INTRODUCTION

TO SPECIAL SECTION ON

MEMBRANES IN CHEMICAL ENGINEERING EDUCATION

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When I was an undergraduate studying chemical engineering, there really was no significant membrane industry worth mentioning. That has certainly changed. Today, the membrane industry has sales of several billion dollars a year. This includes major applications in the treatment of kidney disease by hemodialysis, the separation of commodity gases such as oxygen and nitrogen, the purification of therapeutic proteins and pharmaceuticals, and the treatment and desalination of natural and industrial waters.

About two years ago, the North American Membrane Society conducted a survey to determine the extent to which membrane science and technology was covered in the undergraduate chemical engineering curriculum. This survey revealed a number of programs with significant membrane-related material, including specific laboratory experiments, open-ended design problems, and significant sections in both core and elective ChE courses. In most cases, however, the teaching was done by only one or two "experts," typically faculty who had significant personal experience in the membrane field. Departments that had no faculty working on membranes tended to have little if any coverage of membrane problems within their undergradute programs.

Motivated in large part by the results of this survey, the Membrane-Based Separations Area and the Education Division of the AIChE decided to co-sponsor a session on *Membranes in the Chemical Engineering Curriculum* at the 2001 Annual Meeting. The session was an enormous success, with a series of fascinating presentations covering a wide range of membrane problems within the undergraduate curriculum. The papers presented in this issue of *Chemical Engineering Education* are a direct result of this session, and I would like to personally thank Tim Anderson for his encouragement and support in putting this special issue together.

The papers that follow have been organized "chronologically," beginning with examples of how to introduce membrane technology in the *Introduction to Chemical Engineering* course and then moving through examples in mass transfer, separations, the undergraduate laboratory, and senior design. The specific problems/examples cover the full range of membrane applications, including problems in

1) *Design of appropriate hemodialysis therapy for the treatment of kidney disease*
2) *Optimization of gas separations using hollow fiber modules*
3) *Removal of impurities from therapeutic proteins using membrane diafiltration*
4) *Desalination of salt water by reverse osmosis or electrodialysis*
5) *Recovery of precious metals from spent catalysts*
6) *Concentration of apple juice using ultrafiltration*
7) *Production of ethylene in a ceramic membrane reactor*

Our hope is that these papers will provide faculty with examples that they can use in their classes so that all chemical engineering undergraduates can be exposed to some of the important principles and applications of membrane technology. The authors have tried, wherever possible, to provide sufficient details and references so that faculty can use these examples in their teaching. In addition, all of the authors have indicated they would be happy to answer questions about the problems, and several of the papers contain URLs that provide links to more detailed descriptions of the process simulators or lab experiments.

The North American Membrane Society (NAMS) will also be hosting an education section on its website (www.membranes.org), and anyone who is using these (or other) membrane problems within their courses is strongly encouraged to contact NAMS so that this information can be disseminated as effectively as possible throughout the chemical engineering community.