ChE book reviews

Dynamic Behavior of Processes, John C. Friedly, Prentice Hall, 1972. Morton M. Denn, University of Delaware.

The basic premise of Friedly's "Dynamic Behavior of Processes" is that process dynamics is an area of fundamental importance in chemical engineering which transcends specific applications. Thus, he believes, process dynamics should be studied with an eye towards its broad application, rather than within the usual restrictive context of process control. One need not accept this viewpoint to appreciate the virtues of the book. Freed from the need to provide an adequate treatment of process control, Friedly has utilized the space to cover a significantly wider range of approaches to studying dynamical behavior than can be found in any presently available text.

The book is divided into three parts. The first is a sketchy discussion of process modelling and some basic analytical tools. It is an unfortunate beginning, for the section is the weakest part of the book. The treatment of energy balances is incorrect, as it so often is in books on process dynamics. Thus, for example, Eqs. (2.3-9) — (2.3-12) on page 31 erroneously contain derivatives of the heat capacities, and the discussion on page 52 is totally wrong. Eq. (2.6-19) on that page is the proper formulation even when the heat capacity is temperature dependent. This error is repeated elsewhere in the text, though the assumption of constant heat capacity is always made at some point and incorrect solutions are not obtained.

The major part of the book consists of parallel sections on the dynamical behavior of lumped and distributed parameter systems. This covers input-output representation and the use of transfer functions, state space representation and some of the ideas of modern control theory, approximate representations, and analytical methods for nonlinear systems. While most of the material on lumped parameter systems is available in other texts, the coverage here is complete and generally well done.

The real strength of the book is in the treatment of the dynamics of distributed-parameter processes. Friedly nicely illustrates the significance of wave-like and diffusive responses, and the chapter on construction of approximate transfer functions is particularly instructive. Here, unfortunately, there is no discussion of the weighted-residual methods which have achieved prominence in recent years.

Overall, this reviewer is impressed with the content of the book, but sees no way in which he could use it as a course text. The material is not suitable for most undergraduates. Few schools can afford the luxury of separate first graduate courses in dynamics and control, and a control course based on the book would require too much supplementary material. Finally, there are no homework problems. The book should be available as supplementary reading in graduate and undergraduate courses, however, particularly the chapters on distributed parameter systems, and every graduate student in chemical engineering should be aware of its contents for use as a possible reference. □

Staged Cascades in Chemical Processing, P. L. Thibaut Brian, Prentice-Hall, Englewood Cliffs, N. J., 1972. Joseph D. Henry, Jr., West Virginia University.

The primary goal of this text is to introduce the concepts of staged cascades to beginning chemical engineering students. It is intended for a first course in chemical engineering taught to freshmen or first semester sophomores. Three separation processes are discussed: washing of finely divided solids, liquid-liquid extraction and distillation. Numerous discussions and problems introduce the student to economic concepts as well as the analysis of equilibrium staged processes.

The chapter on simple linear cascades, which discusses the washing of finely divided solids (alumina mud), presents an analysis based on steady state material balances of both cross flow and countercurrent cascades. The washing problem provides a very effective first example of an equilibrium cascade because the equilibrium expression is very simple, i.e., the dissolved solute concentration in the overflow and underflow are equal. The familiar Kremser equation is the result of the analysis for the countercurrent cascade. The optimum allocation of wash water is discussed and cross flow and countercurrent configurations are compared with respect to wash water consumption.

The chapter on liquid-liquid extraction while maintaining the simplicity of constant distribution coefficients treats two modes of operation including single stage and countercurrent extraction. Calculation procedures for fractional extraction cascades are developed by algebraic expressions of the Kremser type and graphical techniques. Several variations of the countercurrent cascade including multiple feed, multiple solvents and extraction with reflux are discussed.

Binary distillation is discussed next. It is the first separation process that is considered which has a nonlinear equilibrium relationship. Expressions for the operating lines are developed for the rectifying and stripping sections by utilizing the constant molal overflow assumption. Stage to stage calculations are illustrated by using numerical values of equilibrium composition obtained from an x, y diagram. An extensive treatment of the McCabe-Thiele diagram then follows with detailed discussions of feed plate location, feed quality, minimum reflux, partial and total condensors (and reboilers), and multiple feed and product streams. Several methods of handling the case of variable molal overflow are then discussed. Finally the economic balance of operating costs versus column investment costs is discussed in enough detail for the student to appreciate the subtleties of the trade offs that are involved.

The final chapter on multicomponent distillation is far beyond the scope of most introductory courses in chemical engineering. The discussion of Lewis-Matheson method is appropriate since it is a direct extension of the binary case with variable molal overflow. The discussion of the Thiele-Geddes procedure illustrates the incentive for digital computation to perform the interative calculations associated with multicomponent distillation.

The Underwood equations for minimum reflux are presented early in the chapter on multicomponent distillation and are typical of the rather advanced level of presentation. First year graduate students often have difficulty applying these equations. This treatment would be particularly evasive for students in a first course in chemical engineering. The only incentive seen by this reviewer for discussion of multicomponent distillation in an introductory course is to illustrate the importance of digital computation.

The major strengths of this text which justify its use in an introductory course are: 1) The choice of subject matter, separation processes, is central to all chemical engineering practice, 2) the level of mathematical treatment is easily within the grasp of the freshman or sophomore student, and 3) economic considerations are introduced early and should give the student some perspective on engineering decision making.

Many schools will find it difficult to devote their first chemical engineering course entirely to staged cascades. Other perhaps more basic concepts such as physical and chemical material balances with recycle and energy balances often require extensive illustration and practice. The chapters on washing and extraction certainly provide an effective introduction to staged separation processes. While mathematical developments throughout the text are accessible to beginning students many of the physical concepts in the latter sections would be excessively difficult for many beginning students.

In addition to use in a beginning course this text should find application in more advanced undergraduate courses, e.g., we base one of our junior design projects on a process similar to the mud washing problem of chapter 2. This text could also be recommended to first year graduate students whose undergraduate education is not in chemical engineering.

Environment, Power, and Society, Howard T. Odum, 331 pp., Wiley-Interscience, New York, 1971. Carl N. Shuster, Jr., Office of Environmental Quality Federal Power Commission.

This exciting, powerful book immerses the reader in a profound discourse on the macroscopic approach to understanding the environment and society. It explains the methodology of the approach and urges the reader to use it in attempting broad interpretations of all kinds of interrelationships among major components of this Earth, including large-scale problems affecting human society. It is the type of book that should be read first to become acquainted with its overall message; application of this message comes later, after the methodology has been assimilated in some detail.

Although "intended for the general reader . . .," probably more than one reader will have to discipline himself to stay with the book, for it presents a formidable array of ecological concepts, mathematical formulations, electrical circuitry analogs, etc., and their pertinence to societal problems. Yet, one will stay with it if one takes the author's words to heart: one need be neither biologist, engineer, or humanist; one need only to see the value of and utilize the macroscopic