

rem" (p. 206) as the three-dimensional Leibniz formula (see Eq. A.5-5 in *Transport Phenomena*, by Bird, Stewart, and Lightfoot, Wiley, New York, 1960, p. 732) appropriately applied to a "dyed" volume element. On p. 207 the Dahler-Scriven paper (*Nature*, 192, p. 36, 1961) should have been cited in connection with the assumption of the symmetry of the stress tensor.

The book would be very good for a general introductory course on fluid dynamics. It does not, however, contain the optimum choice of topics for chemical engineers, who need some background in non-Newtonian fluids, suspensions, emulsions, reacting multicomponent fluids, and nonisothermal systems. Teachers of fluid dynamics courses should have this book in their personal library to use as collateral reading and as a source of inspiration. All in all, an excellent book.

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Modelling Phase Equilibria: Thermodynamic Background and Practical Tools

By S. Malanowski and A. Anderko, Wiley Series in Chemical Engineering, 272 pp., \$69.95.

As the title suggests, the main topic of this monograph is the calculation of fluid-phase equilibria by classical thermodynamic methods. The level of the book suggests that the intended audience is practicing engineers, as well as advanced undergraduate or graduate students, involved in phase equilibria modeling.

The 300-page book is divided into five chapters. Chapter 1 deals with an outline of fundamental thermodynamic principles, following the axiomatic approach of Carathéodory. Relationships between thermodynamic functions useful to the calculation of phase equilibria are also presented. Chapter 2 summarizes briefly methods for calculation of pure-component properties. Chapter 3 "The Gamma-Phi Method," discusses activity and fugacity coefficient models. Chapter 4 is the longest (approximately 1/3 of the total book) and deals with equation-of-state methods. An extensive discussion

is given on cubic equations and their derivatives. Mixing rules are reviewed, including the relatively recent group of composition- and density-dependent mixing rules. Chapter 5 presents elements of thermodynamic consistency checking, and the book concludes with two brief appendices on definitions and some mathematical theorems.

The book has a number of distinguishing features in its favor. In particular, it makes extensive references to eastern European sources of data and correlations, which are not often known to western researchers and practitioners. The long chapter on equation-of-state-based calculations of phase equilibria is comprehensive and up-to-date. On the other hand, many will find that several sections of the book cover essentially similar material to other available up-to-date monographs and textbooks. In particular, there are significant overlaps with the books on *Molecular Thermodynamics of Fluid-Phase Equilibria* by Prausnitz et al. (1986) and *Properties of Gases and Liquids* by Reid et al. (1987). While many researchers and practitioners, especially those interested in equation-of-state methods, will find the present book a useful addition to their library, I think that it lacks the comprehensive coverage to be a good replacement for these standard reference books.

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Filtration Equipment for Wastewater Treatment

By Nicholas P. Cheremisinoff and Paul N. Cheremisinoff, Prentice-Hall, Englewood Cliffs, NJ, 1993

This book claims, "This third volume in the series is written to provide a working knowledge of the equipment and operational concepts of filtration." The notion that the book is concerned with filtration equipment for wastewater treatment is a misnomer.

It includes seven chapters, most of which have no references of significance involving wastewater treatment: "Filtration as a Unit Operation" (11 pages, no references) and "Filtration Equipment" (74 pages, 10 references none of which are dated after 1982). This chapter describes, in general terms, types of cake, cartridge, basket, and diaphragm, filters, thickeners, filter and screw presses, and centrifugal filters. No applications in wastewater treatment are described.

Chapter on Ultrafiltration (17 pages, 10 references between 1966 and 1982). It describes kinds of submicrometer semipermeable membranes, the effective thickness of various membranes and the importance of osmotic pressure. It discusses operational modes (purification, fractionation, concentration and partition) and differentiates dead-end vs. cross-flow filtration. UF applications for electrodeposition of paint, cheese and whey processing and oil/water emulsion treatment are described very briefly.

Chapter on Microporous Membrane Filtration (27 pages with 25 references mostly from the 1970s). It discusses particle removal by sieve retention as a function of pore-size and particle-size distributions, depth-type filters, nominal and absolute ratings, and mechanisms of particle capture, as well as pore-size ratings, pore size and retention, capillary rise, and integrity testing of membranes.

Chapter on Reverse Osmosis (27 pages with 15 references, all prior to 1981). It describes the general principles of RO and different types of RO membranes, as well as 13 installations and case histories, in which RO was used in utility water treatment systems, and in municipal water and wastewater systems.

Chapter on Selection and Sizing of Prefilter/Final Filter Systems (34 pages, with 5 references from 1977 to 1981). It cites information needed to size filter systems and describes effects of differential pressure, parallel vs. series systems, and

the effects of filter blocking. Operational considerations include describing the order in which filters should be selected and where they should fit into the system. Five sample problems are solved to show the reader how to select/size filters.

Chapter on Filter Aids and Filter Media (46 pages with 37 references from the 1950s to the 1960s). The purpose and application of filter aids (diatomite, perlite, asbestos, cellulose, sawdust, charcoal, and fly ash) are described, but with little technical information on those available commercially. Experimental methods are described for filter aid selection for use with vacuum precoat filters, including the development of mathematical models for evaluation of their performance. Various flexible synthetic filter fabrics (asbestos, glass, cotton, woven cotton and wool cloths, paper pulp and fiber cloths, metallic media, and so on) and their technical data describing them are presented (physical properties and chemical resistance). Rigid filter media (metallic and ceramic media, diatomite, coal, ebonite, foam plastic, coal/coke, charcoal, and so on) are briefly described.

Chapter on Filtration Practices for Wastewater Treatment (45 pages, no

references). This chapter, after which the book is named, has many deficiencies and appears to convey inaccurate ideas to the reader. First of all, the lack of references from which much of the chapter is derived, does not give the reader much opportunity to clarify what is written by reference back to the original literature description. The authors separate straining operations in wastewater treatment from deep-bed operations. The physical straining processes described (microscreens, diatomite filters, and ultrafilters), however, are not generally applicable to wastewater treatment. It does not deal with the one straining process—use of “automatic backwashing filters” using 7–8 in. of fine sand to provide a surface cake which is automatically removed after filter head loss increases of 1–2 ft. The granular media filtration section describes equipment used, but not any operation data related to wastewater filtration. In fact, much of the descriptive material was derived from water treatment—not wastewater treatment—reference material. General descriptions of granular media filters, their operation systems, and various systems for backwashing the filter media are given.

Chapter on Handling of Chemicals (38

pages, no reference). You can find useful information on the characteristics of chemicals useful in filtration systems. For example, it includes information on the effects of temperature on alum crystallization and viscosity, and on the freezing point and viscosity of ferric chloride solutions. There are general descriptions on the storage/feeding equipment and what to look for in system design, but details and references needed are not there, such as the set of circumstance that lead to formation of “fish eyes” when mixing certain types of polymers and how to avoid their formation.

Overall, this book appears to have been written about ten years ago and had not been brought up to date for publication in 1993. All the references included are more than ten years old. When chapters relate to filters that might be used in wastewater applications, there are no references at all. This makes it very difficult for the reader to be sure if the book is up-to-date, since no references are included for them.

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