



Book review

PRODUCT DESIGN AND ENGINEERING
Best Practices
Volume 2: Rawmaterials, Aditives and Applications

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The second volume of *Product Design and Engineering* comes as a natural continuation of the first volume of the series in which the editors and contributors have presented the basics of chemical product design, together with the state-of-the-art of technologies employed in chemical product design and manufacturing. The second volume is entirely dedicated to product design and engineering and it presents a series of examples of successful product developments using product-design principles.

The intention of the second volume of the series is to give an overview of how product design is carried out in relation to the specific requirements not only for the products themselves, but also to the other economical or environmental implications that their manufacturing and use may have.

This volume is opened with a chapter written by Axel Eble and Gerhard Wagner and it presents the product design fundamentals. Firstly, the authors have tried to answer to a very important question related to the topic, *Why innovate products*. In present time, product innovation is very closely related to the product's life cycle, and product innovation needs to take place when the product has reached its *aging period* of the life cycle when the prices or profits curve are dropping. This chapter also includes a description of the product design process, presented from the industries point of view.

As product design is a very rapidly developing discipline, in the next chapter, Willi Meier focuses on *New Raw Materials*. The author gives an example of product design principles application to the production of biodiesel. The author demonstrates that the product design principles are valid not only for consumer products, but also to commodities, by-products and semibulk chemicals.

In chapter 4, Claudia Reitz and Peter Kleinebudde give an in-depth presentation of fats, oils and waxes, since these are essential components in many products. The many structures including hydrocarbons and surfactants are discussed with special attention to the structure – properties relationships because these are the primary sources for product design. This chapter also includes a presentation of the options available to modify this class of raw materials into tailor-made products. Finally, the use of fats, oils and waxes in different disperse systems used in special pharmaceutical applications is mentioned.

Chapter 5 is dedicated to the least expensive and most abundant biopolymer available to product design: starch. Starch is a very versatile raw material as it can be used as binding and thickening ingredient to build up texture, improve consistency, increase viscosity and prolong shelf life of different products. This chapter includes presentations of technologies for manufacturing starches and modified starches, basic properties of starch-based products and their main uses.

Due to the great variety of technological and biopharmaceutical properties, gelatine is found in confectionary, meat and dairy products. The most important pharmaceutical applications of gelatine are hard and soft capsules and dried vitamin formulations. This is the reason for which Wilfried Babel presents in chapter six the structure and properties, the raw materials used for obtaining gelatine and collagen, and the commercial aspects of gelatine and collagen products and applications.

In chapter 7, Olaf Hausler covers the product design aspects of sugar based products. The chapter presents the properties and main applications of the

main sugar classes: sucrose, glucose, glucose-fructose syrups, fructose, and sugar-derived products like alcohols.

Chapter 8 is dedicated to synthetic precipitated silicas as carrier materials. After a brief history, Ralf Schmoll gives an overview of properties, characterization methods and surface chemistry of synthetic precipitated silicas. The chapter also covers the production technologies and processes of this product group. A more in-depth description is given to the basic procedures used in product design and engineering of synthetic amorphous silicas (SAS), and detailed examples of product design are presented.

The chemical modification of the chemical structures of the raw materials presented in the previous chapters is often carried out using catalysts and because catalysts design and formulation represent a very clear example of tailor-made product design a whole chapter is dedicated to the presentation of heterogeneous catalysts. This chapter covers the types of heterogeneous catalysts, their geometries, manufacturing methods, design criteria with an emphasis on property – functionality relationships, design strategy and optimization. The chapter also includes two examples of how the development of heterogeneous catalysts should be performed.

The aim of the next chapter is to discuss the secondary properties that influence peroral product performance regarding the stability aspects and formulation enhancement of oral absorption. Karsten Mader discusses the critical parameters that influence stability, like: time, temperature, humidity, light, oxygen and mechanical stress.

In chapter 11, Bruno Leuenberger presents the conceptual design of carotenoid product forms. The author gives an overview of available formulations for different applications in feed, food and nutritional supplement industries. Special attention is paid those factors that define the design and layout of the formulations. A special emphasis is put on the approaches, concepts and processes used to develop these product formulations.

In the next chapter, *Aspirin® – A Successful Example of Formulation Technology*, Ralf Buellesbach reviews the dosage forms of this largely used product as a case study for the formulation technology in the pharma industry.

The chapter *Product Design for Coffee-Based Beverages* presents the wide range of coffee-derived products together with their wide range of process technologies. Attention is also paid to the sensorial aspects and the reconstitution properties of coffee-based products.

The next chapter, Tim Foster analyses the structure design in the food industry and states that product design in food industry comes from the understanding of the structure – functionality relationships of the ingredients used and of their interactions.

The chapter discusses some of the principles employed in food product design, outlining the importance of the ingredients properties impacts on the food product characteristics.

Chapter 15 presents the product design of laundry-powder components. Issues like: detergent powder ingredients, processing and properties and structure are addressed. The chapter also includes a presentation for design of concentrated nonionic granules as an example of product development in this field.

Chapter 16 is dedicated to the formulation opportunities of agrochemical products in relation with the product requirements related to their interactions with the biological targets, but also with environmental components. With increasing knowledge of the fate of agrochemical products in the environment, and subsequently, with the more and more stringent regulations affecting their use, there is a clear need for careful product design in this field.

The next chapter is a perfect example of how product design should be performed. It discusses the development of a new skin protection for UV light. The chapter starts with a presentation of the sunlight interacts with the human skin and of the need for UV filters. Process design in this case starts with the selection of the *backbone* of the UV filter, which has multiple functions, and then it continues with the chromophore selection which represents the constituent that absorbs the UV light.

The last chapter can be seen both as a summary and as an outlook of in product design. Formulation of structured chemical products covers a wide range of scales starting from molecular structures incorporating them into larger structures that will deliver them in the right way to the target environment. To produce these materials efficiently, requires combined understanding of chemistry, processing and material science.

The second volume of *Product Design and Engineering* represents a complimentary instrument to the fundamentals described in the first volume of the series by presenting product design examples from the most diverse fields: catalysts, pharmaceutical products, household products of agricultural products. This volume emphasizes the importance of structure – property – functionality relationships in product design, and the interdisciplinary characteristic of this field.

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