that will cause a serious problem. Compared to *Unit Operations of Chemical Engineering* (4th edition), by McCabe, Smith, and Harriott (which may be the most widely used textbook in the U.S. on the subject), this book contains more example problems, more figures, and more pictures (especially for the section on fluid flow), which may be an important feature for a textbook. It also contains more detailed design aspects of pumps, flow meters, heat exchangers, etc.

Units and dimensions are briefly covered in Chapter 1, followed by elementary thermodynamic principles in Chapter 2. Chapter 3 describes the flow in pipes and channels, including an adequate level of description for non-Newtonian behaviors. The flow of compressible fluids is described in Chapter 4. Starting with the flow of gas through a nozzle or orifice, the unique features of compressible fluid flow are well enough described so that students can comprehend the subject matter without too much difficulty. Multiphase flow, which is important in many areas of chemical engineering but which is a difficult subject to handle at the undergraduate level, is treated in Chapter 5. The empirical developments of liquid-gas and fluid-solid systems are described, including up-to-date literature references. Chapters 6, 7, and 8 describe flow measurements, liquid mixing, and pumping of fluids, respectively.

Chapter 9 is devoted to heat transfer. This long chapter covers the fundamentals of conduction, convection, and radiation as well as heat transfer involving a phase change and heat exchangers. The material and the level of treatment are similar to those of many other undergraduate textbooks. Finally, mass transfer is treated in Chapter 10. However, only the fundamentals of mass transfer are described in this volume—the various mass transfer processes such as distillation, liquid-liquid extraction, and gas absorption are covered in Volume 2 of the Chemical Engineering Series, *Particle Technology and Separation Processes.* The flow past immersed bodies, including fluidized beds and packed beds, is also covered in Volume 2.

In summary, this volume can serve as an excellent textbook or a principal reference for an unit operations course on fluid flow and heat transfer. Chapters 1 through 9 constitute an adequate amount of material to be covered in one semester, and the many example and homework problems contained in this volume are a useful feature. The treatment of mass transfer, however, is rather brief and a separate volume must be used if a course is to be devoted to mass transfer operations. ❐

ChE book review

CHEMICAL ENGINEERING: Vol. 2. Particle Technology and Separation Processes, 4th ed.

by J.M. Coulson, J.F. Richardson, J.R. Backhurst, and J.H. Harker

Pergamon Press, Headington Hill Hall, Oxford, OX3 0BW, United Kingdom; 968 pgs, $51 (paperback) (1991)

Reviewed by
Benjamin J. McCoy
University of California, Davis

This book, nearly 1000 pages in length and weighing over four pounds, is a bargain at $51.00. Part of a six-volume introduction to chemical engineering, this particular volume covers separation and particle processes. The rule-of-thumb that any book in its 4th edition is worth knowing applies in this case. The authors have prepared a carefully written and judiciously planned book which is rewarding to read and study. Material from the 3rd edition has been revised, reordered, and rewritten, and new chapters have been added on adsorption, ion exchange, and chromatographic and membrane separations.

With the need for chemical engineering to expand beyond its traditional central role in the petrochemical industries, this book provides a satisfactory background for the particle and separation technologies important to biotechnology, biomedical applications, materials science, and environmental engineering. It will serve nicely as either a handbook on the shelf of the practicing chemical engineer or the teacher of chemical engineering, or as a textbook used in a course on separations and applied mass transfer. The prerequisite courses are introductory physics, chemistry, and calculus. The book has an adequate supply of homework problems and an abundance of cited references for the researcher.

The authors have maintained a commendable balance of practical engineering and mathematical fundamentals. Necessary for application to industrial applications, the book is well stocked with photographs, diagrams, and explanations of equipment. The book supplements the now-usual mass, momentum, and energy transport phenomena approach and includes thermodynamics of adsorption, physics of particles, and dynamics of chromatography. Treating the essential physical processes, the authors present concise derivations of mathematical relationships that succinctly capture the significant, basic quantitative concepts.

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mance and feedback, the simulator training is deemed to have been successful. In addition to learning certain fundamental aspects of plant operations and plant-wide process control, the simulator was also useful in emphasizing safety aspects such as emergency shutdown procedures. For new engineers, knowledge of operational and safety aspects could be a real asset when they begin work.

To summarize, the simulator was well received by the students and was regarded by the instructors as an effective teaching tool.

ACKNOWLEDGMENT

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4. Luyben, W.L., *Process Modeling, Simulation, and Control for Chemical Engineers,* 2nd ed., McGraw-Hill, New York, Chap. 8 (1990) ❐

REVIEW: *Chemical Engineering, Vol. 2*

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Experience and judgment are evident in the explanations and discussions of the basic science and industrial usage. A level of comparative knowledge is offered that is often omitted from other texts in favor of physics and mathematics. The reasons why one process is chosen over another in industrial applications are explained. In a section on membrane separations of biological materials, a philosophy is suggested for selecting a process: follow the way in which nature has solved the problem. For example, even though dialysis is a slow process unsuited for large-scale industrial separations, its gentle treatment of blood is appropriate for hemodialysis. The discussion of ion exchange delves into the polymer chemistry of the cationic and anionic resins that facilitate the range of applications of this important unit operation. Motivation is provided for the understanding of drying as a process following evaporation, filtration, or crystallization, to improve handling and reduce transportation costs. A brief description of fluidized-bed catalytic cracking explains the essential features of this outstanding achievement of chemical engineering. Insightful explanations such as these are one reason why this reviewer will open this book before some other engineering handbook when seeking background information on a separation technique.

The topics covered include chapters on: Particulate Solids; Size Reduction of Solids; Motion of Particles in a Fluid; Flow of Fluids through Granular Beds and Packed Columns; Sedimentation; Fluidization; Filtration; Gas Cleaning; Centrifugal Separations; Leaching; Distillation; Absorption of Gases; Liquid-Liquid Extraction; Evaporation; Crystallization; Drying; Adsorption; Ion Exchange; Chromatographic Separations; Membrane Separation Processes.

To illustrate the depth of treatment, consider the chapter on sedimentation. Sections fully describe topics on terminal velocity, height of suspension, shape and diameter of vessel, effects of suspension concentration, Kynch theory, flocculation, settling of coarse particles, and analysis of a continuous thickener. A separate chapter deals with centrifugal separations, including centrifugal pressure and shape of the liquid surface, separation of immiscible liquids, sedimentation, filtration, mechanical design, and equipment descriptions. The chapter on adsorption treats the nature and structure of adsorbents, adsorption equilibria (including mathematics of Langmuir, BET, Gibbs isotherms, and Polanyi potential theory), kinetics, equipment, and regeneration (including thermal and pressure swing, parametric pumping, and cycling-zone adsorption). The exposition of these topics is clear and balanced.

To summarize: this book is a useful and usable contribution to the chemical engineering literature, welcome as an introductory text or as a general reference on separation and particle processes. ❐

ChE book review

PLASTICS RECYCLING: PRODUCTS AND PROCESSES

Edited by R.J. Ehrig
Oxford University Press, 200 Madison Ave., New York, NY 10016; $64 (cloth), (1992)

Reviewed by
Charles Beatty
University of Florida

This is an excellent primer on the products and processes used in the early phase of plastics recycling. It covers the commodity plastics that are available for recycling in reasonable volumes. For this

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