

As a case in point, the chapter (7) on Chemical Treatment Processes is only nine (9) pages long. In it, the authors deal with precipitation, chemical feed system design, chemical oxidation, and electro dialysis. Also, the chapter only has five (5) references, four of which are to commercially-produced literature.

As an editor, I was disturbed by the large number of errors in the text at various points, i.e. (1) bod rather than BOD, (2) air floatation vs air flotation, (3) cm/sec vs in./hr.—inconsistent use of periods, (4) continued mixing of SI and British units in the same example.

In most cases, the theory behind a technology is well-developed. But very few worked examples are given. I would have liked the authors to provide numerical calculations based on the equations provided.

Finally, there are three sections of the book I would have omitted. With all due respect to the co-author (an attorney), I would have omitted the first two chapters on the law, especially the second chapter on International Treaties, Laws, and Regulations. Neither chapter added much to the central theme of the book—a practical design manual; nor does the final section at the end of the book, which is a 48-page glossary. Interesting it was, but not a wise use of space, in my opinion. Conversely, I found the 11 pages devoted to the Table of Contents well spent. It is comprehensive.

My overall summary; an excellent book—interesting, well-written (generally), and useful but needing a good technical editor, more references and expansion of some topics (as noted above).

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*Permeable Barriers for Groundwater Remediation: Design, Construction and Monitoring*, Arum R. Gavaskar, Neeraj Gupta, Bruce M. Sass, Robert J. Janosy and Dennis O'Sullivan, Battelle Press, Columbus, OH, \$44.95, 1988, 188 pp., ISBN: 1-57477-036-5

Contamination of the subsurface by dense, nonaqueous phase liquids (DNAPLs) presents a major challenge to current cleanup technology. These liquids, dominated by chlorinated solvents, are denser than water and of limited solubility. Thus they move downward in the soil until they encounter a low-permeability zone or aquitard. Forming pools, these compounds with relatively low solubility present a major challenge to engineers who try to remove them solely by pump-and-treat operations.

Such contamination is not uncommon as chlorinated solvents have been commonly used in a wide variety of operations, such as degreasing, maintenance and dry cleaning. Sloppy handling and ill-advised (from current disposal perspectives) disposal practices have led to widespread contamination of soil and groundwater. Ten of the twenty-five most common groundwater contaminants at hazardous waste sites are chlorinated solvents with trichlorethylene being the most prevalent.

The book describes an alternative to currently used removal/treatment processes—permeable barriers. Guidance is given on the design, construction and maintaining of such a system for removal of contaminated groundwater.

A permeable reactive barrier consists of a zone of reactive material, such as granulated iron (or related iron-based materials), installed in the path of a dissolved chlorinated solvent plume. As the groundwater flows through the barrier, the contaminants are degraded to potentially nontoxic dehalogenated organic and inorganic chlorides. Once installed, the system operates on its own; no pumping is required.

A possible decontamination reaction is shown below:



However, the exact mechanism of degradation of chlorinated compounds by iron or other metals is not fully understood. There are probably a variety of degradation reactions (including biological ones) in addition to the one shown above.

Very early in the book, the authors present data in tabular form describing 15 reactive barrier installations; included in the tables is information (when available) on (1) scale (pilot or full), (2) type of barrier, (3) depth, (4) total cost and media cost, (5) contaminant and its concentration, (6) emplacement technique, (7) installation cost, (8) compliance monitoring well locations and (9) groundwater analysis model.

Having introduced the technology and provided the overview (in the aforementioned tables) the authors give details of the system, its design and monitoring in separate chapters entitled:

- Site Characterization Data
- Reactive Media Selection
- Treatability Testing
- Modeling to Support the Permeable Barrier Design
- Emplacement Techniques for Permeable Barrier Installation
- Monitoring the Performance of a Permeable Barrier
- Permeable Barrier Economics.

Although I found all the chapters interesting (and informative) I particularly was fascinated by the construction (barrier emplacement) technology shown in the sixth chapter and the cost data sprinkled throughout. The book focussed on cost in the eighth chapter. [Personally, I found the chapter wanting in quantity and quality of data and would have preferred the authors place all economic data here; not scattering it throughout the book as they did.] The authors discuss, only briefly, the computer model developed by the US Air Force to estimate costs for various phases of the remediation program and the Remediation Action Cost Engineering and Requirements (RACER) System—but I found the discussion too brief to be useful. A worked example of a cost estimation would have been helpful.

In the final chapter (9), the authors review and summarize the information presented before—including the staggering number of sites that US Department of Defense and the US Department of Energy and Superfund may be confronted with that have been contaminated by chlorinated solvents. Also found in this chapter are flow charts for decision making and remedial system design. Included also is a table of reported degradation rates of chlorinated organics in the presence of iron. The rates were very

short half-lives of 0.02 h for carbon tetrachloride and as long as 12.6 h for vinyl chloride.

Four appendices complete the book.

A. Additional Site Characterization and Monitoring Issues

B. Supporting Information for Hydrogeologic Modeling

C. Supporting Information for Geochemical Modeling

D. Construction Quality Control

Personally, I found the book to be one of the most timely, well-written and informative books that I have reviewed in a long time. I would recommend its purchase by anyone interested or involved in remediation work.

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*Clean Air Handbook, 3rd Edition*, F. William Brownell, (Ed.), (Hunton and Williams) Government Institutes, Rockville, MD, 3rd Edition, 1998, \$95.00, 324 pp (8 1/2 × 11 in.), ISBN: 0-86587-616-9

Environmental laws are complex. US environmental laws are very complex, and of the many major US environmental laws, the Air Pollution Control Act is one of the most complex. For a general overview of the US environmental laws, I turn to Government Institutes Environmental Law Handbook, many editions of which I have reviewed previously in this journal. For details of each law, I turn to their specialty books. This is one of those books that treats a major law governing single environmental area: The Clean Air Act, which, this book notes, is constantly evolving.

The book begins at the beginning of the appearance of laws governing air pollution (or at least close to it) by describing almost the first Clean Air Act (of 1967) which had as one of its main purposes “to protect and enhance the quality of the Nation’s resources and to promote the public health and welfare and productive capacity of the population.” The 1967 Act focussed on regulation of ambient air quality to protect health and welfare. But it had deficiencies, so Congress produced major amendments to it in 1976. Those amendments remain the centerpiece of present day air quality regulations. Further amendments followed in 1977. In this Act, hazardous air pollutants were addressed (among other things).

The background having been established, Brownell et al. move to the more recent Act, the 1990 amendments, to which they add in the heading (to Chapter 2) ‘An Ascendant Federal Partner.’ This law is exceedingly complex, more so than any previous environmental legislation resulting in the creation of substantial new regulatory responsibilities. The law’s major sections are as follows:

- Title 1—The non-attainment program
- Title 2—Mobile sources, fuels and fuel additives
- Title 3—Air toxics
- Title 4—Acid rain
- Title 5—The operating permit program