Books

Computer Simulated Plant Design for Waste Minimization/ Pollution Prevention

Stan Bumble, Lewis Publishers, Boca Raton, FL, 178 pp., $79.95, 2000

Two developments in recent years have renewed interest in the use of process simulation tools to effect green process design. The first development are standards, such as pdXi/STEP and CAPE-OPEN, which open up the architecture of process design tools to third-party application developers. This is an important step because it allows software developers to focus attention on creating tools that are well-integrated into existing design and process-development workflows.

The second development is an increased emphasis on the formal integration of green and inherently safer design principles into new product and process development. This trend is exemplified by ongoing industry collaborative projects, such as the Inherent Safety/Pollution Prevention (IS/P2) collaboration by AIChE's Center for Waste Reduction Technologies (CWRT), which resulted in the publication of, "Making EHS an Integral Part of Process Design." Such efforts represent significant steps forward from the *ad hoc* environmental-design reviews used by many organizations.

Since Bumble's book is one of a small handful dealing with the convergence of these two trends, researchers in this field are likely to look to it for new insights on how to approach the problem of incorporating environmental concerns in the design and optimization process. Environmental managers will be eager to find out what tools are available to simplify the task of moving pollution prevention and clean manufacturing initiatives upstream into the design of new products and processes.

Unfortunately, Bumble's book does little to shed new light on the subject. Instead, he presents a collection of synopses of research projects, publications and software tools dealing with a broad array of conceptual approaches to the problem of integrating pollution prevention into process design. In many cases, the synopses appear to be heavily derived from the original publications, making it difficult to determine where the author's original contributions end and the summary of published work begins.

Coverage of the field is wide ranging; the landscape that the book surveys is a broad one, ranging from policy and programmatic-oriented discussions of clean design initiatives (such as the Zero Emissions Research Institute) to a discussion of the grand partition function. But the subject matter is so broad that it requires a strong organizing framework and a critical evaluation of the ideas being discussed, both of which are lacking.

Readers interested in getting a broad overview of the topic will probably find the book to be a good enough starting point. Bumble surveys an array of conceptual approaches and provides enough information about each to encourage further reading. The book does a good job of introducing mathematical and optimization concepts that are likely to be unfamiliar to readers without a formal background in automated process design and optimization methods.

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Handbook of Bioseparations

Satinder Ahuja, editor, Academic Press, New York, NY, 650 pp., $159.95, 2000

Running to 19 chapters over 700 pages, this book is primarily concerned with the separation and purification of proteins, including antibodies, with some attention to nucleic acids and oligonucleotides. Early chapters cover techniques such as chromatography, electrophoresis, adsorption and liquid-liquid partition. Newer technologies, such as adsorptive membranes for membrane chromatography, expanded-bed adsorption and displacement chromatography are also included. These chapters contain the basic principles together with extensive reference, thus providing a good grounding for the budding protein chemist. Later chapters apply these methods to specific separations with considerable experimental detail, so that they could be repeated or adapted for other applications. Some new processes, such as expanded-bed adsorption, membrane chromatography and simulated moving-bed chromatography (in the pharmaceutical industry) are also given attention.

Three chapters put the principles of bioseparation into the industrial context and introduce the essential concepts of separation strategy, scale-up, process control, economics and the legal/regulatory framework as it applies to the pharmaceutical industry. A final chapter looks to the future, including new separation methodologies and the drugs to which they could be applied, as well as the ailments that are in urgent need of treatment.

This book is a treasure trove for a novice protein chemist, but it also contains much of interest to academic staff teaching courses on downstream processing. The numerous tables and figures provide basic information to the practicing protein chemist. Thus, the book will be attractive to many different workers in the field of protein separations.

Finally, it should be noted that as an edited volume with 27 authors, it manages to show considerable consistency in style without losing the individual nature of the contributors.

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Chemical Engineering Fluid Mechanics, 2nd edition

Ron Darby, Marcel Dekker, New York, NY, 559 pp., $75, 2001

This is one of only a handful of books on fluid mechanics that discuss the subject from the perspective of chemical engineering applications. It is a substantial revision of the first edition (published in 1996) that includes a new chapter on two-phase flows, as well as revised, updated, and expanded material throughout each chapter. This book has two objectives in mind: to show students how the fundamental principles underlying the behavior of fluids can be applied in an organized and systematic manner to the solution of practical chemical engineering problems; and to provide practicing engineers with a ready reference of current information and basic methods for the analysis of problems encountered in industrial engineering situations. The book contains 15 chapters, nine appendices and a subject index. As is the trend nowadays in the academic world, the units are in the SI system.

Basic concepts, such as conservation laws, phenomenological rate or transport laws, and turbulent macroscopic transport models are discussed in Chapter 1. Dimensional analysis and scale-up are reviewed in Chapter 2. There is a useful table in this chapter that lists some dimensionless groups commonly encountered in fluid mechanics problems. Chapter 3 covers fluid properties, and includes discussions of classification of materials and fluid properties; determination of fluid viscous properties by cup-and-bob (Couette) and tube-flow (Poiseuille) viscometers; various types of observed fluid behavior; temperature dependence of viscosity; and density are presented. In Chapter 4, aspects of fluid statics are offered, with topics on stress and pressure, the basic equations of fluid statics, moving fluids systems, buoyancy, and static forces on solid boundaries. A good discussion of conservation principles, reviewing the system, conservation of mass, conservation of energy, irreversible effects, and conservation of momentum is contained in Chapter 5.

Pipe flow is covered thoroughly in Chapter 6. Described are flow regimes; general relations for pipe flows; flow in laminar, turbulent, and all flow regimes for Newtonian, power law, and Bingham plastic fluids; pipe-flow problems; tube-flow, viscometer; and turbulent drag reduction. Various internal flow applications are presented in Chapter 7. These include: non-circular conduits; most-economical diameter determination of Newtonian and non-Newtonian fluids; friction loss in valves and fittings; Reynolds number correlations for non-Newtonian fluids; pipe-flow problems with fittings for Newtonian and non-Newtonian fluids; slack flow; and pipe networks. This is a very useful and practical chapter.

Chapter 8 is a good introduction to pumps and compressors. Among the subjects discussed are positive and centrifugal pumps; pump characteristics; pumping requirements and pump selection; cavitation and net positive suction head; and compressors. In Chapter 9 various aspects of compressible flows are considered, such as gas properties; pipe flow; and generalized expressions for adiabatic flow. This chapter is also useful and practical. A good discussion of flow measurement and control is presented in Chapter 10. The topics reviewed are the pitot tube; the Venturi meter; the nozzle; the orifice meter; loss coefficient; orifice problems and control valves.

In Chapter 11 external flows are discussed, covering drag coefficient, falling particles, correction factors for wall effects and drops and bubbles, and the motion of solids particles, drops or bubbles through non-Newtonian fluid media. Fluid-solid separations by free settling are covered in Chapter 12. The chapter is not just confined to gravity settling of solids, but also discusses centrifugal separation of liquid-solids suspensions and immiscible liquids, as well as cyclone separations. Chapter 13 features a good discussion of flow in porous media, including a detailed description of friction loss; permeability; multidimensional flow; flow in packed columns; and filtration. Fluidization and sedimentation are reviewed in Chapter 14. The section on fluidization covers governing equations, minimum bed voidage, and non-spherical particles, but does not discuss many other pertinent aspects. The other sections in this chapter talk about sedimentation, generalized sedimentation/fluidization and thickening. The sections on sedimentation and thickening could have been combined with the discussion of gravity settling in Chapter 12.

The final chapter is a succinct, but good, review of two-phase flow. The topics discussed include definitions; fluid-solid two-phase pipe flows; and gas-liquid two-phase pipe flow. Methods are presented for calculating critical velocities, flow regimes, and pressure drop in pipes. The appendices cover viscosities and other properties of gases and liquids; generalized viscosity plot; properties of gases; pressure-enthalpy diagrams for various compounds; microscopic conservation equations in rectangular, cylindrical, and spherical coordinates; standard steel pipe dimensions and capacities; flow of water/air through Schedule 40 pipe; typical pump-head capacity range charts; and Fanno line tables for adiabatic flow of air in a constant area duct.

This is an excellent book that can not only be used for a first-level course in chemical-engineering fluid mechanics, but certain sections can also be used in graduate courses. In my opinion, it is useful for practicing engineers. Each chapter has many homework problems that supplement the example problems and help to illustrate the material presented in the text. Most of the chapters also have good references that can be used to follow up on the subject material presented.

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