BOOKS

Fluid Flow for Chemical Engineers, F. A. Holland, Edward Arnold, London (1973). 269 pages. $5.25 (paper).

This book, available in either hard cover or paperback, is an introduction to fluid flow for the undergraduate chemical engineer. SI units are used throughout the book. An adequate list of problems and solutions is included and about twenty sample calculations as well.

Any author who titles a book simply "Fluid Flow" and issues something which is fewer than three volumes leaves himself open to criticism for treating lightly or omitting some pet topic of a reviewer. This book, however, contains most of the standard topics treated in a first course in fluid mechanics—units and dimensions, flow of incompressible Newtonian fluids, flow measurement, pressure drop in pipes, etc.—and has the additional advantage of introducing a number of topics which are often omitted in introductory fluid courses, for example, flow of incompressible non-Newtonian fluids in pipes, mixing of liquids in tanks (including scale-up), pump selection, and flow in the presence of solid particles. The treatment of some of these more specialized topics is necessarily not in great depth because of the length of the text. The great strength of the book is that the examples selected are usually very practical ones. For example, in the chapter "Introduction to Unsteady State Fluid Flow" the examples considered include (1) time to empty liquid from a tank, (2) time to empty an ideal gas from a tank, and (3) time to reach 99% of terminal velocity for a solid sphere falling in a Newtonian fluid, all of which are important problems in real-world situations. Emphasis on the practical is obvious throughout the book and probably comes from Professor Holland both having been a consultant and having offered this course to industrial personnel as well as to academic students.

The book falls into two divisions, the first approximately 186 of the 252 pages of text. This section is concerned primarily with the macroscopic description of flow processes and involves very little mathematics beyond algebra and elementary calculus. The second part of the book, only about 1/3 the length of the first part of the book, begins with an 11-page treatment of vector methods in fluid flow. This is followed by chapters on application of the modified Navier Stokes equation in rectangular coordinates, horizontal cylindrical coordinates, and vertical cylindrical coordinates. The presentation of the macroscopic approach before the microscopic is the soundest from a pedagogical point of view because the prior presentation of the macroscopic section gives the student motivation to study the more involved mathematics in the microscopic section.

Since the treatment is so abbreviated, many times the reader is referred to the literature for items which could perhaps have been included in the text—for example, a monograph of equivalent lengths for valve and fittings. The Reynolds number plot presented is also somewhat small to be useful, and occasionally symbols are introduced without adequate definition. The use of the symbol R for shear stress is somewhat confusing in a text which also has considerable occasion to talk about the radii of pipes. Chapter 7, "Flow of Two Phase Gas Liquid Mixtures in Pipes," is so abbreviated as hardly to be worthwhile. Only the Lockhart-Martinelli method is introduced and that method only for the turbulent-turbulent flow regime. The question of systems and control volumes is passed over with no discussion at all. It also seems unusual to find the transfer of momentum into a volume element by convection and molecular diffusion to be placed in the accumulation term. In fairness to the author, however, it must be noted that he characterizes the book in his introduction as a collection of lecture notes with the emphasis on brevity which he hopes will provide a framework for wider reading in the general field.

In summary, this seems a useful book for an undergraduate chemical engineering course in fluid flow providing some supplementing is done by the instructor, hardly an unreasonable requirement. The book's great strength is in its practical examples and applied flavor unusual in present day introductory treatments. Since it is available in paperback at about $5.25 (although the exchange price of the dollar is fluctuating rather rapidly at the time of this review) it should also find use as an inexpensive reference for students and practicing engineers to practical problems in the flow of fluids.

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Catalysis Reviews, Vol. 4, Heinz Heinemann (ed.), Marcel Dekker, Inc., New York (1970, 1971). 338 pages. $19.50.

Attempting to review a volume consisting of nine reviews is an interesting exercise. It is hardly feasible to comment on each of the reviews, except, perhaps, to note any particular review which is poorly written or lacking in other respects (and there are no such reviews in this volume). This review consists, therefore, of just two points.

First, the high standards set in earlier volumes of *Catalysis Reviews* are maintained in Volume 4. The reviews are well-written, authoritative, and concerned with timely topics in catalysis. They continue to be significant and helpful contributions to the literature on catalysis.

Second, the topics covered in this volume and the author(s) of each review are as follows: (1) Review of ammonia catalysis (Anders Nielsen); (2) The mechanism of the catalytic oxidation of some organic molecules (W. M. H. Sachtler); (3) Equilibrium oxygen transfer at metal oxide surfaces (G. Parravano); (4) Isotopic exchange of oxygen ^{18}O between the gas phase and oxide catalysts (J. Novakova); (5) The use of molecular beams in the study of catalytic surfaces (Robert P. Merrill); (6) Heterogeneous catalysis by electron donor-acceptor complexes of alkali metals (Kenzu Tamaru); (7) X-ray photoelectron spectroscopy: a tool for research in catalysis (W. Nicholas Delgass, Thomas R. Hughes, Charles S. Fadley); (8) Electrocatalysis and fuel cells (A. J. Appleby); and (9) Hydrodesulfurization (S. C. Schuman and H. Shalit).

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Transport Phenomena in Metallurgy. G. H. Geiger and D. R. Poirier, Addison-Wesley Publishing Company, Reading, Mass. (1973). 616 pages. $19.95.

This book was modeled after Bird, Stewart, and Lightfoot's *Transport Phenomena*, with emphasis on metallurgical applications. Although designed as an introductory undergraduate text, it can profitably be used in graduate courses and for self-instruction by practicing materials scientists. As a displaced chemical engineer who has drifted into materials science, it makes me somewhat sad to see others in this field learn my valuable "secrets" in transport phenomena.

Fluid mechanics, heat transfer (including radiation), and mass transfer are all treated. Concepts are introduced through specific problems; the general differential equations are then derived and applied to more examples. Many of these examples and the additional unsolved problems at the end of each chapter are of special interest to the metallurgist. Also discussed are flow from ladles, casting, transport in packed beds, vacuum production, and radiation in furnaces. Although a few topics have been neglected, one cannot really expect an introductory text with such a broad scope to cover every relevant subject in depth.

The authors are to be commended for the service they have performed for the materials science community.

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Fundamentals of Food Engineering, 2nd Edit., S. E. Charm, Avi Publishing Company, Westport, Connecticut (1971). 629 pages.

This is the best book on the subject of engineering principles and concepts utilized in the food processing industry. The material is very well presented and easily read. The approach of presenting a concept and carrying through with its utilization in industrial processes makes for some interesting reading. Scores of formulas for solving various problems encountered in food processing and examples of solved problems utilizing these formulas make this book a very handy reference for a practicing engineer in the food industry. The book is copiously referenced and a reader wanting to know more about the background and rationale of the subjects presented can readily find the source.

The chapters dealing with material and energy balance, evaporation, distillation, extraction, heat transfer, mass transfer, and centrifugation and filtration are treated no differently from those in a standard undergraduate chemical engineering textbook; however, example problems are derived from places in which these unit operations are utilized in the food industry. The chapter on fluid flow puts together the principles of viscometry and analysis of problems involving the flow of non-Newtonian food fluids. Chapters dealing with problems unique in the food industry include ones on thermal process evaluations (sterilization of canned foods), freezing and thawing of foods, dehydration, freeze drying, strength of materials and equipment, and kinetics of biological reactions. Tables in the Appendix provide an excellent source of data on thermal and physical properties of foods.

If I were to find fault with the book, it would be that in the author's attempt to provide mathematical solutions to most problems encountered in food processing, in too many instances he merely presented equations without discussing the basis or limitations of these equations, thus conveying the impression that any problem can be solved by simply plugging numbers into an equation. This inadequacy is offset, however, by the book's excellent list of references, and a cautious engineer can always refer to the original source.

For a book written for both food scientists and engineers, this is much too advanced for the former but would be useful to an engineer working in the food industry.

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Thin Liquid Films and Boundary Layers: Special Disc. of the Faraday Society, No. 1, 1970, Academic Press, New York (1971). 269 pages.

This book consists of the papers presented at a special discussion symposium on *Thin Films and Boundary Layers*, held at the University of Cambridge in September, 1970. This meeting was well attended by investigators from many countries who are actively working in this area of research. The general discussion and comments of various participants at the end of each session constitute a very interesting and stimulating part of this book.

Although the book was published in 1971, it remains the most recent book providing a comprehensive review on thin films and boundary layers. Investigators in chemical engineering and related professions may find this book extremely helpful in bridging the basic research with many applications such as foams, emulsions, flotation of minerals, colloid stability, and boundary lubrication. The following is a brief summary of papers grouped around each of these applications.

The first three papers are related to the mechanism of bursting of soap films, the change in film thickness due to a rapid change in the temperature of the surrounding atmosphere, and the effect of electrolytes on nonionic surfactant films. The results presented have important implications for foams. The next three papers include a discussion by Haydon and his co-workers on composition and energy relationships for thin lipid films and the chain conformation in monolayers at liquid-liquid interfaces. Sonntag et al. have presented their studies on the equilibrium distance, contact angle, and formation velocity of black films between oil droplets which are separated by an aqueous film of surface-active agents. The experimental determination of the critical thickness of liquid films on various solid surfaces described by Padday clearly indicates the need for theoretical development in this area. Adlfinger and Peschel discussed the disjoining pressure of thin layers of organic liquids between fused silica surfaces.

Boundary layer viscosity of polydimethylsiloxane liquids and the structure of Graphon/liquid interfaces were discussed respectively by Deryaguin et al. and Ash and Findenegg. The next two papers are of considerable interest in relation to froth flotation. The first describes the contact between a gas bubble and a solid surface and the next one reports the interfacial energies of clean or fatty acid deposited mica surfaces.

There are three interesting papers from the laboratories of Ottewill, Lyklemia, and Dukhin on the measurements of forces between colloidal particles and the electrochemistry of boundary layers. The next three papers report the studies on the structure of water at interfaces in systems such as polystyrene lattice, lamellar mesomorphic phases, vermiculite clay, and silicates, using nuclear magnetic resonance and neutron scattering techniques.

The last five papers in this book are relevant to lubrication. They include a study on the viscosity of various liquids in quartz capillaries, the effect of surfactant on thinning of oil films between solid surfaces, and the mechanical properties of very thin films.

In this reviewer's opinion the book illustrates the most recent developments in basic research on surface phenomena with emphasis on applications and is a most welcome addition to the library of any investigator working in the area of interfacial phenomena and its application to foams, colloids, flotation, and lubrication.

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