

# Handbook Of Membrane Separations Chemical Pharmaceutical Food And Biotechnological Applications Second Edition

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*Handbook Of Membrane Separations  
Chemical Pharmaceutical Food And  
Biotechnological Applications Second  
Edition*

OMB No. 0184076972296 edited by

## ZACHARY HUDSON

**Membrane Technology** CRC Press

Membrane Separation Principles and Applications: From Material Selection to Mechanisms and Industrial Uses, the latest volume in the Handbooks in Separation Science series, is the first single

resource to explore all aspects of this rapidly growing area of study. Membrane technology is now accepted as one of the most effective tools for separation and purification, primarily due to its simple operation. The result has been a proliferation of studies on this topic; however, the relationships between fundamental knowledge and applications are rarely discussed. This book acts as a guideline for those who are interested in exploring membranes at a more progressive level. Covering methods of pressure driving force, partial pressure driving force,

concentration driving force, electrical potential driving force, hybrid processes, and more, this volume is more complete than any other known resource on membrane separations. Covers membrane material selection, membrane fabrication, membrane characterization, separation mechanisms and applications in each chapter Authored by contributors who are internationally recognized as experts in their respective fields Organized by the driving force behind each type of membrane separation—a unique approach that more clearly links fundamental principles

with their dominant applications

*From Material Selection to Mechanisms and Industrial Uses* Royal Society of Chemistry

Membrane reactors are increasingly replacing conventional separation, process and conversion technologies across a wide range of applications. Exploiting advanced membrane materials, they offer enhanced efficiency, are very adaptable and have great economic potential. There has therefore been increasing interest in membrane reactors from both the scientific and industrial communities, stimulating research and development. The two volumes of the Handbook of membrane reactors draw on this research to provide an authoritative review of this important field. Volume 1 explores fundamental materials science, design and optimisation, beginning with a review of polymeric, dense metallic and composite membranes for membrane reactors in part one. Polymeric and nanocomposite membranes for membrane reactors, inorganic membrane reactors for hydrogen production, palladium-based composite membranes and alternatives to palladium-based membranes for hydrogen separation in membrane reactors are all discussed. Part two goes on to investigate zeolite, ceramic and carbon membranes and catalysts for membrane reactors in more depth. Finally, part three explores membrane reactor modelling, simulation and optimisation, including the use of mathematical modelling, computational fluid dynamics, artificial neural networks and non-equilibrium thermodynamics to analyse varied aspects of membrane reactor design and production enhancement. With its distinguished editor and international team of expert contributors, the two volumes of the Handbook of membrane reactors provide an authoritative guide for membrane reactor researchers and materials scientists, chemical and biochemical manufacturers, industrial separations and process engineers, and academics in this field. Considers polymeric, dense metallic and composite membranes for membrane reactors Discusses ceramic and carbon for membrane reactors in detail Reactor modelling, simulation and optimisation is also discussed

*Hollow Fiber Membrane Contactors* Springer Science & Business Media

Advanced membranes-from fundamentals and membrane chemistry to manufacturing and applications A hands-on reference for practicing professionals, Advanced Membrane

Technology and Applications covers the fundamental principles and theories of separation and purification by membranes, the important membrane processes and systems, and major industrial applications. It goes far beyond the basics to address the formulation and industrial manufacture of membranes and applications. This practical guide: Includes coverage of all the major types of membranes: ultrafiltration; microfiltration; nanofiltration; reverse osmosis (including the recent high-flux and low-pressure membranes and anti-fouling membranes); membranes for gas separations; and membranes for fuel cell uses Addresses six major topics: membranes and applications in water and wastewater; membranes for biotechnology and chemical/biomedical applications; gas separations; membrane contractors and reactors; environmental and energy applications; and membrane materials and characterization Includes discussions of important strategic issues and the future of membrane technology With chapters contributed by leading experts in their specific areas and a practical focus, this is the definitive reference for professionals in industrial manufacturing and separations and research and development; practitioners in the manufacture and applications of membranes; scientists in water treatment, pharmaceutical, food, and fuel cell processing industries; process engineers; and others. It is also an excellent resource for researchers in industry and academia and graduate students taking courses in separations and membranes and related fields.

### HANDBOOK OF MEMBRANE SEPARATIONS

Elsevier

*Synthetic Membranes and Membrane Separation Processes* addresses both fundamental and practical aspects of the subject. Topics discussed in the book cover major industrial membrane separation processes, including reverse osmosis, ultrafiltration, microfiltration, membrane gas and vapor separation, and pervaporation. Membrane materials, membrane preparation, membrane structure, membrane transport, membrane module and separation design, and applications are discussed for each separation process. Many problem-solving examples are included to help readers understand the fundamental concepts of the theory behind the processes. The book will benefit practitioners and students in chemical engineering, environmental

engineering, and materials science.

### A Practical Guide to Membrane Technology and Applications in Food and Bioprocessing

Elsevier  
Surveys the selection, design, and operation of most of the industrially important separation processes. Discusses the underlying principles on which the processes are based, and provides illustrative examples of the use of the processes in a modern context. Features thorough treatment of newer separation processes based on membranes, adsorption, chromatography, ion exchange, and chemical complexation. Includes a review of historically important separation processes such as distillation, absorption, extraction, leaching, and crystallization and considers these techniques in light of recent developments affecting them.

### Handbook of Smart Materials in Analytical Chemistry

John Wiley & Sons

In this essential new volume, Volume 13: Membrane and Desalination Technologies, a panel of expert researchers provide a wealth of information on membrane and desalination technologies. An advanced chemical and environmental engineering textbook as well as a comprehensive reference book, this volume is of high value to advanced graduate and undergraduate students, researchers, scientists, and designers of water and wastewater treatment systems. This is an essential part of the Handbook of Environmental Engineering series, an incredible collection of methodologies that study the effects of pollution and waste in their three basic forms: gas, solid, and liquid. Chapters adopt the series format, employing methods of practical design and calculation illustrated by numerical examples, including pertinent cost data whenever possible, and exploring in great detail the fundamental principles of the field. Volume 13: Membrane and Desalination Technologies is an essential guide for researchers, highlighting the latest developments in principles of membrane technology, membrane systems planning and design, industrial and municipal waste treatments, desalination requirements, wastewater reclamation, biofiltration, and more.

*Chemical, Pharmaceutical, Food, and Biotechnological Applications* CRC Press

Membranes and membrane separation techniques have grown from a simple laboratory tool to an industrial process with

considerable technical and commercial impact. The book deals with both the fundamental concepts of preparation, characterization and modification, practical applications along with recent advancements of electro-spun and phase inverted polymeric membranes. Divided into two parts, part one of this book covers the fundamental concepts and practical applications of novel electro-spun membranes while the latter covers basic concepts and further advancements of the conventional phase inverted membranes extensively. Key Features Covers fundamental concepts and practical applications of electro-spun and phase inverted polymeric membranes Includes general properties, characterization, preparation and modification of polymeric membranes Discusses advanced modification of polymeric membranes (functionalization, grafting) using phase inversion process, and effects of solubility parameter and additives on the phase inversion process Reviews electro-spun membranes for biomedical applications, industrial effluents treatment and removal of water contaminants Explores a separate economic analysis section for the discussed membranes

### REACTOR TYPES AND INDUSTRIAL APPLICATIONS

CRC Press

Membrane Technology - a clean and energy saving alternative to traditional/conventional processes. Developed from a useful laboratory technique to a commercial separation technology, today it has widespread and rapidly expanding use in the chemical industry. It has established applications in areas such as hydrogen separation and recovery of organic vapors from process gas streams, and selective transport of organic solvents, and it is opening new perspectives for catalytic conversion in membrane reactors. Membrane technology provides a unique solution for industrial waste treatment and for controlled production of valuable chemicals. This book outlines several established applications of membranes in the chemical industry, reviews the available membranes and membrane processes for the field, and discusses the huge potential of this technology in chemical processes. Each chapter has been written by an international leading expert with extensive industrial experience in the field. *Handbook of Industrial Membrane Technology* John Wiley & Sons A modern separation process textbook written for advanced undergraduate and graduate level courses in chemical

engineering.

### CARBON MEMBRANE TECHNOLOGY

McGraw-Hill Professional Publishing

This book on hollow fiber contactors presents an up-to-date compilation of the latest developments and milestones in this membrane technology. Hollow Fiber Membrane Contactors: Module Fabrication, Design and Operation, and Potential Applications provides a comprehensive discussion of hollow fiber membrane applications (including a few case studies) in biotechnology, chemical, food, and nuclear engineering. The chapters in this book have been classified using the following, based on different ways of contacting fluids with each other: Gas-liquid contacting; Liquid-liquid contacting; Supported liquid membrane; Supported gas membrane; Fluid-fluid contacting. Other features include: Discusses using non-dispersive solvent extraction, hollow fiber strip dispersion, hollow fiber supported liquid membranes and role of process intensification in integrated use of these processes Provides technical and economic perspectives with several case studies related to specific scenarios Demonstrates module fabrication, design, operation and maintenance of hollow fiber contactors for different applications and performance Presents discussion on newer concepts like membrane emulsification, membrane nanoprecipitation, membrane crystallization and membrane condenser Special focus on emerging areas such as the use of hollow fiber contactor in back end of nuclear fuel cycle, membrane distillation, dehumidification of air and gas absorption and stripping Discusses theoretical analysis including computational modeling of different hollow fiber membrane processes, and presents emphasis on newly developed area of hollow fiber membrane based analytical techniques Presents discussion on upcoming area dealing with hollow fiber contactors-based technology in fermentation and enzymatic transformation and in chiral separations This book is equally suited for newcomers to the field, as well as for engineers and scientists that have basic knowledge in this field but are interested in obtaining more information about specific future applications.

### PRINCIPLES AND APPLICATIONS IN CHEMICAL

### SEPARATIONS AND WASTEWATER TREATMENT

CRC Press

Get Cutting-Edge Coverage of All Chemical Engineering Topics— from Fundamentals to the Latest Computer Applications First published in 1934, Perry's Chemical Engineers' Handbook has equipped generations of engineers and chemists with an expert source of chemical engineering information and data. Now updated to reflect the latest technology and processes of the new millennium, the Eighth Edition of this classic guide provides unsurpassed coverage of every aspect of chemical engineering— from fundamental principles to chemical processes and equipment to new computer applications. Filled with over 700 detailed illustrations, the Eighth Edition of Perry's Chemical Engineering Handbook features: Comprehensive tables and charts for unit conversion A greatly expanded section on physical and chemical data New to this edition: the latest advances in distillation, liquid-liquid extraction, reactor modeling, biological processes, biochemical and membrane separation processes, and chemical plant safety practices with accident case histories Inside This Updated Chemical Engineering Guide - Conversion Factors and Mathematical Symbols • Physical and Chemical Data • Mathematics • Thermodynamics • Heat and Mass Transfer • Fluid and Particle Dynamics Reaction Kinetics • Process Control • Process Economics • Transport and Storage of Fluids • Heat Transfer Equipment • Psychrometry, Evaporative Cooling, and Solids Drying • Distillation • Gas Absorption and Gas-Liquid System Design • Liquid-Liquid Extraction Operations and Equipment • Adsorption and Ion Exchange • Gas-Solid Operations and Equipment • Liquid-Solid Operations and Equipment • Solid-Solid Operations and Equipment • Size Reduction and Size Enlargement • Handling of Bulk Solids and Packaging of Solids and Liquids • Alternative Separation Processes • And Many Other Topics!

Advanced Membrane Technology and Applications CRC Press

The book explains fundamental and advanced topics related to the field of membrane science including extensive coverage of material selection, preparation, characterization and applications of various membranes. Explores both preparation and wide range of applications for all possible membranes, contains an exclusive chapter on functionalized membranes and incorporation of stimuli

responsive membranes in each type and includes exercise problems after each chapter It also discusses new membrane operations as membrane reactors and membrane contactors

### **SYNTHETIC MEMBRANES AND MEMBRANE SEPARATION PROCESSES**

John Wiley & Sons

Contributed by multiple experts, the book covers the scientific and engineering aspects of membrane processes and systems. It aims to cover basic concepts of novel membrane processes including membrane bioreactors, microbial fuel cell, forward osmosis, electro-dialysis and membrane contactors. Maintains a pragmatic approach involving design, operation and cost analysis of pilot plants as well as scaled-up counterparts

### **FUNDAMENTALS AND APPLICATIONS**

Cambridge University Press

This handbook emphasizes the use of sythetic membranes for separations involving industrial or municipal process streams. Discussions on theory, engineering aspects, membrane preparation, and typical and projected applications of the various membrane processes are included.

*Handbook of Separation Process Technology* IWA Publishing  
*Handbook of Membrane Separations* Chemical, Pharmaceutical, Food, and Biotechnological Applications CRC Press

*Membrane Technology in Separation Science* Elsevier

Membrane reactors are increasingly replacing conventional separation, process and conversion technologies across a wide range of applications. Exploiting advanced membrane materials, they offer enhanced efficiency, are very adaptable and have great economic potential. There has therefore been increasing interest in membrane reactors from both the scientific and industrial communities, stimulating research and development. The two volumes of the Handbook of membrane reactors draw on this research to provide an authoritative review of this important field. Volume 2 reviews reactor types and industrial applications, beginning in part one with a discussion of selected types of membrane reactor and integration of the technology with industrial processes. Part two goes on to explore the use of membrane reactors in chemical and large-scale hydrogen production from fossil fuels. Electrochemical devices and

transport applications of membrane reactors are the focus of part three, before part four considers the use of membrane reactors in environmental engineering, biotechnology and medicine. Finally, the book concludes with a discussion of the economic aspects of membrane reactors. With its distinguished editor and international team of expert contributors, the two volumes of the Handbook of membrane reactors provide an authoritative guide for membrane reactor researchers and materials scientists, chemical and biochemical manufacturers, industrial separations and process engineers, and academics in this field. Discusses integration of membrane technology with industrial processes Explores the use of membrane reactors in chemical and large-scale hydrogen production from fossil fuels Considers electrochemical devices and transport applications of membrane reactors

*Uveitis Scoring System* CRC Press

A comprehensive guide to smart materials and how they are used in sample preparation, analytical processes, and applications This comprehensive, two-volume handbook provides detailed information on the present state of new materials tailored for selective sample preparation and the legal frame and environmental side effects of the use of smart materials for sample preparation in analytical chemistry, as well as their use in the analytical processes and applications. It covers both methodological and applied analytical aspects, relating to the development and application of new materials for solid-phase extraction (SPE) and solid-phase microextraction (SPME), their use in the different steps and techniques of the analytical process, and their application in specific fields such as water, food, air, pharmaceuticals, clinical sciences and forensics. Every chapter in Handbook of Smart Materials in Analytical Chemistry is written by experts in the field to provide a comprehensive picture of the present state of this key area of analytical sciences and to summarize current applications and research literature in a critical way. Volume 1 covers New Materials for Sample Preparation and Analysis. Volume 2 handles Analytical Processes and Applications. Focuses on the development and applications of smart materials in analytical chemistry Covers both, methodological and applied analytical aspects, for the development of new materials and their use in the different steps and techniques of the analytical process and their application in

specific fields Features applications in key areas including water, air, environment, pharma, food, forensic, and clinical Presents the available tools for the use of new materials suitable to aid recognition process to the sample preparation and analysis A key resource for analytical chemists, applied laboratories, and instrument companies Handbook of Smart Materials in Analytical Chemistry, 2V Set is an excellent reference book for specialists and advanced students in the areas of analytical chemistry, including both research and application environments.

*Membrane Engineering for the Treatment of Gases* William Andrew Inc.

Membrane technology is a rapidly developing area, with key growth accross the process sector, including biotech separation and biomedical applications (e.g. haemodialysis, artificial lungs), through to large scale industrial applications in the water and waste-water processing and the food and drink industries. As processes mature, and the cost of membranes continues to dramatically reduce, so their applications and use are set to expand. Process engineers need access to the latest information in this area to assist with their daily work and to help to develop and apply new and ever more efficient liquid processing solutions. This book covers the latest technologies and applications, with contributions from leading figures in the field. Throughout, the emphasis is on delivering solutions to practitioners. Real world case studies and data from leading organizations -- including Cargill, Lilly, Microbach, ITT -- mean this book delivers the latest solutions as well as a critical working reference to filtration and separation professionals. Covers the latest technologies and applications in this fast moving bioprocessing sector Presents a wide range of case studies that ensure readers benefit from the hard-won experience of others, saving time, money and effort World class author team headed up by the Chair of Chemical Engineering at Oxford University, UK and the VP of Plant Operations and Process Technology at Cargill Corp, the food services company and largest privately owned company in the US *Hollow Fiber Membrane Contactors* Springer Science & Business Media

Membrane processes have wide industrial ap This handbook reviews the published litera plications covering many existing and emerging ture, presents an in-depth description of com uses in the chemical, petrochemical, petroleum, mercialized membrane

processes, and gives a state-of-the-art review of new membrane processes for environmental, water treatment, pharmaceutical, medical, food, dairy, beverage, paper, and textile concepts under development. It is intended to be a single source of underlying principles, membranes, membrane modules, process applications include: (1) dialysis for the purification of human blood (the artificial kidney), (2) sign, applications, and cost estimates. It is also electro dialysis for the desalination of brackish water, (3) reverse osmosis for the desalination of seawater, (4) There are several groups which may benefit

ultrafiltration for the concentration of large proteins from this handbook. It can be used as educational material for industrial personnel engaged in casein whey, and (5) microfiltration for the sterilization of milk, and (5) microfiltration for the sterilization of pharmaceutical products, beer, and soft drinks. Since membrane processes generally have low capital investment, as source of reference for the entire field. Polymeric Membrane Synthesis, Modification, and Applications  
CRC Press  
The Handbook of Membrane Separations: Chemical,

Pharmaceutical, and Biotechnological Applications provides detailed information on membrane separation technologies as they have evolved over the past decades. To provide a basic understanding of membrane technology, this book documents the developments dealing with these technologies. It explores chemical, pharmaceutical, food processing and biotechnological applications of membrane processes ranging from selective separation to solvent and material recovery. This text also presents in-depth knowledge of membrane separation mechanisms, transport models, membrane permeability computations, membrane types and modules, as well as membrane reactors.

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