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Book Reviews

Recent Developments for In Situ Treatment of Metal Contaminated Soils, USEPA, Washington, DC, EPA-542-R-97-004, Mar. 1997, (gratis), 93 pp.

This report discusses methods for remediating one of the most common contamination problems at hazardous waste sites: metals. The four approaches discussed are electrokinetic remediation, phytoremediation, soil flushing and solidification/stabilization. This report (by a USEPA consultant) discusses different techniques currently in practice or under development, identifies vendors and summarizes performance data, and discusses technology attributes that should be considered during early screening of potential remediation. Costs of each technique also are given.

There is much good information in this book. My major criticism is that often the description of the remediation technology and its operation was too brief to fully understand it. Personally, I would have preferred more detail.

GARY F. BENNETT

P11 S0304-3894(97)00085-X

Municipal Solid Waste Incinerator Residues, A.J. Chandler, et al., The International Ash Working Group, Elsevier Science, Amsterdam, 1997, \$, 974 pp. ISBN: 0-444-82563-0

The International Ash Working Group (IAWG) was established in 1989 to conduct an in-depth review of the existing scientific data and develop a state-of-knowledge treatise on municipal solid waste (MSW) incinerator residue characterisation, disposal, treatment and utilisation. The book constitutes the output of that group working together over the period from February 1990 through July 1996.

Waste incineration can be traced back to England where attempts were made in 1870 to burn waste in a retrofitted coal-burning furnace. Unfortunately, the wet nature of the waste and poor heat transfer in the system resulted in air emissions as the waste smoldered rather than burned. Then air quality deterioration and the public's concern for health effects grew. But initially smoke (particulates) were the issue; more recently the

'toxic' dioxins/furans are the chemicals of concern. But improvements in air pollution control systems have resulted in a dramatic improvement resulting in the World Health Organization's statement that it now longer considers the emissions from modern, well operated and maintained MSW incinerators to be a hazard to human health or the environment. But the same cannot be said for the solid residues.

Recognizing there was a need to compile and evaluate the available information on residues, the IAWG was established to conduct an in-depth review of the existing scientific data and develop a state-of-knowledge treatise on MSW incinerator residues, characterisation, disposal, treatment and utilisation.

That task has been well done. The book is a comprehensive overview of the topic and with international makeup of the working group covered the topic world-wide both from a practical (published agency reports from numerous countries) as well as the conventional published literature aspects.

The fact that the book has almost 1000 pages and the table of contents is over 20 pages illustrates to some extent its comprehensive nature. Further evidence is given by a reporting of its 22 chapter titles:

1. Introduction
2. Municipal Solid waste
3. Municipal Solid waste Incineration Technologies
4. Air Emission Control Strategies
5. Regulation of MSW Incinerators
6. Issues Related to Incinerator Ash Sampling
7. Characterisation Methodologies
8. Fate of Elements During Incineration
9. Bottom Ash
10. Characteristics of Heat Recovery System Ash
11. Characterisation of Air Pollution Control Residues
12. Physical Aspects of Leaching
13. Chemical Aspects of Leaching
14. Leaching Tests
15. Leaching Modelling
16. Leaching Data
17. Separation Processes
18. Solidification & Stabilisation
19. Thermal Treatment
20. Leaching of Products
21. Utilisation
22. Disposal

For a multi-authored text, the book is well and uniformly written. The authors and editors are to be complimented. This is a monumental, definitive report on MSW waste that will be the definitive reference on the topic for years to come.

GARY F. BENNETT

Technological trajectories and the human environment, J.H. Ausubel and H.D. Langford, (Eds.), National Academy of Engineering, National Academy Press, Washington, D.C., 1997, \$42.95, 224 pp. ISBN: 0-309-05133-9

As a reviewer, I would find it hard to improve (or disagree with) the following statement found in the promotional material for this book:

“*Technological Trajectories and the Human Environment* provides a surprising projection of a much greener planet, based on long-range analysis of trends in the efficient use of energy, materials, and land. The authors argue that we will decarbonize the global energy system and drastically reduce greenhouse gas emissions. We will dematerialize the economy by leaner manufacturing, better product design, and smart use of materials. We will significantly increase land areas reserved for nature by conducting productive and environmentally friendly agriculture on less land than is used today. The book concludes that the technological opportunities before us offer the possibility of a vastly superior industrial ecology. The analyses offered will be essential for everyone in the environmental arena concerned with global change, sustainable development, and profitable investments in technology.”

This statement is based on 11 essays that were a result of the National Academy of Engineering (NAE) to ‘increase understanding of long-term interactions between the environment and technological change and to identify opportunities to embed industry and its products more intelligently within nature.’ Thus, energy and materials usage and consequently waste production are the key discussion points of these essays.

Robert M. White, president emeritus of the NAE, stated, in the preface,

“Collectively, the essays strike an optimistic note on a topic that generally evokes pessimism. The logic is sharp and the evidence surprisingly plentiful. Vast efficiencies can be achieved with respect to energy, land, and materials. Indeed, we can begin to envision a quite different ‘industrial ecology’ in which the notion of waste largely disappears. Superb technical possibilities exist consistent with long-term historical developments and with one another. And a new philosophical turn may relocate humans more constructively in nature.”

GARY F. BENNETT

P11 S0304-3894(97)00108-8

Waste Materials Used in Concrete Manufacturing, Satish Chandra (Ed.), Noyes Data, Park Ridge, NJ, 1997, \$86.00, 650 pp., ISBN: 0-8155-1393-3

Although I have reviewed numerous books published by Noyes Data, I was unaware they had a series on Building Materials Science. This book is a new addition to that series, but clearly of importance to the environmental field also as evidenced by its title (and its review here).

The editor notes in his preface that substitution of waste materials potentially replacing clinker or Portland cement by slag, fly ash, silica fume and natural rock minerals will result in less energy use and by-product pollutant production (SO₂ and CO₂). With an annual production rate of Portland cement of 1000 M tons and of waste materials double that, the potential for savings is great.

Not only will the above benefits be achieved by using waste materials in concrete manufacturing, but also there is a potential of improving the microstructure and consequently the durability properties of concrete which are difficult to achieve with Portland cement alone.

The book is a multi-authored volume with 18 contributors from Europe and Asia. Interestingly, none are from the U.S., U.K. or Canada. These 18 authors contributed the following 10 chapters:

- Properties and use of solid residue from fluidized bed coal combustion.
- Production and use of by-product gypsum in the construction industry.
- Fly ash in concrete.
- The use of rice husk ash in concrete.
- Blast furnace slag—the ultimate binder.
- Red mud and phosphogypsum and their fields of application.
- Use of lignin-based products in concrete.
- Recycling of waste as an alternative raw material and fuel in cement manufacturing.
- Use of silica fume in concrete.
- Palm oil shell aggregate for lightweight concrete.

GARY F. BENNETT

PII S0304-3894(97)00109-X

Environmental Audits, Lawrence B. Cahill, et al., Government Institutes, Rockville, MD, 7th ed, 1996, \$79.00, 727 pp., ISBN: 0-86587-525-1

This book begins with the following statement: ‘Managing compliance in today’s regulatory setting has become an almost overwhelming exercise, involving more and more regulations, and affecting more and more organizations.’ For example, while approximately 1000 pages of environmental regulations were issued in 1972, 13 000 pages were published in 1994. And the USEPA’s 1996 agenda showed 429 regulations under development.

As a separate and distinct compliance management tool, environmental auditing began in the late 1970’s stimulated principally by the Securities and Exchange Commission.

The author notes that precisely defining an environmental audit is difficult, but audit programs are typically designed to meet one or more of the following objectives:

- Assuring compliance with regulations
- Determining liabilities

- Protecting against liabilities for company officials
- Fact-finding for acquisitions and divestitures
- Tracking and reporting of compliance costs
- Transferring information among operating units
- Increasing environmental awareness
- Tracking accountability of managers.

This book evolved from (and is used in) a course the author teaches for Government Institutes — and given the high quality of the book, I must conclude that he delivers a very good course — but very intense. For Cahill to cover the material in 25 different chapters would be a major challenge even in a 3-day course.

The book has three major sections:

- Managing a program
- Conducting the audit
- Special auditing topics (i.e. property transfer, international, etc.).

The book also has seven appendices with a sample hazardous waste audit protocol, sample training tools and a sample regulatory inspection protocol. Also published are major (US) regulations one should review before conducting an audit.

GARY F. BENNETT

PII S0304-3894(97)00110-6

Introduction to Industrial Hygiene, Ronald M. Scott, CRC Press (Lewis Publishers), Boca Raton, FL, 1995, (\$69.95) 468 pp., ISBN: 1-56670-140-6

Introduction to Industrial Hygiene was written as a text for a single semester (assumed to be undergraduate) course.

In reading this reviewer's analysis of the book, the reader must understand that he is an environmental engineer and not deeply knowledgeable of industrial hygiene. The reviewer, however, is a University lecturer. From that perspective, he gives the book high marks for readability and utility.

The book has several features I like in a textbook, such as:

- readability
- summary of key points at the end of each chapter
- problems/assignments for the students
- appropriate number of illustrations, diagrams, photographs and tables

The book is divided into three major sections. The first section of the book deals with health and safety problems associated with chemicals with the first three chapters devoted to toxicity. This section has the following chapter headings:

- Kinds of toxic effects
- Measuring and reporting relative toxicity
- Toxicokinetics

Following these introductory sections, the student is faced with a boring (but necessary) section on government regulations.

Next comes a detailed discussion of the chief problems arising from the use of chemicals in industry and protection of the worker there from:

- Occupational dermatosis
- Inhalation toxicology
- Monitoring the plant atmosphere
- Providing clean air

In the next section, Scott deals with threats to the worker arising from the worker's physical environment. Specific hazards discussed are:

- Occupational hearing loss
- Radiation
- Workstation design
- Heat stress

In the final section of the book, the industrial hygiene problems of a few important industries are described under the general heading of metals and polymers.

The final 100 pages of the book are devoted to:

– Answers to the student questions that are at the end of each chapter. This section constitutes my only criticism of the book. The answers to short questions should, in my opinion, be supplied in a separate manual to the teacher.

- Glossary—much needed for this topic
- Sample MSDS (Material Safety Data Sheet)
- Guide to Selection of (Gaseous) Detection Tubes for numerous chemicals; TLV-TWA data are also given for each chemical.

GARY F. BENNETT

PII S0304-3894(97)00111-8

Elements of Environmental Engineering: Thermodynamics and Kinetics, K.T. Valsaraj, CRC Press, Boca Raton, FL, 1995, (\$69.95), 649 pp., ISBN: 1-56670-089-2

This book was written as a single-semester undergraduate textbook for students of environmental engineering. The author states that those students with a good grounding in undergraduate physics, chemistry and mathematics could cope with the material in the text. That may well be so, but I believe that mastery of chemical engineering thermodynamics would enhance their learning experience using this text.

The book is divided into the following six chapters:

- Introduction
- Concepts from classical thermodynamics
- Multicomponent equilibrium thermodynamics concepts in environmental engineering

- Specific applications of equilibrium thermodynamics in environmental engineering
- Concepts from chemical reaction kinetics in environmental engineering
- Specific applications of chemical kinetics in environmental engineering.

Each chapter is followed by an extensive list of references and very usable (and numerous) problems for student assignment. I found the last chapter (Application of Chemical Kinetics in Environmental Engineering) fascinating because it is the application to the real world of the principles discussed in the first five chapters. In illustration of the material discussed in this chapter, let me quote from Valsaraj's introduction to it.

“The discussion will start with the conventional reactor theory as presented in the chemical engineering discipline. The application of chemical reactor theory to the elucidation of the fate of a chemical in a waste impoundment, atmosphere, and soil will be illustrated. This will be followed by a specific example of how reactor theory can be used to design a waste water treatment process. Since adsorption is an important aspect of both water and soil chemistry, I shall discuss in some the detail the kinetics of adsorption processes in natural porous media. Example applications in this context will include diffusion and reaction of pollutants in activated carbon reactors and other natural porous media such as soils and sediments. Following this will be the applications of chemical kinetics in atmospheric chemistry such as the origin of acid rain, the ozone hole, global warming, and their consequences. Finally, the chemical kinetics of biological systems in the environment with special relevance to biodegradation, enzyme kinetics, and bio-accumulation will be discussed.”

My overall assessment is that this is a very good book that will find many adoptions in environmental engineering courses.

GARY F. BENNETT

PII S0304-3894(97)00112-X

Engineering and Science: An Introduction, Ram S. Gupta, Government Institutes, Rockville, MD, 1997, \$79.00, 498 pp., ISBN: 0-86587-548-0

Environmental Engineering and Science: An Introduction was written as a text for beginning students in an Environmental Engineering Program. The author tried to develop a science-based technical approach that did not rely heavily on mathematics. In his text, he provides a ‘comprehensive coverage, presenting a blend of scientific principles and engineering theory and application in quantitative terms at a basic level.’

As a very beginning text for environmental science majors, this is a very good book. It has a wider scope than most textbooks I (as a chemical engineering professor) have used. Indeed, the texts I employ (used at the junior and senior level) are generally monolithic (single topic, single medium) texts devoted to one pollution problem (air, water, hazardous waste, remediation, etc.). Thus, the books I generally use are much more detailed with respect to problem definition but more importantly with respect to solutions—e.g., process and equipment description/discussion. The latter feature is the

one major problem I had with this book. The treatment of solutions is not done well, neither in scope nor in clarity of presentation. Consequently, I would vigorously disagree with the author's claim that the book 'is perfect for professional reference.' Such is not the case.

However, the book does have many good features, especially, as noted above, in its scope—its treatment of energy (and energy alternatives), ecology and the ecosystem are all well discussed in the book's 11 chapters.

Each chapter is followed by pertinent discussion questions and problems (although the latter are relatively simplistic). Answers to the problems are found at the back of the book (a feature as a professor I do not like, preferring the answers and solutions to be supplied in a separate manual).

The book contains a useful (and much needed) 50-page glossary.

GARY F. BENNETT

P11 S0304-3894(97)00113-1

How to Control Costs in Your Pollution Prevention Program, Judith A. Cichowicz, John Wiley and Sons, Inc., New York, NY, 1997, US\$75.00, 445 pp., ISBN: 0-471-18015-7.

In reviewing a book, I most often turn to the preface to read about the author's goals and intent in writing the text. In this book, there is no preface, but the author outlines her intent/coverage in the very first page of the introduction:

"This book views environmental issues as business conditions, made manageable through the implementation of appropriate, cost-effective pollution prevention strategies. Its purpose is to present the reader with a range of practical, immediately usable tools with which to do this.

This book has been written specifically to help small and medium-sized businesses become more adept at controlling costs associated with environmental issues in general, and pollution prevention in particular."

And giving more detail, she says the book presents:

- A discussion of environmental management systems and their application to pollution prevention issues.

- Processes for identifying and characterizing the most cost-effective pollution prevention opportunities.

- A decision tree for determining whether a source creates a waste stream.

- An analysis of performance measurements, from statistical process control to environmental cost accounting.

- Methods for enhancing cost control, from purchasing to payment of invoices.

- A process for selecting functional pollution prevention techniques, with an emphasis on cost control criteria.

When I picked up the book to review it, I was expecting a conventional discussion of industrial waste minimization. Such was not the case. Its author took a much broader

view discussing topics that range from landfill mining (resulting in the landfill's longer life by extraction of re-usable materials) to enhancement of employing commuting, i.e. car pools thus preventing pollution.

I was surprised by the inclusion of (but much interested since I had edited a book on the topic) much material on spill prevention and emergency planning. The sections describing the elements of an emergency response plan are excellent.

Also of interest to the reviewer were discussions of training program managers and underground tank programs.

Unfortunately, the author 'wanders all over the place.' The book jumps from topic to topic with the focus on pollution prevention constantly being directed to tangential topics, such as those noted above.

I also do not appreciate books that have very large appendices and this one has an enormous appendix that encompasses 245 pages of the book's 445 pages (over one half). Much of the material is simply reproduced from Federal lists of hazardous waste categories.

My overall assessment of the book as a pollution prevention book is not high. I'd urge the author to refocus her efforts on the topic and spin off (write another book) on emergency plans spill control.

GARY F. BENNETT

P11 S0304-3894(97)00158-1

Pollution Prevention for Chemical Processes, David T. Allan and Kirsten S. Rosselot, John Wiley & Sons, Inc., New York, NY (Chichester, UK), 1997, £ 55, 434 pp., ISBN: 0-471-11587-8

Pollution prevention has gained widespread acceptance by industry. Reports of the process' success have been made largely through the use of case studies. This initial approach, according to the authors, is giving way to generic design tools which are described in the text.

The authors state: "The text begins with a chapter that briefly introduces the concept of pollution prevention and provides definitions of waste management terms. Since many commonly used terms are loosely defined, the range of definitions currently in use are discussed and precise meanings for use in this book are established. The remainder of the text is divided into three major sections on pollution prevention at the (1) macroscale, (2) mesoscale, and (3) microscale."

As an aside note, the importance of acronyms to the environmental field is evidenced by an acronym glossary directly following the preface.

In the first chapter, the authors define the problem, introduce vocabulary and lay out the task before them. Indeed, the latter (the task ahead) was articulated by the U.S. Congress in the Pollution Prevention Act of 1990:

"The Congress hereby declared it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that

cannot be prevented should be recycled in an environmentally-safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally-safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally-safe manner.”

The authors attempt to define terms although they say universal agreement probably is unattainable. Discussed, however, are numerous definitions (many regulatory ones) of source reduction, waste reduction/minimization, toxics use reduction and pollution prevention.

The first section of the book discusses Pollution Prevention from a macroscale approach which, the authors note, is by industrial sector. The section has three chapters. In Chapter 2, an overview of waste generation is presented: how much, what type and by whom. Chapters 3 and 4 discuss two different approaches to study complex systems used to convert to raw materials to production. One approach (discussed in Chapter 3) involves selecting a particular material (such as lead) and following it as it proceeds from a raw material to a product. The second approach (discussed in Chapter 4) is life-cycle assessment. In this analysis, one begins with the product and then identifies all raw facets of materials involved in the product's manufacture, use and disposal.

In the second major section of the book (encompassing chapters 5–10), specific examples of methods/processes for reducing waste are examined with a focus (not surprisingly since the senior author is a chemical engineer) on the chemical process industries, chemical manufacturing and petroleum refining—industries that produce over half of all the hazardous waste generated in the United States. Perhaps the coverage is best shown by the chapter titles:

5. Waste Audits and Emission Inventories
6. Pollution Prevention for Unit Operations
7. Preventing Fugitive and Secondary Emissions
8. Flowsheet Analysis for Pollution Prevention
9. Management of Pollution Prevention Activities at Industrial Facilities
10. Pollution Prevention Case Study Problem Modules

I found Chapter 5 unique (not being covered heretofore in texts I have read), interesting and well-done, perhaps because of the authors' training (chemical engineering) and mine are the same. Nominally, the chapter deals with waste audits and this topic is briefly discussed. But very soon the authors enter into a detailed discussion of emission inventories 'performed to assess the quantity of pollutants emitted directly to the environment by a facility'. Petroleum refineries were used as the study example. VOC emission calculations for leaking valves (fugitive emissions) and emission from secondary sources such as an API separator and wastewater treatment water are discussed—resplendent with mathematical equations calculating VOC emissions.

The book ends with Chapter 11 (comprising the totality of major Section III), Microscale Pollution Prevention. In this chapter, the authors present two pollution prevention case studies: (1) design of substitute materials, and (2) systematic evaluation of reaction pathways.

Each chapter ends with student exercises (assignments) generally of three types: (1) questions for discussion, (2) problems, and (3) open-ended problems.

My overall assessment of the book is enthusiastic praise. It is the first student-oriented text on pollution prevention I have seen. It will, I predict, become the major book used in classes on that topic—which, I am afraid, are few now, but hopefully will increase in numbers in the future.

GARY F. BENNETT

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