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Book Reviews

Chemical Reaction Analysis. By E. E. Petersen. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1965. 276 pp. Price $14.

During the past decade, progress in applied kinetics and catalysis has been characterized by a growing emphasis on the use of basic mathematical techniques. The combined interaction of diffusion, heat transfer, hydrodynamics, and chemical reactions has also received increasing attention from chemists and chemical engineers alike. Professor Petersen's *Chemical Reaction Analysis* represents a timely attempt to bring together some of these disciplines at an intermediate level of sophistication. The author states that "this book deals with chemical kinetic processes and physical rate processes, and the manner in which these processes interact to govern the apparent overall behavior of chemically reactive systems."

This book is written primarily from the viewpoint of the chemical engineer and is oriented toward readers who possess at least an elementary background in kinetics, mathematics, and fluid mechanics. Thus, this work will be most useful to graduate students and research workers who have achieved a reasonable level of facility in the areas of heterogeneous catalysis and reaction engineering.

The volume is devoted almost entirely to *theoretical* analysis and the development of generalized results for heterogeneous kinetics. Despite the quotation of Francis Bacon's famous aphorism in the introduction, the author presents hardly any experimental data that critically test the theoretical generalizations. The approach to the chemical reaction is macroscopic or "phenomenological" in that it deals with overall symbolic descriptions rather than the microscopic and molecular-scale phenomena of pure kinetics.

The book contains a very brief review of homogeneous and heterogeneous kinetics. Chapters 4 and 5 deal at length with the question of the interaction of heat and mass transport with the kinetics of reactions in porous catalysts. Chapter 6 offers a treatment of reactions catalyzed by solid surfaces adjacent to hydrodynamic boundary layers. Chapters 7, 8, and 9 treat the subject of chemical reaction in tubular and fixed bed reactors. Chapter 10 discusses the question of residence time distribution and conversion in dynamic moving bed systems with decaying catalysts.

This volume has many attractive features, including clear discussions of the *physical interpretations* of the concepts treated theoretically. The author has organized his subject material in an orderly progression from the elementary to the more complex. However, in view of the ostensible purpose of the work, a number of significant omissions are apparent. Notable among these is the absence of a discussion of the work of C. D. Prater and J. Wei on the applications of linear algebra to the analysis of complex reaction systems [reported in *Advan. Catalysis* **13**, 204–392 (1962), and elsewhere]. Also, Sections 4.4 to 4.6 present various approximate and asymptotic approaches to the problem of the nonisothermal effectiveness factor. However, exact numerical work of P. B. Weisz and J. S. Hicks [*Chem. Eng. Sci.* **17**, 265 (1962)] is not discussed, nor is mention made of their exposition of triple-valued solutions.

Of particular use to the research worker is Professor Petersen's cogent analyses of the assumptions and limitations associated with the present state of theoretical developments in chemical reactor engineering. Chapter 10 contains a very well developed treatment of moving bed systems that, because of its applicability to Thermofor (TCC) and fluidized (FCC) catalytic cracking systems, should be of use to research workers in the petroleum industry.

This book seems to reflect one aspect of the present state of development in the field of applied chemical kinetics and catalysis. Specifically, the last decade has witnessed a voluminous publication of theoretical papers that are, with few exceptions, unsupported by corroborating experimental data.

In view of the author's obvious talent for clarifying the presentation of his subjects from a conceptual viewpoint, it is regrettable that this book could not have been expanded in scope beyond its present size. Professor Petersen is to be congratulated for his presentation of important materials that must form the background of in-

vestigators wishing to conduct rational research into chemical reaction systems.

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Catalytic Hydrogenation. Techniques and Applications in Organic Synthesis. By ROBERT L. AUGUSTINE. Marcel Dekker, Inc. New York, 1965. xii + 188 pp. Price $8.75.

In the book entitled "Catalytic Hydrogenation" a range of recipes is presented for the application of heterogeneous catalytic hydrogenation in organic synthesis. The recipes are mainly taken from literature, and partly repeated by the author. In Chapter 2 a survey is given of the equipment required for catalytic hydrogenation. The description of this equipment is divided into three categories: high pressure and high temperature hydrogenators, low pressure and low temperature hydrogenators, and apparatus used at atmospheric pressure and room temperature. The discussion dealing with "high pressure autoclaves" might have contained a warning on the corrosion resistance of the material, also because in the following chapters reactions are discussed in which strongly corrosive compounds are used or formed (e.g., hydrochloric acid). In Chapter 3 various hydrogenation catalysts and their preparation and main characteristic properties are dealt with. In addition the influence of the reaction conditions (temperature, pressure, solvent, and amount of catalyst) on the reaction velocity and on the selectivity of hydrogenations is considered.

The following chapters, 4, 5, and 6, constitute the highlights of the book. In Chapters 4 and 5 recipes are provided for the hydrogenation of many functional groups in organic compounds, such as double bonds and triple bonds, aromatics, aldehydes, ketones, esters, lactones, nitrogenous groups and heterocyclic groups. In Chapter 6 the hydrogenolysis of the chemical bond between carbon and other atoms is discussed. It is a great pity that the reaction equations are not systematically taken up in the text. In the examples much attention is drawn to the stereochemistry of heterogeneous hydrogenation. The selective character of various hydrogenations is illustrated on the basis of complex compounds, such as steroids, and aromatic ketones of compounds containing several functional groups. Knowledge on this subject will be limited with most organic chemists and biochemists. Therefore, the book is particularly recommended to them, also because the author has succeeded in demonstrating how valuable the tool of heterogeneous catalytic hydrogenation is to the chemist doing organosynthetic work. The price of the book is on a reasonable level.

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