MULTIPHASE CHEMICAL: REACTORS: THEORY, DESIGN, SCALE-UP

edited by Agostino Gianetto, Peter L. Silveston; Hemisphere Publishing Corp., 79 Madison Ave., New York 10016 (1986); 682 pages, $110

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This volume was developed from notes prepared for a short course on the theory, design, and scale-up of multiphase reactors held in 1982. The course was given by a group of researchers in multiphase reactors or in some closely related areas of study.

The first chapter (by A. Gianetto) deals with the classification, characteristics, and uses of these types of reactors. Chapters 2 to 5 (by J. C. Charpentier) are extensive reviews of various aspects of gas-liquid reactors. They cover: mass transfer coupled with chemical reaction (Chap. 2); solubility and diffusivity of gases in liquids (Chap. 3); measurement of gas-liquid parameters (Chap. 4); and simulation of industrial and pilot scale gas-liquid absorbers (Chap. 5). Generally, the term multi-phase reactors implies reactors with more than two phases. The author, at the introduction of Chapter 2, explains the reason for including the gas-liquid (two-phase) system in a monograph devoted to multiphase reactors, on the basis of its similarity with the latter types of systems.

Chapters 6 and 7 (by P. L. Silveston) deal with diffusion and reaction within porous catalysts, and with the structure of the solid phase and its influence on diffusivity. These classical subjects can also be classified under the two-phase category.

Chapters 8 to 12 introduce the core of the book. They treat in detail three phase fixed bed reactors, with special attention paid to trickle-bed reactors. Hydrodynamics (Chap. 8), Mass Transfer (Chap. 9), Solid Wetting (Chap. 10), Heat Transfer (Chap. 11), and Scale-Up of Trickle-Beds (Chap. 12) are developed by H. Hofmann, J. C. Charpentier, J. M. Smith, G. Baldi, and A. Gianetto, respectively. The general evaluation of three-phase reactors is completed with Chapters 13 to 15, where the hydrodynamics and mass transfer in bubble columns (by H. Hofmann), hydrodynamics and gas-liquid mass transfer in stirred slurry reactors (by G. Baldi) and modeling of slurry reactors (by J. M. Smith) are presented.

All through these chapters correlations and models are critically reviewed, with each author developing his subject in his own style. Hofmann presents his chapters in a concise and clear way, with appropriate recommendations whenever possible. Mass transfer in fixed beds, developed by Charpentier, is written with numerous references and correlations of experimental data. Smith presents the wetting factor in trickle-beds and modeling of slurry reactors in two short chapters. Heat transfer in three-phase fixed beds and hydrodynamics and gas-liquid mass transfer in stirred slurry reactors by Baldi, and the scale-up of trickle-bed reactors by Gianetto, are written in a manner that can be easily followed by the reader.

In addition, there are three chapters in which the design and scale-up of multiphase reactors for Hydrotreating (by A. Gianetto and P. L. Silveston), Coal Liquefaction (by P. L. Silveston) and Biological Processes (by M. Moo-Young) are evaluated. In particular, the last chapter puts formally under the framework of multiphase reactors an important area of research not included in previous books about the present subject.

The goal of this monograph, as stated by the editors, is to present the dominant physical processes occurring in the most widely used three-phase reactors, and to provide models for their scale-up. Since there are several authors, the reader faces different styles of presentation as well as some overlapping (claimed unavoidable and even desirable by the editors). Part of the presented material is an enriched version of previous contributions by some of the authors to already published seminars and journal reviews.

The production quality of text could have been improved: there are many typographical errors. Despite being published in 1986, the monograph's references (with a few exceptions) reach only until 1982. The literature in this area grows at such a rapid rate that the book should have come out just after the conference to create its maximum impact. The book will be particularly useful for those researchers who have to deal with multiphase reactors, and who need an overview of the whole area. The monograph provides substantial contributions that will be helpful for those facing this subject for the first time. For those researchers familiar with multiphase reactors, the book provides another set of review that complements the already available excellent monographs in the area. □