

# Contents

Foreword .....	ix
Preface.....	xii
Editors.....	xiii
Contributors .....	xv

## ***SECTION I Membrane Applications in Chemical and Pharmaceutical Industries and in Conservation of Natural Resources***

<b>Chapter 1</b> Membrane Applications in Chemical and Pharmaceutical Industries and in the Conservation of Natural Resources: Introduction.....	3
<i>Anil K. Pabby, Syed S.H. Rizvi, and Ana Maria Sastre</i>	
<b>Chapter 2</b> Advanced Materials in Ultrafiltration and Nanofiltration Membranes.....	7
<i>W.J. Lau, A.F. Ismail, T. Matsuura, N.A. Nazri, and E. Yuliwati</i>	
<b>Chapter 3</b> Reverse Osmosis Membrane .....	35
<i>Dipak Rana, Takeshi Matsuura, Mohd Azraai Kassim, and Ahmad Fauzi Ismail</i>	
<b>Chapter 4</b> Industrial Applications of Membrane Contactors .....	53
<i>Anil K. Pabby, J.V. Sonawane, Ana Maria Sastre, and Y. Kulkarni</i>	
<b>Chapter 5</b> Membrane Applications in Oil Refining and Petrochemical Industry.....	77
<i>A. Brunetti, G. Barbieri, and Enrico Drioli</i>	
<b>Chapter 6</b> Membrane and Monolithic Convective Chromatographic Supports.....	101
<i>M.E. Avramescu, Zandrie Borneman, and M. Wessling</i>	
<b>Chapter 7</b> Membranes in Gas Separation .....	143
<i>May-Britt Hägg and Liyuan Deng</i>	
<b>Chapter 8</b> Pervaporation: Theory, Practice, and Applications in the Chemical and Allied Industries .....	181
<i>Vishwas G. Pangarkar and Samit Kumar Ray</i>	
<b>Chapter 9</b> Ceramic Membranes Technology: Current Applications and Future Development .....	215
<i>Christian Guizard and Adam Stevenson</i>	
<b>Chapter 10</b> Techniques to Enhance Performance of Liquid-Phase Membrane Processes by Improved Control of Concentration Polarization.....	259
<i>S. Chang and A.G. Fane</i>	

<b>Chapter 11</b> Zeolite Membranes: Synthesis, Characterization, Important Applications, and Recent Advances .....	293
<i>M.P. Pina, Manuel Arruebo, and Reyes Mallada</i>	
<b>Chapter 12</b> Current Challenges in Reducing Membrane Fouling .....	355
<i>Mattheus F.A. Goosen</i>	
<b>Chapter 13</b> Membrane Extraction in Preconcentration, Sampling, and Trace Analysis .....	377
<i>Jan Åke Jönsson and Estelle Larsson</i>	
<b>Chapter 14</b> Advancements in Membrane Processes for Pharmaceutical Applications .....	403
<i>Ralf Kuriyel, Masatake Fushijima, and Gary W. Jung</i>	
<b>Chapter 15</b> Membranes in Drug Delivery.....	419
<i>Simona Maria Fiorentino, Rossella Farra, Barbara Dapas, Bruna Scaggiante, Federica Tonon, Gabriele Grassi, and Mario Grassi</i>	
<b>Chapter 16</b> Chitosan and Its Derivatives as Potential Materials for Membrane Technology .....	465
<i>Rajesha Kumar and Arun M. Isloor</i>	

## **SECTION II Membrane Applications in Biotechnology, Food Processing, Life Sciences, and Energy Conversion**

<b>Chapter 17</b> Membrane Applications in Biotechnology, Food Processing, Life Sciences, and Energy Conversion: Introduction .....	483
<i>Anil K. Pabby, Ana Maria Sastre, and Syed S.H. Rizvi</i>	
<b>Chapter 18</b> Membranes in Power Generation: A Review of Current Uses and Emerging Applications.....	485
<i>Dhaval Bhandari, Anthony Y. Ku, and Surinder Singh</i>	
<b>Chapter 19</b> Applications of Membrane Technology in the Dairy Industry .....	505
<i>Philipina A. Marcelo and Syed S.H. Rizvi</i>	
<b>Chapter 20</b> Transporting and Separating Molecules Using Tailored Nanotube Membranes .....	539
<i>Kexin Jiao, Punit Kohli, and Charles R. Martin</i>	
<b>Chapter 21</b> Proton-Conducting Membranes for Fuel Cells .....	567
<i>Vineet Rao, Norbert Kluy, Wenbo Ju, and Ulrich Stimming</i>	
<b>Chapter 22</b> On the Use of Ionic Liquid Technology for the Selective Separation of Organic Compounds and Metal Ions ....	615
<i>A. Pérez de los Ríos, F.J. Hernández-Fernández, L.J. Lozano, C. Godínez, S. Sánchez-Segado, F.J. Alguacil, F. Tomás-Alonso, and S. Galai</i>	
<b>Chapter 23</b> A Critical View on Separation Processes by Membrane Technology Applied in Vegetable Oil Refining.....	629
<i>Cesar de Morais Coutinho</i>	

## **SECTION III Membrane Applications in Industrial Waste Management (Including Nuclear), Environmental Engineering, and Future Trends in Membrane Science**

<b>Chapter 24</b>	Membrane Applications in Industrial Waste Management (Including Nuclear), Environmental Engineering, and Future Trends in Membrane Science: Introduction .....	663
	<i>Anil K. Pabby and Ana Maria Sastre</i>	
<b>Chapter 25</b>	Advancement in Membrane Methods for Liquid Radioactive Waste Processing: Current Opportunities, Challenges, and the Global Scenario .....	665
	<i>Grazyna Zakrzewska-Koltuniewicz</i>	
<b>Chapter 26</b>	Overview and the Current Status of Membrane-Based Processing of Radioactive Nuclear Plant Waste: Evaluation of Some Case Studies.....	709
	<i>Anil K. Pabby, J.V. Sonawane, S.K. Gupta, S.R. Sawant, N.S. Rathore, and Y. Kulkarni</i>	
<b>Chapter 27</b>	Polymer Inclusion Membranes.....	723
	<i>Spas D. Kolev, M. Inês G.S. Almeida, and Robert W. Cattrall</i>	
<b>Chapter 28</b>	Membrane Bioreactors for Wastewater Treatment.....	741
	<i>Eoin Syron and Eoin Casey</i>	
<b>Chapter 29</b>	Concentration-Driven Membrane Processes for the Recovery of Valuable Compounds from Industrial Wastes .....	759
	<i>Eugenio Bringas, M. Fresneda San Román, Ana M. Urtiaga, and Inmaculada Ortiz</i>	
<b>Chapter 30</b>	Membrane Contactors for the Absorption of Carbon Dioxide from Gaseous Streams: State of the Art on Membrane Improvements.....	773
	<i>Alessandra Criscuoli and Enrico Drioli</i>	
<b>Chapter 31</b>	Liquid Membranes for Studies Involving Nuclear Waste Remediation Using Hollow-Fiber Contactors.....	787
	<i>Seraj A. Ansari, Pankaj Kandwal, and Prasanta K. Mohapatra</i>	
<b>Chapter 32</b>	Hollow-Fiber Renewal and Strip Dispersion Liquid Membrane Techniques: Application for Metal Separation, Recovery, and Wastewater Treatment .....	813
	<i>Anil K. Pabby, Suman C. Roy, J.V. Sonawane, N.S. Rathore, C.B. Patil, Ana Maria Sastre, and Y. Kulkarni</i>	
<b>Chapter 33</b>	Future Progress in Membrane Engineering .....	825
	<i>Enrico Drioli and Gianluca Di Profio</i>	
<b>Index</b>	.....	847