ChE book reviews

Nonlinear Differential Equations of Chemically Reacting Systems, G. R. Gavalas.

Springer-Verlag New York Inc., (1968), ix, 107 pp. $8.50.

This is an important monograph in the field of the mathematical theory of chemically reacting systems — a field of increasing activity in recent years. The study of chemical reactions and reactors is central to the profession of chemical engineering. This field is of great importance since some reactions are not exceedingly fast, and there may be competing reactions leading to undesired products.

Despite its central importance, the quantitative study of chemical reactions and reactors did not receive much attention until the end of World War II. Gradually, we have built up the classical theoretical models of chemical reactions and reactors that are still the principal ones used today, such as the Langmuir-Hinshelwood-Hougen-Watson kinetics, the cascade of stirred tank reactors, the dispersion model and the stochastic model of reactors, and the diffusion model of a pellet. In the last ten years, we have seen increased use of mathematics to study the *consequences* of these fundamental models. With the coming of high-speed electronic competers, many models have been studied and solutions for particular sets of variable values can be computed to a great deal of accuracy. Another line of development is concerned, for a range of values, with the *properties* of these solutions such as: the existence and multiplicity of solutions, the a priori bounds of the solutions, the stability and transient behavior of these solutions. This monograph represents one of the most important contributions in this direction.

This book is of primary interest to theoretical engineers in research and in teaching. It represents the research results of the author on three specific systems: the batch reactor, the stirred tank reactor and the catalyst pellet. He used the concepts of topology and functional analysis with exceptional skill. His theorems are rigorously derived, but contain few surprises. The short-term impact of this monograph on chemical technology is likely to be small, since it is addressed to the specialist in academic research rather than to the engineers facing current problems. The main pleasure in reading this book is to see many questions settled with authority and economy.

There is a danger of a growing divergence of terminology between the chemist and the chemical engineer. The concept of "mechanism" to a chemist represents more than the stoichiometry of an elemental reaction, it includes also a stereochemical description of the molecules as they unfold and break apart. It is quite conceivable that many different mechanisms could lead to the same kinetic expression, which describes the rate of chemical reaction as a function of concentrations, temperatures, pressures, amounts of catalyst, etc. Two reactions are said to be "independent" to a chemist if they proceed by different mechanisms, for example a hydrocarbon molecule may crack into two smaller molecules by a thermal mechanism or a catalytic mechanism by way of a carbonium ion. The overall stoichiometry of these two reactions could be identical, but to a chemist they clearly belong to two different mechanisms and are independent of each other. With a little care, a chemical engineer can refer to those two reactions as "linearly dependent" but "mechanistically independent." The chemist and the chemical engineer must remain on speaking terms for many years to come, and it would be preferable if they speak the same language.

JAMES WEI
Mobil Oil Corporation

ACKNOWLEDGMENTS:

Industrial Institutions

In lieu of advertising, the following have donated funds for the support of **CHEMICAL ENGINEERING EDUCATION:**

C. F. Braun & Co
The Dow Chemical Company
Mallinckrodt Chemical Works
The Monsanto Company
The Procter and Gamble Company
Standard Oil (Indiana) Foundation
The Stauffer Chemical Company

ACKNOWLEDGMENTS: Educational Institutions (New)

In addition to **eighty** institutions listed in the Winter 1969 Issue, the following have donated funds for the support of **CHEMICAL ENGINEERING EDUCATION:**

University of Arizona
University of Massachusetts
University of Mississippi
Nova Scotia Technical College
South Dakota School of Mines and Technology
University of Southwestern Louisiana
University of Texas
Texas A & M University
Villanova University
University of West Virginia
University of Wisconsin