Bubbles, Drops, and Particles in Non-Newtonian Fluids

By R. P. Chhabra, CRC Press, 1993, $169.95

The author is a professor of Chemical Engineering at the Indian Institute of Technology, Kanpur. He has not only published widely in the field of non-Newtonian fluid mechanics and multiphase flow, but written a book that reviews his own work, as well as that of the others who have played a major role in clarifying the issues regarding the dynamics of multiphase flow in non-Newtonian (and Newtonian) liquids.

The book is easy to read, and its 400 pages are organized logically. After a brief introductory chapter, the author presents a fairly compact review of non-Newtonian rheology. Those readers already conversant with the topic will not find a need to read this chapter. Those whose main interest is in the dynamics of multiphase systems will find this a sufficient introduction to support their reading of the rest of the book.

Chapters 3 and 4 deal with the dynamics of rigid spheres in time-independent and viscoelastic liquids. These chapters, as well as those that follow, are clearly written. Review papers are cited, and specific studies are illustrated with a presentation of relevant equations and correlations, and displays of experimental data. The reader gets a good idea of what correlations are useful, and the extent to which simple theoretical models mimic the observations.

Chapter 5 covers the important topic of drops and bubbles in non-Newtonian fluids. Some sections of this chapter are very brief (coalescence of bubbles and drops covers only two pages). Wisely, the author has avoided the presentation of sophisticated theory here and instead describes clearly the variety of studies that others have carried out, so that the reader may go to the source literature where theory and experiment are presented.

Chapter 6 covers the topic of flow through fixed beds and porous media, followed by a brief chapter (Chapter 7) on fluidization and sedimentation. Chapter 8 reviews the topic of heat and mass transfer very briefly, but quite well referenced.

The final chapter is a review of the technique of falling ball viscometry.

In summary, this is a valuable and well written book. Those interested in this field will find brief reviews of specific topics accompanied by citations of the relevant literature. As such, the book is especially well recommended to those who are beginning a study of the issues that surround the complex flow of non-Newtonian fluids in particulate systems.

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The Microkinetics of Heterogeneous Catalysis

By J. A. Dumesic, D. F. Rudd, L. M. Aparicio, J. E. Rekoske, and A. A. Treviño, ACS Professional Reference Book, American Chemical Society, Washington, DC, 1993, 315 pp.

Impressive advances in both surface spectroscopy and catalyst characterization techniques now allow for the near molecular resolution of surface reactants, products, and in some instances controlling surface intermediates on various catalytic surfaces. These techniques also serve as probes in elucidating the nature of active catalytic sites. Despite these advances, a quantitative identification of many of the governing intermediates is at best a difficult task due to their fleeting surface lifetimes. As a result, the rather extensive set of fundamental information available in the literature is extremely fragmented, thereby making it difficult to utilize in any quantitative manner. In addition, complex and competing physicochemical effects obscure the way in which this information relates to industrial conditions. For example, many processes operate at substantially high reactor pressures where the relevance of single crystal experimental results which were carried out under ultrahigh vacuum has to be carefully examined. Together the fragmented fundamental database and its application at industrial conditions have limited the development of mechanism-based reaction models for catalytic processes. A majority of the industrially relevant reaction models, such as those based on Langmuir-Hinshelwood-Hougen-Watson and empirical power-law kinetics, have been derived from limiting approximations.

The authors of this book, however, have identified a general methodology which enables detailed surface science experiments, theory, and kinetic information to be directly incorporated into robust simulations of the surface chemistry. This allows for reliable predictions of the industrial catalytic reaction process over an extensive range of operating conditions. The aim, therefore, is to develop a mechanism-based model which incorporates and describes a continuum of experiments which start from well-characterized molecular processes on single crystal surfaces and end with the complex catalytic system at operating conditions. The two basic tools in the authors' approach are *microkinetic analysis* and *catalytic reaction synthesis*. Microkinetic analysis is defined as "an examination of catalytic reactions in terms of elementary chemical reactions that occur on the catalytic surface and their relation with each other and with the surface during a catalytic cycle." Catalytic reaction synthesis is "the combining of surface chemical information from diverse experimental and theoretical sources to create a coherent description of how the catalyst, catalytic reaction cycles, and reaction conditions may be formulated to achieve high yields of particular desired products."

The major focus of the book is, understandably, the microkinetic analysis, that is, the development of comprehensive reaction models. As microkinetic