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## Synthetic Membranes and Membrane Separation Processing

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## BOOK REVIEW

T. Matsuura, *Synthetic Membranes and Membrane Separation Processing*, CRC Press, Boca Raton, Florida, 1994, viii + 467 pages, \$89.95.

The author of this new textbook has had twenty five years of research as a member of the Canadian group that was responsible for the development of the first asymmetric membranes thirty years ago. With this well-written volume he presents a textbook for a course on membrane separation processes, starting from his notes at the University of Ottawa. I doubt that there are many Universities that can offer the luxury of a course on membranes; yet, I welcome this book as a text that can be used as an important reference for all those involved in separation processes.

The author's approach to the subject is distinctly scientific, as it becomes evident from the dedication of seven chapters (1 through 6, and 8) to areas of materials and diffusional analysis. Other membrane books in the past have failed to provide a pedagogical approach to the subject because they have concentrated to an enumeration of a myriad of "industrial" membrane processes (many of them not even used any more in industry) without any effort to analyze the underlying fundamentals. In his book, Matsuura has taken the more appropriate method of *analyzing* (not simply mentioning) industrial processes in Chapters 7, 9 and 10.

With this positive introduction, specific sections of the book may or may not satisfy all researchers of the field. For example, in Chapter 2 Matsuura

spends a considerable number of pages analyzing solubility parameters and their importance in membrane separation. The analysis is very much influenced by van Krevelen's group contribution work and is offered without much discussion. "Old" (non-SI) units are used (an almost fatal mistake in academic institutions) and the student is often confused by industrial notations of membranes (e.g., copolyamide 31B, copolyamidohydrazide 81B, etc.). The next section discusses liquid chromatography with little or not effort to connect this to membrane separation except in a very general "interfacial properties" analysis.

Chapter 3 presents a number of methods for membrane preparation and is accompanied with a rather detailed mathematical analysis of the produced membrane structure. I was particularly happy to see the Yilmaz-McHugh analysis presented in detail. Chapter 4 concentrates on the microscopic structure of membranes.

Chapter 5 gives an analysis of membrane transport based on irreversible thermodynamics. Although generally nicely written, it is no match for the exceptional analysis of E. Lightfoot in his now out-of-print 1974 book; in fact, I wonder if a student would not be confused by the various analyses in terms of concentrations, chemical potentials, etc. The free-volume based models receive little attention, and gel membranes are not discussed. (The author avoids discussing mesh size, non-porous systems, reptation mechanisms and other important physical models of transport). Chapter 6 discusses various pore models, notably those appropriate for analysis of reverse osmosis and gas separation membranes.

Chapter 8 presents detailed analysis of solute transport in membranes with emphasis on the separation characteristics under laminar flow conditions. The three industrial membrane/design chapters present ample opportunity for application of the fundamentals of the previous chapters.

Overall, the book is well written with a strong chemical engineering flavor. A limited number of solved "example problems" is presented. The figures are most of the times helpful, although I would have preferred more detailed figure captions. Literature citation is impartial and covers a wide range of papers from the '40s until 1992. Yet, two notable omissions are citations of Japanese work (unless published in "western" Journals) and- especially- Soviet work on membrane separation processes (e.g. N. Plate's work is nowhere to be found!). The subject index could have been more detailed.

In conclusion, this is a nice textbook on membrane separations that should be consulted in an appropriate class or used by researchers new to the field. One may always find that his/her favorite subject is not presented in great detail, but this is always a problem with textbooks.

Reviewed by

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