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BOOK REVIEWS

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Geotechnical Practice for Waste Disposal. David E. Daniel, ed. Chapman & Hall: London, 1993; (683 pp., ISBN 0-412-35170-6) $89.95, L55 hardcover.

This one-volume work, edited by a respected researcher in the field, presents information on a variety of waste disposal practices in four sections. Part One discusses general principles; Part Two discusses disposal facilities; Part Three discusses remediation; and Part Four discusses monitoring. Approximately one-half of the book focuses on landfill disposal facilities, whereas the other half concentrates on remediation technologies. The information presented gives interested readers an overview of the included topics in a form that is easy to read and understand.

The discussion of general principles is well written and similar to what would be found in most texts on the subject of flow and transport in subsurface environments. It is assumed that water is the fluid of interest and that the contaminants are dissolved in the water. Transformations are assumed to follow first-order kinetics. Part Two's discussion on disposal facilities provides a good introduction to the terminology used in the industry and describes the advantages and disadvantages of different commercial materials to be used as barriers to flow.

Also included is a discussion of transformations that can be expected in landfills and the impact of these transformations on the stability of the system. The section on remediation focuses on current practice with little information on the technologies that are on the horizon. Current practice for remediation is discouraging and is little more than an interim holding pattern until some of the more innovative technologies are developed. Current practices are effective in limiting the spread of contamination and are effective where contaminants are fully dissolved in the aqueous phase. The section on monitoring is divided into the saturated environment and unsaturated environment. The focus is on monitoring what is in the water. Discussions of monitoring the vapor solids of other nonaqueous phase liquids are not included.

The book is not appropriate for use as a textbook on waste disposal practice, because there is not sufficient information to perform design activities. The book is best used as a survey of common geotechnical practice for waste disposal.

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***In Situ* Thermal Technologies for Site Remediation.** Lawrence A. Smith and Robert E. Hinchee. Boca Raton, FL: Lewis Publishers, 1993. (209 pp., ISBN 0-87371-604-3) $69.95 ($84.00 outside USA) hardcover.

This book gives a good review of various *in situ* heating technologies for remediation of soils contaminated with volatile and semivolatile contaminants. The work is timely and provides, under one umbrella, a summary of most of the papers and reports published in the open literature on the topic up to 1990. Divided into six chapters, the book covers the descriptions and results of bench, pilot, and field tests but excludes the models that have been developed to describe the remediation processes. The first chapter deals with basic principles of heat and mass transfer in soils. This chapter includes physical laws that govern heat and mass transfer, soil thermophysical properties, water solubility of various components, and effects of soil temperature on biodegradation. This information is somewhat elementary and will be of use only to beginners in this field.

The next four chapters of the book cover soil remediation technologies: Steam Injection *In Situ* Soil Heating; Radio Frequency *In Situ* Soil Heating; Joule Resistance *In Situ* Soil Heating; and Surface Modifications to Alter the Soil Heat Balance. Steam injection involves heating of the contaminated soil to vaporize or mobilize the volatile and semivolatile contaminants absorbed and retained in the soil. Vaporized volatile liquids are carried to the surface as a mixture of wet steam and organic vapor. The vapor mixture is collected by a vacuum system to remove the organic contaminants. In radio frequency

heating, RF energy is deposited into the soil and is utilized to vaporize volatile and semivolatile compounds present in the soil matrix. Vapors from the soil are collected through hollow electrodes connected to a vacuum system at the soil surface. Joule heating involves ohmic heating of the soil by passing an electrical current through the soil. The technique is more suitable for *in situ* vitrification when mixtures of several types (e.g., organic, inorganic, and radioactive) of contaminants are present in the soil. Surface modifications to alter the soil heat balance consist of increasing the solar energy absorbed in the soil while at the same time reducing the heat loss. The technique has been implemented for agricultural purposes only and has not yet been used for remediation of soils. Because of the low energy density, it is not clear if this technique will ever be used for remediation purposes.

For each technology, its status, advantages and disadvantages, and literature review summaries are provided. The status includes the level (e.g., bench scale, pilot tests, and field tests) to which a given technology has been investigated; the conditions (e.g., pressures, temperatures, etc.) under which tests have been made; the degree to which a contaminant or a group of contaminants have been removed; and the associated time frame for remediation. The literature summaries are similar to abstracts of the work described in quoted technical papers and reports. Some summaries, apart from providing the technical information pertinent to a given technology, give estimates of costs for cleanup of soil. This information is of value. It is important, however, to recognize that costs for a given technology strongly depend on the level to which a given contaminant or groups of contaminants are removed.

In the sixth chapter, several other *in situ* soil heating technologies are briefly described: soil vapor extraction with heating of the soil with preheated air; fiber optics; and warm water injection. Vacuum venting with preheated air is a promising technique that is simple, less expensive, and easy to implement. The technology falls into the same class as steam injection and probably should have been covered in the second chapter.

Finally, the material presented in the book, including the information on cleanup costs per kilogram of soil, will be of value to the decision makers on potential application of various *in situ* heating technologies to a given remediation site. To a beginning graduate student, the text on the status of the *in situ* heating technologies and bibliography of technical articles and reports will be very helpful. The material presented in the book could have been better organized. The presented material is not too technical, and duplications are found in several literature summaries.

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