

BOOKS

Industrial Crystallization: The Present State of the Art, Jaroslav Nyvlt. Verlag Chemie (Weinheim · New York) 1978., 182 p., \$19.50 paper.

This book gives a broad-brush overview of the problems and practice of crystallization technology. The volume starts with a discussion of the benefits of crystallization as a separation process and leads quickly to the importance of crystal-size distribution (CSD). CSD is then discussed in most of the following sections of the book which include selection of crystallizer type, mode of operation, and size and performance of crystallizers. The latter section includes such conventional topics as crystal growth and nucleation, supersaturation generation and measurement, design scale-up, and process modelling. The treatment of each topic is so generalized that it would be difficult to apply to a specific case without consulting the original references. (There are 273 references cited). Some of the strengths of this book are the sections on crystallizer mode (should the crystallizer be batch or continuous?) and a table listing over 100 additives and mixtures that have shown growth modifying characteristics for various crystal systems. One or two ideas from these sections could easily pay for the book.

The weakest section concerns the mathematical modelling of crystallizers. The author describes the "European", "American", and "Japanese" approaches to CSD modelling and states that they are all "based on the general theme" and "lead to similar conclusions". Actually, the model bases are quite different. Only the population balance in particle phase space (the "American" approach) leads to *a priori* prediction of the detailed interaction between system kinetics, size-dependent particle residence-time distributions and mass balance constraints. Again, the level of presentation is far too general to enable detailed comparison of the models and the reader would certainly have to consult the original references before the models could be practically applied.

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Chemical Reactor Analysis and Design, Gilbert F. Froment and Kenneth B. Bischoff. John Wiley and Sons, New York, 1979. 765 pages, \$29.95

This book is divided into two main sections. The first part is titled *Chemical Engineering Kinetics* and consists of six chapters. The first two chapters deal with homogeneous and heterogeneous kinetics. They are very thorough and discuss aspects of experimental design and planning not usually seen in texts. The third chapter deals with intraparticle and external heat and mass transfer resistances and introduces effectiveness factors. The last three chapters in this first section cover the topics of gas-solid non-catalytic reactions, catalyst de-activation and gas-liquid reactions respectively. All of these chapters are replete with good examples taken from the literature involving reactions with practical importance.

The second part of the book is titled *Analysis and Design of Chemical Reactors* and it consists of eight chapters. The first chapter in this section deals with mass and energy balances for homogeneous fluids in a very general way, but does not talk about details of transport processes. For example, time-averaging of equations for turbulent flow, or volume averaging for multiphase systems. In fact, some of the material in this chapter had to be invoked in previous chapters in the first part of the book, and one wonders why the authors decided on its current location. This is followed by three fairly routine chapters on batch reactors, tubular reactors and continuous stirred tank reactors. Chapter 11, on fixed bed catalytic reactors is by far the longest chapter in the book (130 pages). It covers in considerable detail some qualitative aspects of fixed bed reactor design, one and two dimensional pseudo-homogeneous models of fixed bed reactors, and one and two-dimensional heterogeneous models. The current ideas about the estimation of the parameters in these models is well covered, but no time is spent in explaining how the governing equations used are derived. The last three chapters of this second section are devoted to non-ideal flow in reactors, fluidized bed reactors and multiphase flow reactors respectively.

This book has several strong points. It presents very clear qualitative discussions of the main problems associated with the analysis and design of chemical reactors. It serves as an excellent introduction to the literature, primarily through its well-chosen examples, and presents a comprehensive view of the state-of-the-art in chemical reactor design. In addition, it offers an introduction to many topics that are often neglected in reactor design texts. In particular, one can point to the analysis of the kinetics of complex reactions and optimal design of experiments in Chapter 2, the entire catalyst poisoning problem in Chapter 5, the coverage of gas-liquid reactions in Chapter 6 and the practical design aspects for fixed and fluidized beds in Chapters 11 and 13.

By the same token, one can see some unfortunate omissions. There is no chapter on the thermodynamics of chemically reacting systems, and as a result there is little discussion of yields and how they are affected by thermodynamic variables. Equations, in general, are not derived but merely stated. This is the case not only when discussing the fundamental mass and energy balances for reactors, but also in discussing the results to be found in the literature. The philosophy followed in the text is that the governing equations for reactors, which involve several phases and normally turbulent flows, are the same as those for pure fluids with some modification of the parameters. This overlooks some of the complexities of transport phenomena in multiphase systems. The authors suggest that the book can be used as both an undergraduate or graduate text, but it seems that graduate students might benefit more from the examples and would be more familiar with how the equations used are to be derived. This text would also be of great benefit to the practitioner who needs a good introduction to the literature and current design techniques.

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