

preceding sections on the theoretical aspects of that process. This was particularly true in the chapters on cross-flow microfiltration; the presentation of the design considerations had essentially no discussion of how to actually use any of the available theoretical models that have been developed for the filtrate flux in these systems.

As is almost inevitable in a book of this nature, there were a number of topics which were probably given insufficient coverage (despite the overall length of the text). For example, the chapters on membrane ultrafiltration provide almost no discussion of the issue of membrane selectivity or of the factors that ultimately determine the selectivity (such as the detailed pore size distribution and the presence of a small number of defects in the membrane skin). Likewise, there was only a very brief discussion of the hydrodynamic models that have been developed for the evaluation of membrane properties in terms of the solute and pore characteristics. I would also have liked to see a more detailed discussion of membrane fouling, including a more extensive discussion of the mechanisms and effects of protein fouling on the performance of both ultrafiltration and microfiltration systems, although this is probably in part just a reflection of my own particular interests in this area.

Overall, this book should prove to be an extremely valuable reference for researchers and practitioners interested in the underlying theory, application and design of a wide range of membrane processes. I have had a copy of the *Membrane Handbook* on my shelf for over a year, and I have used it extensively in both my teaching and research. Maybe even more importantly, the book has been borrowed by many of my colleagues, some of whom have only a passing interest in membranes, and they all found it to be a very valuable resource for their work.

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Rheology: Principles, Measurements, and Applications

By C. Macosko, VCH Publishers, 1994, 550 pp., \$95.00.

Professor Macosko has established a solid reputation in the field of rheology and polymer processing. He is highly qualified to write a book covering these fields. The result is an excellent book and one highly recommended to all who have an interest in rheology and polymer processing.

The book is organized into three sections of 11 chapters in all. Part I covers constitutive relations, beginning with the elastic solid and the viscous liquid, and moving on from that base to chapters on linear and then nonlinear viscoelasticity. The treatment is a good combination of fundamental theory coupled with experimental observations. A large number of worked examples illustrates the major points of each subsection of these chapters.

Part II, nearly half the book, covers the broad range of principles and devices for rheological measurement. The material presented is comprehensive. In addition to the description of commercial instruments and the development of the equations with which one connects observations to material constants or functions, there is extensive presentation of flows that may be used to characterize complex fluids without necessarily yielding fundamental material constants.

The final section of the book is labeled "Applications," but is really two chapters on the relationship of the "structure" of a fluid to its rheological responses. Chapter 10 of that section is coauthored with Jan Mewis of Katholieke Universiteit Leuven in Belgium, a leading expert in the field of suspension rheology, which is the topic of that chapter. Again, basic principles are coupled with extensive experimental evidence for the relationships between suspension rheology and particle shape, concentration, size and interparticle forces.

Chapter 11 covers the rheology of polymeric liquids and is authored by Matthew Tirrell of the University of Minnesota, a leader in the applications of molecular theory to polymeric fluid dynamics. The treatment is concise, with appropriate referencing of the more extensive works of Bird, Doi and Edwards, des Cloizeaux and Jannink, de Gennes, and Graessley. The goal of connecting macromolecular structure to rheological response is achieved.

In addition to the contributions of Mewis and Tirrell, Chapter 4 (Nonlinear Viscoelasticity) is authored by Ronald Larson of ATT Bell Labs, and Chapter 9 (Rheo-Optics: Flow Birefringence) is authored by Timothy Lodge of the University of Minnesota. Thus, the book, as a whole, features chapters written by leading experts in their respective fields.

There are a few features of the book that I find fault with. Exercises of the type one would assign as homework problems are provided only for the first four chapters, and the number is small. Hence if one wished to assign this book as a text it would be necessary to supplement the book with a large number of appropriate exercises. Some of the typography is too small for comfort, such as Tables 2.2.1 and 4.4.1.

But these are minor points. Macosko's book will appeal to those with an interest in practical rheology, its applications, and the fundamental bases for designing and using the rheologist's tools.

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