
Industrial Membrane Separation Technology 1st Edition

Basic Principles of Membrane Technology
Membrane Technology
Membrane Separation Systems
Membrane Technology and Applications
Industrial Membrane Separation Technology
Handbook of Membrane Separations
Membrane Separation Principles and Applications
Handbook of Industrial Membrane Technology
Fundamentals of Membrane Separation Technology
Membrane Handbook
Handbook of Membrane Separations
Membrane Characterization
Membrane Technology in Separation Science
Membrane Technology: Applications to Industrial Wastewater Treatment
Liquid Membranes
Effective Industrial Membrane Processes: Benefits and Opportunities
Membrane Separation Technology
Membrane Technology
Membrane Processes in Separation and Purification
Handbook of Membrane Separations
Industrial Membrane Separation Technology
Applications of Membrane Technology for Food Processing Industries
Synthetic Membranes and Membrane Separation Processes
Ion-Exchange Membrane Separation Processes
MEMBRANE SEPARATION PROCESSES
Advanced Membrane Technology and Applications

Membrane Contactor Technology
Membrane-Based Separations in Metallurgy
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Membrane Separations Technology

*Industrial Membrane Separation
Technology 1st Edition*

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GWENDOLYN TORRES

Basic Principles of Membrane Technology Elsevier

This publication presents the lectures given at the course on Advanced Separation Technology for Industrial Waste Minimization: Environmental and Analytical Aspects (13-15 October, 1992, Ispra, Italy) organized jointly by the Technical University of Lisbon, University of Calabria and the Environment Institute of the Joint Research Centre of the Commission of the European Communities at Ispra. This course is integrated in a programme for education and training in Advanced Separation Technology for Industrial Waste Minimization supported by the

Community Action Programme for Education and Training for Technology (COMETT II). The lecture material is based on case studies of importance to textile, tanneries, pulp and paper, metal finishing and electroplating, food, and other industries.

Environmental regulations have lead industrial engineers to search for more efficient, less energy consuming and less waste producing processes. Membrane-based separation processes contributed to recover water, raw materials and energy and to achieve simultaneously pollution control. Along this book emphasis will be given to this fast growing area of process technology.

Membrane Technology Springer Science & Business Media
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Membrane Separation Systems John Wiley & Sons

Membranes already have important applications in artificial organs, the processing of biotechnological products, food manufacture, waste water treatment, and seawater desalination. Their uses in gaseous mixture separations are, however, far from achieving their full potential. Separation of air components, natural gas dehumidification and sweetening, separation and recovery of CO₂ from biogas, and H₂ from refinery gases are all examples of current industrial applications. The use of membranes for reducing the greenhouse effect and improving energy efficiency has also been suggested. New process intensification strategies in the petrochemical industry have opened up another growth area for gas separation membrane systems and membrane reactors. This two volume set presents the state-of-the-art in membrane engineering for the separation of gases. It addresses future developments in carbon capture and utilization, H₂ production and purification, and O₂/N₂ separation. Topics covered include the: applications of membrane gas separation in the petrochemical industry; implementation of membrane processes for post-combustion capture; commercial applications of membranes in gas separations; simulation of

membrane systems for CO₂ capture; design and development of membrane reactors for industrial applications; Pd-based membranes in hydrogen production; modelling and simulation of membrane reactors for hydrogen production and purification; novel hybrid membrane/pressure swing adsorption process for gas separation; molecular dynamics as a new tool for membrane design, and physical aging of membranes for gas separations. Volume 2 looks at problems combined with membrane reactors.

Membrane Technology and Applications CRC Press

Membrane Characterization provides a valuable source of information on how membranes are characterized, an extremely limited field that is confined to only brief descriptions in various technical papers available online. For the first time, readers will be able to understand the importance of membrane characterization, the techniques required, and the fundamental theory behind them. This book focuses on characterization techniques that are normally used for membranes prepared from polymeric, ceramic, and composite materials. Features specific details on many membrane characterization techniques for various membrane materials of industrial and academic interest Contains examples of international best practice techniques for the evaluation of several membrane parameters, including pore size, charge, and fouling Discusses various membrane models more suitable to a specific application Provides examples of ab initio calculations for the design, optimization, and scale-up of processes based on characterization data

Industrial Membrane Separation Technology National Academies 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

Handbook of Membrane Separations Elsevier

The field of membrane separation technology is presently in a state of rapid growth and innovation. Many different membrane separation processes have been developed during the past half century and new processes are constantly emerging from academic, industrial, and governmental laboratories. While new membrane separation processes are being conceived with remarkable frequency, existing processes are also being

constantly improved in order to enhance their economic competitiveness. Significant improvements are currently being made in many aspects of membrane separation technology: in the development of new membrane materials with higher selectivity and/or permeability, in the fabrication methods for high-flux asymmetric or composite membranes, in membrane module construction and in process design. Membrane separation technology is presently being used in an impressive variety of applications and has generated businesses totalling over one billion U.S. dollars annually. The main objective of this book is to present the principles and applications of a variety of membrane separation processes from the unique perspectives of investigators who have made important contributions to their fields. Another objective is to provide the reader with an authoritative resource on various aspects of this rapidly growing technology. The text can be used by someone who wishes to learn about a general area of application as well as by the knowledgeable person seeking more detailed information.

Membrane Separation Principles and Applications Springer Science & Business Media

This manual contains necessary and useful information and data in an easily accessible format relating to the use of membranes. Membranes are among the most important engineering components in use today, and each year more and more effective uses for membrane technologies are found - for example: water purification, industrial effluent treatment, solvent dehydration by per-vaporation, recovery of volatile organic compounds, protein recovery, bioseparations and many others. The pace of change in the membrane industry has been accelerating rapidly in recent

years, occasioned in part by the demand of end-users, but also as a result of the investment in R&D by manufacturers. To reflect these changes the author has obtained the latest information from some of the leading suppliers in the business. In one complete volume this unique handbook gives practical guidance to using selected membrane processes in individual industries while also providing a useful guide to equipment selection and usage.

Handbook of Industrial Membrane Technology CRC Press
 Membrane Separation Processes: Theories, Problems, and Solutions provides graduate and senior undergraduate students and membrane researchers in academia and industry with the fundamental knowledge on the topic by explaining the underlying theory that is indispensable for solving problems that occur in membrane separation processes. All major membrane processes are discussed, and an economic analysis is provided. Separation processes such as RO, UF, MF, RO, PRO and MD are thoroughly discussed. During the last two decades, the scope of the R&D of membrane separation processes has been significantly broadened. Other sections in the book cover membrane contactor and membrane adsorption. In addition, hybrid systems in which two or more membrane systems are combined are now being investigated for large-scale applications. Written by renowned experts with extensive experience with industry, education and R&D who have complementary expertise In-depth coverage of the most important conventional and emerging membrane processes Provides fundamental membrane theories for solving problems in separation processes without using complicated software

Fundamentals of Membrane Separation Technology William Andrew

Membrane technologies play an increasingly important role in unit operations for resource recovery, pollution prevention, and energy production, as well as environmental monitoring and quality control. They are also key component technologies of fuel cells and bioseparation applications. Membrane Technologies and Applications provides essential data and background information on various dimensions of membrane technologies, with a major focus on their practical application. Membranes of inorganic materials offer cost-effective solutions for simple to complex separation problems. This book is designed for anyone interested in water and wastewater treatment, membrane suppliers, as well as students and academics studying the field.

Membrane Handbook Elsevier

The aim of the Technical Advisory Committee, in planning the content of this meeting, was to illustrate the range of separation processes in which the use of membranes was practical and effective at an industrial scale. As Professor Strathmann reveals, the market for process equipment built around membranes is now worth about \$5x10⁹ annually, and it seemed important to review this technology, and to point the direction of future technical advances. All but the most critical reader should find some items of interest. The Committee would admit to not fulfilling all of their aims, although those delegates who attended the meeting in Edinburgh judged it a success. In the event it provided representative examples of processes from the food and beverage industry, from water treatment, and from the chemical industry, of which the removal of alcohol from

fermented beverages, shipboard desalination and solvent recovery are three. The major uses of charged membranes and sterile processes are not covered, nor is the largest market, \$1.2x10 annually, for artificial kidney dialysis. However, it is interesting to see artificial kidney now finding an alternative use as a reactor for the production of monoclonal antibodies. We are also reminded by Professor Michel of the importance and efficiency of natural membranes in the kidney under conditions where fouling is crucial to their performance and enhances their selectivity.

Handbook of Membrane Separations Springer Science & Business Media

Liquid Membranes: Principles and Applications in Chemical Separations and Wastewater Treatment discusses the principles and applications of the liquid membrane (LM) separation processes in organic and inorganic chemistry, analytical chemistry, biochemistry, biomedical engineering, gas separation, and wastewater treatment. It presents updated, useful, and systematized information on new LM separation technologies, along with new developments in the field. It provides an overview of LMs and LM processes, and it examines the mechanisms and kinetics of carrier-facilitated transport through LMs. It also discusses active transport, driven by oxidation-reduction, catalytic, and bioconversion reactions on the LM interfaces; modifications of supported LMs; bulk aqueous hybrid LM processes with water-soluble carriers; emulsion LMs and their applications; and progress in LM science and engineering. This book will be of value to students and young researchers who are new to separation science and technology, as well as to scientists

and engineers involved in the research and development of separation technologies, LM separations, and membrane reactors. Provides comprehensive knowledge-based information on the principles and applications of a variety of liquid membrane separation processes. Contains a critical analysis of new technologies published in the last 15 years.

Membrane Characterization John Wiley & Sons

Separation is one of the most energy-intensive operations used in the industrial sector. This brochure and collection of DOE Office of Industrial Technologies fact sheets discuss current R & D in improving separation technologies. Seven fact sheets and one project contact list are included in the brochure.

Membrane Technology in Separation Science John Wiley & Sons

Membranes already have important applications in artificial organs, the processing of biotechnological products, food manufacture, waste water treatment, and seawater desalination. Their uses in gaseous mixture separations are, however, far from achieving their full potential. Separation of air components, natural gas dehumidification and sweetening, separation and recovery of CO₂ from biogas, and H₂ from refinery gases are all examples of current industrial applications. The use of membranes for reducing the greenhouse effect and improving energy efficiency has also been suggested. New process intensification strategies in the petrochemical industry have opened up another growth area for gas separation membrane systems and membrane reactors. This two volume set presents the state-of-the-art in membrane engineering for the separation of gases. It addresses future developments in carbon capture and utilization, H₂ production and purification, and O₂/N₂ separation.

Topics covered include the: applications of membrane gas separation in the petrochemical industry; implementation of membrane processes for post-combustion capture; commercial applications of membranes in gas separations; simulation of membrane systems for CO₂ capture; design and development of membrane reactors for industrial applications; Pd-based membranes in hydrogen production; modelling and simulation of membrane reactors for hydrogen production and purification; novel hybrid membrane/pressure swing adsorption process for gas separation; molecular dynamics as a new tool for membrane design, and physical aging of membranes for gas separations. Volume 1 focuses predominantly on problems relating to membranes.

Membrane Technology: Applications to Industrial Wastewater Treatment John Wiley & Sons

An eye-opening exploration of membrane contactors from a group of industry leaders In Membrane Contactor Technology: Water Treatment, Food Processing, Gas Separation, and Carbon Capture, an expert team of researchers delivers an up-to-date and insightful explanation of membrane contactor technology, including transport phenomena, design aspects, and diverse process applications. The book also includes explorations of membrane synthesis, process, and module design, as well as rarely discussed process modeling and simulation techniques. The authors discuss the technical and economic aspects of this increasingly important technology and examine the geometry, flow, energy and mass transport, and design aspects of membrane contactor modules. They also cover a wide range of application opportunities for this technology, from the materials

sciences to process engineering. Membrane Contactor Technology also includes: A thorough introduction to the membrane contactor extraction process, including dispersion-free membrane extraction processes and supported liquid membrane processes Comprehensive explorations of membrane transport theory, including discussions of diffusional mass and heat transfer modeling, as well as numerical modeling In-depth examinations of module configuration and geometry, including design and flow configuration Practical discussions of modes or operation, including membrane distillation, osmotic evaporation, and forward osmosis Perfect for process engineers, biotechnologists, water chemists, and membrane scientists, Membrane Contactor Technology also belongs in the libraries of chemical engineers, polymer chemists, and chemists working in the environmental industry.

Liquid Membranes Springer Science & Business Media

The chapters of this book are based upon lectures presented at the NATO Advanced Study Institute on Membrane Processes in Separation and Purification (March 21 - April 2, 1993, Curia, Portugal), organized as a successor and update to a similar Institute that took place 10 years ago (p.M.Bungay, H.K. Lonsdale, M.N. de Pinho (Eds.): Synthetic Membranes: Science, Engineering and Applications, NATO ASI Series, Reidel, Dordrecht, 1986). The decade between the two NATO Institutes witnesses the transition from individually researched membrane processes to an applied and established membrane separation technology, as is reflected by the contents of the corresponding proceeding volumes. By and large, the first volume presents itself as a textbook on membrane processes, still valid, while the present

volume focuses on areas of separation need as amenable to membrane processing: Biotechnology and Environmental Technology. Accordingly, the contributions to this volume are grouped into "Membranes in Biotechnology" (11 papers), "Membranes in Environmental Technology" (6 papers), and "New Concepts" (4 papers). This is followed by one contribution each on "Energy Requirements" and "Education", i.e., membrane processes within an academic curriculum. The book thus amounts to a state of the art of applied membrane processing and may well augment the more fundamental approach of its predecessor. Effective Industrial Membrane Processes: Benefits and Opportunities William Andrew Inc.

This concise and systematically organized text, now in its second edition, gives a clear insight into various membrane separation processes. It covers the fundamentals as well as the recent developments of different processes along with their industrial applications and the products. It includes the basic principles, operating parameters, membrane hardware, flux equation, transport mechanism, and applications of membrane-based technologies. Membrane separation processes are largely rate-controlled separations which require rate analysis for complete understanding. Moreover, a higher level of mathematical analysis, along with the understanding of mass transfer, is also required. These are amply treated in different chapters of the book to make the students comprehend the membrane separation principles with ease. This textbook is primarily designed for undergraduate students of chemical engineering, biochemical engineering and biotechnology for the course in membrane separation processes. Besides, the book will also be

useful to process engineers and researchers. KEY FEATURES • Provides sufficient number of examples of industrial applications related to chemical, metallurgical, biochemical and food processing industries. • Focuses on important biomedical applications of membrane-based technologies such as blood oxygenator, controlled drug delivery, plasmapheresis, and bioartificial organs. • Includes chapter-end short questions and problems to test students' comprehension of the subject. NEW TO THIS EDITION • A new section on membrane cleaning is included. Membrane fabrication methods are supplemented with additional information (Chapter 2). • Additional information on silt density index, forward osmosis and sea water desalination (Chapter 3). • Physicochemical parameters affecting nanofiltration, determination of various resistances using resistance in series model and few more industrial applications with additional short questions (Chapter 4). • Membrane cross-linking methods used in pervaporation, factors affecting pervaporation and few more applications (Chapter 9). • Membrane distillation, membrane reactor with different modules, types of membranes and reactions for membrane reactor (Chapter 13).

Membrane Separation Technology CRC Press

Membrane science and technology is an expanding field and has become a prominent part of many activities within the process industries. It is relatively easy to identify the success stories of membranes such as desalination and microfiltration and to refer to others as developing areas. This, however, does not do justice to the wide field of separations in which membranes are used. No other 'single' process offers the same potential and versatility as that of membranes. The word separation classically conjures up a

model of removing one component or species from a second component, for example a mass transfer process such as distillation. In the field of synthetic membranes, the terminology 'separation' is used in a wider context. A range of separations of the chemical/mass transfer type have developed around the use of membranes including distillation, extraction, absorption, adsorption and stripping, as well as separations of the physical type such as filtration. Synthetic membranes are an integral part of devices for analysis, energy generation and reactors (cells) in the electrochemical industry.

Membrane Technology PHI Learning Pvt. Ltd.

This book presents recent research and advances in various solid-liquid separation technologies and some applications for treating produced water. It covers fundamental principles and the importance of produced water in major industrial sectors and compares solid-liquid separation technologies. In addition, this book presents the results of research studies conducted to evaluate the performance of solid-liquid separation technologies. Discusses a wide range of technologies, including membrane, filtration, crystallization, desalination, supercritical fluids, coagulation, and floatation. Includes experimental, theoretical, modeling, and process design studies. With its comprehensive coverage, this book is an essential reference for chemical researchers, scientists, and engineers in industry, academia, and professional laboratories. It is also an important resource for graduate and advanced undergraduate students studying solid-liquid separations.

Membrane Processes in Separation and Purification

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

This handbook emphasizes the use of sythetic membranes for separations involving industrial or municipal process streams. The ten chapters are authored by some of the world's leading

experts in the field of membrane science and technology. Discussions on theory, engineering aspects, membrane preparation and typical and projected applications of the various membrane processes are included.

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