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## Book reviews

*Phytoremediation of Contaminated Soil and Water*, Norman Terry, Gary Banuelos (Eds.), Lewis Publishers, Boca Raton, FL, 2000, 389 p., \$69.95, ISBN 1-56670-450-2.

This book is a compilation of articles provided by speakers at a symposium that was held in June, 1997 as part of the Fourth International Conference on the Biogeochemistry of Trace Elements at the University of California, Berkeley. In addition to the articles from the symposium on “Phytoremediation of Trace Elements in Contaminated Soil and Water,” there are invited articles on special topics. All articles have been peer-reviewed. The trace elements considered include lead, selenium, zinc, cadmium, nickel, mercury, arsenic, copper and cobalt; the listing is in the order of amount of attention given to each element with lead receiving the most coverage.

The interest in this topic goes beyond the U.S. borders as there are also authors from Australia, Belgium, France, Germany, the Netherlands, New Zealand, Spain, Switzerland, and the UK. There is more consideration given to phytoaccumulation of trace elements in plants than to the other topics which include phytovolatilization and phytostabilization. When different technologies are compared based on economics, phytostabilization is shown to be the most attractive.

The work described includes laboratory studies, field demonstrations, and reviews of the literature. Economic and regulatory issues are also addressed. There is more emphasis on science than engineering. The genetics, molecular biology, physiology, and ecology of trace element phytoaccumulation and tolerance of plants are described. Transport phenomena are described but there is little quantification and modeling of transport processes. Some attention is given to microbial processes.

Those working in the field will find this book to be an important compilation of current work. The editors and authors have made a significant contribution to the field by making these papers available in this form.

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*EPA Environmental Engineering Sourcebook*, Russell Boulding (Ed.), Ann Arbor Press, Chelsea, MI, 1996, 404p., \$69.95, ISBN: 1-57504-002-6.

The U.S. Environmental Protection Agency (EPA) has published a wealth of information on an infinite variety of pollution topics. Nowhere is the publishing activity more evident than in the hazardous chemical-contaminated site remediation.

But for the ordinary engineer, even the researcher, EPA material (reports, etc.) is difficult to find. Even though my University library has an extensive government document section, I find it difficult, on occasion, to find the document I want. Thus, the book serves a major purpose in publishing synopses of 28 EPA reports prepared by EPA personnel and EPA consultants.

This book is divided into two equal sections:

- Part I: Containment, pump-and-treat, and in situ treatment;
- Part II: Ex situ treatment methods for contaminated soils, ground water and hazardous waste.

While I was tempted to reproduce the table of contents listing the titles of all 28 chapters, I resisted. Suffice it to say that the editor selected a wide variety of reports covering, among others, the following topics: (1) ex situ processes included air stripping, soil washing, solvent extraction, chemical oxidation, chemical dehalogenation, slurry biodegradation, rotating biological contractors, solidification/stabilization, thermal desorption, pyrolysis, and supercritical water oxidation; and (2) a host of in situ processes among which are vitrification, bioremediation, and soil vapor extraction

All reports, as one might expect from an EPA project, are very well-referenced.

G.F. BENNETT

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*Industrial water reuse and wastewater minimization*, James G. Mann and Y.A. Liu, McGraw-Hill, New York, NY, 1999, 524 p. plus CD-ROM disk, US\$99.95, ISBN: 0-07-134855-7.

Anyone opening this book expecting a conventional approach to wastewater use and reuse will be very surprised as the text is a very modern, mathematical approach to a very old problem. Water-pinch technology is a radically modern computational analysis. This new approach allows engineers "... to analyze water-using processes before design and operation, as well as after, to minimize both freshwater consumption and wastewater generation."

The book's authors review the application of the new water-pinch technology and its use. By combining an analysis of the theoretical principles underlying the technology, including a detailed discussion of the theoretical principles which they combine with a step-by-step analysis of methodologies for the practical applications of these principles,

they show how to analyze, synthesize, and retrofit water-using operations as well as effluent treatment systems in manufacturing processes.

The technology underlying that work began in the 1970s in the design and retrofitting of heat exchange networks. Using the basic principle of thermodynamics and energy balances, engineers can analyze the heat flows across various temperature intervals throughout a manufacturing process and identify a temperature called the pinch point. Below the pinch point, extended heating utilities are unnecessary; above the pinch point, extended cooling systems are equally unnecessary.

Extension of this technology to water-using operations allows engineers to maximize water reuse while simultaneously minimizing wastewater generation and treatment. Essentially, this technology treats a water-using operation as a problem of mass transfer from a contamination-rich process to a water stream. Contaminants may include suspended solids, chemical oxygen demand or other reuse-limiting chemicals. As in the heat-exchange application, a pinch-point (in this case, water-pinch point) is determined based on contaminant concentration basis. The reduction in water use is attained by reusing contaminated streams in systems that do not need fresh water.

An example of a water-using network is given in Chapter 1 to illustrate the authors' point. A petroleum refinery is modelled. Conventionally, 135 te/h of water are used. But by using water-pinch analysis and the reuse of some streams, that flow is reduced approximately 20% to 107 te/h. If regeneration is added, the water rate decreases to 55.5 te/h.

The concepts embodied in the book are graphically illustrated in the five figures in Chapter 1. There are four blocks shown (and the relevant chapters identified):

1. Wastewater Minimization Through Water Reuse:  
Chapters 2 and 3 (single contaminant);  
Chapters 7 to 9 (multiple contaminants).
2. Wastewater Minimization Through Regeneration, Recycle and Reuse:  
Chapter 5 (single contaminant);  
Chapters 7 to 9 (multiple contaminants).
3. Wastewater Minimization Through Process Changes:  
Chapter 6 (single contaminant);  
Chapter 7 (multiple contaminants).
4. Design of Distributed Effluent-Treatment Systems:  
Chapter 4 (single and multiple contaminants);  
Section 9.5.5 (multiple contaminants).

The final chapter (9) entitled "Wastewater Minimization Through Mathematical Optimization," clearly illustrates the unique aspect of this book that differentiates it from conventional wastewater minimization texts — it's a strongly mathematical analysis approach to the problem. That approach is assisted by an inclusion of a CD-ROM disc that has three components: (1) Water Design installation files, (2) Water Design example files and (3) TK Solver files.

The book contains, at the end of each chapter, problems to be worked by the students. And solutions (surprisingly to me) are given in the Appendix. Personally, as a faculty member, I'd prefer a separate answer book.

G.F. BENNETT

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*The Wiley Encyclopedia of Environmental Pollution and Cleanup, Volumes 1 and 2*, Robert A. Meyers, (Ed.-in-Chief), Diane Kender Dittrick, Ed., Wiley, New York, NY, 1999, 2 vols., 1890 p. (8 1/2 × 11 format), US\$249.00, ISBN: 0-471-31612-1.

Any review of such a massive, comprehensive multi-topic work presents an editor with a daunting task. All he/she can do (in a reasonable period of time) is leaf through the book, reading the topics of interest and if the reader is, like this reviewer, perusing the references.

As I have often said in reviews, it is simple to criticize a book for what the author/editor has omitted; or to detect inequalities between various writers of a multi-authored work. This book is no exception, but I believe the editors have done better than most. The book is massive and should, I believe, be a standard work found on the shelves of most libraries both academic and public.

This encyclopedia is a condensation of Wiley's "critically acclaimed eight-volume Encyclopedia of Environmental Analysis in Remediation." I cannot imagine how difficult it was to make the "cuts" necessary to reduce the encyclopedia by 75%.

My evaluation, based on a sample of areas of interest — oil spills, industrial waste treatment, air pollution and nuclear power among others — is that this is an excellent book. I fail to see how it could have been improved (although in a few cases, the reference sections were not up to standard).

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*Surfactants and cosolvents for NAPL remediation: a technology practices manual*, Donald F. Lowe, Carroll L. Oubre and C. Herb Ward (Eds.), CRC Press, Boca Raton, FL, 1999, 472 p., US\$69.96, ISBN: 1-8493-4117-5.

In 1993, the U.S. Department of Defence (DOD) awarded a US\$19.3 million grant to a University consortium of environmental research centers led by Rice University in Houston, TX. The goal of the project was to "enhance the development of innovative remediation technologies for DOD by facilitating the process from academic research to full-scale utilization." The goal was to "...select, test, and document performance of innovative environmental technologies for the remediation of DOD sites." This volume, *Surfactants and Cosolvents for NAPL Remediation*, is one of a 10-monograph series of

books resulting from this work. The other nine manuscripts in the series are listed below:

- Sequenced Reactive Barriers for Groundwater Remediation
- Modular Remediation Testing System
- Phytoremediation of Hydrocarbon-Contaminated Soil
- Steam and Electro-Heating Remediation of Tight Soils
- Soil Vapor Extraction Using Radio frequency Heating: Resource Manual and Technology Demonstration
- Laser-Induced Fluorescence for Subsurface Contaminant Monitoring
- Reuse of Surfactants and Cosolvents for NAPL Remediation
- Remediation of Firing-Range Impact Berms
- NAPL Removal: Surfactants, Roams, and Microemulsions.

This report addresses the problem of groundwater contamination by nonaqueous solvents and polychlorinated biphenyl (PCB) oils. These contaminants present a major cleanup problem, especially for pump-and-treat remediation technology. The problem is that NAPLs exist in the surface as a separate liquid phase, slowly dissolving into groundwater. These new techniques are being studied to improve the efficacy of removing NAPLs. Consequently, “this manual has been prepared to assist with the evaluation and potential application of surfactant/cosolvent flushing for the remediation of subsurface contamination. The target audience for the manual is decision makers involved in the selection and implementation of remediation projects.”

Specifically, the objectives of the book are to provide the reader with the following:

- a basic understanding of surfactant/cosolvent flushing technologies
- an understanding of what surfactant/cosolvent flushing can and cannot achieve at a site
- an understanding of the factors to be considered when evaluating and implementing surfactant/cosolvent flushing projects
- an appreciation of the major design, construction, start-up, and operations and maintenance considerations that impact the cost of surfactant/cosolvent flushing projects.

The information is presented in nine chapters entitled:

- Introduction
- Technology Description and Current Status
- Geology and Contaminant Distribution
- Surfactant/Cosolvent Enhanced Recovery of NAPL
- Produced Fluids Management and Surfactant/Cosolvent Recycling
- A Stepwise Approach to Implementation of Surfactant/Cosolvent Flushing
- Cost Considerations
- Future Research
- References

Other very interesting features were a cost analysis chapter (7), recommendations for future research (8), and a reference section (9) where approximately 250 works were cited.

The last half of the book is devoted to:

- field project case histories
- literature summary database
- hypothetical site cost studies.

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*Soil Vapor Extraction Using Radio Frequency Heating: Resource Manual and Technology Demonstration* Donald F. Lowe, Carroll L. Oubre, and C. Herb Ward, Eds., Lewis Publishers, Boca Raton, FL, 1999, 328 p., US\$69.95, ISBN: 1-56670-464-2.

A work product of a Department of Defense-funded Advanced Applied Technology Demonstration Facility at Rice University in Houston, TX was a series of 10 manuals (published as texts by Lewis Publishers) [the first book reviewed by the reviewer was entitled *Surfactant and Cosolvents for NAPL Remediation: a Technology Practices Manual*].

This text (which appears to be the second in the series) discusses one of the most widely used techniques for treating soils contaminated with volatile organic compounds — soil vapor extraction (SVE). In the text, the SVE system is modified by heating the soil, thus increasing the vapor pressure and enhancing the removal of semi-volatile compounds. Soil can be heated in situ by injecting hot air or steam by direct resistive heating or by applying electromagnetic energy in the radio frequency range. To date, experiments with this method of soil treatment have been entirely successful, since the project was initiated at Kirtland Air Force Base, Albuquerque, NM.

The test site used for the demonstration of this technology was a former fire training pit that contaminated a variety of fuels, oil and lubricants at concentration (of total petroleum hydrocarbons) from 500–2900 mg/kg of dry soil. Based on their tests, the researchers evaluated a hypothetical RF-SVE design for a full-scale process. Studied were both the economics and the design sensitivity of the RF-SVE process. They concluded that the process can be efficient, but less so on a cost basis if soil volumes are large. Thus, they recommend consideration of this technology for small volumes of soil and relatively high molecular weight compounds, and soils that are moist and permeable.

The report has six chapters entitled:

1. Introduction
2. Measurement Procedures
3. Summary of Technology Demonstration

4. Engineering Design
5. Costs and Economic Analysis
6. Potential Applications.

The chapter material cited above takes up only the first 102 pages of the book. Eleven Appendices plus the reference section make up the rest. Here is where the data and details of the process are found.

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