Ion Exchange Membranes For Electro Membrane Processes

Thank you entirely much for downloading Ion Exchange Membranes For Electro Membrane Processes.Most likely you have knowledge that, people have see numerous period for their favorite books considering this Ion Exchange Membranes For Electro Membrane Processes, but stop stirring in harmful downloads.

Rather than enjoying a good ebook with a cup of coffee in the afternoon, otherwise they juggled similar to some harmful virus inside their computer. Ion Exchange Membranes For Electro Membrane Processes is handy in our digital library an online access to it is set as public consequently you can download it instantly. Our digital library saves in combination countries, allowing you to get the most less latency epoch to download any of our books later than this one. Merely said, the Ion Exchange Membranes For Electro Membrane Processes is universally compatible subsequently any devices to read.

Ion Exchange: Science and Technology A.E. Rodrigues 2012-12-06 Proceedings of the NATO Advanced Study Institute on Ion Exchange: Science and Technology, Troía, Portugal, July 14-26, 1985
Membrane Technology Enhancement for Environmental Protection and Sustainable Industrial Growth Zhien Zhang 2020-12-14 This book presents a detailed discussion of the fundamentals and practical applications of membrane technology enhancement in a range of industrial processes, energy recovery, and resource recycling. To date, most books on the applications of membrane technology have mainly focused on gas pollution removal or industrial wastewater treatment. In contrast, the enhancement of various membrane processes in the areas of energy and the environment has remained largely overlooked. This book highlights recent works and industrial products using membrane technology, while also discussing experiments and modeling studies on the membrane

enhancement process.
Ion Exchange Membranes Yoshinobu Tanaka 2015-01-19 Fundamental study and industrial application of ion exchange membranes started over half a century ago. Through ongoing research and development, ion exchange membrane technology is now applied to many fields and contributes to the improvement of our standard of living. Ion Exchange Membranes, 2nd edition states the ion exchange membrane technology from the standpoint of fundamentals and applications. It discusses not only various phenomena exhibited by membranes but also their applications in many fields with economical evaluations. This second edition is updated and revised, featuring ten expanded chapters. New to this edition is a computer simulation program of ion-exchange membrane electrodialysis for water desalination that provides a guideline for designing, manufacturing and operating a practical-scale electrodialyzer. Meant to replace experiments, this program will be an important asset to those with time and monetary budgets. New edition features ten revised and expanded chapters, providing the latest developments in ion exchange membrane technology Computer simulation program, accessible through a companion website, provides a guideline for designing, manufacturing and operating practical-scale electrodialyzers Attractive visual presentation, including many figures and diagrams
Water Resources Research Catalog 1966
Bibliography of Membrane Technology Pertaining to Saline Water Desalination James M. Shackelford 1965
Membrane Technologies for Water Treatment Alberto Figoli 2016-02-18 Focuses on the application of membrane technologies in removing toxic metals\metalloids from water. Particular attention is devoted to the removal of arsenic, uranium, and fluoride. These compounds are all existing in the earth’s crust at levels between two and five thousands micrograms per kg (parts per million) on average and these compounds can be considered highly toxic to humans, who are exposed to them primarily from air, food and water. In order to comply with the new maximum contaminant level, numerous studies have been undertaken to improve established treatments or to develop novel treatment technologies for removing toxic metals from contaminated surface and groundwater. Among the technologies available, applicable for water treatment, membrane technology has been identified as a promising technology to remove such toxic metals from water. The book describes both pressure driven (traditional processes, such as Nanofiltration, Reverse Osmosis, Ultrafiltration,etc) and more advanced membrane processes (such as

forward osmosis, membrane distillation, and membrane bio-reactors) employed in the application of interest. Key aspect of this book is to provide information on both the basics of membrane technologies and on the results depending on the type of technology employed.
Electromembrane Processes Luigi Gurreri 2021-09-08 Electromembrane processes offer a multitude of applications, allowing for the recovery of water, other products, and energy. This book is a collection of contributions on recent advancements in electromembrane processes attained via experiments and/or models. The first paper is a comprehensive review article on the applications of electrodialysis for wastewater treatment, highlighting current status, technical challenges, and key points for future perspectives. The second paper focuses on ZSM-5 zeolite/PVA mixed matrix CEMs with high monovalent permselectivity for recovering either acid or Li+. The third paper regards direct numerical simulations of electroconvection in an electrodialysis dilute channel with forced flow under potentiodynamic and galvanodynamic regimes. The fourth paper investigates the reasons for the formation and properties of soliton-like charge waves in overlimiting conditions. The fifth paper focuses on the characterization of AEMs functionalized by surface modification via poly(acrylic) acid yielding monovalent permselectivity for reverse electrodialysis. In the sixth paper, CFD simulations of reverse electrodialysis systems are performed. The seventh paper proposes an integrated membrane process, including electrochemical intercalation–deintercalation, for the preparation of Li2CO3 from brine with a high Mg2+/Li+ mass ratio. Finally, the eighth paper is a perspective article devoted to the acid–base flow battery with monopolar and bipolar membranes.
Overcoming Limitations of Iontronic Delivery Devices Maria Seitanidou 2020-02-17 Organic electronic devices are considered as one of the best candidates to replace conventional inorganic electronic devices due to their electronic conductive functionality, low-cost production techniques, the ability to tune their optical and electronic properties using organic chemistry, and their mechanical flexibility. Moreover, these systems are ideal for bioelectronic applications due to their softness, biocompatibility, and most importantly, their electronic and ionic transport. Indeed, these materials are compatible with biological tissues and cells improving the signal transduction between electronic devices and electrically excitable cells. As ions serve as one of the primary signal carriers of cells, they can selectively tune a cell’s activity; therefore, an improved interface between electronics and biological systems can offer several advantages in

healthcare, e.g. the development of efficient drug delivery devices. The main focus of this thesis is the development of electronic delivery devices. Electrophoretic delivery devices called organic electronic ion pumps (OEIPs) are used to electronically control the delivery of small ions, neurotransmitters, and drugs with high spatiotemporal resolution. This work elucidates the ion transport processes and phenomena that happen in the ion exchange membranes during ion delivery and clarifies which parameters are crucial for the ion transport efficiency of the OEIPs. This thesis shows a systematic investigation of these parameters and indicates new methods and OEIP designs to overcome these challenges. Two novel OEIP designs are developed and introduced in this thesis to improve the local ion transport while limiting side effects. OEIPs based on palladium proton trap contacts can improve the membrane permselectivity and optimize the delivery of ?-aminobutyric acid (GABA) neurotransmitters at low pH while preventing any undesired pH changes from proton transport in the biological systems. And OEIPs based on glass capillary fibers are developed to overcome the limitations of devices on planar substrates, related to more complex and larger biologically relevant ion delivery with low mobility for implantable applications. This design can optimize the transport of ions and drugs such as salicylic acid (SA) at low concentrations and at relatively much higher rates, thereby addressing a wider range of biomedically relevant applications and needs.
Electrochemically Enabled Sustainability Kwong-Yu Chan 2014-06-13 Electrochemically Enabled Sustainability: Devices, Materials and Mechanisms for Energy Conversion covers topics related to current research in electrochemical power sources, highlighting some of the latest concepts in electrochemical conversion for sustainability. The book examines the most recent and innovative technologies employed in battery and fuel cell technology. It introduces the fundamental concepts applied to these electrochemical power sources and provides in-depth discussion on the materials, design, and performance of these devices. Written by internationally acclaimed experts, the chapters illustrate how key technologies for sustainability are enabled by electrochemical conversion. Topics include the reduction of carbon dioxide to resolve issues of carbon capture, energy storage, and generation of portable fuel; turning waste into energy using microbial fuel cells; the promise of vanadium redox flow batteries for massive energy storage; and improved performance of hybrid devices. The book addresses numerous aspects of lithium-type batteries for vehicle propulsion and energy storage, presenting a broad range of lithium batteries, and considering nano-structuring issues, layered-

structure materials, and hierarchical structure. This book provides timely coverage of critical issues in emerging and conventional technologies, presenting a wide range of electrochemical devices, related materials, and operation mechanisms. It stimulates an appreciation for the novelty of these electrochemical power sources and offers a projection of future integration of these devices in practice.

Membrane Separations Technology R.D. Noble 1995-01-17 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.

Electromembrane Processes Luboš Novák 2021-12-20 The book is a comprehensive view of all electromembrane processes, including electromembrane processes for energy conversion - a currently very significant problem. The necessary theory and basic information needed for understanding the technology are explained in Part I. Materials used for ion-selective membranes and seoaration processes are described in Part II, and the applications for synthesis and energy conversion in Part III.

Fundamental Modeling of Membrane Systems Patricia Luis 2018-06-29 Fundamental Modelling of Membrane Systems: Membrane and Process Performance summarizes the state-of-the-art modeling approaches for all significant membrane processes, from molecular transport, to process level, helping researchers and students who carry out experimental

research save time and accurately interpret experimental data. The book provides an overview of the different membrane technologies, handling micro-, ultra-, and nanofiltration, reverse and forward osmosis, pervaporation, gas permeation, supported liquid membranes, membrane contactors, membrane bioreactors and ion-exchange membrane systems. Examples of hybrid membrane systems are also included. Presents an accessible reference on how to model membranes and membrane processes Provides a clear, mathematical description of mass transfer in membrane systems Written by well-known, prominent authors in the field of membrane science

Electrodialysis Technology United States. Office of Water Research and Technology 1979

Ion Exchange Membranes Yoshinobu Tanaka 2015-01-20 Fundamental study and industrial application of ion exchange membranes started over half a century ago. Through ongoing research and development, ion exchange membrane technology is now applied to many fields and contributes to the improvement of our standard of living. Ion Exchange Membranes, 2nd edition states the ion exchange membrane technology from the standpoint of fundamentals and applications. It discusses not only various phenomena exhibited by membranes but also their applications in many fields with economical evaluations. This second edition is updated and revised, featuring ten expanded chapters. New to this edition is a computer simulation program of ion-exchange membrane electrodialysis for water desalination that provides a guideline for designing, manufacturing and operating a practical-scale electrodialyzer. Meant to replace experiments, this program will be an important asset to those with time and monetary budgets. New edition features ten revised and expanded chapters, providing the latest developments in ion exchange membrane technology Computer simulation program, accessible through a companion website, provides a guideline for designing, manufacturing and operating practical-scale electrodialyzers Attractive visual presentation, including many figures and diagrams

Ion Exchange Membranes Toshikatsu Sata 2007-10-31 Various separation membranes have been developed since their discovery over half a century ago, providing numerous benefits and fulfilling many applications in our everyday lives. They lend themselves to techniques ranging from microfiltration and gas separation, to what can be considered as the most advanced technique - ion exchange. This book, aimed at academic researchers, engineers and industrialists, contains a brief history of ion exchange and goes on to explain the preparation, characterization,

modification and applications of these important membranes. Discussions include the use of ion exchange in analytical and medical techniques, as well as the development of future applications.

Sustainable Materials and Systems for Water Desalination Inamuddin 2021-09-30 This edited book explores the most promising and reliable technological developments expected to impact on the next generation of desalination systems. The book includes research studies which takes the reader on a fascinating walk through the multidisciplinary world of membrane science applied to water treatment. Concerning the ultimate technological advancement, the book seeks to investigate how to bridge the gap between the laboratory scale and the applicability to industry.

Industrial Membrane Separation Technology K. Scott 2012-12-06 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 desali nation 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.

Ion Exchange Membrane Electrodialysis Yoshinobu Tanaka 2010 Industrial application of ion exchange membranes started from saline water desalination. However, now it extends widely in many fields such as drinking water or wastewater treatment, demineralisation of amino acid, whey, sugar liquor, recovery of useful components, treatment of organic substances and contributes to the improvement of our standard of living. The application of ion exchange membranes must expand further if we pay attention to unique functions of the membranes for separating ionic species from non-ionic substances or other kinds of ionic species. This book discusses the performance of an electrodialyser from the stand point of fundamental and practical views.

Water Treatment Membrane Processes AWWARF 1996 Best water

filtration strategies for the '90s. Get the engineering savvy you need to capitalize on membrane technology for effective water filtration. Water Treatment Membrane Processes, by the American Water Works Association Research Foundation, enables you to use membrane filtration methods for purifying drinking water--and utilize new research for wastewater treatment. This richly illustrated guide shows you how to apply membrane processes in numerous water treatment applications. . .model membrane performance. . .and take charge of field evaluation and piloting. You'll see how to implement nanofiltration, ultrafiltration, microfiltration, and electrodialysis techniques--and make the most of membrane reactors, bioreactors and ion exchange membrane reactors.

In-Depth on the Fouling and Antifouling of Ion-Exchange Membranes Las^aad Dammak 2021-12-31 The use of ion-exchange membranes (IEMs) has accelerated over the past two decades in a wide variety of industrial processes (electrodialysis, electro-electrodialysis, electrolysis, dialysis, etc.) for applications related to chemical, pharmaceutical and food industries, energy production, water treatments, etc. Organic and mineral fouling (or scaling) phenomena are two major factors limiting the efficiencies of IEMs processes and performances (reduction of the IEMs selectivity and stability, increase of their electrical resistance, deduction of the energy efficiency of the process, etc.) leading to significant economic losses. The current washing, cleaning and sterilization processes (anti-fouling treatments) make it possible to recover some of the IEMs performances, but frequently induce degradation on the membrane material. Another essential point in the fouling studies is the choice of the best and appropriate analysis and diagnostic technique to evaluate this or that magnitude, or observe this or that object on the surface or in the mass of the membrane. This book is focused on recent advancements in techniques for diagnosing and characterizing the fouling effects on membranes, in mechanisms governing this complex phenomenon, and in the various innovative and economically viable solutions for reducing fouling.

Sustainable Water for the Future Isabel C. Escobar 2009-10-05 This book is part of a series on sustainability. Specifically, it deals with the issue of sustainable water use. Fresh sources of potable water are being depleted across the world. Pure water is the goal of water utilities as well as several industries. Well past the experimental stage, membrane processes are now a proven and reliable method of providing high-quality, cost-effective water. Membrane technologies have immediate applications to treatment of fresh, brackish and sea waters, as well as wastewater reclamation. With

innovative module design and engineering, micro- and ultra-filtrations have become effective and economical for drinking water production, particularly for removal of microorganisms. Membrane bioreactors are being developed for municipal and industrial water recycling. Various membrane processes are also used to remove contaminants from industrial wastewaters. This book covers the fundamental and practical concepts and issues regarding the application of membrane technologies for sustainable water treatment. It describes and compares the effectiveness of desalination versus water recycling for long-term sustainable water use. - Describes the global water situation with respect to sustainability - Emphasizes the role of membrane technologies - Compares the strategies of water recycling and desalination

Nanotechnology in Membrane Processes Kailash Chandra Khulbe 2021-01-09 Nanotechnology has been established in membrane technology for decades. In this book, comprehensive coverage is given to nanotechnology applications in synthetic membrane processes, which are used in different fields such as water treatment, separation of gases, the food industry, military use, drug delivery, air filtration, and green chemistry. Nanomaterials such as carbon nanotubes, nanoparticles, and dendrimers are contributing to the development of more efficient and cost-effective water filtration processes. Gas separation and carbon capture can be significantly improved in flue gas applications. Nanoporous membrane systems engineered to mimic natural filtration systems are being actively developed for use in smart implantable drug delivery systems, bio artificial organs, and other novel nano-enabled medical devices. The microscopic structure of nanoporous ceramic membranes, mainly focusing on zeolite materials, as well as the energy-saving effect of membrane separation, contribute to various chemical synthesis processes. In the food industry, nanotechnology has the potential to create new tools for pathogen detection and packaging. For each application, nanotechnology is mostly used to make composite membranes, and the book provides a detailed look at the mechanisms by which the composite membrane works in each application area.

Ion-Exchange Membrane Separation Processes H Strathmann 2004-01-29 Today, membranes and membrane processes are used as efficient tools for the separation of liquid mixtures or gases in the chemical and biomedical industry, in water desalination and wastewater purification. Despite the fact that various membrane processes, like reverse osmosis, are described in great detail in a number of books, processes involving ion-exchange membranes are only described in a fragmented way in scientific

journals and patents; even though large industrial applications, like electrodialysis, have been around for over half a century. Therefore, this book is emphasizing on the most relevant aspects of ion-exchange membranes. This book provides a comprehensive overview of ion-exchange membrane separation processes covering the fundamentals as well as recent developments of the different products and processes and their applications. The audience for this book is heterogeneous, as it includes plant managers and process engineers as well as research scientists and graduate students. The separate chapters are based on different topics. The first chapter describes the relevant Electromembrane processes in a general overview. The second chapter explains thermodynamic and physicochemical fundamentals. The third chapter gives information about ion-exchange membrane preparation techniques, while the fourth and fifth chapter discusses the processes as unit operations giving examples for the design of specific plants. First work on the principles and applications of electrodialysis and related separation processes Presently no other comprehensive work that can serve as both reference work and text book is available Book is suited for teaching students and as source for detailed information

Focus on Solid State Chemistry Arte M. Newman 2007 This book on solid state chemistry presents studies of chemical, structural, thermodynamic, electronic, magnetic, and optical properties and processes in solids. Research areas include: bonding in solids, crystal chemistry, crystal growth mechanisms, diffusion epitaxy, high-pressure processes, magnetic properties of materials, optical characterisation of materials, order-disorder, phase equilibria and transformation mechanisms, reactions at surfaces, statistical mechanics of defect interactions, structural studies and transport phenomena.

Ion and Molecule Transport in Membrane Systems Victor Nikonenko 2021-08-10 Membranes play an enormous role in our life. Biological cell membranes control the fluxes of substances in and out of cells. Artificial membranes are widely used in numerous applications including “green” separation processes in chemistry, agroindustry, biology, medicine; they are used as well in energy generation from renewable sources. They largely mimic the structure and functions of biological membranes. The similarity in the structure leads to the similarity in the properties and the approaches to study the laws governing the behavior of both biological and artificial membranes. In this book, some physico-chemical and chemico-physical aspects of the structure and behavior of biological and artificial

membranes are investigated.
Introduction to Membrane Science and Technology Heinrich Strathmann 2011-10-17 "The objective of this book is to provide a short but reasonably comprehensive introduction to membrane science and technology suitable for graduate students and persons with engieering or natural science background to gain a basic understanding of membranes, their function and application without studying a large number of different reference books."--P. xiii.
Ion Exchange Technology I Inamuddin Dr. 2012-06-02 Ion-exchange Technology I: Theory and Materials describes the theoretical principles of ion-exchange processes. More specifically, this volume focuses on the synthesis, characterization, and modelling of ion-exchange materials and their associated kinetics and equilibria. This title is a highly valuable source not only to postgraduate students and researchers but also to industrial R&D specialists in chemistry, chemical, and biochemical technology as well as to engineers and industrialists.
Electrocatalysis in Alkaline Media and Anion Exchange Membranes for Alkaline Fuel Cells Jimmy John 2013 The central theme of this thesis is the investigations of fundamental processes of relevance to the operation of fuel cells in alkaline media. In this respect, broadly speaking, aspects of electrocatalysis in alkaline media and phenomena active in hydroxide-conducting anion exchange membranes were explored. Specifically, the electrocatalytic oxidation of formate on platinum in alkaline media was examined in detail. Results from a suite of electrochemical measurements, complemented with in situ mass-spectrometric measurements in the form of differential electrochemical mass spectrometry (DEMS), revealed a highly adsorbate-mediated reaction mechanism of formate oxidation. In a comparative analysis of results, the relative inactivity of formate towards oxidation, vis-à-vis formic acid in acidic media, is inferred to be due to the slow kinetics associated with the rate-determining steps of the formation of an electro-active adsorbate from formate and its subsequent oxidation. This mechanistic study is detailed in Chapter 3. A prototypical quaternary-ammonium based anion exchange membrane material was the subject of electroanalytical investigations into the processes relevant to the application of anion exchange membranes in fuel cells. The uptake of carbonate ions, and any subsequent carbonate precipitation in the membrane, was studied using the electrochemical quartz crystal microbalance (EQCM) technique. The EQCM studies demonstrated reversible carbonate and formate (produced simultaneously with carbonate by the oxidation of methanol) exchange in the membrane. The studies,

further, established that the membranes exhibit a finite capacity of carbonate/formate uptake which would preclude any precipitation. On an associated aspect, acoustic impedance measurements showed the membranes to undergo swelling on hydration. Further, during the EQCM measurements, the extent of swelling in the membrane changed ii dynamically in response to the electrochemically driven anion exchange process in the membrane. The results from these studies are documented in Chapter 4. Physical and charge transport in the membrane were probed by employing redox active molecules which are neutral and negatively charged, respectively, and the applicable transport mechanisms inferred from the electrochemical studies. Preliminary results from ex-situ microscopic/spectroscopic studies targeting a more detailed physicochemical understanding of the membrane phenomena are also documented. These studies are intended to be a prelude to a comprehensive in situ characterization of the membrane in the future that will be needed to critically address the form-function relationships in these material systems. The transport and the ex-situ studies form the subject matter of Chapter 5. As for the methodologies employed in this work, the theoretical and the experimental aspects of the DEMS and the EQCM techniques are presented in Chapter 2. On a related note, the development of advanced in situ FTIR setups is described in Chapter 6. The preliminary testing of these setups is also reported. It is expected that, in the future, these advanced spectroscopic tools would be an invaluable aid in examining electrochemical interfaces. The final chapter deals with the rotating disc electrode voltammteric studies of the oxidation of hydrogen in the presence of carbon monoxide on platinum lead (PtPb) intermetallic in acidic media. This study was motivated by the promising electrocatalytic activity of the PtPb intermetallic for formic acid and methanol oxidation in acidic media. iii.

Membrane Technology and Applications Richard W. Baker 2004-05-31 Table of Contents Preface Acknowledgments for the first edition Acknowledgments for the second edition 1 Overview of Membrane Science and Technology 1 2 Membrane Transport Theory 15 3 Membranes and Modules 89 4 Concentration Polarization 161 5 Reverse Osmosis 191 6 Ultrafiltration 237 7 Microfiltration 275 8 Gas Separation 301 9 Pervaporation 355 10 Ion Exchange Membrane Processes - Electrodialysis 393 11 Carrier Facilitated Transport 425 12 Medical Applications of Membranes 465 13 Other Membrane Processes 491 Appendix 523 Index 535.

Membrane Processes in Separation and Purification J.G. Crespo 1994-06-

30 The current vigour in separations research principally derives from the need for pioneering separations processes in an emerging technology (biotechnology), from new societal emphases (reduction of chemical emissions into the environment), as well as from opportunities for achieving dramatic improvements in the efficiency of a number of manufacturing technologies through the development of a new generation of membranes (novel membrane applications). 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 review of applied membrane processes. Even though other texts have appeared in recent years, a more documented, practical book is needed, with a strong interaction with the collateral disciplines of materials sciences, life sciences and environmental science. This book emphasizes the need for such an integrated approach to membrane processes.

Mass Transfer and Kinetics of Ion Exchange L. Liberti 2012-12-06 While ion-exchange processes were originally used for the treatment of very dilute solutions, many applications for the treatment of concentrated solu tions have been developed in recent years. In these situations, the mass transfer bottlenecks are located in the~, rather than the liquid phase. Therefore, the development of quantitative models for ion-exchange kinetics requires knowledge about the conductance characteristics of ions and solvent in the solid phase. A useful approach towards this aim is the study of trans port characteristics of these species, and of their interactions in solid ion exchange membranes. Many different transport processes and related phenomena can be observed in membrane-solution systems, e.g., ion migration, electroosmosis, diffusion arid self-diffusion, osmosis, hydraulic flow, hyperfiltration (reverse osmosis) or ultrafiltration, streaming potential and streaming current, and membrane potentials (also called "membrane concentration potentials"). It is important to correlate all these phenomena so as to avoid a very large number of unnec essary measurements. Such correlation is often possible [Meares, 1976] since all these phenomena are determined by the ease of migration of the different species across the membrane. Important correlations have been made and summar ized even before high-capacity ion-exchange membranes became commercially available [Sollner, 1950, 197iJ.

Proceedings of the Symposia on Fundamentals of Electrochemical Process Design

1995
Comprehensive Membrane Science and Engineering Enrico Drioli 2010-07-09 This multivolume work covers all aspects of membrane science and technology - from basic phenomena to the most advanced applications and future perspectives. Modern membrane engineering is critical to the development of process-intensification strategies and to the stimulation of industrial growth. The work presents researchers and industrial managers with an indispensable tool toward achieving these aims. Covers membrane science theory and economics, as well as applications ranging from chemical purification and natural gas enrichment to potable water Includes contributions and case studies from internationally recognized experts and from up-and-coming researchers working in this multi-billion dollar field Takes a unique, multidisciplinary approach that stimulates research in hybrid technologies for current (and future) life-saving applications (artificial organs, drug delivery)
Membrane Technology Suzana Pereira Nunes 2006-12-13 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.
Development of Monovalent Selective Ion-exchange Membranes for Desalination and Reuse Enhancement Xuesong Xu 2018 The reduction of the salinity and the selective separation of mono- and multi-valent ions has important applications for meeting the product water quality requirements for water reuse, desalination, and salt production. This study mainly focused on the evaluation of the technical feasibility of the innovative selective electrodialysis using monovalent perm-selective ion-exchange membranes (IEMs) that are manufactured by General Electric Water & Process Technologies (now Suez Water Technologies & Solutions) for

treating impaired water resources including reclaimed water, brackish groundwater, and RO (reverse osmosis) concentrate. The desalination performance, ion permselectivity, and energy consumption of the monovalent permselective IEMs (sodium selective IEMs CR671 and nitrate selective IEMs AR112B) were evaluated in comparison with standard normal grade IEMs (CR67 and AR204). Bench- and pilot-scale testing was conducted at the Water Campus of the City of Scottsdale, Arizona, where tertiary reclaimed water was treated and at the Kay Bailey Hutchinson Desalination Plant, El Paso, Texas, where groundwater and RO concentrate was treated. The CR671 was developed onsite by coating polyethyleneimine onto the normal grade CR67. The covalently bonded polyethyleneimine layer on the membrane surface was characterized by a methylene blue dye test, infrared spectrometry with attenuated total reflection (ATR-FTIR), and electrochemical impedance spectroscopy (EIS). The normal grade and monovalent permselective IEMs achieved the same desalting efficiency at the current density during the bench- and pilot-scale studies. The ion permselectivity of the electrodialysis was primarily affected by the membrane properties, salinity level and ion composition of the feedwater, and the applied current density. The CR671 coated with polyethyleneimine was demonstrated selectively favor the transport of mono- over divalent cations during electrodialysis. Compared to the normal grade IEMs, the monovalent permselective IEMs exhibited a relatively stable ion selectivity over a broad range of current densities. For the same hydraulic conditions (e.g., staging, spacers, and linear velocity), the overall desalination behavior and ion permselectivity of the bench- and pilot-scale electrodialysis testing were highly consistent. The study also elucidated the impact of the operating conditions on the ion selectivity and the overall salt removal for both the selective and normal grade IEMs. Another important finding of the study is that bench-scale testing results can be used to simulate and predict the desalination performance and ion selectivity of pilot-scale electrodialysis plants.

Principles of Desalination K Spiegler 2012-12-02 Principles of Desalination focuses on the principles of the developing technology of large-scale desalting. This book presents the principal desalting methods and explores the process of hyperfiltration or reverse osmosis. Comprised of 11 chapters, this book starts with an overview of the water use and the problem of a potential water shortage. This text then discusses the fundamentals of the major desalting methods in use and explores the basic scientific and design principles that underlie the methods. Other chapters consider the method of vapor reheat distillation, which incorporates the

liquid–liquid heat exchange principle. This book discusses as well the various aspects of ion exchange and explores the mechanisms in dual-purpose plants producing both distilled water and steam-turbine raised power. The final chapter considers the cost of conventional water supplies. This book is a valuable resource for technologists and scientists. Students in the graduate courses of engineering will also find this book useful.
MEMBRANE SEPARATION PROCESSES KAUSHIK NATH 2017-01-01
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).
Electromembrane Desalination Processes for Production of Low Conductivity Water

Andrej Grabowski 2010 Water of very low mineral content, i.e. low ionic conductivity, is required in many industrial processes and laboratory applications. The demand for total output volume and purity of such water has been significantly increasing during the last decades. Electromembrane processes provide a more sustainable and cost effective water purification compared to alternative processes like distillation and ion-exchange deionization. In the first part of the publication a review of processes used for deionization of water is presented and main physicochemical phenomena occurring in electromembrane processes will be discussed. The subsequent parts are devoted to the experimental verification of novel improvements for two electromembrane processes: electrodialysis and continuous electrodeionization. Considering electrodialysis, an investigation on ion-exchange membranes with profiled surfaces will be presented. It includes a section of appropriate membrane manufacturing procedures and desalination tests with profiled membranes. It turns out that electrodialysis with profiled ion-exchange membranes is superior to conventional electrodialysis with flat membranes and spacers, in particular with respect to desalination degree and reduced energy consumption. Considering continuous electrodeionization, experimental studies concerning improvements of continuous electrodeionization with bipolar membranes will be presented and discussed. Influence of ion-exchange membrane permselectivity on the product water quality is demonstrated and proposed improvements are aimed to reduce this influence. Concepts with a so-called protection compartment will be discussed and compared experimentally with a concept where the concentrate compartments are filled with ion exchange resin beads. It will be shown that improved continuous electrodeionization with bipolar membranes is able to produce ultrapure water in a quality comparable to conventional mixed-bed ion-exchangers but in a more cost effective and sustainable way.

Ion Exchange Membranes in Aqueous, Methanolic and Ethanolic Electrolyte Solutions Frank Sarfert 2005 Ion exchange membranes serve as the selective barrier in (electro-)dialytic separation processes. To date they are applied almost exclusively to aqueous electrolyte systems. In principal, however, ion exchange membranes also should be applicable to non aqueous solutions. In order to clarify how and why the membrane behavior in non aqueous electrolyte systems deviates from aqueous systems, equilibrium and transport properties of commercial monopolar and bipolar membranes are determined experimentally for aqueous, methanolic and ethanolic sodium perchlorate solutions in this study. Based

on these results the dependence of the membrane performance on solution characteristics such as the relative permittivity, the solute concentration and the ionic mobility and on membrane specifics such as the type of functional groups and the membrane morphology is discussed. Thus, evidence is found for the importance of ion pair formation in the solution as well as in the membrane phase. Both effects lead to a more or less pronounced degradation of the membrane performance. Further insights into the stationary and dynamic behavior of ion exchange membranes is obtained from a detailed, physically meaningful and dynamic bipolar membrane model. It is characterized by the consideration of four ionic species as well as solvent and electric potential, the existence of a space charge region at the cation/anion exchange layer interface, the description of non-idealities by means of solution and membrane phase activity coefficients and the solvent dissociation according to the chemical reaction model. Thus, a model is developed which is able to reproduce all observed experimental trends for both aqueous and non aqueous solutions. Membrane Technology Sundergopal Sridhar 2018-09-03 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