

Shreves Chemical Process Industries

This book has proved its worth over the years as a text for courses in Production Management at the Faculty of Automotive Engineering in Turin, Italy, but deserves a wider audience as it presents a compendium of basics on Industrial Management, since it covers all major topics required. It treats all subjects from product development and “make or buy”-decision strategies to the manufacturing systems setting and management through analysis of the main resources needed in production and finally exploring the supply chain management and the procurement techniques. The very last chapter recapitulates the previous ones by analysing key management indicators to pursue the value creation that is the real purpose of every industrial enterprise. As an appendix, a specific chapter is dedicated to the basics of production management where all main relevant definitions, techniques and criteria are treated, including some numerical examples, in order to provide an adequate foundation for understanding the other chapters. This book will be of use not only to Automotive Engineering students but a wide range of readers who wish to gain insight in the world of automotive engineering and the automotive industry in general. Chemical Process Engineering presents a systematic approach to solving design problems by listing the needed equations, calculating degrees-of-freedom, developing calculation procedures to generate process

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specifications- mostly pressures, temperatures, compositions, and flow rates- and sizing equipment. This illustrative reference/text tabulates numerous easy-to-follow calculation procedures as well as the relationships needed for sizing commonly used equipment.

Soap Manufacturing Technology, Second Edition, is the most authoritative and up-to-date book on soap technology available today. Editor and contributing author Luis Spitz leads a world-renowned team in providing comprehensive information on all components of soap manufacturing including formulation,

performance evaluation, cleansing systems, and more.

This new edition includes two new chapters, Integrated Saponification and Drying Systems and Laundry Bars, and the others are completely revised and updated.

Includes new chapters and figures, tables, and text updated from the first edition Serves as a technical reference book ideal for both experienced and beginning soap producers and suppliers Provides an overview of the AOCS methods used for the evaluation of soap and soap products

Includes two new chapters on Integrated Saponification and Drying Systems and Laundry Bars

Introduction to Process Engineering and Design covers basic principles to design alternate systems, develop process diagrams and select the best alternative to be adopted. Multiple industrial examples provided in the book will enhance the skills of the readers for innovative designs. Salient Features:

- Focuses on process design of chemical plants and equipment
- State-of-the-art technique of supercritical extraction, reactive distillation, short path distillation discussed
- Process Flow-charts

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are provided throughout the book

Montgomery, Runger, and Hubele provide modern coverage of engineering statistics, focusing on how statistical tools are integrated into the engineering problem-solving process. All major aspects of engineering statistics are covered, including descriptive statistics, probability and probability distributions, statistical test and confidence intervals for one and two samples, building regression models, designing and analyzing engineering experiments, and statistical process control. Developed with sponsorship from the National Science Foundation, this revision incorporates many insights from the authors teaching experience along with feedback from numerous adopters of previous editions.

"The most complete, up-to-date, problem-solving toolkit for chemical engineers and process designers. Industrial Chemical Process Design, Second Edition provides a step-by-step methodology and 25 downloadable, customizable, needs-specific software applications that offer quick, accurate solutions to complex process design problems. These applications uniquely fill the gaps left by large, very expensive commercial process simulation software packages used to select, size, and design industrial chemical process equipment. Written by a hands-on industry consultant and featuring more than 200 illustrations, this book thoroughly details: Sizing and cost estimating of process unit operation equipment Design and rating of fractionation equipment and three-phase separation equipment Chemical optimization Commercial distillation Packaged plant cost analysis

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Estimating cost for modular packages Performing operations such as liquid-liquid extraction and gas liquid separation vessel sizing and rating Green engineering New to the Second Edition: Added focus on sustainability with new green engineering coverage: crude oil database; vegetable oils and plant greenhouse production for use in automobile fuels; gasoline and diesel fuel database; greenhouse fuels; water removal treatment in three-phase vessel design New focus on engineering economics Simplified shell/tube design method and improved shell/tube exchanger software improvements Fluid flow coverage includes both single- and two-phase flow and the very desirable addition of complete process engineering of NO_x removal and catalytic SCR reactor processes necessary in all electric generator power plants and refinery furnace systems (per mandatory EPA regulations) Coverage of the Fischer-Tropsch process converting natural methane gas to crude oil products, liquids, gasoline, diesel, and jet fuel - all sulfur-free! Includes a plan to decrease reliance on crude oil imports Contains a packaged cost analysis natural gas-to-liquids plant turn-key software program "-- This book bridges the gap between theory and practice. It provides fundamental information on heterogeneous catalysis and the practicalities of the catalysts and processes used in producing ammonia, hydrogen and methanol via hydrocarbon steam reforming. It also covers the oxidation reactions in making formaldehyde from methanol, nitric acid from ammonia and sulphuric acid from sulphur dioxide. Designed for use in the chemical industry and by those in teaching, research and

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the study of industrial catalysts and catalytic processes. Students will also find this book extremely useful for obtaining practical information which is not available in more conventional textbooks.

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Reading Explorer, a six-level reading series, prepares learners for academic success with highly visual, motivating National Geographic content that features real people, places, and stories. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Chemical Engineering Volume 2 covers the properties of particulate systems, including the character of individual particles and their behaviour in fluids. Sedimentation of particles, both singly and at high concentrations, flow in packed and fluidised beds and filtration are then examined. The latter part of the book deals with separation processes, such as distillation and gas absorption, which illustrate applications of the fundamental principles of mass transfer introduced in Chemical Engineering Volume 1. In conclusion, several techniques of growing importance - adsorption, ion exchange, chromatographic and membrane separations, and process intensification - are described. A logical progression of chemical engineering concepts, volume 2 builds on fundamental principles contained in Chemical Engineering volume 1 and these volumes are fully cross-referenced. Reflects the growth in complexity and stature of chemical engineering over the last few years. Supported with further reading at the end of each

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chapter and graded problems at the end of the book. Substantially revising and updating the classic reference in the field, this handbook offers a valuable overview and myriad details on current chemical processes, products, and practices. No other source offers as much data on the chemistry, engineering, economics, and infrastructure of the industry. The Handbook serves a spectrum of individuals, from those who are directly involved in the chemical industry to others in related industries and activities. It provides not only the underlying science and technology for important industry sectors, but also broad coverage of critical supporting topics. Industrial processes and products can be much enhanced through observing the tenets and applying the methodologies found in chapters on Green Engineering and Chemistry (specifically, biomass conversion), Practical Catalysis, and Environmental Measurements; as well as expanded treatment of Safety, chemistry plant security, and Emergency Preparedness. Understanding these factors allows them to be part of the total process and helps achieve optimum results in, for example, process development, review, and modification. Important topics in the energy field, namely nuclear, coal, natural gas, and petroleum, are covered in individual chapters. Other new chapters include energy conversion, energy storage, emerging nanoscience and technology. Updated sections include more material on biomass conversion, as well as three chapters covering biotechnology topics, namely, Industrial Biotechnology, Industrial Enzymes, and Industrial Production of Therapeutic Proteins.

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This book is designed to apprise the students of chemical engineering with a variety of different processes of chemical technologies. The book is richly illustrated and covers the essential information with the help of flow diagrams, enabling the students to gain a full understanding of both the fundamental concepts and chemical reactions involved in process technologies. Newer technologies have been dealt with and some technologies which have lost their relevance have been omitted. Computer simulation methods have been described for many important technologies. In short, the book considers computer design tools and design software, in a manner that integrates this knowledge smoothly into the main subject. The book is expected to become useful not only to the students for courses in Chemical Technology but also to practising engineers and process designers for innovative process development. There are topics on natural products and fermentation process chemicals, organic chemicals, inorganic chemicals, refinery operations, oil and gas operations and nanotechnology products. In some of these topics, computer simulation and costing examples are included. An illustration of modelling and simulation using C++, is also given as an example of user-written programs for simulation. Another method that can be used for simulation is the use of spreadsheets, which is also described with the help of an example. A new important topic of today being 'polysilicon' used in the manufacture of computer chips and solar panels, is also covered in detail.

Upper-level undergraduate text for process design

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courses in chemical engineering. Introduces students to the technology and terminology they will encounter in industrial practice. Presents short-cut techniques for specifying equipment or isolating important elements of a design project. Emphasizes project definition, flow sheet development and equipment specification. Covers the economics of process design. End-of-chapter exercises guide students through step-by-step solutions of design problems. Includes four case studies from past AIChE competitions.

Chemistry and chemical engineering have changed significantly in the last decade. They have broadened their scope into biology, nanotechnology, materials science, computation, and advanced methods of process systems engineering and control so much that the programs in most chemistry and chemical engineering departments now barely resemble the classical notion of chemistry. Beyond the Molecular Frontier brings together research, discovery, and invention across the entire spectrum of the chemical sciences from fundamental, molecular-level chemistry to large-scale chemical processing technology. This reflects the way the field has evolved, the synergy at universities between research and education in chemistry and chemical engineering, and the way chemists and chemical engineers work together in industry. The astonishing developments in science and engineering during the 20th century have made it possible to dream of new goals that might previously have been considered unthinkable. This book identifies the key opportunities and challenges for the chemical sciences, from basic research to societal needs

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and from terrorism defense to environmental protection, and it looks at the ways in which chemists and chemical engineers can work together to contribute to an improved future.

This textbook is targeted to undergraduate students in chemical engineering, chemical technology, and biochemical engineering for courses in mass transfer, separation processes, transport processes, and unit operations. The principles of mass transfer, both diffusional and convective have been comprehensively discussed. The application of these principles to separation processes is explained. The more common separation processes used in the chemical industries are individually described in separate chapters. The book also provides a good understanding of the construction, the operating principles, and the selection criteria of separation equipment. Recent developments in equipment have been included as far as possible. The procedure of equipment design and sizing has been illustrated by simple examples. An overview of different applications and aspects of membrane separation has also been provided. 'Humidification and water cooling', necessary in every process industry, is also described. Finally, elementary principles of 'unsteady state diffusion' and mass transfer accompanied by a chemical reaction are covered.

SALIENT FEATURES :

- A balanced coverage of theoretical principles and applications.
- Important recent developments in mass transfer equipment and practice are included.
- A large number of solved problems of varying levels of complexities showing the applications of the theory are

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included. • Many end-chapter exercises. • Chapter-wise multiple choice questions. • An Instructors manual for the teachers.

With an emphasis on passive sampling, this volume focuses on the environmental monitoring for common gaseous pollutants. It offers an overview of the history and nature of pollutants of concern to museums and the challenges facing scientists, conservators, and managers seeking to develop target pollutant guidelines to protect cultural property.

The petrochemical industry is a scientific and engineering field that encompasses the production of a wide range of chemicals and polymers. The purpose of this book is not only to provide a follow-on to form the later chapters of the highly successful Chemistry and Technology of Petroleum 5th Edition but also provides a simplified approach to a very diverse chemical subject dealing with the chemistry and technology of various petroleum and petrochemical process. Following from the introductory chapters, this book provides the readers with a valuable source of information containing insights into petrochemical reactions and products, process technology, and polymer synthesis. Provides readers with a valuable source of information containing insights into petrochemical reactions and products, process technology, and polymer synthesis Introduces the reader to the various petrochemical intermediates are generally produced by chemical conversion of primary petrochemicals to form more complicated derivative products The reactions and processes involved in transforming petroleum-based hydrocarbons into the chemicals that form the basis of the multi-billion dollar petrochemical industry are reviewed and described The book includes information on new process developments for the production of raw materials and intermediates for petrochemicals Includes a description of the origin of the raw

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materials for the petrochemicals industry – including an overview of the coal chemicals industry

The importance of industrial chemistry Chemistry is a challenging and interesting subject for academic study. Its principles and ideas are used to produce the chemicals from which all manner of materials and eventually consumer products are manufactured. The diversity of examples is enormous, ranging from cement to iron and steel, and on to modern plastics which are so widely used in the packaging of consumer goods and in the manufacture of household items. Indeed life as we know it today could not exist without the chemical industry. Its contribution to the saving of lives and relief of suffering is immeasurable; synthetic drugs such as those which lower blood pressure (e. g. β -blockers), attack bacterial and viral infections (e. g. antibiotics such as the penicillins and cephalosporins) and replace vital natural chemicals which the body is not producing due to some malfunction (e. g. insulin, some vitamins), are particularly noteworthy in this respect. Effect chemicals also clearly make an impact on our everyday lives. Two examples are the use of polytetrafluoroethylene (polytetrafluoroethene Teflon or Fluon) to provide a non-stick surface coating for cooking utensils, and silicones which are used to ease the discharge of bread from baking tins. It should also be noted that the chemical industry's activities have an influence on all other industries, either in terms of providing raw materials or chemicals for quality control analyses and to improve operation, and to treat boiler water, cooling water and effluents.

This book is the author's attempt to translate his knowledge of peace studies into the language of sociology, so that the former can be grasped as a more complete whole. It aims to increase interest among sociologists in issues of war and peace because they provide food for sociological thought.

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This volume is devoted to exploring a subject which, on the surface, might appear to be just a trending topic. In fact, it is much more than a trend. It relates to an ancient, permanent issue which directly connects with people's life and basic needs: the recognition and protection of individuals' dignity, in particular the inherent worthiness of the most vulnerable human beings. The content of this book is described well enough by its title: 'Human Dignity of the Vulnerable in the Age of Rights'. Certainly, we do not claim that only the human dignity of vulnerable people should be recognized and protected. We rather argue that, since vulnerability is part of the human condition, human vulnerability is not at odds with human dignity. To put it simply, human dignity is compatible with vulnerability. A concept of human dignity which discards or denies the dignity of the vulnerable and weak is at odds with the real human condition. Even those individuals who might seem more skilled and talented are fragile, vulnerable and limited. We need to realize that human condition is not limitless. It is crucial to re-discover a sense of moderation regarding ourselves, a sense of reality concerning our own nature. Some lines of thought take the opposite view. It is sometimes argued that humankind is – or is called to be – powerful, and that the time will come when there will be no vulnerability, no fragility, no limits at all. Human beings will become like God (or what believers might think God to be). This perspective rejects human vulnerability as an intrinsic evil. Those who are frail or weak, who are not autonomous or not able to care for themselves, do not possess dignity. In this volume it is claimed that vulnerability is an inherent part of human condition, and because human dignity belongs to all individuals, laws are called to recognize and protect the rights of all of them, particularly of those who might appear to be more vulnerable and fragile.

Drawing from the best of the widely dispersed literature in the

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field and the author's vast professional knowledge and experience, here is today's most exhaustive, one-stop coverage of the fundamentals, design, installation, and operation of industrial refrigeration systems. Detailing the industry changes caused by the conversion from CFCs to non-ozone-depleting refrigerants and by the development of microprocessors and new secondary coolants, *Industrial Refrigeration Handbook* also examines multistage systems; compressors, evaporators, and condensers; piping, vessels, valves and refrigerant controls; liquid recirculation; refrigeration load calculations; refrigeration and freezing of food; and safety procedures. Offering a rare compilation of thermodynamic data on the most-used industrial refrigerants, the Handbook is a mother lode of vital information and guidance for every practitioner in the field.

The fourth edition of Ludwig's *Applied Process Design for Chemical and Petrochemical Plants, Volume Three* is a core reference for chemical, plant, and process engineers and provides an unrivalled reference on methods, process fundamentals, and supporting design data. New to this edition are expanded chapters on heat transfer plus additional chapters focused on the design of shell and tube heat exchangers, double pipe heat exchangers and air coolers. Heat tracer requirements for pipelines and heat loss from insulated pipelines are covered in this new edition, along with batch heating and cooling of process fluids, process integration, and industrial reactors. The book also looks at the troubleshooting of process equipment and corrosion and metallurgy. Assists engineers in rapidly analyzing problems and finding effective design methods and mechanical specifications. Definitive guide to the selection and design of various equipment types, including heat exchanger sizing and compressor sizing, with established design codes. Batch heating and cooling of process fluids supported by Excel

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programs

This latest edition covers the technical performance and mechanical details of converting the chemical and petrochemical process into appropriate hardware for distillation and packed towers. It incorporates recent advances and major innovations in distillation contacting devices and features new generations of packing. In addition, this new edition reflects the significant progress that has been made in process design techniques in recent years. Volume 2's example calculation techniques guide in the preparation of preliminary and final rating designs. In some instances, the book includes manufacturers' procedures and notes clearly indicate when manufacturers should verify results. Covers distillation and packed towers, and contains material on azeotropes and ideal and non-ideal systems Includes important findings from recent literature to illustrate alternate design methods New illustrations and rating charts

Survey of Industrial Chemistry arose from a need for a basic text dealing with industrial chemistry for use in a one semester, three-credit senior level course taught at the University of Wisconsin-Eau Claire. This edition covers all important areas of the chemical industry, yet it is reasonable that it can be covered in 40 hours of lecture. Also an excellent resource and reference for persons working in the chemical and related industries, it has sections on all important technologies used by these industries: a one-step source to answer most questions on practical, applied chemistry. Young scientists and engineers just entering the workforce will find it especially useful as a readily available handbook to prepare them for a type of chemistry quite different than they have seen in their traditional coursework, whether graduate or undergraduate.

Sre Shreves Chemical Process Industries Handbook,
5/EMcGraw-Hill Education

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Pigments, corrosion products, and minerals are usually considered separately, either as painting materials or as the deterioration products of metals, even though they are often the same compounds. This 190-year review of the literature on copper and its alloys integrates that information across a broad spectrum of interests that are all too frequently compartmentalized. The author discusses the various environmental conditions to which copper alloy objects may be exposed—including burial, outdoor, and indoor museum environments—and the methods used to conserve them. The book also includes information on ancient and historical technologies, the nature of patina as it pertains to copper and bronze, and the use of copper corrosion materials as pigments. Chapters are organized primarily by chemical corrosion products and include topics such as early technologies, copper chlorides and bronze disease, the chemistry and history of turquoise, Egyptian blue and other synthetic copper silicates, the organic salts of copper in bronze corrosion, and aspects of bronze patinas. A detailed survey of conservation treatments for bronze objects is also provided. Four appendixes cover copper and bronze chemistry, replication experiments for early pigment recipes, a list of copper minerals and corrosion products, and X-ray diffraction studies.

Want to become a truly great trader – either for yourself or for a proprietary trading firm? This book will help you get there. This unique approach is the closest thing to signing up for a “trader boot camp” yourself! You’ll learn by watching new traders walk through actual trades, explain what they’ve tried to do, and try to survive brutally tough expert critiques. One trade at a time, *The Playbook* reveals how professional traders must think in order to succeed “under fire,” how they assess their own performance, and how they work relentlessly to improve. Using concrete, actionable setups

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drawn from his extensive trading and training experience, Bellafiore walks through an extraordinary array of trades, showing readers how to maximize profits and avoid disastrous hidden pitfalls. He covers support plays, bull-and-bear flags, opening drives, important intraday levels, bounce and fade trades, pullbacks, scalps, technical opportunities, consolidation, relative strength, market trades, and more. He also presents indispensable insights on psychology and trader development, based on his work with hundreds of traders on a major commodity exchange and an elite prop firm's trading desk. Packed with color, personality, and realism, this is an exciting guide to real-world trading.

This book earns its name! Over the course of 172 pages, I have taken all the great material in the first ed, and added to it a series of recipes and procedures which are very low profile and stunningly effective. This treasure trove of information features the Hardware Store Nitro recipe, fuel/air explosives, butt kicking ammonium nitrate formulations, nitromethane mixtures and a vastly improved detonator section. The fun doesn't stop there either. Read all about the construction of remote control cruise missiles and RC torpedoes. Claymore mines and air cannons add spice to the stew. Then top it off with my commentary on the easiest way to obtain all the materials one would need. I've read all the books on the topic of explosives, from tiny paperbacks to 600 page volumes written by PhDs. I have no hesitation saying I've topped them all!

The cleaning of a work of art often involves removing not only dirt and grime but also unwanted layers of varnish, gilding, and paint from the work's surface. The challenge for conservators lies in finding a cleaning agent that will act on one layer without affecting the layer being preserved and without leaving any harmful residues on the cleaned work. This book, which examines gel cleaning in the treatment of

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paintings and painted works of art, presents the methodologies, data, and results of a collaborative project of the Getty Conservation Institute and Winterthur Museum. Among the issues covered are the theory and application of gel cleaning systems, the detection of residues left on the surfaces of objects cleaned with these systems, research into solvent-gel and solvent residues, stability of surfactants during natural and artificial aging, and recommendations for formulating gels for specific cleaning tasks.

What makes a family? That's what twelve-year-old Nicky Dillon wonders after she and her widowed father discover a wailing abandoned baby in the snow-filled woods near their New Hampshire home. Through the days that follow, the Dillons and an unexpected visitor who soon turns up at their door—a young woman evidently haunted by her own terrible choices—face a thicket of decisions, each seeming to carry equal possibilities of heartbreak and redemption. Writing with all the emotional resonance that has drawn millions of readers around the world to her fiction, Anita Shreve unfolds in *Light on Snow* a tender and surprising novel about love and its consequences.

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

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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 book is about Sulph(on)ation Technology in its technical entirety, aiming at superiority in final product quality, raw material utilisation, sustained plant reliability and safety, minimisation of liquid effluent and gaseous emissions; it is about the total quality of the operation. It will be of value to engineers and chemists who are, or will be, involved in the practical daily operation of sulphonation plants or R&D activities. The book can also be used as a tool for the teacher in preparing final year projects in a chemical engineering curriculum. The book covers sulphonation of alkylbenzenes, primary alcohols, alcohol ethers, alpha-olefins and fatty acid methyl esters, with a strong emphasis on the sulphur-based S₂/air sulphonation technology. The first part deals with raw material specifications, hazards, storage, handling and physical properties. In the following section the process chemistry is discussed, indicating main chemical reactions, undesired parallel and consecutive reactions, exothermal heat effects and all other process chemistry data that are

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relevant for process selection and equipment design. The section about the actual process equipment from the various plant equipment suppliers (Ballestra, Chemithon, Mazzoni, Meccaniche Modeme and Lion Corp.) takes into account the chemical reaction engineering aspects derived from the sulphonation technology processing chemistry. Product quality, product storage and handling, product safety and physical properties are the contents of the next section. The effluent handling and exhaust gas treatment of the SO₂ air sulphonation technology are further discussed in detail. The impact of light on works of art and archival materials has long been an issue of concern to conservators and other museum professionals, yet the literature on this subject has never been systematically reviewed. This volume fills that gap by providing a survey of the impact of exposure to light with an emphasis on photoflash and reprographic sources. The information provided will assist the professional audience, especially conservators and collections managers, in assessing the risk to art and archival objects of such exposures. The text surveys relevant photophysical and photochemical principles, photometric and radiometric measurement, and the spectral outputs of several light sources. Materials discussed include colorants and natural fibers; pulp, paper, and wood; natural and synthetic polymers; fluorescent whitening agents; photographic and reprographic materials; and objects containing combinations of materials. Approximations and assumptions used in the evaluation process are discussed in some detail, with examples of the different types of calculations. The Research in Conservation reference series presents the findings of research conducted by the Getty Conservation Institute and its individual and institutional research partners, as well as state-of-the-art reviews of conservation literature. Each volume covers a topic of current interest to conservators and conservation

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scientists.

This volume is a valuable reference work for the student and the practising engineer in the chemical, pharmaceutical, minerals, food, plastics, paper and metallurgical industries. The second edition of this successful text has been thoroughly rewritten and updated. Based on the long running post-experience course produced by the University of Bradford, in association with the Institution of Chemical Engineers, it covers all aspects of mixing, from fundamentals through to design procedures in single and multi-phase systems. Experts from both industry and academia have contributed to this work giving both a theoretical practical approach. It covers dry and wet powders, single and two-phase liquids, solid/liquid and gas/liquid systems. The range of mixers available for such diverse duties is dealt with, including tumbler mixers for powders, mechanically agitated vessels, in-line continuous mixers and jet mixers. Coverage is given of the range of mixing objectives, varying from achieving product uniformity to obtaining optimum conditions for mass transfer and chemical reactions. This volume is a valuable reference work for the student and the practising engineer in the chemical, pharmaceutical, minerals, food, plastics, paper and metallurgical industries. The second edition of this successful text has been thoroughly rewritten and updated. Based on the long running post-experience course produced by the University of Bradford, in association with the Institution of Chemical Engineers, it covers all aspects of mixing, from fundamentals through to design procedures in single and multi-phase systems. Experts from both industry and academia have contributed to this work giving both a theoretical practical approach. It covers dry and wet powders, single and two-phase liquids, solid/liquid and gas/liquid systems. The range of mixers available for such diverse duties is dealt with, including tumbler mixers for

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powders, mechanically agitated vessels, in-line continuous mixers and jet mixers. Coverage is given of the range of mixing objectives, varying from achieving product uniformity to obtaining optimum conditions for mass transfer and chemical reactions.

Designed as an undergraduate-level textbook in Chemical Engineering, this student-friendly, thoroughly class-room tested book, now in its second edition, continues to provide an in-depth analysis of chemical engineering thermodynamics. The book has been so organized that it gives comprehensive coverage of basic concepts and applications of the laws of thermodynamics in the initial chapters, while the later chapters focus at length on important areas of study falling under the realm of chemical thermodynamics. The reader is thus introduced to a thorough analysis of the fundamental laws of thermodynamics as well as their applications to practical situations. This is followed by a detailed discussion on relationships among thermodynamic properties and an exhaustive treatment on the thermodynamic properties of solutions. The role of phase equilibrium thermodynamics in design, analysis, and operation of chemical separation methods is also deftly dealt with. Finally, the chemical reaction equilibria are skillfully explained. Besides numerous illustrations, the book contains over 200 worked examples, over 400 exercise problems (all with answers) and several objective-type questions, which enable students to gain an in-depth understanding of the concepts and theory discussed. The book will also be a useful text for students pursuing courses in chemical engineering-related branches such as polymer engineering, petroleum engineering, and safety and environmental engineering. New to This Edition • More Example Problems and Exercise Questions in each chapter • Updated section on Vapour–Liquid Equilibrium in Chapter 8 to highlight the

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significance of equations of state approach • GATE Questions up to 2012 with answers

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