

1. Record Nr.	UNINA9910974499203321
Autore	De Sirshendu
Titolo	Electric field enhanced membrane separation system : principles and typical applications // Sirshendu De, Biswajit Sarkar and Sunando DasGupta
Pubbl/distr/stampa	New York, : Nova Science Publishers, c2009
ISBN	1-61728-389-4
Edizione	[1st ed.]
Descrizione fisica	1 online resource (214 p.)
Altri autori (Persone)	SarkarBiswajit DasGuptaSunando
Disciplina	660/.28424
Soggetti	Membrane separation Electric fields
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- ELECTRIC FIELD ENHANCED MEMBRANE SEPARATION SYSTEM: PRINCIPLES AND TYPICAL APPLICATIONS -- ELECTRIC FIELD ENHANCED MEMBRANE SEPARATION SYSTEM: PRINCIPLES AND TYPICAL APPLICATIONS -- CONTENTS -- PREFACE -- Chapter 1 INTRODUCTION -- 1.1. APPLICATION OF MEMBRANE SEPARATION PROCESSES -- 1.1.1. Electro-painting -- 1.1.2. Water Purification -- 1.1.3. Textile Industry -- 1.1.4. Dairy Industry -- 1.1.5. Soy Protein Extraction -- 1.1.6. Fruit Juice Clarification -- 1.1.7. Biotechnological Application -- 1.1.8. Pulp and Paper Industry -- 1.1.9. Sugar Processing Industry -- 1.1.10. Tanning and Leather Industry -- 1.2. ADVANTAGE OF MEMBRANE SEPARATION PROCESSES -- 1.3. LIMITATIONS OF MEMBRANE SEPARATION PROCESSES -- 1.3.1. Concentration Polarization -- 1.3.2. Irreversible Membrane Fouling -- 1.4. APPROACHES TO IMPROVE MEMBRANE PERFORMANCE -- 1.4.1. Surface Modification -- 1.4.1.1. Chemical Treatment and Physical Coating -- 1.4.1.2. Plasma Treatment -- 1.4.1.3. Ion Beam Irradiation -- 1.4.1.4. Grafting Polymers -- 1.4.2. Change of Hydrodynamic Conditions -- 1.4.2.1. Turbulent Flow -- 1.4.2.2. Unsteady Flows and Induction of Instabilities -- 1.4.2.2.1. Turbulence Promoter -- 1.4.2.2.2. Gas Sparging -- 1.4.2.3. Secondary Flow -- 1.4.2.4. Pulsatile Flow -- 1.4.3. Change of Physico-chemical Environment of the Solution

-- 1.4.4. External Field -- REFERENCES -- Chapter 2 CLARIFICATION OF CITRUS FRUIT JUICE -- ABSTRACT -- NOMENCLATURE -- Greek Letters -- 2.1. IMPORTANCE AND TECHNIQUES OF CLARIFICATION OF FRUIT JUICE -- 2.2. APPLICATION OF EXTERNAL FIELD -- 2.2.1. Application of Electric Field during Fruit Juice Clarification -- 2.3. MEMBRANE EXPERIMENT -- 2.3.1. Cross-flow Electro-ultrafiltration Cell -- 2.3.2. Procedure for Conducting Experiments -- 2.3.2.1. Materials -- 2.3.2.2. Operating Conditions -- 2.3.2.3. Preparation of Feed. -- 2.3.2.4. Conduction of Experiments -- 2.3.2.5. Analysis of the Feed and Permeate -- Variation of Zeta Potential of Synthetic Juice (A Mixture of Pectin and Sucrose) with pH -- 2.3.2.6. Optical Studies -- 2.4. PREDICTION OF THE PERMEATE FLUX AND DEPOSITION THICKNESS -- 2.4.1. Analysis of Transient Flux -- 2.4.1.1. Theoretical Aspects -- 2.4.1.2. Analysis of Transient Flux Decline of Synthetic Juice -- Effect of Constant Electric Field -- Optical Quantification of Gel Layer Thickness -- Effect of Pulsed Electric Field -- 2.4.1.3. Mosambi (Citrus Sinensis (L.) Osbeck) Juice -- Effect of Constant Electric Field -- Effect of Pulsed Electric Field -- 2.4.2. Analysis of Steady State Flux -- 2.4.2.1. Theoretical Aspect -- 2.4.2.2 Analysis of Steady State Flux of Synthetic Juice -- Effect of Constant Electric Field -- Effect of Transmembrane Pressure -- Effect of Cross Flow Velocity -- Variation of Permeate Flux with Axial Position -- Effect of Pulsed Electric Field -- Effect of Pulse Ratio -- Effect of Cross Flow Velocity -- Estimation of Electric Power Consumption per Unit Volume of Permeate -- 2.4.2.3. Analysis of Steady State Flux of Mosambi (Citrus Sinensis (L.) Osbeck) Juice -- Theoretical Aspect -- Effect of Constant Electric Field on Permeate Flux -- Effect of Cross Flow Velocity on Permeate Flux -- Effect of Pulsed Electric Field -- Effect of Pulse Ratio -- Effect of Cross Flow Velocity -- Characterization of Clarified Mosambi Juice -- Power Consumption and pH Variation -- 2.5. CONCLUSION -- REFERENCES -- Chapter 3 SEPARATION AND FRACTIONATION OF PROTEIN SOLUTION -- ABSTRACT -- NOMENCLATURE -- Greek Letters -- Subscript -- Superscript -- 3.1. ELECTRIC FIELD ASSISTED ULTRAFILTRATION OF PROTEIN FROM AQUEOUS SOLUTION -- 3.1.1. Mass Transfer Analysis during Electric Field Assisted Ultrafiltration -- Estimation of Mass Transfer Coefficient. Prediction of  $c_{m1}$  and  $v_w$  -- Algorithm Used for Estimation of  $c_m$  and  $v_w$  -- 3.1.2. Importance of Membrane Surface Charge -- Electrokinetic Theory -- Calculation of Zeta Potential and Surface Charge Density of Membrane -- 3.1.3. Detailed Experiment -- 3.1.3.1. Ultrafiltration of BSA from Aqueous Solution -- Membrane and Materials -- Electro-ultrafiltration Cell and Operating Conditions -- Steps Used during Experiment -- Preparation of Feed Solution -- Conduction of Experiments -- Analysis of the Feed and Permeate -- 3.1.3.2. Evaluation of Membrane Surface Charge -- Membrane -- Preparation of Feed Solution -- Streaming Potential Measurement -- Zeta Potential and Surface Charge Density of Membrane -- 3.1.4. Osmotic Pressure of Protein Solution -- 3.1.4.1. Effect of pH and Solute Concentration on Osmotic Pressure of BSA -- 3.1.4.2. Effect of pH and Solute Concentration on Osmotic Pressure of Lysozyme -- 3.1.5. Quantification of Permeate Flux and Membrane Surface Concentration -- 3.1.5.1. Effect of Electric Field on Concentration Boundary Layer Thickness -- 3.1.5.2. Effect of Electric Field on the Variation of Membrane Surface Concentration and Permeate Flux along the Length of the Channel -- 3.1.5.3. Effect of Electric Field on the Membrane Surface Concentration and Permeate Flux -- 3.1.5.4. Effect of Pressure on the Permeate Flux -- 3.1.5.5. Effect of Cross Flow Velocity on Permeate Flux -- 3.1.5.6. Variation of Mass Transfer Coefficient --

3.1.5.7. Effect of Solution pH during Ultrafiltration of BSA from Aqueous Solution -- 3.2. ELECTRIC FIELD ENHANCED FRACTIONATION OF BSA AND LYSOZYME -- 3.2.1. Theoretical Aspects -- Algorithm for Numerical Calculation -- 3.2.2. Detailed Experiment -- 3.2.2.1. Membrane and Materials -- 3.2.2.2. Electro-ultrafiltration Cell -- 3.2.2.3. Experimental Design -- 3.2.2.4. Procedure -- Conduction of Experiments. Analysis of the Feed and Permeate -- 3.2.3. Quantification of Permeate Flux and Solute Retention -- 3.2.3.1. Effect of Pressure on Permeate Flux and Observed Retention during Ultrafiltration of Single Protein Solution -- 3.2.3.2. Effect of Solution pH -- 3.2.3.3. Effect of Electric Field on Observed Retention and Permeate Flux -- 3.2.3.4. Effect of Cross Flow Velocity on Permeate Flux and Observed Retention -- 3.2.3.5. Effect of Pressure on Permeate Flux and Observed Retention -- 3.2.3.6. Effect of Electric Field on Membrane Surface Concentration -- 3.3. CONCLUSIONS -- APPENDIX 1 -- Calculation of Osmotic Pressure -- Electrostatic Interaction -- London-van der Waals Interaction -- Entropic Pressure -- REFERENCES -- Chapter 4 ELECTRIC FIELD ASSISTED MICELLAR ENHANCED ULTRAFILTRATION -- ABSTRACT -- NOMENCLATURE -- Greek Letters -- 4.1. INTRODUCTION -- Dye Removal: A Case Study -- 4.2. PRINCIPLE OF ELECTRIC FIELD ASSISTED MEUF -- 4.3. LIMITING FLUX PHENOMENA -- 4.3.1. Calculation of Limiting Pressure and Limiting Flux -- 4.4. MEMBRANE EXPERIMENTS -- 4.4.1. Chemicals -- 4.4.2. Membrane -- 4.4.3. Cross Flow Cell and Operating Conditions -- 4.4.4. The Steps Used in Experiment -- 4.4.5. Analysis of Feed and Permeate -- 4.4.5.1. Concentration of SDS and Methylene Blue -- 4.4.5.2. Measurement of Viscosity, Conductivity and pH -- 4.4.6. Determination of Particle Size -- 4.4.7. Determination of Gel Porosity -- 4.5. ANALYSIS OF PERMEATE FLUX, GEL-LAYER THICKNESS AND SOLUTE RETENTION -- 4.5.1. Electric Field Assisted MEUF of Pure Surfactant Solution -- 4.5.1.1. Variation of Gel Layer Thickness with Pressure -- 4.5.1.2. Effect of Pressure on Permeate Flux -- In Absence of Electric Field -- In Presence of Electric Field -- 4.5.1.3. Effect of Pressure on Gel Layer Thickness -- 4.5.1.4. Effect of Electric Field on Permeate Flux. 4.5.1.5. Effect of Electric Field on Gel Layer Thickness -- 4.5.2. Electric Field Assisted MEUF of SDS Solution Containing of Methylene Blue Dye -- 4.5.2.1. Effect of Surfactant to Dye Concentration Ratio -- 4.5.2.2. Effect of Electric Field -- 4.5.2.3. Effect of Cross Flow Velocity -- 4.5.2.4. Effect of Pressure -- 4.6. CONCLUSION -- REFERENCES -- INDEX -- Blank Page.

## Sommario/riassunto

The membrane separation process has emerged as a powerful separation technique and has become an integral part of modern process industries. This has found wide applications in the field of biotechnology, beverage, dairy industry, clarification of fruit juice, waste water treatment etc. The advantages of these processes are their unique separation capabilities, low energy consumption, high throughput, and ease of scaling etc., compared to conventional separation processes. However, the application of membrane separation process has been limited by the presence of concentration polarization and membrane fouling. These lead to decline in permeate flux and change in retention behaviour. Therefore, the ways to reduce concentration polarization and thereby enhancing the filtration rate are currently active areas of research in view of the increasing demand of membranes application to various industrial separation processes. To minimize the membrane fouling and concentration polarization, several techniques have been investigated. In this regard, application of external d.c. (direct current) electric field across the membrane is a

promising method to reduce concentration polarization and fouling. This book deals with the relevant principles, technology and the theoretical details involved in this process. It is to be emphasized that no such book dealing with electric field assisted membrane filtration exists currently. Therefore, this book obviously has significant advancement compared to existing books on membrane technology. This book can be used as one of the Texts for the course like Novel Separation Processes taught in Postgraduate level. Of course, this book can be an extremely useful reference book for the students and professionals in Chemical and Environmental Engineering. We believe this book will have two fold impacts. Firstly, its academic value is quite high; Secondly, it will have remarkable impact of scaling up such system in actual industrial scale from pilot plant data in an emerging area. Moreover, a book on such a topic does not exist today; the importance of it from an academic point of view is undoubtedly remarkable. This book presents detailed description of the effect of electric field to a number of typical applications, e.g. fruit juice clarification, separation and fractionation of protein solution, micellar enhanced ultrafiltration for dye removal. The results are analyzed in full detail.

---