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A Review of: "Pervaporation Membrane Separation Processes"

C. Stewarr Slater^a

^a Manhattan College,

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BOOK REVIEW

PERVAPORATION MEMBRANE SEPARATION PROCESSES

R.Y.M. Huang, ed.
Elsevier Science Publishers,
Amsterdam, The Netherlands, 1991
hardbound, 549 pages, \$168.50

The various aspects of pervaporation membrane processes have been effectively organized into R.Y.M. Huang's "Pervaporation Membrane Separation Processes". This is the first book in Elsevier's Membrane Science and Technology series. This text is composed of thirteen chapters by leading experts in the field. The contributors do a thorough job in addressing theory, design and applications and bring the reader up to date with this rapidly advancing technology.

The text is well illustrated with 201 figures and 66 tables. There are extensive references at the end of each chapter (704 total) for those seeking further information. The text has been published on a timely basis due to the camera-ready copy provided by the contributors.

The first chapter, "Introduction to Pervaporation" by Jean Neel, presents the background on pervaporation and its development. This is an excellent introductory chapter that would suffice a novice in the field. The chapter includes a short historical survey of the development of pervaporation, a discussion of the pervaporation concept and related techniques, basic mechanisms of the process, and engineering aspects. The chapter includes several tables that list various membrane materials and the separation that can be accomplished. The tables are an excellent source of information and are supported by 262 references.

Chapter 2, "Separation Characteristics of Pervaporation Membrane Separation Processes" by R.Y.M. Huang and J.W. Rhim, discusses the fundamental transport theory and relevant models. The transport mechanism and the separation characteristics of the process are described. The chapter gives

insight into predicting separation factors and permeabilities for binary systems. The effect of process conditions on performance and selection of membrane materials is also discussed.

Chapter 3, "Engineering Aspects of Pervaporation: Calculation of Transport Resistances, Module Optimization and Plant Design," is written by R. Rautenbach, C. Herion and U. Meyer-Blumenroth. The chapter focuses on some semi-empirical transport equations and their application to analyzing membrane transport. The section on module and process design presents some operational concerns and scale-up.

Chapter 4, "Thermodynamic Principles of Pervaporation," is authored by M.H.V. Mulder. This chapter presents a thorough analysis of pervaporation from a thermodynamic perspective. The chapter treats single component transport and binary mixtures. The solubility aspects of single and binary components in the membrane are reviewed. The relationship between preferential sorption and pervaporation is also mentioned.

Membrane materials are discussed in Chapter 5, "Estimation and Evaluation of Polymeric Materials for Pervaporation Membranes," written by G.H. Koops and C.A. Smolders. This chapter deals with the polymers used for various pervaporation applications. The evaluation of membrane polymers and their proper selection is presented along with techniques to improve their separation capabilities.

Chapter 6, "Sorption and Diffusion in Pervaporation Membranes" by A. Heintz, H. Funke and R.N. Lichtenhaler, discusses the significance of solubility and diffusivity in pervaporation. Experimental methods for measuring solubility and diffusivity parameters are presented along with their use in process calculations. Chapter 7, "Synthesis of Novel Copolymer Membranes for Pervaporation," written by T. Shimidzu and M. Yoshikawa, presents information on fixed carrier membrane materials. The contributors focus on the strategy for developing novel membranes and methods for synthesis.

"Pervaporation in Biotechnology" is the subject of Chapter 8. H. Strathmann and W. Gudernatsch have reviewed the application of pervaporation to the biotechnology industry for the separation, concentration and purification of bioreaction products and by-products. Chapter 9, "Recent Progress in Pervaporation Membranes for Water/Ethanol Separation," is written by Y. Maeda

and M. Kai. This chapter describes dehydration applications and the various membranes utilized. The presentation on membrane materials is well organized and adequately referenced.

Chapter 10, "Selective Pervaporation of Organics from Water," is authored by K.W. Böddeker and G. Bengtson. This chapter presents information on organophilic membranes and presents information on applications for extracting alcohols, acids, dioxane, aromatic hydrocarbons, and chlorinated hydrocarbons from aqueous mixtures. The chapter is supported by several tables and numerous references. "Plasma Grafted Membranes" is the subject of Chapter 11 written by T. Hirotsu. The chapter presents information on the technique of plasma grafting and the performance of membranes prepared in this manner.

Chapter 12, "Pervaporation Membrane Plant, Industrial Experience and Plant Design in Japan," is written by T. Asada. This chapter briefly reviews several pervaporation installations in Japan and includes some process diagrams and system photographs. "Development of Vapour Permeation for Industrial Applications" by U.H.F. Sander is the subject of Chapter 13. This concluding chapter addresses an important new process variant of pervaporation. Industrial applications and system design are summarized.

This is an excellent text for organizing the principles of pervaporation into one source. The strong introductory chapter by J. Neel is nicely complemented by chapters on various aspects of theory and membrane materials. Applications of pervaporation technology to traditional chemical processing and to the emerging area of biotechnology are addressed. The subject of plant performance (i.e., Chapter 12) could have been expanded. One of the best features of the text is the thorough and extensive reference listings and organization of membrane materials into easy to read tables. R.Y.M. Huang's book is highly recommended to anyone interested in the exciting and rapidly advancing field of pervaporation membrane processes.

*C. Stewart Slater
Manhattan College*