

# Basic Principles of Membrane Technology

second edition

Marcel Mulder



Kluwer Academic Publishers

# Basic Principles Of Membrane Technology Second Edition

**J. Mulder**



## **Basic Principles Of Membrane Technology Second Edition:**

**Basic Principles of Membrane Technology** Marcel Mulder, 2012-12-06 III 2 Preparation of synthetic membranes 72 III 3 Phase inversion membranes 75 III 3 1 Preparation by evaporation 76 III 3 2 Precipitation from the vapour phase 76 III 3 3 Precipitation by controlled evaporation 76 Thermal precipitation 76 III 3 4 III 3 5 Immersion precipitation 77 Preparation techniques for immersion precipitation 77 III 4 Flat membranes 77 III 4 1 78 III 4 2 Tubular membranes 81 III 5 Preparation techniques for composite membranes 82 III 5 1 Interfacial polymerisation Dip coating 83 III 5 2 III 5 3 Plasma polymerisation 86 III 5 4 Modification of homogeneous dense membranes 87 III 6 Phase separation in polymer systems 89 III 6 1 Introduction 89 III 6 1 1 Thermodynamics 89 III 6 2 Demixing processes 99 III 6 2 1 Binary mixtures 99 III 6 2 2 Ternary systems 102 III 6 3 Crystallisation 104 III 6 4 Gelation 106 III 6 5 Vitrification 108 III 6 6 Thermal precipitation 109 III 6 7 Immersion precipitation 110 III 6 8 Diffusional aspects 114 III 6 9 Mechanism of membrane formation 117 III 7 Influence of various parameters on membrane morphology 123 III 7 1 Choice of solvent nonsolvent system 123 III 7 2 Choice of the polymer 129 III 7 3 Polymer concentration 130 III 7 4 Composition of the coagulation bath 132 III 7 5 Composition of the casting solution 133 III 7

**Handbook of Detergents, Part F** Uri Zoller, Paul Sosis, 2008-11-20 This sixth part of the multi volume Handbook of Detergents focuses on the production of surfactants builders and other key components of detergent formulations including the various multi dimensional aspects and implications on detergent formulations and applications domestically institutionally in industry and agriculture with all the environmental consequences involved Thus Part F constitutes a comprehensive treatise of the multi dimensional issues relating to this industry production technology emphasizing the alignment of scientific knowledge and up to date technological and technical know how with the relevant contemporary applied practice An international effort and industry academia collaboration this volume features expert contributions focusing on the contemporary state of the art concerning the many facets of the production of detergents and surfactants Thus the Handbook of Detergents Part F Production deals with the production of anionic cationic nonionic and amphoteric surfactants key builders bleaching and whitening agents enzymes and other components of detergent formulations in different contexts gauges and related concerns and discusses various technological procedures of production processes involving the components of surfactants and detergents

**Membrane Technology for Sustainability** Rizwan Nasir, Danial Qadir, Hafiz Abdul Mannan, 2025-09-30 This book is a comprehensive assessment of the pivotal role that membrane technology plays in addressing ongoing environmental and sustainability challenges It covers various aspects of membrane technology with a focus on gas separation and water treatment membranes and explains their principles design and applications Readers interested in sustainable engineering will learn about membrane materials fabrication techniques performance optimization and system integration along with a holistic perspective on the capabilities and limitations of membranes This book presents real world case studies and success stories highlighting the practical implementation of

membrane technologies in various industries Features Explains the use of membrane technology and its transformative potential for a greener and more resilient environment Discusses membrane technology and its applications in gas and water treatment Includes case studies that illustrate the performance of membrane processes in different applications with regard to sustainability Provides insights into the challenges and opportunities of using membrane technology to improve gas and water treatment Includes information on new membrane materials processes applications and future trends This book is a great reference for researchers and graduate students in environmental engineering water engineering and chemical engineering It is also an excellent resource for environmental engineers and professionals in the water and gas industry interested in sustainability *Food Engineering Handbook, Two Volume Set* Theodoros Varzakas, Constantina

Tzia, 2014-12-12 *Food Engineering Handbook Two Volume Set* provides a stimulating and up to date review of food engineering phenomena It also addresses the basic and applied principles of food engineering methods used in food processing operations around the world Combining theory with a practical hands on approach this set examines the thermophysical properties **Basic Principles of Membrane Technology** J. Mulder, 2013-04-18 Membranes play a central role in our daily life or as indicated by one of my foreign colleagues Richard Bowen If you are tired of membranes you are tired of life Biological membranes are hardly used in industrial applications but separations with synthetic membranes have become increasingly important Today membrane processes are used in a wide range of applications and their numbers will certainly increase Therefore there is a need for well educated and qualified engineers chemists scientists and technicians who have been taught the basic principles of membrane technology However despite the growing importance of membrane processes there are only a few universities that include membrane technology in their regular curricula One of the reasons for this may be the lack of a comprehensive textbook For me this was one of the driving forces for writing a textbook on the basic principles of membrane technology which provides a broad view on the various aspects of membrane technology I realise that membrane technology covers a broad field but nevertheless I have tried to describe the basic principles of the various disciplines Although the book was written with the student in mind it can also serve as a first introduction for engineers chemists and technicians in all kind of industries who wish to learn the basics of membrane technology

Advanced Materials for Membrane Preparation Maria Giovanna Buonomenna, G. Golemme, 2012 The need to reduce pollution and the waste of energy and resources imposes a wider diffusion of environmentally friendly membrane systems The expanding domain of membrane operations demands tailored materials with unprecedented performances and resistance

Progress in Filtration and Separation, 2014-10-14 *Progress in Filtration and Separation* contains reference content on fundamentals core principles technologies processes and applications It gives detailed coverage of the latest technologies and research models applications and standards practical implementations case studies best practice and process selection Extensive worked examples are included that cover basic calculations through to process design including the effects of key

variables Techniques and topics covered include pervaporation electrodialysis ion exchange magnetic LIMS HIMS HGMS ultrasonic and more Solves the needs of university based researchers and R D engineers in industry for high level overviews of sub topics within the solid liquid separation field Provides insight and understanding of new technologies and methods Combines the expertise of several separations experts *Hollow Fiber Membrane Contactors* Anil K. Pabby, S. Ranil Wickramasinghe, Kamalesh K. Sirkar, Ana-Maria Sastre, 2020-11-23 This book on hollow fiber contractors 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 **Handbook of Membrane Separations** Anil Kumar Pabby, Syed S.H. Rizvi, Ana Maria Sastre Requena, 2015-04-09 The Handbook of Membrane Separations Chemical Pharmaceutical Food and Biotechnological Applications Second Edition provides detailed information on membrane separation technologies from an international team of experts The handbook fills an important gap in the current literature by providing a comprehensive discussion of membrane application Membranverfahren Thomas Melin, Robert Rautenbach, 2007-08-15 Membranverfahren sind unentbehrlich f r Wasser Lebensmittel und Medizintechnik Mit hohen Wachstumsraten in Umweltschutz und Chemie geh ren sie zu den Schl sseltechnologien des 21 Jahrhunderts Bei Rautenbach nachlesen sagen Praktiker bereinstimmend wenn es um die konkrete Anwendung einen Verfahrensvergleich Pilotversuche oder die Interpretation geht Die 3 Auflage beh lt die erfolgreiche Kombination von Handbuch und Lehrbuch bei Basic Equations of Mass Transport Through a Membrane

Layer Endre Nagy, 2018-11-05 Basic Equations of Mass Transport Through a Membrane Layer Second Edition has been fully updated to deliver the latest research in the field This volume covers the essentials of compound separation product removal concentration and production in the chemical biochemical pharmaceutical and food industries It outlines the various membrane processes and their applications offering a detailed mathematical description of mass transport and defining basic mass transport and concentration distribution expressions Additionally this book discusses the process parameters and application of the expressions developed for a variety of industrial applications Comprehensive explanations of convective diffusive mass transport are provided both with and without polarization layers that help predict and process performance and facilitate improvements to operation conditions and efficiency Basic Equations of Mass Transport Through a Membrane Layer is an ideal resource for engineers and technologists in the chemical biochemical and pharmaceutical industries as well as researchers professors and students in these areas at both an undergraduate and graduate level Cites and analyzes mass transport equations developed for different membrane processes Examines the effect of biochemical chemical reactions in the presence of convective and diffusive flows in plane and cylindrical spaces Defines the mass transfer rate for first and zero order reactions and analytical approaches are given for other order reactions in closed mathematical forms Analyzes the simultaneous convective and diffusive transports with same or different directions Food Engineering Handbook

Theodoros Varzakas, Constantina Tzia, 2014-12-02 Food Engineering Handbook Food Engineering Fundamentals provides a stimulating and up to date review of food engineering phenomena Combining theory with a practical hands on approach this book covers the key aspects of food engineering from mass and heat transfer to steam and boilers heat exchangers diffusion and absorption A complement to Food Engineering Handbook Food Process Engineering this text Explains the interactions between different food constituents that might lead to changes in food properties Describes the characterization of the heating behavior of foods their heat transfer heat exchangers and the equipment used in each food engineering method Discusses rheology fluid flow evaporation and distillation and includes illustrative case studies of food behaviors Presenting cutting edge information Food Engineering Handbook Food Engineering Fundamentals is an essential reference on the fundamental concepts associated with food engineering today **Lactose and Lactose Derivatives** Néstor

Gutiérrez-Méndez, 2020-11-11 Lactose is a unique disaccharide found exclusively in the milk of mammals This sugar has a crucial role in nourishing newborn and young mammals however some adults have difficulties in fully metabolizing lactose Despite lactose intolerance in the population the dairy industry produces 400 000 tons of crystalline lactose worldwide The food and pharmaceutical industries use lactose as well as lactose derivatives in a wide variety of products This book reviews some aspects of lactose properties and synthesis as well as recent advances in the recovery of lactose and lactose derivatives from cheese whey Membrane Technology and Engineering for Water Purification Rajindar Singh, 2014-09-25 Membrane Technology and Engineering for Water Purification Second Edition is written in a practical style with emphasis on process

description key unit operations systems design and costs plant equipment description equipment installation safety and maintenance process control plant start up and operation and troubleshooting It is supplemented by case studies and engineering rules of thumb The author is a chemical engineer with extensive experience in the field and his technical knowledge and practical know how in the water purification industry are summarized succinctly in this new edition This book will inform you which membranes to use in water purification and why where and when to use them It will help you to troubleshoot and improve performance and provides case studies to assist understanding through real life examples Membrane Technology section updated to include forward osmosis electrodialysis and diffusion dialysis Hybrid Membrane Systems expanded to cover zero liquid discharge salt recovery and removal of trace contaminants Includes a new section on plant design energy and economics

*Unit Operations in Environmental Engineering* Louis Theodore, R. Ryan Dupont, Kumar Ganesan, 2017-09-18 The book presents the principles of unit operations as well as the application of these principles to real world problems The authors have written a practical introductory text exploring the theory and applications of unit operations for environmental engineers that is a comprehensive update to Linvil Rich's 1961 classic work *Unit Operations in Sanitary Engineering* The book is designed to serve as a training tool for those individuals pursuing degrees that include courses on unit operations Although the literature is inundated with publications in this area emphasizing theory and theoretical derivations the goal of this book is to present the subject from a strictly pragmatic introductory point of view particularly for those individuals involved with environmental engineering This book is concerned with unit operations fluid flow heat transfer and mass transfer Unit operations by definition are physical processes although there are some that include chemical and biological reactions The unit operations approach allows both the practicing engineer and student to compartmentalize the various operations that constitute a process and emphasizes introductory engineering principles so that the reader can then satisfactorily predict the performance of the various unit operations equipment This is a definitive work on Unit Operations one of the most important subjects in environmental engineering today It is an excellent reference well written easily read and comprehensive I believe the book will serve well those working in engineering disciplines including those beyond just environmental and chemical engineering Bottom line A must for any technical library Kenneth J Skipka CCM

*ICOST 2019* Sri Harini, Hafsan, Sahara, Isna Rasdianah Aziz, Robbi Rahim, 2020-06-14 We are delighted to introduce the proceeding of the first edition of the International Conference on Science and Technology ICoST that was held in Claro Hotel May 2-3 2019 It was organized by Faculty of Science and Technology Universitas Islam Negeri Alauddin Makassar in partnership with Forum Dekan Fakultas Sains dan Teknologi PTKIN The theme of the ICoST is Roles and Challenges of Science and Technology in Guaranteeing Halal Products in the Industrial Revolution 4.0 The Indonesian government has begun to respond this industrial change by launching the roadmap of Making Indonesia 4.0 as a strategy to ease Indonesia's steps to become one of the new powers in Asia in April 2018 This roadmap provides a clear direction for the

movement of the national industry in the future including a focus on developing priority sectors that will become Indonesia's strength towards Industry 4.0. The proceeding of ICoST contains the scientific research written by the academicians, researchers, practitioners and government elements who have the same thoughts about the effort to develop the society's ability to adapt the advancement of science and technology in the global competition to face the industrial revolution 4.0. We are also very grateful to all keynote speakers and committee members willing to act as referee for their time and efforts to keep our conference going well. In the future we expect the ICoST will be able to provide another scientific atmosphere and stimulate more participants to join this conference.

Mass Transfer Operations for the Practicing Engineer Louis Theodore, Francesco Ricci, 2011-12-06. An invaluable guide for problem solving in mass transfer operations. This book takes a highly pragmatic approach to providing the principles and applications of mass transfer operations by offering a valuable, easily accessible guide to solving engineering problems. Both traditional and novel mass transfer processes receive treatment. As with all of the books in this series, emphasis is placed on an example-based approach to illustrating key engineering concepts. The book is divided into two major parts. It starts with the principles underlying engineering problems, showing readers how to apply general engineering principles to the topic of mass transfer operations. It then goes on to provide step-by-step guidance for traditional mass transfer operations including distillation, absorption and stripping, and adsorption, plus novel mass transfer processes. Essential topics for professional engineering exams are also covered. Geared towards chemical, environmental, civil and mechanical engineers working on real world industrial applications. *Mass Transfer Operations for the Practicing Engineer* features numerous sample problems and solutions with real world applications. Clear, precise explanations on how to carry out the basic calculations associated with mass transfer operations. Coverage of topics from the ground up for readers without prior knowledge of the subject. Overview of topics relevant to the ABET Accreditation Board for Engineering and Technology for those taking the Professional Engineering (PE) exams. Appendix containing relevant mass transfer operation charts and tables.

*Herbicides* Marcelo Larramendy, Sonia Soloneski, 2011-01-08. The content selected in *Herbicides: Theory and Applications* is intended to provide researchers, producers and consumers of herbicides an overview of the latest scientific achievements. Although we are dealing with many diverse and different topics, we have tried to compile this raw material into three major sections in search of clarity and order: Weed Control and Crop Management; Analytical Techniques of Herbicide Detection; and Herbicide Toxicity and Further Applications. The editors hope that this book will continue to meet the expectations and needs of all interested in the methodology of use of herbicides, weed control, as well as problems related to its use, abuse and misuse.

Membrane Gas Separation Benny Freeman, Yuri Yampolskii, 2011-06-20. Gas separation membranes offer a number of benefits over other separation technologies and they play an increasingly important role in reducing the environmental impacts and costs of many industrial processes. This book describes recent and emerging results in membrane gas separation, including highlights of nanoscience and technology, novel polymeric and inorganic



membrane materials new membrane approaches to solve environmental problems e g greenhouse gases aspects of membrane engineering and recent achievements in industrial gas separation It includes Hyperbranched polyimides amorphous glassy polymers and perfluorinated copolymers Nanocomposite mixed matrix membranes Polymeric magnetic membranes Sequestration of CO<sub>2</sub> to reduce global warming Industrial applications of gas separation Developed from sessions of the most recent International Congress on Membranes and Membrane Processes Membrane Gas Separation gives a snapshot of the current situation and presents both fundamental results and applied achievements **Innovation in Food Engineering** Maria Laura Passos, Claudio P. Ribeiro, 2016-04-19 Consumer driven products have kept the food industry at the forefront of technological innovations For example the redefinition of the once accepted compromise between convenience and quality is just one of the current issues driving the development of new products An overview of a range of solutions for these challenges Innovation in Food Engi

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