alytic product selectivity (for example, the use of ZSM-5 for xylene isomerization and the methanol-to-gasoline process). However, the present ability to capitalize on diffusion effects clearly falls short of its potential; many more industrial applications could be realized if the diffusion process were better understood. For these reasons, diffusion in zeolites has been the focus of a considerable body of research. Various aspects of this work have been covered previously by chapters and reviews appearing in various books and journals. The time is ripe for an entire book such as this one to be dedicated to the subject.

Because of the interdisciplinary nature of the subject, one of the goals of the book, as stated in the Preface, was to bridge the gap between theoreticians and experimentalists, and between scientists and engineers. This goal has apparently been achieved as a result of the collaboration between two authors having very different backgrounds.

The book comprises an introductory chapter and 16 subsequent chapters grouped into four parts as follows:

Part I:
Theory of Diffusion in Microporous Solids
Part II:
Measurement of Diffusion in Microporous Solids
Part III:
Diffusion in Selected Systems
Part IV:
Diffusion Controlled Processes

The first four chapters (Introduction and Part I) cover both molecular and continuum theories. The bulk of Chapters 5-7 (in Part II) is devoted to an authoritative discussion of the measurement of diffusivity by NMR techniques. The NMR techniques are "microscopic" that measure the diffusivity within the crystal of the zeolite. Chapters 8-10 (also in Part II) discuss more traditional "macroscopic" methods for measuring diffusivity, including uptake, steady-state and transient measurements, and chromatographic techniques. The next five chapters, which form Part III, are probably the most useful part of the book to the practitioner, because they address the diffusion in different zeolites and molecular sieve carbon. These include three chapters each covering diffusion in one of the three types of zeolites: A, X (and Y) and ZSM-5. Chapter 15, under the heading "Selected Topics," is an interesting chapter; it speculates on the possible reasons for the observed discrepancies between the diffusivities measured by the NMR techniques and those measured by the macroscopic techniques. This problem was apparently the matchmaker that initially stimulated the two authors to collaborate on the book. The last two chapters (Chapters 16 and 17, forming Part IV) summarize catalytic and separation processes in which diffusion plays a role.

The book is comprehensive, and in fact, tends to be overly exhaustive in some places. There are, however, two subjects that could have used more coverage: binary/multicomponent diffusion and molecular dynamics simulation. It is known that the multicomponent effects are very significant for diffusion in zeolites as manifested in the large magnitude of the cross-term diffusion coefficients. Discussions on this topic are scattered throughout the book, totaling about only ten pages. Because of the importance of the subject, a separate chapter dedicated to it would have been more desirable. Molecular dynamics simulation receives a five-page coverage. It would have been a good idea to invite a guest author who works in this area to address this topic. It is worth noting that these two subjects are moving rapidly and that much work has been done since the authors completed the book in January, 1991. The experimental techniques are discussed in great detail—taking up over 200 pages. However, there is only one page on the differential adsorption bed (DAB) technique. The DAB technique is a most powerful and versatile method for measuring mixture diffusion; it can also provide equilibrium as well as information on pure components. Moreover, the initial contribution by Habgood on this technique (published in 1958) is not mentioned.

Despite these minor criticisms, as a whole, it is indeed an excellent reference book. The authors should be commended for undertaking such a monumental effort in producing this text. No doubt, it will serve as an essential reference for anyone interested in diffusion in zeolites.

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Dynamic Modeling of Transport Process Systems

By C. A. Silebi and N. E. Schiesser, Academic Press, 1992, 518 pp.

This book is apparently the outgrowth of notes for a second-semester, third-year course in chemical engineering at Lehigh University. It is proposed as a text for such courses as well as for use by analysts and researchers outside as well as inside chemical engineering.

Transient problems of increasing complexity are generally described first in purely mathematical terms and then illustrated with one or more physical examples. The mathematical descriptions of physical problems are derived in great detail, with particular attention to attaining correct signs and consistent units from term to term. Surprisingly, all of the problems are solved in dimensional terms; dimensional analysis and dimensionless forms are not utilized.

Methods of integration are discussed in varying detail before referring to standardized computer programs prepared by the authors or others. Their own programs are fully documented in the Appendices as are programs to call subroutines such as the well-known LSODE and DASSL for stiff ordinary differential equations (ODEs). The software discussed and utilized in the book is said to be available on diskette from the authors for use with a FORTRAN 77 computer. Programs for the 200 applications listed in the Appendix are also said to be available from the authors in the same format. The charges, if any, for these necessary complements of the book are not specified.

The first of three chapters describe Euler's method and Runge-Kutta algorithms for ODEs. A good case is made for using error control to select the step size in time. The transient level in a tank with inflow and outflow, and the transient composition in a continuous, perfectly mixed, isothermal reactor with a first-order reaction are used for illustration.

Stability analysis is introduced in the fourth chapter, primarily in the framework of stiffness. Backward differentiation formulas are first discussed. The LSODE and DASSL integrators are then introduced and applied. Details of these two codes are not provided. Patience in waiting for a discussion of the qualifications and limitations of various procedures is usually rewarded, but not with

LSODE and DASSL, which are known to be unsuccessful with some sets of nonlinear equations such as those that represent pyrolysis and combustion in the absence of backmixing.

The fifth chapter describes a number of applications requiring stiff integrators: the level and temperature of a heated, perfectly mixed tank with different inflow and outflow; the levels of two tanks interconnected through a long line; the composition in a continuous, perfectly mixed isothermal reactor with two parallel reactors; the composition in a countercurrent liquid-liquid extractor; and the response of a human pancreas to an infusion of glucose. The opportunity to demonstrate the effect of a parameter was taken advantage of for the pancreas but not for the interconnected tanks. Examples are also given of the control of a batch distillation column with ideal stages and of a double-effect evaporator. The idealizations which were made in modeling these several processes are quite justifiable in pedagogical terms but should be pointed out in the text. Omissions in this regard include: the absence of dissipation and turbulent transport from Table 5.1, the postulates of perfect mixing, negligible heat losses, negligible evaporation and constant CP and U for the heated tank, the neglect of entrance and exit effects in the problems involving the level in tanks; the limitations on Eqs. 1.4, 5.8, 5.9 and 5.10. The designation of a system as discrete or distributed or both (p. 80) is a postulate not a free choice. Systems modeled by first-order, one-dimensional, partial differential equations (PDEs) are examined in Chapter 6 in terms of single-pass and multipass heat exchangers, the convective cooling of a sheet of polymer, a catalytic packed-bed reactor, and a packed column for adiabatic humidification. The opportunity to compare the approach of the transient, numerical solution to the steady-state analytical solution for a single-pass heat exchanger was not elected. A considerable discussion is also included on the derivation of solutions for the advection equation itself. The representation of a step function in Figure 6.6 may be better in some applications than that of Figures 6.7 and 6.8. The seventh chapter considers second-order PDEs. Although a great deal of attention is given to finite-difference formulations in space, none is afforded those for time (the explicit representations discussed in prior chapters are implied). Illustrative solutions are presented for thermal conduction in planar and spherical solids and for adsorption and diffusion in a cylindrical pore. The eighth and last chapter discusses the solution of more complex problems and the derivation of higher-order representations for the derivatives. An example is given of the use of orthogonal collocation as an alternative method of solution, but the development is too brief to have any utility to students.

The distribution of a pollutant entering a river from a "point" source (actually a planar source) is used to illustrate a combined parabolic-hyperbolic equation with nonunique boundary conditions, a nuclear fuel-rod assembly to illustrate the treatment of a source term, and a tubular reactor with an electrical discharge to illustrate the combination of these complexities.

I found it feasible to read the book page by page from cover to cover at one sitting, but third-year students will need supplemental explanations of the purpose of some processes (for example, double-effect evaporators and stirred reactors), and they can be expected to find the gradient in sophistication very steep in the last three chapters. Practicing engineers will need to acquire the software described but not included with the book.

The authors assert justifiably that industrial systems are subject to unexpected disturbances and changes and that dynamic behavior is therefore very important. The major disappointment in the book is its failure to demonstrate the impact of such changes. Most of the examples, other than those dealing with control, illustrate only the effect of a discrete change or a startup.

The text is written clearly and methodically, and with some slight reservations as noted above, appears to be accessible to its proposed audience. It is remarkably free from typographical errors. The use of nouns as modifiers occasionally produces possible ambiguities such as *model equations* and *large problem time scale*. The latter term is further confused by the failure to define time scale. The "graphical output" is said to be "listed" in Table 5.2. The use of jargon is mercifully restrained for a book on computational techniques, but identification of the acronyms and abbreviations used is a nuisance, forcing a search through earlier chapters or the index for their definition. The acronyms and capitalized abbreviations are indeed all included in the index but considerable tracking may be required. An example is the entry *JMAP (see FORTRAN)*. A search of more than a column of listings under *FORTRAN* reveals that JMAP is not indexed under *J* but does appear under the subheading *for the integration of ODEs* as *JMAP subroutine, p. 300–301*. On page 301, the reader is finally referred to Table 6.1 for a description of JMAP. A separate direct listing, definition and brief description of such terms would be helpful. In the same context, it is often necessary to search the relevant program line by line to discover the definition of a quantity which appears in a table or the text (for example, CA on p. 52). A complete listing of the nomenclature would also be helpful.

The graphs are printed very lightly with minimal labeling on the axes and none on the parametric curves. The reader must search for the more complete description of the quantities in the ordinate and abscissa from the associated text, program or tabulation, and infer the distinction between curves from the magnitude of the independent and dependent variables in the tabulation. What is the meaning of $a \log 10(t)$ in Figure 4.3?

All in all, the book appears to meet its stated objectives very well. It is quite suitable for self-study or as an undergraduate text, although not every department will allot space in their crowded curriculum for this particular topic. I recommend the book highly; the specific criticisms above are trivial in terms of its overall merit. The authors are to be commended for a significant contribution to the literature.

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