Fluid Dynamics, Richard H. F. Pao, Chas. E. Merrill Books, Inc., Columbus, Ohio (1966). pp. xiii + 497, $11.75.

This is a sound, elementary text for engineers in which fluid mechanics is presented in the traditional manner with some reference to topics of recent importance. It should be a useful book to the teacher since it is well provided with examples.

Two introductory chapters describe the basic concepts and laws of fluid flow and are followed by three on potential flows. The first of these takes up the general properties of irrotational flow, introducing the velocity potential. The second, on incompressible potential flows, is divided between the planar and the axisymmetric, while the third is an introduction to the applications of conformal transformations. Chapters 6 to 8 are concerned with viscous flows and, as well as giving the Navier-Stokes equations and some exact solutions, deal with turbulence and boundary-layer theory. After the introduction of thermodynamic considerations, Chapter 9, on compressible flow, deals with the one-dimensional case in some detail and gives an introduction to multidimensional flows. The final chapter on magnetofluidmechanics is a refreshingly up-to-date topic for an introductory text and gets some of the basic ideas across to the student.

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Heat and Mass Transfer in Capillary-Porous Bodies, A. V. Luikov, Pergamon Press, New York (1966). 523 pages, $20.00.

This book, translated from the Russian edition, is intended as a graduate-level text and reference work for architectural engineers. It should be of interest to chemical engineers in connection with drying and processing of moist porous materials. The chapters are:

1. Thermodynamics of the Phenomena of Heat and Mass Transfer
2. Equations of Heat and Mass Transfer and Conditions of Single-Valuedness
3. Fundamentals of the Theory of Similarity
4. Heat and Mass Transfer of a Solid Body with the Surrounding Medium
5. Basic Properties of Capillary-Porous Bodies
6. Heat and Mass Transfer in Capillary-Porous Bodies
7. Heat and Mass Transfer in Walls
8. Heat and Mass Transfer in Some Engineering Processes
9. Experimental Methods of Investigation
10. Methods of Numerical Solution

INFORMATION RETRIEVAL

Effect of the resonance parameter on a chemical reaction subjected to ultrasonic waves, Aerstin, Franklyn G. P., Klaus D. Timmerhaus, and H. Scott Fogler, **A.I.Ch.E. Journal,** 13, No. 3, p. 453 (May, 1967).

Key Words: A. Mathematical Model-8, Ultrasonic Waves-6, Chemical Reactions-7, Yields-7, Chlorine-2, Water-1, Carbon Tetrachloride-1, Height-6, Liquid-9, Transducer-10, Resonance Parameter-6, 8.

Abstract: Experimental results are presented which indicate that the application of a fixed intensity of ultrasonic waves to a water-tetrachloride solution containing dissolved air provides yields of chlorine varying from zero to maximum simply as a function of the liquid height in the capillary above the transducer. A mathematical model to explain this phenomenon is presented.

Nonisothermal adsorption in fixed beds, Meyer, Oscar A., and Thomas W. Weber, **A.I.Ch.E. Journal, 13,** No. 3, p. 457 (May, 1967).

Key Words: A. Adsorption-8, 4, Methane-9, Fixed Bed-10, Mathematical Modeling-8, 2, 10, Charcoal-1, Helium-1, 5, Numerical Solution-2, 10, Heat Transfer-6, Mass Transfer-6, Pore Diffusion-6, Dynamic-0, Nonisothermal-0, Adiabatic-0. B. Equilibria-8, 7, Correlating-2, Methane-1, Charcoal-10, 5, Adsorption-0, Isothermal-0.

Abstract: Removal of methane from a helium stream by adsorption on Columbia SXC activated carbon was studied experimentally and theoretically. A mathematical model for the process was developed and the governing differential equations were solved numerically. The model incorporates heat and mass transfer resistances within and around the adsorption particle. Wall effects and moderate heat loss to the surroundings are also included. The required heat and mass transfer correlations were obtained from the literature. Simple expressions were developed to determine the relative resistances, for heat and mass transfer, within and around the adsorption particles.

Frequency response of gas mixing in a fluidized-bed reactor, Barnstone, Leonard A., and Peter Harriott, **A.I.Ch.E. Journal, 13,** No. 3, p. 465 (May, 1967).

Key Words: A. Frequency Response-8, Models-8, Mixing-9, Gases-9, First-Order Reactions-9, Fluidized Beds-9, Fluidization-8, 9, Mass Transfer-9.

Abstract: Frequency response methods were used to compare dynamic models for gas mixing and first-order reaction in a fluidized-bed reactor and for the experimental determination of interphase transfer characteristics. Theoretical predictions of frequency response characteristics were derived for two models based on the two-phase theory of fluidization.

A generalized model for the dynamic behavior of a distillation column, Tetlow, N. J., D. M. Groves, and C. D. Holland, **A.I.Ch.E. Journal, 13,** No. 3, p. 476 (May, 1967).

Key Words: A. Mathematical Model-8, Equations-8, Operation-9, Unsteady State-0, Distillation Column-9, Separation-10, 7, Mixture-9, Multicomponent-0, Channeling-6, Transfer Lag-6, Mixing-6, Mass Transfer-6, Digital Computer-10, Control-4.

Abstract: The generalized model accounts for the effects of channeling, transfer lag, mixing, and mass transfer that occur on each plate of a column in the process of separating a multicomponent mixture at unsteady state operation. The equations required to describe the model were tested by solving a wide variety of numerical examples. Selected numerical results are presented to demonstrate certain characteristics and uses of the generalized model.

Model-reference adaptive control system, Casciano, Robert M., and H. Kenneth Staffin, **A.I.Ch.E. Journal, 13,** No. 3, p. 485 (May, 1967).

Key Words: A. Adaptive Process Control-8, Reaction-9, Models-10, Differential Equations-10, Analog Computer-10, Stability-7, Pole-6, Lag-6, Measurement-9.

Abstract: An adaptive process control scheme, which uses a differential equation model, requires no differentiations in the adaptive circuitry, and no identification of the varying process parameter, was analyzed mathematically and studied on an analog computer. The effects on system stability with a pure delay, measurement lag, or an additional pole in the process are presented.

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Friction factors and pressure drop for sinusoidal laminar flow of water and blood in rigid tubes, Hershey, Daniel, and Geasoon Song, **A.I.Ch.E. Journal, 13,** No. 3, p. 491 (May, 1967).

Key Words: A. Friction Factor-8, 7, Pressure Drop-8, Flow-9, Sinusoidal-0, Pipes-9, Navier-Stokes Equations-10, Fanning Equation-10, Frequency-6, Kinematic Viscosity-6, Water-9, Blood-9.

Abstract: From the Navier-Stokes equations and a modified Fanning equation, a theoretical equation was derived for computing friction factors and pressure drop for sinusiodal flow in rigid pipes. Friction factors were calculated from experimental data and it was found that the theoretical friction factors predicted the experimental values to within less than 5%.

Analysis of data in reverse osmosis with porous cellulose acetate membranes used, Kimura, Shoji, and S. Sourirajan, **A.I.Ch.E. Journal, 13,** No. 3, p. 497 (May, 1967).

Key Words: A. Diffusivity-8, 7, Sodium Chloride-9, Sodium Nitrate-9, Sodium Sulfate-9, Magnesium Chloride, Magnesium Sulfate-9, Water-9, Membrane-9, Cellulose Acetate-5, Reverse Osmosis-10, Mass Transfer Coefficient-8, Pressure-6, Shrinkage-6, Film-9.

Abstract: Reverse osmosis experimental data for some inorganic salts with the porous cellulose acetate membrane used were analyzed to obtain their diffusivity in the membrane. A parameter including the diffusivity was found constant for each film in the concentration range investigated for a particular solute at a particular pressure.

An investigation of solids distribution, mixing, and contacting characteristics of gas-solid fluidized beds, El Halwagi, M. M., and Albert Gomezplata, **A.I.Ch.E. Journal 13,** No. 3, p. 503 (May, 1967).

Key Words: A. Distribution-8, Contact-8, Mixing-8, Solids-9, Fluidized Bed-9, Gases-9, Concentration-8, 7, Velocity-6, Flow-8.

Abstract: This two-part series describes an integrated experimental investigation. The first part is concerned with the determination of axial and radial solids concentration profiles at different superficial gas velocities. The second part is concerned with steady state point sources gas tracer experiments to evaluate the extent of gas back-mixing and the contacting characteristics of the fluidized system.

Hot-film anemometry measurements of turbulence in pipe flow: organic solvents, Patterson, Gary K., and Jacques L. Zakin, **A.I.Ch.E. Journal, 13,** No. 3, p. 513 (May, 1967).

Key Words: A. Measurement-8, Fluid Mechanics-8, Fluid Flow-8, Turbulence-9, 8, 7, Hot-Film Anemometer-10, Pipe-9, Velocity-6, Size-6, Radial Position-6, Energy Spectra-7, 8, Toluene-9, Benzene-9, Cyclohexane-9, Integral Scale-7, Microscale-7.

Abstract: Longitudinal turbulence intensities, autocorrelations, and energy spectra have been measured in the flow of toluene, benzene, and cyclohexane. These measurements were made with a constant-temperature hot-film anemometer. Turbulence was slightly affected by the diameter of the pipe. There was little effect of tube diameter or radial position on the energy spectra from the center to $r/a = 0.85$. Integral scales of the turbulence were proportional to bulk mean velocity to a power less than one for a given tube. Microscale values were relatively independent of velocity and pipe diameter.

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There are also appendices to several of the chapters, giving additional data and mathematical information.

The main contribution of the book lies in Chapters 5 to 10, pp. 187-478. These chapters show how experimental data can be obtained and used, with the aid of flux expressions from irreversible thermodynamics, to analyze heat and moisture transfer in porous media. Applications are given to drying, kilning of building materials, and transfer through composite walls. The treatment in these chapters is less abstract than that of Luikov and Mikhailov (*1*), and therefore easier to follow; the numerical data and examples are particularly helpful in this respect.

Chapters 1 to 4 are summaries of largely well-known material. The books of DeGroot and Mazur (*2*), Eckert (*3*), and Eckert and Drake (*4*) are extensively cited. Some topics drawn from the Russian literature are included in Chapters 3 and 4. The discussion of analogies is of much earlier origin; the Lewis analogy is improperly recommended for turbulent flow for all values of the Lewis number.

Chapters 1 to 3 contain some material of debatable value. Pages 50 to 53, for example, deal with the kinetic-energy gradient as a diffusional driving force; this is incorrect on several grounds, the crucial one being that this gradient does not appear in the entropy production expression (*2, 5*). Chapter 3 includes a discussion of dimensional analysis by integral-transform methods; this is quite misleading since more general information can be obtained by simpler methods (*6, 7*).

This book provides a useful introduction to the Russian literature on heat and moisture transfer in porous media. The topics covered are of interest to specialists in drying, food processing, soil mechanics, and architectural engineering. The book does not provide any significant information, however, relative to catalysis, exchange adsorption, or barrier diffusion processes.

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2. DeGroot, S. R., and P. Mazur, "Non-Equilibrium Thermodynamics," North-Holland Publishing Co., Amsterdam (1962).
3. Eckert, E. R. G., "Introduction to the Transfer of Heat and Mass," McGraw-Hill, New York (1950).
4. ———, and R. M. Drake, "Heat and Mass Transfer," McGraw-Hill, New York (1959).

5. Hirschfelder, J. O., C. F. Curtiss, and R. B. Bird, "Molecular Theory of Gases and Liquids," second printing with notes added, Wiley, New York (1964).
6. Bird, R. B., W. E. Stewart, and E. N. Lightfoot, "Transport Phenomena," Wiley, New York (1960).
7. Stewart, W. E., *Chem. Eng. Progr. Symp. Ser. No. 58*, **61**, 16-27 (1965).

Computer Calculations for Multicomponent Vapor-Liquid Equilibria, J. M. Prausnitz, C. A. Eckert, R. V. Orye, and J. P. O'Connell, *Prentice-Hall, Englewood Cliffs, New Jersey* (1967). 238 pages.

This monograph should be of very great value to those interested in making multicomponent vapor-liquid equilibrium calculations for systems at low to moderate pressures. The pressure restriction is stated explicitly by the authors, and is to be heeded. Thus, this work is directed more toward chemical than to petroleum separations. Professor Prausnitz promises a second monograph devoted to high-pressure vapor-liquid equilibria, and its publication will provide the complement to the present volume.

The approach taken is thermodynamic; that is, the basic equations are completely rigorous expressions of the thermodynamic criteria of equilibrium. The thermodynamic method and the basic equations for the required fugacities are concisely presented in the first two chapters. Chapter 3 treats the calculation of fugacities of the components in the vapor phase through use of the virial equation truncated after the second term. Generalized methods for arriving at values for the second virial coefficients are included. Chapter 4 deals with the calculation of fugacities of the components in the liquid phase. Here the Wilson equation for the excess Gibbs energy is employed. Its great advantage is that it provides an expression for multicomponent liquid mixtures which requires no other constants than those determined from data for the constituent binaries. Thus no ternary or multicomponent data are needed. This is probably the best that can be hoped for; it seems most unlikely that it will prove possible in general to predict mixture behavior from pure-component data alone. Methods are included for dealing with liquid mixtures containing "non-condensable" components, that is, components whose critical temperature is less than the mixture temperature. Chapter 5 outlines the main computer programs and subroutines for multicomponent calculations, and presents sample results. Chapter 6 discusses the methods and computer programs used to determine the param-

INFORMATION RETRIEVAL

Dynamics of a tubular reactor with recycle: Part II. Nature of the transient state, Reilly, M. J., and R. A. Schmitz, **A.I.Ch.E. Journal 13,** No. 3, p. 519 (May, 1967).

Key Words: A. Dynamics-8, Reactor-9, Plug-Flow-0, Tubular-0, Recycle-10, Equations-10, Difference Equations-10, Liapunov's Direct Method-10, Stability-8, 9, Steady State-9, Phase Plane-10, Region of Asymptotic Stability-8, 9, Concentration-9, Temperature-9.

Abstract: The purpose of this paper is to investigate the complete transient nature of the reactor-recycle system. The methods utilize the notion of a phase plane representation of the transient outlet state. The study of the behavior in the phase plane is based first on linearized transient equations and second on numerical solution of the nonlinear transient equations for some numerical examples. Finally, results obtained by applying Liapunov's direct method to predict regions of asymptotic stability are presented and compared with those obtained by numerical solution of the transient equations.

Constant total pressure evaporation with heat reuse by a built-in engine, Cheng, Chen-yen, and Sing-wang Cheng, **A.I.Ch.E. Journal, 13,** No. 3, p. 528 (May, 1967).

Key Words: A. Evaporator-8, 10, Evaporation-8, 10, Built-In Engine-8, 10, Process-8, Nonspontaneous-0, Isobaric-0, Free Energy-10, Heat of Condensation-10, Reuse-8, 10, Heat-9, Boiling Point Depressor-10, Absorbent-10, Pressure-8, Condenser-9, Boiler-9.

Abstract: A new way of promoting a nonspontaneous process, namely, a built-in engine, is introduced, showing that a process with a large temperature coefficient of free energy change can be utilized to promote a nonspontaneous process which has a small temperature coefficient of free energy change. When such a built-in engine is incorporated into an evaporating system, heat reuse in the system can be obtained under a constant total pressure condition.

Concentrated polymer solutions: Part II. Dependence of viscosity and relaxation time on concentration and molecular weight, Williams, Michael C., **A.I.Ch.E. Journal, 13,** No. 3, p. 534 (May, 1967).

Key Words: A. Concentration-6, Molecular Weight-6, Solutions-9, Polymers-9, Viscosity-7, 8, Relaxation Time-7, 8, Friction Coefficient-7, 8, Rheology-8, Segment Distribution Function-7, Pair Correlation Function-7.

Abstract: A previously presented molecular theory for non-Newtonian viscosity in moderately concentrated polymer solutions is extended in this paper to a specific consideration of the influence of solute concentration and molecular weight on the limiting viscosity and the relaxation time.

Determination of transient plate efficiencies from operational data, Groves, D. M., N. J. Tetlow, and C. D. Holland, **A.I.Ch.E. Journal, 13,** No. 3, p. 540 (May, 1967).

Key Words: A. Plate Efficiency-8, 7, Transient-0, Temperature-6, Composition-6, Liquid Phase-9, Distillation Columns-9, Tests-10, Mixing-8.

Abstract: Methods are presented for the determination of the transient values of the vaporization efficiencies from the knowledge of various combinations of the transient values of operating variables. For the case where the temperature and the composition of the liquid phase for each plate are known, a direct solution for the vaporization efficiencies is presented. Also, a method is presented for the determination of the mixing parameters of a generalized plate model on the basis of known transient values of certain operating variables.

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