



Book review

PRODUCT DESIGN AND ENGINEERING
Best Practices
Volume 1: Basics and technologies

Ulrich Bröckel, Willi Meier and Gerhard Wagner (Editors)

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Product Design and Engineering emerged as a necessity to refine a very broad interpretation of this concept which is employed more and more in scientific papers. With this idea in mind, the editors Ulrich Bröckel, Willi Meier and Gerhard Wagner tried to summarize the basic technologies and typical product examples in the field of chemical product design in one book. The overall objective of this two-volume book is to give an overview of the basic knowledge and the related basic technologies which are essential in product-design area, as well as to discuss in more detail how product design is carried out in reality.

The first volume provides a reliable description of the state-of-the-art in product design and engineering by gathering together experts from universities, research institutes and industry and asking them to present the state of different technologies.

In the first chapter, *Introduction*, the editors motivate their efforts in writing this book that product design and especially chemical product design is of vital importance for chemistry and chemical engineering, especially to the economic evolution of the global chemical product market but also to the environmental aspects. Also, the editors present the structure of the book series, showing that the first volume is divided into two parts: basics and fundamentals, and technologies.

The first part of the volume, dedicated to the basic and fundamentals of chemical engineering, starts in chapter 2, with an extensive presentation of the Interactions Forces between Particles, written by Helmar Schubert because interaction forces are essential for the understanding of particle technology

and especially for the formulation of powder materials, a cutting-edge domain in the last years.

Chapter 3, written by Joachim Ulrich and Matthew J. Jones, presents the fundamentals of crystallization with an emphasis on the production of solids and product design. The chapter covers the thermodynamic and kinetic fundamentals of crystallization. Particular attention is paid to polymorphism and salvation states of crystalline solids, physical properties and characteristics of crystalline materials. The authors also focus on methods and strategies to manipulate the crystalline material's properties with respect to the product design principles.

In chapter 4, Heike P. Schumann presents the emulsification techniques for the formulation of emulsions and suspensions. Product design is very important in this field because emulsions and suspensions are products that need special attention in both picking the right ingredients and choosing and controlling the formulation parameters. This chapter depicts the design of emulsions with respect to target consumers and process needs and it covers the basic technologies, processes and property functions that are available to date.

Reinhard Polke and Michael Schafer present in chapter 5 an extensive characterization of disperse systems. The determination and control of disperse systems properties for process design is of crucial importance because the property and process functions of disperse systems must be determined in advance. Characterization of disperse systems depends on four major aspects: the sampling procedure, the sample treatment, the selection of and appropriate measurement technique and the correlation of particle properties and measures values.

Special attention is given to the measurement technologies of physical properties of particulate systems.

Chapter 6 opens the second part of this volume which is dedicated to basic technologies. Jonathan P.K. Seville, Peter J. Fryer and Ian T. Norton present in this chapter an introduction to the technologies used for structuring chemical products. Their review concentrates on agglomerated solid products and liquid-rich "soft solids", which are mostly specific for the food, pharmaceutical and speciality industries. For these two product categories it is important to develop a microstructure and to maintain this microstructure and the authors focus on strategies and methods to achieve these objectives.

Matthias Kind and Jens Stein present in Chapter 7 the product design by spray drying. Spray drying is a commonly used process for the production of powder products from suspensions, emulsions or solutions. The chapter covers the process fundamentals, including thermodynamics and kinetics, droplet formation and transformation mechanisms. The last section of the chapter is dedicated to an extensive presentation of the control of product properties by design and operation of spray-drying.

Chapter 8 is dedicated to wet granulation in agitated processes. This chapter is divided into three parts: the first part deals with a general presentation of the bonding mechanisms and the binding forces that are responsible of the agglomerate growth in the agitated wet granulation processes. The second and third parts concern the coating and granulation of solid particles by aqueous solutions of polymers or inorganic salts, aiming to understand the effects of process-related variables and physicochemical-related variables.

In chapter 9, Ulrich Brockel extensively presents the compaction process, which is as a well-established technology in the solids industry to obtain products with a defined shape. The first section of the chapter covers the compaction process fundamentals, while the second and the third are dedicated to the roller-press operating systems and the tableting process, respectively.

Chapter 10, *Extrusion Technology for Product Design*, written by Bernhard van Lengerich, Friedrich Meuser and Christine Ng, focuses on some key mechanical features of twin-screw extruders which are used for the extrusion of biopolymers. A systems analytical approach that can be applied to product development and analysis, process optimization and scale-up is thoroughly described.

Jorg Rosenberg presents in chapter 11 the melt-extrusion technology used in manufacturing of pharmaceutical dosage forms, as an emerging opportunity for improving pharmaceutical products by using the intrinsic thermoplasticity of polymers, enabling direct shaping of pharmaceutical tablets from a drug-containing melt.

Chapter 12, *Modeling of Chemical Systems to Predict Product Properties* is written by Rafiqul Gani and Jens Abildskov. The objective of this chapter is to highlight the use and role of property models in solving various types of chemicals of chemical product design problems. Emphasis is placed on the prediction of the needed properties and the models that may be used, rather than the solution if the product design problem. The chapter is divided into three main sections: a discussion if the property model needs for typical chemical product design problems, followed by a presentation of which models can be used and how they can be adapted for special needs of chemical product design and finally examples of applications of property models used in various product design calculations.

The first volume of the book ends in chapter 13 with a review by David Nicolaidis on knowledge management and decision support in product development. Starting from the concept that an efficient manufacturing process relies on the "just in time" delivery of materials, the author proposes a similar approach for information management in product development, thus enabling companies to apply more efficient product design strategies based on decision analysis. The author focuses on the components of a decision, and then on describing the relation between decisions and the concepts underlying the conventional knowledge management. An important section of the chapter is dedicated to the role of product design software systems, a new tool designed to ensure that decision components find their right place at the right time in the decision making process that process design relies on.

The first volume of *Process Design and Engineering* represents an important tool for everyone involved in chemical product design because it provides a reliable state-of-the-art with examples of the field of product design and engineering.

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