

Downstream Process Technology A New Horizon In Biotechnology

Ecological Management of Mining: Achieving Environmental Compliance is a study and comparison - global in scope - of current practices used by mining firms striving for ecological management. The author takes an integrated and interdisciplinary approach in addressing, analyzing and working towards solutions regarding the complex challenges posed by managing the environmental impacts of mining. The issues addressed range from the ecotoxicological effects of metal residues to the land use effects of mining and from socioeconomic impacts to environmental regulation. The goal of this book is to assist mining companies throughout the world to achieve environmental compliance and improve competitiveness in the context of growing environmental regulation and technological innovation. It is an essential book for the wide variety of professionals working on issues in mining. Like the book and the research itself, the audience is integrated and interdisciplinary including engineers, planners, ecologists, policy makers and economists. Features

Expanded bed adsorption chromatography is a novel processing technique for the purification of biomolecules, combining clarification, concentration and initial purification in one step. By such an integration it is possible to reduce the number of steps in the purification process, to shorten the processing time and to improve the yields. The technology is new, and interesting developments have taken place concerning the adsorbents, the processing technology and potential applications. Both small-scale laboratory processes and larger industrial processes are being developed. Expanded bed chromatography is one of the most exciting new developments in downstream processing in recent years. The technology will be a standard procedure when new biotechnological processes are being developed.

Bioprocess Engineering: Downstream Processing is the first book to present the principles of bioprocess engineering, focusing on downstream bioprocessing. It aims to provide the latest bioprocess technology and explain process analysis from an engineering point of view, using worked examples related to biological systems. This book introduces the commonly used technologies for downstream processing of biobased products. The covered topics include centrifugation, filtration, membrane separation, reverse osmosis, chromatography, biosorption, liquid-liquid separation, and drying. The basic principles and mechanism of separation are covered in each of the topics, wherein the engineering concept and design are emphasized. This book is aimed at bioprocess engineers and professionals who wish to perform downstream processing for their feedstock, as well as students.

This book will update the original edition published in 1997. Since the publication of the first edition, the biotechnology and biologics industries have gained extensive knowledge and experience in downstream processing using

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chromatography and other technologies associated with recovery and purification unit operations. This book will tie that experience together for the next generation of readers. Updates include: - sources and productivity - types of products made today - experiences in clinical and licensed products - economics - current status of validation - illustrations and tables - automated column packing - automated systems New topics include: - the use of disposables - multiproduct versus dedicated production - design principles for chromatography media and filters - ultrafiltration principles and optimization - risk assessments - characterization studies - design space - platform technologies - process analytical technologies (PATs) - biogenerics - comparability assessments Key Features: - new approaches to process optimization - use of platform technologies - applying risk assessment to process design

An affordable, easily accessible desk reference on biomanufacturing, focused on downstream recovery and purification Advances in the fundamental knowledge surrounding biotechnology, novel materials, and advanced engineering approaches continue to be translated into bioprocesses that bring new products to market at a significantly faster pace than most other industries. Industrial scale biotechnology and new manufacturing methods are revolutionizing medicine, environmental monitoring and remediation, consumer products, food production, agriculture, and forestry, and continue to be a major area of research. The downstream stage in industrial biotechnology refers to recovery, isolation, and purification of the microbial products from cell debris, processing medium and contaminating biomolecules from the upstream process into a finished product such as biopharmaceuticals and vaccines. Downstream process design has the greatest impact on overall biomanufacturing cost because not only does the biochemistry of different products (e.g., peptides, proteins, hormones, antibiotics, and complex antigens) dictate different methods for the isolation and purification of these products, but contaminating byproducts can also reduce overall process yield, and may have serious consequences on clinical safety and efficacy. Therefore downstream separation scientists and engineers are continually seeking to eliminate, or combine, unit operations to minimize the number of process steps in order to maximize product recovery at a specified concentration and purity. Based on Wiley's Encyclopedia of Industrial Biotechnology: Bioprocess, Bioseparation, and Cell Technology, this volume features fifty articles that provide information on downstream recovery of cells and protein capture; process development and facility design; equipment; PAT in downstream processes; downstream cGMP operations; and regulatory compliance. It covers: Cell wall disruption and lysis Cell recovery by centrifugation and filtration Large-scale protein chromatography Scale down of biopharmaceutical purification operations Lipopolysaccharide removal Porous media in biotechnology Equipment used in industrial protein purification Affinity chromatography Antibody purification, monoclonal and polyclonal Protein aggregation, precipitation and crystallization Freeze-drying of biopharmaceuticals

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Biopharmaceutical facility design and validation Pharmaceutical bioburden testing Regulatory requirements Ideal for graduate and advanced undergraduate courses on biomanufacturing, biochemical engineering, biopharmaceutical facility design, biochemistry, industrial microbiology, gene expression technology, and cell culture technology, Downstream Industrial Biotechnology is also a highly recommended resource for industry professionals and libraries.

Providing a critical and extensive compilation of the downstream processes of natural gas that involve the principle of gas processing, transmission and distribution, gas flow and network analysis, instrumentation and measurement systems and its utilisation, this book also serves to enrich readers understanding of the business and management aspects of natural gas and highlights some of the recent research and innovations in the field. Featuring extensive coverage of the design and pipeline failures and safety challenges in terms of fire and explosions relating to the downstream of natural gas technology, the book covers the needs of practising engineers from different disciplines, who may include project and operations managers, planning and design engineers as well as undergraduate and postgraduate students in the field of gas, petroleum and chemical engineering. This book also includes several case studies to illustrate the analysis of the downstream process in the gas and oil industry. Of interest to researchers is the field of flame and mitigation of explosion: the fundamental processes involved are also discussed, including outlines of contemporary and possible future research and challenges in the different fields.

High Value Processing is concerned with all the processes and activities of converting raw materials and commodity materials into valuable products required by manufacturers or the end consumer. Efficient processing of raw materials and commodity goods is of great significance for continuing economic welfare. There is a need to develop products that have high value in world markets, and therefore people must understand fully the properties of materials as diverse as food, wood, metals, plastics and fuel. Advanced technologies and knowledge are required to design, manufacture and process these materials into high-value products. It is also important to understand the properties of these high-value products and how they will interact with their environment, whether it be within the body or in the atmosphere. This book will serve industrial and other activities where material is undergoing a change, whether that change is chemical, biochemical or physical. Improving the understanding of how to prepare feed materials, how to make reactions occur, separating and purifying products, controlling wastes, minimizing energy usage, and ultimately adding value to the raw materials used to produce something useful to people is an essential aspect to this composition. This book reads more as a single authored book with fully integrated chapters than as one compiled by editors, having benefited directly from the discussions by true experts in their fields.

An ideal book for upper level undergraduate and postgraduate students taking modules on Renewable resources, green chemistry, sustainable development,

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environmental science, agricultural science and environmental technology. With a focus on actual industrial processes, e.g. the production of light alkenes, synthesis gas, fine chemicals, polyethylene, it encourages the reader to think “out of the box” and invent and develop novel unit operations and processes. Reflecting today’s emphasis on sustainability, this edition contains new coverage of biomass as an alternative to fossil fuels, and process intensification. The second edition includes: New chapters on Process Intensification and Processes for the Conversion of Biomass Updated and expanded chapters throughout with 35% new material overall Text boxes containing case studies and examples from various different industries, e.g. synthesis loop designs, Sasol I Plant, Kaminsky catalysts, production of Ibuprofen, click chemistry, ammonia synthesis, fluid catalytic cracking Questions throughout to stimulate debate and keep students awake! Richly illustrated chapters with improved figures and flow diagrams Chemical Process Technology, Second Edition is a comprehensive introduction, linking the fundamental theory and concepts to the applied nature of the subject. It will be invaluable to students of chemical engineering, biotechnology and industrial chemistry, as well as practising chemical engineers. From reviews of the first edition: “The authors have blended process technology, chemistry and thermodynamics in an elegant manner... Overall this is a welcome addition to books on chemical technology.” – The Chemist “Impressively wide-ranging and comprehensive... an excellent textbook for students, with a combination of fundamental knowledge and technology.” – Chemistry in Britain (now Chemistry World)

This new volume examines the state of the art of several important separation processes as they relate to biotechnology. Focusing on isolation and purification of downstream processing, it presents recent research results of several promising techniques. Its 15 chapters cover extraction and membrane processing, processes using biospecific interaction with proteins, and novel isolation and purification processes. Many of the chapters contain data that have not been published before. This volume presents the spectrum of current thinking and activities on bioseparation, specifically of large molecules such as proteins and polysaccharides.

We are all aware of opportunities created by advances in molecular biology. Living cells and their components can be used to produce a large number of useful compounds such as therapeutics and other products. But to obtain significant benefits as a commercial operation, molecular biology needs the support of biochemical engineering. The vital area of biotechnology that is concerned with practical application of biological agents (whole cell systems and biocatalysts) and the methodologies and processes associated with it on an industrial scale is biochemical engineering. Biochemical engineering is applicable in different areas of biotechnology such as biochemical reactions, enzyme technology, environmental biotechnology, microbial manipulations, bioseparation technology, plant and animal cell cultures, and food technology. It consists of the

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development of new process technology, designing bioreactors, developing efficient, and economically feasible extraction and purification procedures (downstream processing). Chapter 1 and 2 discuss about the basic concept of biotechnology and biochemical engineering. Chapter 3 tells about the concept of enzyme kinetics, their evolution and use in biochemical engineering. Chapter 4 and 5 describe immobilized enzyme and industrial applications of enzymes. Chapter 6 depicts about industrial microbiology. This chapter discuss different concepts about fermentation process, cell products and other modified compounds. Chapter 7 tells about different types of cell cultivations in microbial, animal, and plant. Chapter 8 discuss about the fermentation process and its control. Chapter 9 and 10 describe cell kinetics and fermenter design and also how the cell grows. Chapter 11 discuss about the bioreactor design. Chapter 12 depicts the downstream processing, centrifugation, sedimentation and other technology. Chapter 13 tells about the sterilization.

This book is aimed at both graduates and postgraduates interested in a career in the pharmaceutical industry by informing them about the breadth of the work carried out in chemical research and development departments. It is also of great value to academics wishing to advise students on the merits of careers in chemical development over discovery.

The third edition of *Filtration and Purification in the Biopharmaceutical Industry* greatly expands its focus with extensive new material on the critical role of purification and advances in filtration science and technology. It provides state-of-the-science information on all aspects of this field including the current methods, processes, technologies and equipment. It also covers industry standards and regulatory requirements for the pharmaceutical and biopharmaceutical industries. An essential, comprehensive source for all professionals involved with filtration and purification practices and compliance, this text describes such technologies as viral retentive filters, membrane chromatography, downstream processing, cell harvesting, and buffer filtration.

In *Downstream Processing of Proteins: Methods and Protocols*, Mohamed A. Desai and a team of experienced biotechnologists review both conventional and novel isolation techniques used in industrial applications for the downstream processing of protein molecules. These techniques include primary and secondary separations during the isolation of biomolecules, as well as unique laboratory-scale research methods with a potential for scale-up. Also treated are the various strands of the downstream biological process essential for a successful product license application, including both the validation of DSP stages, and the design and validation of viral clearance stages during the purification process. *Downstream Processing of Proteins: Methods and Protocols* provides scientists everywhere, but particularly in the biopharmaceutical and biotechnology industry, with a much-needed introduction to this critical technology. Every bioprocess scientist and engineer working to design and validate biological processes for novel proteins-and successfully apply for their new product licenses-will find this important book an eminently practical resource.

Filtration and Purification in the Biopharmaceutical Industry, First Edition greatly expands its focus with extensive new material on the critical role of purification and the

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significant advances in filtration science and technology. This new edition provides state-of-the-science information on all aspects of filtration and purification, in Chemical Engineering and Chemical Process Technology is a theme component of Encyclopedia of Chemical Sciences, Engineering and Technology Resources in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty Encyclopedias. Chemical engineering is a branch of engineering, dealing with processes in which materials undergo changes in their physical or chemical state. These changes may concern size, energy content, composition and/or other application properties. Chemical engineering deals with many processes belonging to chemical industry or related industries (petrochemical, metallurgical, food, pharmaceutical, fine chemicals, coatings and colors, renewable raw materials, biotechnological, etc.), and finds application in manufacturing of such products as acids, alkalis, salts, fuels, fertilizers, crop protection agents, ceramics, glass, paper, colors, dyestuffs, plastics, cosmetics, vitamins and many others. It also plays significant role in environmental protection, biotechnology, nanotechnology, energy production and sustainable economical development. The Theme on Chemical Engineering and Chemical Process Technology deals, in five volumes and covers several topics such as: Fundamentals of Chemical Engineering; Unit Operations – Fluids; Unit Operations – Solids; Chemical Reaction Engineering; Process Development, Modeling, Optimization and Control; Process Management; The Future of Chemical Engineering; Chemical Engineering Education; Main Products, which are then expanded into multiple subtopics, each as a chapter. These five volumes are aimed at the following five major target audiences: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, managers, and decision makers and NGOs.

This is the most comprehensive treatise of this topic available, providing invaluable information on the technological and economic benefits to be gained from implementing continuous processes in the biopharmaceutical industry. Top experts from industry and academia cover the latest technical developments in the field, describing the use of single-use technologies alongside perfusion production platforms and downstream operations. Special emphasis is given to process control and monitoring, including such topics as 'quality by design' and automation. The book is supplemented by case studies that highlight the enormous potential of continuous manufacturing for biopharmaceutical production facilities.

Promoting a continued and much-needed renaissance in biopharmaceutical manufacturing, this book covers the different strategies and assembles top-tier technology experts to address the challenges of antibody purification. • Updates existing topics and adds new ones that include purification of antibodies produced in novel production systems, novel separation technologies, novel antibody formats and alternative scaffolds, and strategies for ton-scale manufacturing • Presents new and updated discussions of different purification technologies, focusing on how they can address the capacity crunch in antibody purification • Emphasizes antibodies and innovative chromatography methods for processing

Microorganisms have been exploited for many centuries for the production of fermented foods and beverages and for bread-making. The production of alcoholic beverages using microbes was the first major industrialized process.

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The technology developed for large-scale brewing was adapted for other anaerobic processes such as acetone and butanol in the early 1900s. With the discovery of penicillins, rapid developments were made in the technology of submerged culture fermentation of aerobic microorganisms under controlled conditions. The advancements in microbiology and process biochemistry improved our ability to harness the potential of microorganisms through improved bioprocessing methods to manufacture new products with economic viability. Microbial derived bioproducts have been gaining importance in the food, pharmaceutical, textile, leather, cosmetic and chemical industries, and most important among them are therapeutic proteins and peptides, enzymes, antigens, vaccines, antibiotics, drugs, etc. Not all microbial production processes involve culture of the organism in liquid medium. Instead, the organism can be grown on the surface of a solid substrate. Solid substrate (or solid state) fermentation (SSF) is an established traditional technology in many countries, producing edible mushrooms, fungal-fermented foods and soy sauce. Before the development of processes in liquid culture, citric acid and some microbial enzymes were produced by SSF. Carbon composting is also a form of SSF. Edited to avoid duplication and favor comprehensiveness, 20 contributors detail the recovery, separation, and purification operations of bioprocess technology. Individual chapters in this classic yet still highly relevant work emphasize concepts that are becoming more and more important when applied to the large scale versions of techniques that are considered well established. Aside from fully discussing processes, Separation Processes in Biotechnology includes sections on concentration separation and operation, purification operations, and product release and recovery. It also discusses plant operation and equipment and delves into economic considerations. Surveys the selection, design, and operation of most of the industrially important separation processes. Discusses the underlying principles on which the processes are based, and provides illustrative examples of the use of the processes in a modern context. Features thorough treatment of newer separation processes based on membranes, adsorption, chromatography, ion exchange, and chemical complexation. Includes a review of historically important separation processes such as distillation, absorption, extraction, leaching, and crystallization and considers these techniques in light of recent developments affecting them. Carbon dioxide has been implicated in the global climate change, and CO₂ sequestration is a technology being explored to curb the anthropogenic emission of CO₂ into the atmosphere. The injection of CO₂ for enhanced oil recovery (EOR) has the dual benefit of sequestering the CO₂ and extending the life of some older fields. This volume presents some of the latest information on these processes covering physical properties, operations, design, reservoir engineering, and geochemistry for AGI and the related technologies. The Japanese biotechnology community has developed a unique system of scientific bilateral communications at the international level. It consists of closed

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seminars where a restricted number of speakers from Japan and a selected country are invited. Thereby the actual state of biotechnology is visualized very effectively and valuable information exchanged during the discussions and personal contacts. As a result strong relationships between several European and American countries have been built up during recent years and numerous colleagues from abroad have improved their knowledge of Japanese science, economy, and culture. The present volume reports on an American-Japanese meeting held in Moriyama, which is situated on the lovely Lake Biwa in Japan. The well prepared and efficiently organized event covered the major aspects of bioprocess engineering including animal and plant cell culture, biocatalysts, downstream processing, sensor and bioprocess control, as well as genetic engineering. Altogether a broad spectrum, indicating the strengths and weaknesses of the current efforts being made for the improvement of process technology and the search for new products.

This book provides fundamental principles, terminology, mechanisms, methods, types and applications of unit operation in downstream processing of various fields, ranging from engineering, technology, pure sciences and applied sciences. The discussion revolves around the principle of unit operations such as filtration, coagulation and flocculation, centrifugation, cell disruption, adsorption, chromatography, distillation, crystallization and drying. This book is designed to serve as a reference book for students, researchers, professionals and others who work in the processing industries.

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. A rich array of methods and discussions of productive microbial processes. • Reviews of the newest techniques, approaches, and options in the use of microorganisms and other cell culture systems for the manufacture of pharmaceuticals, industrial enzymes and proteins, foods and beverages, fuels and fine chemicals, and other products. • Focuses on the latest advances and findings on the current state of the art and science and features a new section on the microbial production of biofuels and fine chemicals, as well as a stronger emphasis on mammalian cell culture methods. • Covers new methods that enhance the capacity of microbes used for a wide range of purposes, from winemaking to pharmaceuticals to

