BOOK REVIEWS

Heterogeneous Reactor Design

By H. H. Lee, Butterworths, 1985, 531 pp., $42.95.

This book is primarily intended for use as the textbook for a graduate level course in heterogeneous catalytic reactor design. Part I (91 pp.) serves to introduce the reader to the concepts and nomenclature of catalysis, catalyst structure and characterization, and heterogeneous kinetics. Part II (187 pp.) deals with the analysis of single catalyst pellets, and is the basis for the analysis and design of catalytic reactors as covered in Part III (195 pp.). Fixed bed reactors receive the majority of attention, but fluidized bed and multiphase reactors are also discussed. Transport in pellets and catalytic reactors is covered very briefly in Part IV (26 pp.). Thus, the book has the content and structure necessary to introduce students with a background in chemical reaction engineering to the field of catalytic reaction engineering. More general texts such as Carberry's *Chemical and Catalytic Reaction Engineering* or Froment and Bischoff's *Chemical Reactor Analysis & Design* could also be used for such a course, if supplemented by a catalysis oriented text such as Satterfield's *Heterogeneous Catalysis in Practice.*

The book would also provide a different perspective for engineers practicing in the field. The strong theoretical orientation of the text may disillusion industrial practitioners; however, the extensive treatment of reactor design for systems with deactivating catalysts will be of particular interest in this arena. Due to its focus on catalytic reactors and its coverage of the basics of catalysis, it complements other reference texts such as Tarhan's *Catalytic Reactor Design* and Rase's *Chemical Reactor Design for Process Plants.* Though the book has an appropriate place in the library of a practicing reaction engineer, its academic orientation is clear.

Professor Lee emphasizes the heterogeneity inherent to the problem, and does not even introduce pseudohomogeneous models. After developing and discussing the conservation equations for fixed bed reactors, he focuses on the concept of the "reactor point effectiveness," the ratio of global rate to intrinsic rate, expressed in terms of bulk conditions. It eliminates the need to solve the pellet conservation equations. There is nothing fundamentally new about reactor point effectiveness; however, its use simplifies the analysis of catalytic reactors. Reactor point effectiveness is emphasized throughout the discussion on the analysis and design of fixed bed reactors, along with the pertinent assumptions and approximations. The equations and logic flow diagrams that result from several different sets of assumptions are presented. Though some direction is given as to how these results were developed, guidance by the instructor is likely to be required if students are to verify them. Thus, the instructor adopting this text should be willing to focus on and support the use of reactor point effectiveness.

A few other aspects of *Heterogeneous Reactor Design* should be considered before its adoption as a textbook. Even though the scope is limited to catalytic reactors, the breadth of material covered results in less than thorough treatment of some topics. for example, the material in Part I is a sound introduction, but there are very few references more recent than the late 1970's. Also, both external and internal referencing could have been done better. After being introduced to a topic and given a few literature references, the reader is often not kept informed as to which external reference is the source of the material being presented. Though Prof. Lee's writing style is clear and easy to read, it is often helpful for the reader to refer to the original work for a different perspective. Examples of imprecise internal referencing are numerous. For example, in Part III there are several references to the material in Part II. These often go something like ". . . as discussed in Chapter 4. . . ." The reader should be given more precise information. For example, it took me some effort to locate the discussion in Chapter 4 on the limitation of the reactor point effectiveness concept to reactions exhibiting kinetics of positive order. The subject reference in Chapter 10, could have been more informative. Another difficulty is Lee's tendency to make statements and/or introduce equations without justifying them or giving appropriate references. The reader is left "high and dry," without even having the benefit of a statement like "The reader can show for himself. . . ."

On the more positive side, there seem to be relatively few typos for a new text. I have already received a list of errata allowing me to correct many of those which are present. The problems at the end of each chapter have been developed over the years at the University of Florida, and a very complete solutions manual is available. The problems are ample in number and appear to be well designed. Nomenclature at the end of each chapter facilitates reading; however, one of the few symbols I looked up was not listed properly.

The textbook has been selected by a colleague for use in a graduate course in heterogeneous catalytic reactor design here at Arizona State University. It is really the only text capable of being used alone in such a course, and shows great potential. I am looking forward to feedback from the students and the instructor of that course on their experience with this unique text.

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Recent Advances in the Engineering Analysis of Chemically Reacting Systems

By L. K. Doraiswamy, Ed., Halsted Press, 1984, 611+X pp., $49.95.

The 26 articles in this book describe the methods of analysis of chemically reacting systems. Included are the re-