

CHEMICAL PRODUCT DESIGN

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12.1 INTRODUCTION

Chemical product design (CPD) emerged in the last years as a challenging activity of chemists and chemical engineers. The first teaching book devoted to this discipline was written only recently by Cussler and Moggridge (2001), for which the second edition is available (2011). Two monographs have been published regarding the scientific aspects, such as property estimation (Kontogeorgis and Gani, 2004) and case studies (Ng et al., 2007). A number of universities propose today CPD courses as either stand-alone or integrated in the process design course.

The concepts in this area are still in development, as well as the teaching methods. In the last years, there is a tendency to integrate chemical product and process design in a broader view. As advocated by Seider et al. (2009a,b) "all designs involving chemicals and their applications are properly referred to as product design, with process design being a subset of the product development process; in most cases, the new chemical products require new or adapted manufacturing options; for product design, design teams are challenged to create process designs". This viewpoint is shared in this chapter.

In approaching the subject, a clear distinction has to be made between *commodities* and *speciality products*. Commodities are produced on large scale, over 10,000 tons per year. The key issue is a competitive product price, in general of reduced margin. The process design is based on classical unit operations, and looks primarily for the optimisation of the capital and operation costs. The major design constraints are the nature and the costs of raw materials and energy, as well the environmental legislation. Most of the innovation opportunities today regard how to use low-cost feedstock and renewable raw materials. Some commodities are in fact large-scale chemical products, as, for example, the transportation fuels that result from blending various hydrocarbon fractions to the same end-user properties.

When designing a chemical speciality product, the key issue is the satisfaction of the customer's needs by its usage properties. Consequently, a chemical speciality product has the advantage of a weaker correlation of the selling price with the manufacturing costs. As a result, a lower manufacturing rate, but much higher added value, may lead to significant profit opportunities. The speciality products are based in general on the chemical properties of complex molecules, such as pharmaceuticals, agrochemicals, polymers, etc., as well as on the physical properties of microstructures resulting from the interactions of components in mixtures, such as paints, skin care products, paper goods, etc. Some speciality products may originate from commodities modified by the adjunction of other chemicals, such as additives, activators, binders, etc. For example, higher quality paints can be manufactured from commodity latex by adding suitable ingredients in view of modifying the rheology and the coating properties.

Chemical Product Design

Ka M. Ng, Rafiqul Gani, Kim Dam-Johansen

Chemical Product Design Chemical Product Design:

Chemical Product Design E. L. Cussler,G. D. Moggridge,2011-05-12 The chemical industry is changing going beyond commodity chemicals to a palette of higher value added products This groundbreaking book now revised and expanded documents this change and shows how to meet the challenges implied Presenting a four step design process needs ideas selection manufacture the authors supply readers with a simple design template that can be applied to a wide variety of products Four new chapters on commodities devices molecules drugs and microstructures show how this template can be applied to products including oxygen for emphysema patients pharmaceuticals like taxol dietary supplements like lutein and beverages which are more satisfying For different groups of products the authors supply both strategies for design and summaries of relevant science Economic analysis is expanded emphasizing the importance of speed to market selling ideas to investors and an expectation of limited time in the market Extra examples homework problems and a solutions manual are available

Chemical Product Formulation Design and Optimization Ali Elkamel,Hesham Alhumade,Navid Omidbakhsh,Keyvan Nowruzi,Thomas Duever,2023-01-17 Chemical Product Formulation Design and Optimization Explore the cutting edge in chemical product formulation and design In Chemical Product Formulation Design and Optimization Methods Techniques and Case Studies a team of renowned technologists and engineers delivers a practice guide to chemical product design Offering real world case studies for disinfectant formulation the optimization of defined media and the formulation of biocomposites the book contains introduction to the current product design process In addition to the background of related statistical techniques readers will find Clear illustrations figures and tables that improve understanding and retention of critical topics Thorough introductions to the mathematical principles of chemical product design A complete examination of intellectual property considerations in the chemical product design process Ideal for process and chemical engineers Chemical Product Formulation Design and Optimization Methods Techniques and Case Studies is a must read resource for professionals in the pharmaceutical and cosmetics industry as well as chemical engineers working in the food paint and dye industries who seek a one stop resource that includes the latest advances in chemical product formulation

[Introduction to Chemical Product Design](#) Nishanth G. Chemmangattuvalappil,Jecksin Ooi,Mario R. Eden,2026-03-19 Chemical engineering has traditionally focused on design of chemical processes to produce commodity chemicals but there has been more attention on engineering high performance chemical products This book covers chemical product design explains the role of chemical engineers and explains approaches to design different chemical products

[Tools For Chemical Product Design](#) Mariano Martín Martín,Mario R. Eden,Nishanth G. Chemmangattuvalappil,2016-09-19 Tools for Chemical Product Design From Consumer Products to Biomedicine describes the challenges involved in systematic product design across a variety of industries and provides a comprehensive overview of mathematical tools aimed at the design of chemical products from molecular design to customer products Chemical product

design has become increasingly important over the past decade and includes a wide range of sectors including gasoline additives and blends in the petroleum industry active ingredients and excipients in the pharmaceutical industry and a variety of consumer products and specialty chemicals Traditionally such products have been designed through trial and error methods which not only are time consuming but more importantly only provide limited knowledge that can be translated into next generation products Features an impressive collection of contributions from leading researchers in the field Presents the latest tools available across a variety of industries Describes the challenges involved in systematic product design as well as the latest methods for solving such problems Covers a wide range of sectors including gasoline additives and blends in the petroleum industry active ingredients and excipients in the pharmaceutical industry and a variety of consumer products and specialty chemicals

Chemical Product Design: Towards a Perspective through Case Studies Ka M. Ng, Rafiqul Gani, Kim Dam-Johansen, 2006-10-24 Chemical Product Design Towards a Perspective through Case Studies provides a framework for chemical product design problems which are clearly defined together with different solution approaches This book covers the latest methods and tools currently available in the field and discusses future challenges that the chemical industry is faced with It focuses on important issues of chemical product design and provides a good overview on industrial chemical product design problems through case studies supplied by leading experts The editors of Chemical Product Design teach chemical product design at graduate level courses and also serve as consultants for various chemical companies They have also developed experimental techniques for chemical product design as well as computer aided design methods and tools

Highlights important issues of chemical product design through case studies Case studies supplied by leading experts in chemical product design Provides a complete framework for chemical product design

Product-Driven Process Design

Edwin Zondervan, Cristhian Almeida-Rivera, Kyle Vincent Camarda, 2020-01-20 Product driven process design from molecule to enterprise provides process engineers and process engineering students with access to a modern and stimulating methodology to process and product design Throughout the book the links between product design and process design become evident while the reader is guided step by step through the different stages of the intertwining product and process design activities Both molecular and enterprise wide considerations in design are introduced and addressed in detail Several examples and case studies in emerging areas such as bio and food systems pharmaceuticals and energy are discussed and presented This book is an excellent guide and companion for undergraduate graduate students as well as professional practitioners

Chemical Product Formulation Design and Optimization Ali Elkamel, Hesham Alhumade, Navid Omidbakhsh, Keyvan Nowruzi, Thomas Duever, 2023-01-09 Chemical Product Formulation Design and Optimization Explore the cutting edge in chemical product formulation and design In Chemical Product Formulation Design and Optimization Methods Techniques and Case Studies a team of renowned technologists and engineers delivers a practice guide to chemical product design Offering real world case studies for disinfectant formulation the optimization of defined media and the

formulation of biocomposites the book contains introduction to the current product design process In addition to the background of related statistical techniques readers will find Clear illustrations figures and tables that improve understanding and retention of critical topics Thorough introductions to the mathematical principles of chemical product design A complete examination of intellectual property considerations in the chemical product design process Ideal for process and chemical engineers Chemical Product Formulation Design and Optimization Methods Techniques and Case Studies is a must read resource for professionals in the pharmaceutical and cosmetics industry as well as chemical engineers working in the food paint and dye industries who seek a one stop resource that includes the latest advances in chemical product formulation **Product Design and Engineering** Ulrich Bröckel,Willi Meier,Gerhard Wagner,2013-08-02

Covering the whole value chain from product requirements and properties via process technologies and equipment to real world applications this reference represents a comprehensive overview of the topic The editors and majority of the authors are members of the European Federation of Chemical Engineering with backgrounds from academia as well as industry Therefore this multifaceted area is highlighted from different angles essential physico chemical background latest measurement and prediction techniques and numerous applications from cosmetic up to food industry Recommended reading for process pharma and chemical engineers chemists in industry and those working in the pharmaceutical food cosmetics dyes and pigments industries **Chemical Product Design** Joseph A. Shaeiwitz,2000 *Product and Process Design Principles* Warren D. Seider,J. D. Seader,Daniel R. Lewin,Soemantri Widagdo,2016-04-18 The new 4th edition of Seider s Product and Process Design Principles Synthesis Analysis and Design covers content for process design courses in the chemical engineering curriculum showing how process design and product design are inter linked and why studying the two is important for modern applications A principal objective of this new edition is to describe modern strategies for the design of chemical products and processes with an emphasis on a systematic approach This fourth edition presents two parallel tracks 1 product design what to make and 2 process design how to make with an emphasis on process design Process design instructors can show easily how product designs lead to new chemical processes Alternatively product design can be taught in a separate course subsequent to the process design course adapted from description on publisher web site

Product and Process Design Principles Warren D. Seider,J. D. Seader,Daniel R. Lewin,2003-07-24 One of the most important objective in this text describes the strategies and approaches for the design of chemical processes It covers economic optimization and environmental issues The latest design strategies are described most of which have been improved significantly with the advent of computers mathematical programming methods and artificial intelligence Various methods are utilized to perform the extensive calculations and provide graphical results that are visualized easily including the usage of computer programs for simulation and design optimization **Chemical Engineering in the Pharmaceutical Industry** Mary T. am Ende,David J. am Ende,2019-04-08 A guide to the important chemical engineering concepts for the development

of new drugs revised second edition The revised and updated second edition of Chemical Engineering in the Pharmaceutical Industry offers a guide to the experimental and computational methods related to drug product design and development The second edition has been greatly expanded and covers a range of topics related to formulation design and process development of drug products The authors review basic analytics for quantitation of drug product quality attributes such as potency purity content uniformity and dissolution that are addressed with consideration of the applied statistics process analytical technology and process control The 2nd Edition is divided into two separate books 1 Active Pharmaceutical Ingredients API s and 2 Drug Product Design Development and Modeling The contributors explore technology transfer and scale up of batch processes that are exemplified experimentally and computationally Written for engineers working in the field the book examines in silico process modeling tools that streamline experimental screening approaches In addition the authors discuss the emerging field of continuous drug product manufacturing This revised second edition Contains 21 new or revised chapters including chapters on quality by design computational approaches for drug product modeling process design with PAT and process control engineering challenges and solutions Covers chemistry and engineering activities related to dosage form design and process development and scale up Offers analytical methods and applied statistics that highlight drug product quality attributes as design features Presents updated and new example calculations and associated solutions Includes contributions from leading experts in the field Written for pharmaceutical engineers chemical engineers undergraduate and graduation students and professionals in the field of pharmaceutical sciences and manufacturing Chemical Engineering in the Pharmaceutical Industry Second Edition contains information designed to be of use from the engineer s perspective and spans information from solid to semi solid to lyophilized drug products

Product and Process

Design Principles Warren D. Seider,J. D. Seader,Daniel R. Lewin,Soemantri Widagdo,2008-12-22 Armed with this book chemical engineers will have a collection of modern strategies for the design of chemical products and processes It emphasizes a systematic approach and integrates product design more thoroughly throughout the chapters New case studies on process design are included to make the concepts more relevant The social aspects and economics of product design are introduced and the Stage Gate Product Development Process is explored in parallel tracks for several chemical products The accompanying registration card grants access to a companion website that also provides chemical engineers with numerous examples of the simulator input and output with frame by frame instructions to discuss the nature of the models provided for the processing units

Chemical Engineering Design Gavin Towler,Ray Sinnott,2008 Product Description Chemical Engineering Design is a complete course text for students of chemical engineering Written for the Senior Design Course and also suitable for introduction to chemical engineering courses it covers the basics of unit operations and the latest aspects of process design equipment selection plant and operating economics safety and loss prevention It is a textbook that students will want to keep through their undergraduate education and on into their professional lives Provides students with a text of

unmatched relevance for the Senior Design Course and Introductory Chemical Engineering Courses Teaches commercial engineering tools for simulation and costing Comprehensive coverage of unit operations design and economics Strong emphasis on HS 108 realistic commercial design projects from diverse industries A rigorous pedagogy assists learning with detailed worked examples end of chapter exercises plus supporting data and Excel spreadsheet calculations plus over 150 Patent References for downloading from the companion website Extensive instructor resources include lecture slides image bank and solutions manual for adopting instructors For further information <http://textbooks.elsevier.com>

Chemical Product Design, Engineering and Development Prof, Ton Broekhuis,2012-07-13

Product Design and Engineering Ulrich Bröckel,Willi Meier,Gerhard Wagner,2007-04-09

Covering the whole value chain from product requirements and properties via process technologies and equipment to real world applications this two volume work represents a comprehensive

overview of the topic The editors and majority of the authors are members of the European Federation of Chemical Engineering and they describe here best practice in product design and production taking in fundamentals technologies and applications The first volume is devoted to basics and technologies while volume two looks at raw materials additives and applications Various industrial examples illustrate the different cases treated with contributions from DSM Novozym BASF Abbott Degussa Bayer Unilever and Syngenta Recommended reading for process pharma and chemical engineers chemists in industry and those working in the pharmaceutical food cosmetics dyes and pigments industries

The Marketing of Chemical Products Robert Sancier Aries,William Copulsky,1948

Chemical Product Design, Engineering and Development Prof. Ton Broekhuis,2012-07-13

Product and Process Design Jan Harmsen,André B. de Haan,Pieter L. J.

Swinkels,2024-05-20 Product and process design driving sustainable innovation is the 2nd edition of a comprehensive textbook for product and process design courses at BSc MSc EngD and PhD level It covers both heuristics based design methods as well as systems engineering approaches It contains specific methods to co design products and processes so that both designs are better than when these designs are made separately This integrated combination makes the book unique For making designs that contribute to the Sustainable Development Goals of the United Nations specific methods are provided for the People Planet and Prosperity dimensions This second edition of the book includes examples and exercises for each design method which makes it very suitable for teaching purposes The book is furthermore of interest to industrial process and product developers for many industry branches as it provides methods for design modelling and experimental validation for each innovation stage It is also very useful for R D managers as it provides guidelines for essential activities in each innovation stage discovery concept feasibility development detailed engineering leading to successful implementations of new processes and new products

The Chemical Trade Journal and Chemical Engineer ,1925

Chemical Product Design Chemical Product Design Book Review: Unveiling the Magic of Language

In an electronic digital era where connections and knowledge reign supreme, the enchanting power of language has been much more apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is actually remarkable. This extraordinary book, aptly titled "**Chemical Product Design Chemical Product Design**," published by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we will delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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