

reflects their breadth of expertise. A large number of literature citations is given at the end of each section so that the reader can follow up on material. All practicing control engineers should have this handbook in their library; it is a real bargain. On the other hand, the Borer text can easily be omitted from one's library without a significant loss.

Thomas McAvoy
Department of Chemical
& Nuclear Engineering
The University of Maryland
College Park, MD 20742

The Chemistry of Coal

By N. Berkowitz, Elsevier, 1985, 513 pp.

This book covers a broad range of coal chemistry topics at a level of detail and degree of advancement that should serve as an introduction for engineers, scientists or graduate students not familiar with coal or as an overview and review for those already knowledgeable about some of the topics. The author of the book has long been a productive researcher in many areas of coal chemistry, and he describes authoritatively the well established information as well as the knowledge gaps.

The book is divided into four parts. The first part consists of three chapters on the history of coal chemistry, the diversity of coal in terms of its organic and mineral heterogeneities, and the methods used to measure chemical and physical properties of coal.

Part II begins with a chapter on coal as an undefined organic compound, including a presentation of physical properties and a discussion of the implications of elemental composition and evidence from function group determinations. Four other chapters discuss chemical reactions at electron-rich centers, including nitration, halogenation, oxidation and dehydrogenation, as well as acid- and base-catalyzed reactions, pyrolysis, and the action of solvents on coal.

Practical applications of coal chemistry are covered in Part III, with chapters on chemical aspects of direct combustion, carbonization, gasification, and liquefaction. A separate chapter on the environmental chemistry of coal discusses the nature of solid, liquid and gaseous pollutants and techniques for their control.

Part IV is presented as a postscript on the chemical structure of coal. Representations of coal structure are given along with a discussion of the significance of structural models and anomalous rank effects.

The main strength of the book is its coverage of coal chemistry from a scientific point of view. Thus the chemical characterization of coal and its reactions are extensively described in detail. The underlying experimental evidence for conclusions and remaining ambiguities are carefully given and identified.

A possible weakness of the book is the treatment of engineering aspects of coal chemistry. More often than not the chemical reactions of coal are coupled with transport processes that can significantly affect the behavior, be it softening and swelling or product yields, distributions, and overall reaction kinetics. While the book does offer valuable discussion of these physical influences, the treatment is not as quantitative as chemical engineers usually prefer. However, this possible weakness is more than offset by the many strengths of the book.

J. B. Howard
Dept. of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, MA 02139

Synthetic Polymeric Membranes: A Structural Perspective, Second Edition

By R. E. Kesting, John Wiley & Sons, 1985, 348 pp.

The membrane field has grown significantly over the past fifteen years since publication of the first edition of R. E. Kesting's book that focused on membrane types and formation techniques. His recently published second edition includes updates on advances in membrane formation, material selection and membrane processes. The title to the new edition has been lengthened to include the words "A Structural Perspective," reflecting an expansion in the scope compared to the first edition. The substantially rewritten book seeks to make a direct connection between primary polymer structure and functional properties of membranes. Relationships between polymer molecular weight, molecular weight distribution, crystallizability and mechanical properties are integrated into discussions of membrane properties in Chapter 4. A discussion of polymer solutions has also been added in Chapter 5. This latter chapter

has a strong practical tone with little quantitative theory; nevertheless, it contains many useful observations and rules to guide one in the art of successful membrane formation.

As in the first edition, there are no formal illustrative examples or problems, so it is not appropriate as a conventional text for academic instruction. The information covered, however, suits it well as a reference for researchers in advanced membrane materials or membrane formation development. Only a very short discussion of module configurations and packaging is offered in the introductory chapter of the second edition, and while such topics are not the primary focus, a bit more information here would have been nice. Also, more discussion of adsorptive fouling of membranes and how polymer structural features suppress or promote this problem would have been useful and well within the scope of the topic area. Overall, however, this book is highly recommended as an easily readable means of obtaining a deeper understanding of characteristics of membrane formation processes and of the types of materials currently available.

The point of view expressed by Kesting emphasizes the need for chemical engineers to understand polymer science in order to participate effectively in the evolving field of membrane science. Unlike traditional unit operations such as distillation and extraction, the detailed material properties of the medium from which the separation device is made enters *directly* into the separation process itself. Both polymer/penetrant thermodynamic interactions and polymer-controlled diffusion of the permeating species, governed by the membrane composition, determine the effectiveness of the unit operation.

Chapter three, dealing with miscellaneous membrane applications, is a nice addition to this expanded edition. This chapter treats cases falling outside the normal separation realm typically associated with membranes. Examples of such applications include: selective membrane electrodes, collector membranes for sampling, controlled release devices, membrane reactors, and solid state electrolytes. These new areas are based largely on the same fundamental principles as in conventional membrane separation situations. Such miscellaneous uses constitute a rapid growth segment of the

membrane field that may equal or surpass simple membrane separation processes in economic importance by 1990. Unfortunately, an area not included in Chapter 3 involves barrier polymer films and smart barriers that can pass one component (eg. CO₂) while minimizing the passage of another (eg. O₂).

Compared to the first edition, the expanded second edition includes more detailed discussions of the principles controlling the various membrane separation techniques. Division of processes into concentration-driven, electrically-driven and pressure-driven categories is used to structure the discussion. Basic requirements and properties of membranes for each of these areas are clearly delineated. Properties of biological membranes, not treated in the original edition of the book, are described concisely in a separate chapter of the new edition. As in the other nine chapters of the book, the treatment of biological membranes and discussions of membrane formation processes and characterization of membrane properties are simple and written in clear understandable language that will not intimidate the uninitiated. Good up-to-date references are provided for the reader who is interested in delving deeper into the topic. Good summary discussions supported by a useful number of references characterize the treatments and make the book a recommended addition to the collection of anyone active or interested in becoming active in the membrane field.

W. J. Koros
Department of Chemical Engineering
The University of Texas at Austin
Austin, Texas 78711

Economic Methods for Multipollutant Analysis and Evaluation

By W. D. Baasel, Marcel Dekker, Inc., Pollution Engineering and Technology: A Series of Reference Books and Textbooks, Vol. 25, 1985, \$65.00.

This text presents the Multimedia Environmental Assessment System developed by the Industrial Environmental Research Laboratory of the United States Environmental Protection Agency. The Multimedia Environmental Assessment System is designed to provide an economic and systematic screening tool for defining the potential hazard associated with polluted discharges to the air, water and soil. Unlike the typical approaches to

defining risk that focus on the effects of single contaminants, this assessment method attempts to evaluate risks associated with multiple contaminants introduced into the environment by several paths. It is an attempt to address the problems associated with some of the overly narrow pollution control attempts of the past that have resulted in exacerbation of related pollution problems.

As with any simple method, however, it is subject to its share of criticisms. Particularly simplistic is the assumption of additivity of hazard associated with mixtures of pollutants when information to the contrary is unavailable. In addition, much of the method is simply the renaming of familiar measures of risk, such as threshold limit value, and the definition of new risk measures such as severity, which is simply the ratio of observed to desired concentration levels.

Regardless of the merits of the particular assessment system, however, it is an honest attempt to address the multipollutant, multimedia environmental problems that face the world today. He begins with an example of the pollution associated with a coal fired power plant and clearly demonstrates the need for simultaneous consideration of the risks associated with all discharges rather than approaching pollutants one at a time. The author provides an overview of the assessment process and follows this with chapters dealing with the details of each phase of this process. Throughout these chapters the author refers to concrete examples with tables of data appropriate for the examples. In addition, an extensive appendix is provided that summarizes desired concentrations (i.e. the multimedia environmental goals that are at the heart of the assessment system).

Other than my own hesitation to embrace the described assessment procedures, my main problem with the text was uncertainty over its readership. It seems aimed at a survey course in environmental assessment, and like most survey courses, it does not really prepare the reader to do anything. The preface suggests that the book will prove useful in the preparation of environmental impact statements but I think it is probably too general to be of much use in such an exercise. In addition, the author was forced to choose an almost uncomfortable balance between detail and generality. For example, the three paragraph discussion of gas

chromatography in the chapter on chemical analyses is unlikely to impart much understanding to a person who knows nothing about the technique but is equally unlikely to be of much use to one who does.

However, the text does provide an overview of the current practice of multimedia environmental assessment to the reader. I found the book useful in that it reminded me of the important environmental decisions that must be made based upon incomplete and sketchy data and often seemingly arbitrary analysis techniques.

Danny D. Reible
Department of Chemical Engineering
Louisiana State University
Baton Rouge, LA 70803

Spray Drying Handbook, Fourth Edition

By K. Masters, Halstead Press, New York, 1985, 696 pp.

Since the appearance of the First Edition in 1972, Keith Masters' tome on spray drying has been the standard first reference consulted by practitioners in the field. With the Third Edition (1979), it became known as a Handbook, which is certainly an appropriate description.

The book gives primary emphasis to three areas. The first of these is description and selection criteria for equipment. The second is discussion of atomizers and atomizer characteristics, including analysis of drop-size distributions. The third is a listing and discussion of the many different product applications. The presentations on atomizers, drop-size characteristics, and equipment are probably the most comprehensive available. The coverage of products is good but somewhat uneven. For example, within the foods area there is much discussion of spray-dried milk products, but only 2½ pages cover instant coffee, which is a major product.

The Fourth Edition is not much different from the Third. Only one new subsection has been added (Equipment to Agglomerate Spray Dryer Fines). The figures are essentially the same. The list of references is exactly the same, with the result that there is, very unfortunately, no reference more recent than 1978. How little can one change in a book and still call it a new edition?

There is a good amount of current research in spray drying, as becomes