

Book reviews

Environmental Control in Petroleum Engineering, J.C. Reis, Gulf Publishing, Houston, TX, 1996, \$65.00, 274 pp., ISBN: 1-88415-273-1.

Like all manufacturing, the petroleum industry has come under increasing environmental regulation/scrutiny. The goal of this government (and environmental groups) oversight is to minimize the environmental impact of the petroleum industry's operations.

The author's goal in writing this book was to collect, collate and present information on environmental topics affecting petroleum operations. It is written from an academic viewpoint based on the course notes of the author. It is intended for those persons with little or no training in the environmental issues facing the petroleum industry.

The first chapter is an introduction to environmental control in the industry. It contains an overview and discussion of environmental impact, migration management, and management of waste. Site cleanup, environmental regulations and a final section discussing the new 'environmental' attitude complete the chapter.

The second chapter begins at the beginning; Drilling and Production Operations. Included is a discussion of the chemistry, physical properties and environmental impact of drilling fluids. Even an emission from internal combustion engines used in the drilling process and fugitive emissions from valves are covered. The third chapter is a further discussion of the environmental impacts of the releases discussed in the prior chapter.

The Environmental Transport of Petroleum Wastes is the fourth (very short) chapter. Discussed are surface, subsurface and atmospheric pathways of transport. Chapter 5 is a forward looking chapter that outlines future plans (or planning) for environmental protection. Topics included here include audits, waste management plans, contingency plans, and employee training.

Waste treatment methods are the focus of chapter 6. Both wastewater treatment and air pollution control techniques are discussed, albeit qualitatively and briefly. Given the topics are a major area of interest to me, its not surprising I found the discussion lacking in detail and not providing numerical information on effluent quality, percent removal of pollutants by various treatment processes and design data.

Waste Disposal Methods (Chapter 7) and Contaminated Site Remediation (Chapter 8) are short. Both are useful but, again, I found them shorter and containing less data than I would have liked. I do, however, commend the author for the latter chapter; he does discuss current remediation methods and pump-and-treat technology, vaporization, soil flushing and bioremediation. Topics new to me included a discussion of brine- and sulfate-contaminated sites.

The book ends with four appendices: (1) Environmental Regulations, (2) Sensitive Habitats, (3) Major U.S. Chemical Waste Exchanges and (4) Offshore Releases of Oil.

GARY F. BENNETT

PII S0304-3894(98)00080-6

Industrial Environmental Management: A Practical Handbook, Jack E. Daugherty, Government Institutes, Inc., Rockville, MD, \$79.00, 1996, 572 pp.

As one who has devoted over 30 years to environmental topics, I approached, with little enthusiasm, a “book written for nonexpert generalists.” In this case, I was surprised by the scope, quality and depth of the material presented.

Indeed, the author has written clearly, in a conversational style, for the nonexpert generalist (although I disagree with his contention that “Manufacturing plants, especially small to medium-sized ones, typically assign environmental compliance responsibilities to an overworked individual who is talented in his or her field, but a complete novice in environmental management. These *nonexpert generalists* may be personnel managers, plant engineers, maintenance superintendents, purchasing agents, etc. Often, they are not even technically oriented though some, such as plant engineers, do have a technical background.” While that condition may have been true in the past, I sincerely doubt it now). He has covered a lot of material in a most entertaining fashion, even interesting in fact. I believe the book could well be adopted as a text for a beginning environmental course in which the instructor wishes to cover all facets of environmental (pollution) control.

As a college text, it has some strengths and a few weaknesses. Its major strength is its very readable style. I also found very beneficial the extensive reference lists at the end of each chapter, although citations in the body of the text often are not linked to the references and much factual material is not backed up by a citation.

Again, as a teaching tool, I was delighted by the inclusion of the theory (and mathematical analysis, i.e. equations) behind many treatment processes. Unfortunately, in only a few instances did the author provide worked numerical examples.

The book has twelve chapters (see below) beginning with a definition of the practices progressing through compliance strategies (laws) and finishing with control of air, water and hazardous waste problems (opportunities) are also discussed. The author first discussed the pollution problem caused by industrial emissions, i.e. smog, eutrophication and contaminated land. He then discussed control methods. The chapters are titled: 1. Understanding Environmental Hazards 2. Coping Daily with Compliance 3. Coping with Compliance Audits and Inspections 4. Pollution Prevention 5. Permitting 6. Regulating Environmental Hazards 7. Controlling Air Pollution 8. Controlling water Pollution 9. Managing Hazardous Waste On-Site 10. Shipping Environmentally Hazardous Materials 11. Preventing Environmental Disasters 12. Cleaning Up Environmental Hazards

Along the way, the author gives excellent advice on compliance methods, tips (hints) on pollution control process operation and data on design and operational efficiency of control (processes).

In conclusion, as an introductory book, I would have to give it an 'A' grade. Even the 'expert' will find much information and good advice on pollution control.

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PII S0304-3894(98)00081-8

Scientific Basis for Nuclear Waste Management XIX, W.M. Murphy and D.A. Knecht, (eds.), Materials Research Society Symposium Proceedings, Vol. 412, MRS, Pittsburgh, PA, 1996, 937 pp., ISBN: 1-55899-315-0

These proceedings are the output from a conference held in Boston, MA in the fall of 1995. It contains 115 papers from contributors world-wide and is arranged into 13 topical sections:

- Excess Plutonium Dispositioning
- Spent Nuclear Fuel
- Glass Waste Forms
- Ceramic and Crystalline Waste Forms
- Cement Waste Forms
- Waste Processing
- Waste Container Materials
- Speciation and Sorption
- Bentonite Barriers
- Flow and Transport
- Repository Site Characterization
- Natural Analogs
- Performance Assessment

There are both an author index and a subject index for the book. I might suggest to the Materials Research Society that they use a procedure employed by the Purdue University Industrial Waste Conference and incorporate the indices of several prior conferences.

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PII S0304-3894(98)00083-1

Proceedings of the Fourteenth Technical Seminar on Chemical Spills, Environmental Protection Service, Environment Canada, Ottawa, Ontario, Canada, 1997, 244 pp.

Environment Canada sponsors the only annual seminar on chemical spills that I know of—and one of its major contributors is M. F. Fingas, Chief of the Emergencies Science Division (and a member of the journal's advisory board).

This year the seminar has held in Vancouver, British Columbia in June. Since I received the proceedings the same month, I assume they were available in a most timely fashion to seminar attendees.

The proceedings contribute 20 papers in the following five categories:

- Countermeasures
- Health and Safety
- Analytical
- Fate and Effects
- The Spill Problem

Of all the above categories of papers, the Analytical papers were the greatest (eight in number). Contributors to the papers were mainly from Environment Canada and the US EPA and its contract consulting firms.

The published papers span a wide variety of topics, as is the case with most conference proceedings. The following titles are a sample:

- Cleanup of Metals and Hydrocarbon Contaminated Soils Using the ChemTech Process
- An Overview of Health and Safety at Spill Sites
- Mercury Clean-up Levels and Decontamination Methods in Schools, Commercial and Industrial Areas vs. Residential Homes
- Environmental Impact of Methyl *tert*-Butyl Ether (MTBE)
- On-Site Dispersal and Monitoring of an Offshore Sodium Hydroxide Spill; A Case-Study in Controlling Environmental Effects
- The ERT Homepage—One Stop Shopping

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PII S0304-3894(98)00084-3

Technology of Underground Liquid Storage Tank Systems, John P. Hartmann, Wiley, New York, NY, 1997, \$75.00, 292 pp. ISBN: 0-471-15412-1

Proper installation and monitoring of underground storage tanks is both a financial as well as a regulatory necessity. In the United States, regulations adopted by the U.S. EPA and the various states are detailed in Vol. 40, Code of Federal Regulations (CFR), Parts 280 and 281, 'Underground Storage Tanks; Technical Requirements and state Program Approval.' Finally, the cost of cleanup of leaking tanks can be very high; prudent procedure dictates no leaks be allowed to escape detection and containment.

The book is based on the author's continuing education course he has taught for many years for the University of Wisconsin. It is the second 'course book' I have reviewed recently. Both are excellent. The course (and this book) was designed for those (engineers, contractors, tank owners/operators and inspectors) who need information on the technology in regulatory requirements involved in designing, installing and closing/removing underground storage tanks (USTs).

The author covers the topic thoroughly in 18 chapters. Little about the topic (to my knowledge) was missed as he starts (Chapter 1) with ‘Codes, Regulation and Recommended Practices’ and ends (Chapter 18) with ‘Vapor Recovery Systems.’ The coverage is shown completely in the very detailed Table of Contents and the text contains numerous illustrations.

The main part of the book ends with two chapters on tank removal and soil remediation. Chapter 19 is entitled ‘Site Assessment, Investigation and Responsibility,’ while the final chapter (20) deals with Corrective Action. While the former chapter is detailed, the latter is cursory. It is needed to complete ‘the text’s coverage’ but readers who need information on the topic will have consult other sources.

And that is my only criticism of this book: NO REFERENCES to the literature, except for laws and codes. Citation of information reported in the text as well as guides to further reading would improve the book, in my opinion.

GARY F. BENNETT

P11 S0304-3894(98)00085-5

Pollution Prevention Through Process Integration: Systematic Design Tools, Mahmoud M. El-Halwagi, Academic Press, San Diego, CA, 1997, \$59.95, 318 pp. ISBN: 0-12-236845-2

In the environmental field, pollution prevention is a topic receiving much attention as the ‘green movement’ tries to move industry towards sustained development. Most books on the topic present case studies of how and when pollution occurs and how process changes (as opposed to end-of-the-pipe treatment) can be used to minimize (or hopefully eliminate) pollutant emissions.

This book takes a radically different approach to the topic as described by the author in the preface:

“This work is the first textbook of its kind, systematizing what is seemingly a pollution-prevention art that depends heavily on experience and subjective opinions into a science that is rooted in fundamental chemical engineering concepts and process integration. The book is intended to build a bridge between the academic world of fundamentals and the industrial world of applicability. It presents systematic and generally applicable techniques for cost-effective pollution prevention that are neither simple rules of thumb or heuristic nor all-inclusive sophisticated mathematical optimization programs geared exclusively toward academic researchers.”

The process for pollution prevention described by the author begins with a process flow sheet. The process is then described mathematically—be it mass transfer or heat transfer. Using mathematical techniques, one then derives an optimum procedure that minimizes pollution emissions and optimizes the economics.

None of the examples is simplistic. Indeed, the inclusion of CD-Rom software package that contains two PC-based packages, the Mass Exchange Network (for

developing algebraic and optimization-based solutions) and LINGO Software for optimization of linear, non-linear and mixed integer linear and nonlinear programs.

The single (unique) unit operation that received discussion in its own chapter was reverse osmosis, and a particularly interesting and well-done chapter it was, too. The chapter appears to be based on a paper of the author's notes as being in process and (appropriately) contains a glossary (but for this chapter alone).

The book is based mainly on the pioneering work of the author. Indeed, a major fraction of the references are to his own papers, presented at chemical engineering meetings. It is a difficult text, with many new concepts and a radical departure from normal discussion of the topic. Moreover, the writing often is strained, and the writer's logic is difficult to follow. Utilization of a co-author, a little more detached from the original research may well have improved the book (As a minor note, a co-author might have, as I did, seen the need for a glossary.)

Each chapter is accompanied by (student) problems. There are four short appendices: 1. Useful Relationships for Compositions 2. Conversion Factors 3. Overview of Process Economics 4. Instructions for Software Package.

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PII S0304-3894(98)00086-7

Handbook of Diagnostic Procedures for Petroleum-Contaminated Sites, Paul Lecomte and Claudio Mariotti, (eds.), Wiley, Bognor Regis, West Sussex, UK, 1997, £45.00, (\$80.00), 210 pp. ISBN: 0-471-97108-1

This handbook is a product of the EUREKA RESCOPP Project (Remediation of Soils Contaminated by Petrochemical Products) as conducted by French and Italian investigators over a five-year period from 1992 to 1996. According to the editors:

“The main objective of the Handbook is to help people faced by petroleum contamination problems with the evaluation of polluted sites. This objective is tackled through the definition of methods and procedures for assessing the nature and degree of such pollution, and through recommendations on how to design the work to be conducted on the site and to choose the most suitable remediation techniques.”

An introductory chapter on subsurface pollution and the transport of contaminants therein is followed by a chapter on preliminary studies of a contaminated site, which essentially is a guide to document, inform and inquiry to be made to gather information on activities on the site, current or past.

Having garnered the site-related available data from available documentation and other sources, the investigator now goes onto the site. Chapter 3, entitled ‘Field Survey Activities,’ details the steps to be taken on site to: 1) locate, define and characterize contamination sources 2) define the extent and level of contamination in direct receptors (soil, surface and groundwater) 3) identify the pathways and targets of contamination, e.g. wells, surface waters, etc. 4) define the objectives of reclamation, if requested. (The

length of the chapter, 60 pages, gives evidence of the importance of this phase of the investigation.)

The next two chapters (4 and 5) deal with chemical analysis of the samples taken on site and their summary of data and interpretation of results.

Costs of the foregoing (survey, sampling and analysis) are discussed very generally in Chapter 6. The authors of this chapter report that approximately 30% of the total cost goes for drilling and installation of wells; chemical analysis required a further 30%; and the remainder of expenditure goes for overhead (supervising, other activities, etc.).

The book has three appendices: 1) Summary of legislation concerning Polluted Sites 2) Petrochemical Pollutants: Their Physico-Chemical Characteristics and Behaviour in the Environment 3) Remediation Systems

The last appendix briefly describes the most commonly used and readily available remediation systems for petroleum-contaminated sites. For each system the following information is processed: 1) the main characteristics of the system 2) the environmental medium of application (soil matrix, groundwater, etc.) 3) the type or group of pollutants treated 4) the expected remediation time 5) a rough range of costs 6) a simple layout of the system.

GARY F. BENNETT

PII S0304-3894(98)00087-9

Environmental Electrochemistry: Fundamentals and Applications in Pollution Abatement, Krishnan Rajeshwar and Jorge Ibanez, Academic Press, San Diego, CA, 1997, \$95.00, 776 pp. ISBN: 0-12-576260-7

As the environmental area matures, books being published have made a change from very general to the specific—that is, books are now appearing that deal with a single topic and are generally science (research)-based. This is one such book. In it, the authors discuss “the positive role that electrochemical science and engineering can play in the detection, quantification, and treatment of environmental pollutants.”

The authors describe the contents as follows:

“The book is divided into eight chapters. the first two are introductory chapters. Those well versed in environmental problems will find little that is new in Chapter 1. Similarly, practicing electrochemists can safely skip Chapter 2. Chapter 3 provides a survey of the electrochemical data base on common types of environmental pollutants. Chapters 4 through 7 attempt to delve into the details of environmental electrochemical analyses (Chapter 4), electrochemical methods for pollution abatement (Chapter 5), photo-assisted methods for pollution control (Chapter 6), and water/air disinfection approaches (Chapter 7).”

Indeed those readers familiar with environmental problems will find little new in chapter 1. Conversely they may, as I do, disagree with some aspects of it. I find the cited examples of the runaway reaction at Seveso and the Bhopal methyl isocyanate release (incorrectly described as an explosion) and the Castleford explosion ‘environmental’ examples. They were straightforward industrial accidents. Nor do I agree with the

description of the PCB poisoning example in Yusho; my recollection (though it may not be totally accurate) was that the poisoning was due to another contaminant and not the PCBs.

Another error, that of omission, is the table on major constituents of a city sewage system; viruses are noted but not bacteria; pH (acid and bases) are also not included. Also, his description of air stripping for removal of VOCs shows a lack of understanding of the process. That the process relies fundamentally on Henry's Law is correct but how should be explained [answer: the magnitude of Henry's Law constant governs the efficiency of removal]. It is true that the emitted VOCs can be controlled by combustion (or catalytic combustion) but I have never seen pyrolysis used nor electrostatic precipitators as air stripping removes dissolved volatile organics; solid particles are not emitted. In conclusion, I feel these authors should have left the discussion of those topics they appear to be unfamiliar with alone.

In contrast, their short (introductory) discussion in Chapter 1 of Advanced Oxidation Processes is excellent. So in Chapter 2, which contains much material of interest to me as I am not "a practicing electrochemist who can safely skip the chapter."

For the authors, the book really begins with Chapter 3 in which they discuss what is known about the electrochemical behavior of organic, inorganic and organometallic pollutants. The discussion, they note, sets the stage for their discussion of specific pollutant assay and cleanup procedures in the subsequent three chapters. They deal generally with:

- sensors/detection
- electrolysis of pollutant/electrochemical remediation
- photocatalysis

The first two chapters describe application of the forgoing theories. Disinfection of water is described in Chapter 7. First discussed is chemical disinfection (such as chlorine). Following is a treatise on electrochemical disinfection, disinfection by high-energy radiation, UV disinfection and photoelectrochemical disinfection.

The final chapter explores the commercial application of many of the processes described in prior chapters. Description of commercially viable processes with some (albeit scarce) cost data are given.

The book ends with four short appendices, one of which lists companies (complete with addresses) that market electrochemical technologies and accessories for pollution sensors and pollution abatement. Ordinarily I do not approve of including such company lists in books as they become out of date quickly, but in this case the 'uniqueness' of the technologies of concern overrides that personal objection.

Finally, I make the following observations:

- Each chapter contains an extensive bibliography, in one case numbering almost 400 references; each chapter's bibliography is followed by a list of (1) reviews and (2) books and monographs for supplemental reading.
- The English often is strained. It would have been beneficial to have a technical editor review the manuscript.

GARY F. BENNETT

Chlorine and Chlorine Compounds in the Paper Industry, Victor Turoski, (ed.), Ann Arbor Press, Inc., 121 South Main Street, Chelsea, MI, 1998, \$79.95, 378 pp. ISBN: 1-87504-066-2

The USA and Canada recently have signed the Great Lakes Initiative that calls for major reduction in wastewater emissions of chlorinated organics to the five Great Lakes. One of the persistent organics of concern is dioxin. So feared are dioxins as chlorinated organics, Greenpeace has called for a ban on the use of chlorine, a stand with which I strongly disagree.

So did one of the speakers at this conference, C. T. Howlett, who said:

“And perhaps that is what is so vexing about the whole situation. Rather than being guided by what we know—the scientific facts—about chlorine and chlorinated compounds and the many benefits they have brought to society, the debate is revolving around what we don’t know and the fears that spring from a lack of understanding and rush to judgment.

Environmental activists, such as Greenpeace, the Sierra Club, and others, are calling for a ban on all industrial uses of chlorine. They base their justification for this ban on alleged health and environmental issues that have been raised about a few chlorinated compounds, such as dioxins and PCBs. With hair-raising rhetoric, they tag chlorine and chlorinated compounds as the ‘root of all evil,’ responsible for a broad range of adverse health effects from cancer, to reproductive, to hormonal, to immune system problems.

No one—including myself and C-3 (Chlorine Chemistry Council)—would suggest for a moment that these are not serious health and environmental concerns that need addressing. We know that we don’t have all the answers. We know that more information is needed. But we know the harm a rush to judgment can do, particularly when one of the fundamental chemical building blocks of modern life that had benefited society in thousands of ways and saved countless numbers of lives is at stake. That is why C-3 and our members are working to address these questions by sponsoring scientific research to fill in the information gaps and ensure that the chlorine industry follows the principles of Responsible Care in the manufacture, use, and disposal of the products of chlorine chemistry.

Parenthetically, I might add this concern and commitment is having results. Releases of chlorine and chlorine compounds in the Great Lakes states, one of the areas of greatest environmental concern, were down significantly between 1987 and 1993. In that region, total air releases are down 56.2%, total water releases are down more than 81.6%, and total releases on land have dropped nearly 81.8%, for an overall reduction of chlorine releases of 56.5%.

Despite this progress and the fact that the use of chlorine and chlorine-related compounds as disinfectants and pharmaceuticals has saved more lives than any other chemical in the history of the human race, the war against chlorine continues to escalate.

Chlorine is ‘public enemy number one’ to many environmental activists these days, which just goes to prove the lingering wisdom of Bertrand Russell’s observation that, “The degree of one’s emotion varies inversely with one’s knowledge of the facts—the less you know, the hotter you get.”

The problem with the charges being levied by chlorine's opponents is that while they might grab attention and make eye-catching headlines in the media, the scientific data to support a chlorine ban or restrictions on its uses are sketchy or nonexistent."

The foregoing comments were from one of 30 papers presented at an American Chemical Society conference held in Chicago in 1995. The purpose of the symposium was to provide a platform for in-depth discussions of the scientific, technical, and regulatory issues surrounding chlorine, Government, industry and environmental group participants.

In the preface, the editor writes:

"Chlorine, in some form, affects the lives of us all. It is used to disinfect drinking water, to bleach clothes and clean household surfaces, to bleach wood pulp for the manufacture of white paper, to serve as an essential component in some plastics and medications, and in many other applications. Chloroorganic compounds can be formed as a by-product of some industrial processes and naturally occurring phenomena. A very small percentage of these compounds are toxic, at least to certain organisms at some dosages. Because of the concern about these materials, research is being conducted throughout the world on the origin, fate, and potential hazards presented by chloroorganic compounds. Many industrial operations are being modified to minimize the potential formation of these compounds, and some environmental advocacy groups are seeking the elimination of chlorine from industrial processes. For the past several years the United States Environmental Protection Agency has been considering draft rules regarding pulp and paper industry discharges of chlorine compounds."

And later he says, "The quality of the papers presented at the symposium was exceptional." I agree. In addition to a foreword and a keynote address, the book contains 29 papers divided into five areas:

- Current and Proposed Bleaching Alternatives
- Analytical and Environmental Aspects
- Public Perceptions
- Regulatory Aspects
- Toxicology and Mechanisms

The book ends with a 15-page panel discussion of risk posed by chlorine and its derivatives.

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