- thermal desorption, followed by incineration, or solidification/stabilization, or dehalogenation to treat PCBs;
- soil vapor extraction, followed by *in situ* bioremediation, or *in situ* flushing, or solidification/stabilization, or soil washing to remove semivolatile organics;
- dechlorination, followed by soil washing for inorganics;
- solvent extraction, followed by solidification/stabilization, or incineration of extracted contaminants and solvents;
- bioremediation, followed by solidification/stabilization of inorganics; and
- *in situ* flushing followed by *in situ* bioremediation of organic residuals.

STATUS OF REMEDIAL TECHNOLOGIES
(Soils and Ground Waters)

Emerging ——— *Innovative* ——— *Established/Available* >

Bench-Scale Testing Data	**Field Demonstration Use**	**Selected for Remediation**	**Limited Full-Scale Use or Limited**	**Common Full-Scale**
In situ electrokinetics	Radio-frequency heating	Solvent extraction	Thermal desorption	Incineration
			Land treatment	Solidification/ stabilization
X-ray treatment	*Ex situ* furnace vitrification	*In situ* soil flushing	Soil vapor extraction	Above-ground treatment(gw)
Electron irradiation	Pneumatic or hydraulic fracturing	Dechlorination	Soil washing	
		Bioventing	*In situ* bioremediation	
Laser-induced oxidation	Treatment wall (gw)	Air sparging (gw)		
			Slurry-phase bioremediation	
			In situ vitrification	

gw = ground water

Figure 1(1).

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