

1. Record Nr.	UNINA9910830097903321
Titolo	Nanofiltration : principles, applications, and new materials // edited by Andrea Iris Schafer, Anthony G. Fane
Pubbl/distr/stampa	Hoboken, New Jersey : , : John Wiley & Sons, Incorporated, , [2020] ©2020
ISBN	3-527-82497-9 3-527-82496-0 3-527-82498-7
Edizione	[2nd ed.]
Descrizione fisica	1 online resource (1242 pages)
Disciplina	660.284245
Soggetti	Nanofiltration
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Includes index.
Nota di contenuto	Cover -- Title Page -- Copyright -- Contents -- Foreword (Second Edition, 2020) -- Foreword (First Edition, 2005) -- Acknowledgements -- Dedication -- Introduction -- Part I Principles -- Chapter 1 History of Nanofiltration Membranes from 1960 to 1990 -- 1.1 Overview -- 1.2 Introduction -- 1.3 FirstGeneration NF Membranes -- 1.3.1 Cellulose Acetate Asymmetric Membranes -- 1.3.2 Deficiencies in Cellulosic Membranes -- 1.3.3 Polyelectrolyte Complexes -- 1.3.4 Polyamide Membranes -- 1.3.5 Polysulfones and Other Polymer Membranes -- 1.4 Early Studies of Charged Reverse Osmosis (Hyperfiltration) Membranes -- 1.4.1 Dynamic Membranes -- 1.4.2 Polyelectrolyte Membranes -- 1.5 Early Models of NF Selectivity -- 1.6 Negative Salt Rejection -- 1.6.1 Solutions of One Electrolyte -- 1.6.2 Separation by Negative Salt Rejection -- 1.7 Early Development of Industrial NF: Ionic Modification of Asymmetric Cellulose Acetate -- 1.8 Early NF Composites -- 1.8.1 General -- 1.8.2 Plasma Polymerization -- 1.8.3 Graft Polymerization -- 1.9 NF Composites of the 1980s -- 1.9.1 Piperazineamide Membranes -- 1.9.2 Other NF Interfacially Produced Composites -- 1.9.3 Modification of RO Membrane Composites to Bring Them into the NF Range -- 1.10 Composites Produced by Noninterfacial Crosslinking -- 1.10.1 Polyvinyl Alcohol Composites -- 1.10.2 Sulfonated Engineering Plastics as Selective

Barriers -- 1.10.3 Polyethyleneimine -- 1.11 Chemically Stable NF Membranes -- 1.11.1 Chemically Stable Polymeric Asymmetric Membranes -- 1.11.2 Oxidant and pH Stable Composite Membranes -- 1.11.3 Solvent Stable NF Composites -- 1.11.4 Chemically Stable Inorganic NF and Polymeric/Inorganic Hybrids -- 1.12 Conclusions -- Abbreviations -- References -- Chapter 2 Nanofiltration Membrane Materials and Preparation -- 2.1 General Introduction -- 2.2 Phase Inversion -- 2.2.1 Introduction. 2.2.2 Basic Principles -- 2.2.3 Polymer Type -- 2.2.4 Casting Solution -- 2.2.4.1 Polymer Concentration -- 2.2.4.2 Addition of Volatile Cosolvents -- 2.2.4.3 Addition of Nonsolvents -- 2.2.4.4 Addition of Other Additives -- 2.2.5 Postcasting Evaporation -- 2.2.6 Coagulation Bath -- 2.2.7 Posttreatment -- 2.2.7.1 Annealing -- 2.2.7.2 Cross linking -- 2.2.7.3 Drying -- 2.3 Interfacial Polymerization -- 2.3.1 Introduction -- 2.3.2 Support Materials -- 2.3.3 Monomers -- 2.3.3.1 Amines -- 2.3.3.2 Acyl Chlorides -- 2.3.3.3 Other Polymer Types -- 2.3.4 Monomer Concentrations and Reaction Time -- 2.3.5 Solvent -- 2.3.6 Additives -- 2.3.7 New Approaches -- 2.3.8 Posttreatment -- 2.4 Coating -- 2.4.1 Introduction -- 2.4.2 Examples -- 2.5 Surface Modification -- 2.5.1 Introduction -- 2.5.2 Plasma Treatment -- 2.5.3 Organic Reactions -- 2.5.3.1 Covalent Linking of Monomers -- 2.5.3.2 Sulfonation -- 2.5.3.3 Nitration -- 2.5.4 Polymer Grafting -- 2.5.5 Photochemical Modification -- 2.6 Ceramic Membranes -- 2.6.1 Introduction -- 2.6.2 General Synthesis Procedure -- 2.6.2.1 Sol -- 2.6.2.2 Coating -- 2.6.2.3 Gel -- 2.6.2.4 Sintering -- 2.6.3 Membrane Types -- 2.6.3.1 Titania -- 2.6.3.2 Zirconia -- 2.6.3.3 Alumina -- 2.6.3.4 Silica -- 2.6.3.5 Mixed Oxides -- 2.6.3.6 Organic Doped Ceramic Membranes -- 2.6.4 Supports -- 2.6.5 Surface Modification -- 2.7 Hollow Fiber Preparation -- 2.7.1 Introduction -- 2.7.2 General Synthesis Procedure -- 2.7.3 Composite Hollow Fiber Membranes -- 2.8 Commercial and Novel (SR)NF Membranes -- 2.8.1 Commercial (SR) NF Membranes -- 2.8.2 Novel (SR)NF Membranes -- 2.9 Outlook -- Acknowledgements -- Abbreviations -- References -- Chapter 3 Nanofiltration Module Design and Operation -- 3.1 Introduction -- 3.1.1 Role of the Module -- 3.1.2 Concentration Polarization and CrossFlow -- 3.1.3 Fouling -- 3.2 Module Types and Characteristics. 3.2.1 Plate and Frame -- 3.2.2 Spiral Wound -- 3.2.3 Tubular -- 3.2.4 Hollow Fiber and Capillary -- 3.2.5 Others -- 3.2.5.1 Submerged Membranes -- 3.2.5.2 High Shear Devices -- 3.2.5.3 Laboratory Modules -- 3.2.6 Module Characteristics -- 3.3 Spiral Wound Module (SWM) - Design Features -- 3.3.1 Feed Channel Spacers -- 3.3.2 Modeling and Optimization -- 3.4 Strategies to Improve Control of Concentration Polarization -- 3.4.1 Process Limitation by Concentration Polarization -- 3.4.2 High Shear - Vibrating the Membrane -- 3.4.3 High Shear - Rotor/Stator Modules -- 3.4.4 Two Phase Flow -- 3.4.5 Unsteady Shear Comparison -- 3.5 System Design and Operation -- 3.5.1 System Configurations -- 3.5.2 Diafiltration -- 3.5.3 Reflux/Recycle Cascade (Combining RO and NF) -- 3.5.4 Batch Operation - Energy Saving (Closed Circuit) -- 3.6 Conclusions -- Nomenclature -- Subscripts -- Greek Symbols -- Abbreviations -- References -- Chapter 4 Nanofiltration Membrane Characterization -- 4.1 Introduction -- 4.2 Structural Characteristics -- 4.2.1 Microscopy -- 4.2.2 Pore Size -- 4.2.2.1 Solvent Permeation and Rejection of Probe Solutes -- 4.2.2.2 Spectroscopic and Scattering Methods -- 4.2.3 Thickness and Morphology of the Active Layer -- 4.2.4 Surface Characteristics -- 4.2.4.1 Atomic Force Microscopy (AFM) -- 4.2.4.2 Contact Angle -- 4.2.5 Membrane Swelling and Solvent Uptake -- 4.2.6 Chemical Structure -- 4.2.6.1 Attenuated Total Reflection-Fourier

Transform InfraRed Spectroscopy (ATR-FTIR) -- 4.2.6.2 X-ray Photoelectron Spectroscopy (XPS) -- 4.2.6.3 Rutherford Backscattering Spectroscopy (RBS) -- 4.2.7 Mechanical Properties -- 4.3 Charge Related Parameters -- 4.3.1 Electrokinetic Measurements -- 4.3.2 Titration and Ion Exchange -- 4.3.3 Membrane Potential -- 4.3.4 Electrochemical Impedance Spectroscopy -- 4.4 Nanofiltration Membranes for Nonaqueous Systems.

4.5 Conclusions -- Nomenclature -- Greek Symbols -- Abbreviations -- References -- Chapter 5 Modeling Nanofiltration of Electrolyte Solutions -- 5.1 Introduction -- 5.2 Basic Equations and Concepts -- 5.2.1 Derivation of Equations -- 5.2.1.1 Single Salts -- 5.2.1.2 Trace Ions -- 5.2.2 Solution of Transport Equations for Macroscopically Homogeneous Membranes: Single Salts and Trace Ions -- 5.2.2.1 Spiegler-Kedem Approximation -- 5.2.2.2 Trace Ions -- 5.2.3 Specification of Phenomenological Coefficients Within the Scope of a Model of Straight, Narrow Capillaries -- 5.3 Nanopore Models of NF -- 5.3.1 Steric Exclusion and Hindrance -- 5.3.2 Local Equilibrium Partitioning Mechanisms -- 5.3.2.1 Donnan Exclusion -- 5.3.2.2 Superposition of Donnan Exclusion and Steric Hindrance/Exclusion -- 5.3.2.3 Dielectric Exclusion -- 5.4 Solution-Diffusion-Electromigration Models of Nanofiltration -- 5.4.1 An Analytical Solution to Transport of Three Ions with Different Charges -- 5.4.2 Determining Single-Ion Permeances Using NF with Trace Ions -- 5.4.3 "Under-Osmotic" Operation -- 5.4.4 Deviations from Local Electrical Neutrality in Ultrathin Barrier Layers -- 5.5 Conclusions -- Acknowledgements -- Nomenclature -- Greek Symbols -- Abbreviations -- References -- Chapter 6 Chemical Speciation Effects in Nanofiltration Separation -- 6.1 Introduction -- 6.2 Chemical Speciation -- 6.2.1 Effect of Ionic Strength on Chemical Speciation -- 6.2.2 Effects of Temperature and Pressure on Chemical Speciation -- 6.3 Review of Effects of Solute Size, Charge, and Concentration on Rejection by NF Membranes -- 6.4 Solution Processes Influencing Speciation and Rejection -- 6.4.1 Acid-Base Transformations -- 6.4.2 Complexation -- 6.4.3 Precipitation -- 6.4.4 Oxidation-Reduction -- 6.4.5 Adsorption -- 6.5 Effect of Concentration Polarization on Speciation and Rejection.

6.5.1 Exceedance of Solubility Product and Precipitation of Solids -- 6.5.2 Aggregation of Macromolecules and Precipitated Solids -- 6.5.3 Formation of Alternative Complexes and Multinuclear Species -- 6.6 Conclusions -- Nomenclature and Symbols -- Abbreviations -- References -- Chapter 7 Fouling in Nanofiltration -- 7.1 Introduction -- 7.2 Fouling Characterization -- 7.2.1 Flux Measurement and Fouling Protocols -- 7.2.1.1 Membrane Compaction -- 7.2.1.2 Variation of Membrane Permeability with Solution Chemistry -- 7.2.1.3 Fouling Study Protocols -- 7.2.2 Normalization of Membrane Performance -- 7.2.3 Water Fouling Potential -- 7.2.3.1 Water Analysis -- 7.2.3.2 Silt Density Index (SDI) -- 7.2.3.3 Modified Fouling Index (MFI_{0.45}) -- 7.2.3.4 Modified Fouling Index UF (MFI_{UF}) -- 7.2.3.5 Biofilm Formation Rate (BFR) -- 7.2.4 Membrane Autopsy -- 7.3 Fouling Mechanisms -- 7.3.1 Concentration Polarization (CP) -- 7.3.2 Osmotic Pressure -- 7.3.3 Solute Adsorption -- 7.3.4 Gel Layer Formation -- 7.3.5 Cake Formation and Pore Blocking -- 7.3.6 Critical Flux and Operating Conditions -- 7.3.7 Additional Fouling Mechanisms -- 7.4 Organic Fouling -- 7.4.1 Introduction and Definition of Organic Fouling -- 7.4.2 Common Organic Foulants -- 7.4.3 Adsorption of Organic Matter -- 7.4.4 Gel Layer Formation -- 7.4.5 Cake Formation -- 7.4.6 Pore Blocking/Plugging -- 7.4.7 Impact of Solute-Solute Interactions and Salts -- 7.4.8 Impact of Fouling on Retention -- 7.5 Scaling -- 7.5.1 Introduction and Definition of Scaling -- 7.5.2 Solubility and

Supersaturation of Salts -- 7.5.3 Common Scalants -- 7.5.3.1 Calcium Sulfate (CaSO_4) Scale -- 7.5.3.2 Calcium Carbonate (CaCO_3) Scale -- 7.5.3.3 Barium Sulfate (BaSO_4) and Strontium Sulfate (SrSO_4) Scale -- 7.5.3.4 Silica Scale -- 7.5.3.5 Calcium Phosphate Scale -- 7.5.4 Characterization of Scales.
7.5.5 Mechanisms of Scale Formation.

Sommario/riassunto

"Nanofiltration is a membrane filtration process that is used for removing small particles from liquids. Traditionally nanofiltration has been used for water treatment and especially water softening through the removal of ions like Ca^{2+} and Mg^{2+} . Nowadays it is used in a wide range of industries, including milk and juice production as well as the pharmaceutical and chemical industries"--
