INFORMATION RETRIEVAL*

Effect of axial diffusion of vorticity on flow development in circular conduits: Part I. Numerical solutions, Vrentas, J. S., J. L. Duda, and K. G. Bargeron, **A.I.Ch.E. Journal, 12,** No. 5, p. 837 (September, 1966).

Key Words: A. Mathematical Analysis-8, 4, Fluid Flow-9, 8, Laminar Flow-9, Newtonian Fluids-9, Circular Pipe-9, Entrance Model-10, 8, Boundary-Layer Equations-10, Equations of Motion-10, Derivation-8, Calculation-8, Vorticity Transport Equation-2, 10, Velocity-2, 7, Velocity Profile-2, 7, Pressure Drop-2, 7, Vorticity-6, Axial Diffusion-6, Entrance Length-7.

Abstract: An entrance model is presented which extends the analysis of the flow development in the entrance region to flow regimes which are inadequately described by a boundary-layer analysis. Results are presented for the numerical solutions of the boundary-layer equations and the complete equations of motion at five different Reynolds numbers. The effect of the axial diffusion of vorticity on the pressure drop, entrance length, and the development of the vorticity and velocity fields is demonstrated.

Catalytic oxidation of hydrogen—intrapellet heat and mass transfer, Maymo, J. A., and J. M. Smith, **A.I.Ch.E. Journal, 12,** No. 5, p. 845 (September, 1966).

Key Words: A. Reaction-8, 9, Oxidation-8, 9, Catalysis-8, Hydrogen-1, Oxygen-1, Water-2, Catalyst-10, Platinum-10, Aluminum Oxide-5, Pellets-5, 9, Particles-5, Measuring-8, Rate-9, 1, Temperature-9, 1, 7, Intrapellet Gradients-9, Heat Transfer Coefficients-9, Thermal Conductivity-9, 1, Surface Position-6, Calculating-8, Effective Diffusivity-2, Effectiveness Factor-2. B. Calculating-8, Rate-2, 7, Heat Transfer Coefficients-2, Temperature-6, Partial Pressure-6, Oxidation-9, Reaction-9, Oxygen-1, 9, Hydrogen-1, 9, Water-2, 6, Platinum-10, Catalyst-10, Aluminum Oxide-5.

Abstract: Rates of oxidation of hydrogen by using platinum-aluminum oxide catalyst particles and, in separate trials, 1.86—cm. pellets are measured. The pellet reactor is of the recirculation, stirred-tank type with injection nozzles. Variations in temperature with position on the pellet surface and variations of local heat transfer coefficients between pellet and gas with surface position are observed. The effective thermal conductivity of the pellet is measured independently and used with experimental temperature measurements to establish the effective diffusivity. Experimental effectiveness factors are obtained by comparing rates of reaction for catalyst particles and for pellets.

Shape of liquid drops moving in liquid media, Wellek, R. M., A. K. Agrawal, and A. H. P. Skelland, **A.I.Ch.E. Journal, 12,** No. 5, p. 854 (September, 1966).

Key Words: A. Predicting-8, Correlating-8, Shape-9, 8, 7, Eccentricity-9, 8, 7, Deformation-9, 8, 7, Drops-9, Nonoscillating-0, Size-6, Velocity-6, Viscosity-6, Density-6, Weber Number-6, 9, 10, Eotvos Number-6, 9, 10, Mass Transfer-4, Liquid-Liquid System-5.

Abstract: An investigation of the effects of various physical properties, drop size, and drop velocity on drop shape was carried out for nonoscillating liquid drops falling through stationary liquid continuous phases. The data of forty-five dispersed-continuous phase systems (twenty-eight new and seventeen literature systems) were studied. Relatively simple empirical relations involving the Weber number, Eotvos number, and viscosity ratio were obtained which enabled the prediction of the eccentricity of nonoscillating drops over a wide range of Reynolds number (6.0 to 1,354) with average deviations of 6 to 8%.

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* For details on the use of these Key Words and the A.I.Ch.E. Information Retrieval Program, see **Chem. Eng. Progr.,** Vol. 60, No. 8, p. 88 (August, 1964). A free copy of this article may be obtained by sending a post card, with the words "Key Word Article" and your name and address (please print) to Publications Department, A.I.Ch.E., 345 East 47 St., N. Y., N. Y., 10017. Price quotations for volume quantities on request.

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Mechanics of Fluid Flow, P. A. Longwell, McGraw-Hill, New York (1966). 433 pages, $14.75.

Longwell's considerable experience in teaching first-year graduate students of chemical engineering at the California Institute of Technology is reflected in this carefully written text. Fundamental concepts are clearly developed and there is a wealth of pertinent examples worked out in the text and problems to be assigned for homework. Although primary emphasis is on momentum transport, some energy transport is also included to illustrate how fluid mechanics enters into the solution of broader problems. Detailed subject matter development covers a wide selection of topics which should be of use to chemical engineers.

A fairly conventional order of subject development is followed in the nine-chapter treatise. The first three chapters cover basic definitions together with derivations of the continuity and momentum balance equations. The treatment here might be considered a review of undergraduate fluid mechanics at a more advanced level. Use is made of vector notation but the formalism of tensors is avoided, emphasis being on the solution of problems in specific coordinate systems.

There follows a chapter on flow in porous media, a subject not often treated in chemical engineering courses despite its important applications. Following a civil engineering approach, it is largely empirical in development of the underlying concepts. In view of the space given in the book to development of basic equations, it is unfortunate that the connection between the equations of motion and Darcy's law for flow through porous media is not more clearly established. Examples here also seem more in line with civil engineering practice including such subjects as seepage through porous media under dams and flow in wells rather than more typical chemical engineering problems like flow in various packed beds.

After this digression a classic treatment of the Navier-Stokes and energy equations is resumed. Solutions of the Navier-Stokes equations are developed at some length with numerous references to recent research. Problems worked out in detail include flow between nonparallel plates, flow between porous walls, flow near a rotating disk, flow past a circular cylinder, flow past a sphere, and laminar flow in the inlet section of parallel plates. The last problem is the subject of Longwell's own recent research interest.

Two subsequent chapters develop laminar boundary-layer theory and turbulent flow, respectively. The boundary-layer concept as developed draws

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Constitutive equations for viscoelastic fluids for short deformation periods and for rapidly changing flows: significance of the Deborah number, Metzner, A. B., J. L. White, and M. M. Denn, **A.I.Ch.E. Journal, 12,** No. 5, p. 863 (September, 1966).

Key Words: A. Characterizing-8, 4, Describing-8, 4, Flow-9, 8, 7, Behavior-9, 7, Deformation-9, 7, Viscoelastic Fluids-9, Constitutive Equations-10, 8, 2, 9, Derivation-8, Asymptotic Characteristics-2, 9, Reynolds Number-1, 6, Weissenberg Number-1, 6, Deborah Number-1, 6, 8.

Abstract: The proper forms and asymptotic characteristics of constitutive equations which may be useful for the description of viscoelastic fluids in flow fields are considered. It is seen that the Deborah number emerges as a natural ordering parameter which determines whether simple approximations explicit in stress may suffice to describe the fluid properties or whether implicit or integral equations are required. Methods of using the Reynolds, Weissenberg, and Deborah numbers for scale-up criteria in engineering design for viscoelastic fluids are discussed.

Mass transfer in supported froths, Workman, Walter L., and Seymour Calvert, **A.I.Ch.E. Journal, 12,** No. 5, p. 867 (September, 1966).

Key Words: A. Describing-8, Predicting-8, Efficiency-9, 8, 7, Apparatus-9, 8, Mass Transfer-4, 9, Froth-10, Supported Froth-10, Deriving-8, Mathematical Model-10, 2, Operating Diagram-10, Gas Rate-6, Liquid Rate-6, Packing-6, Support-6, Froth Height-7.

Abstract: A mass transfer apparatus utilizing supported high density froth is described. The apparatus consists of a dual-flow sieve plate column with eggcrate packing above the plate (the packing supports the froth). Mass transfer systems studied are ammonia-air-water and carbon dioxide-air-water. A model based on measurable physical parameters is developed and used to account for important parameters in mass transfer and to predict the efficiency of the froth equipment.

Optimality and computational feasibility in transient control: Part I. A modified criterion for optimality, Paradis, W. O., and D. D. Perlmutter, **A.I.Ch.E. Journal, 12,** No. 5, p. 876 (September, 1966).

Key Words: A. Optimality-8, Feasibility-8, Criterion-9, 2, 8, Deriving-8, Equations-2, Optimization-4, 8, Transient Control-4, 9, Process-9, Stirred-Tank Reactor-9, Mathematical Analysis-10, Nonlinear Analysis-10.

Abstract: The notion of optimality with regard to transient control is critically examined with a particular view toward the computational difficulties of solving the optimal control problem, and the arbitrary aspects of the usual objective functions. A criterion for transient control is developed which requires a minimum of computational effort for practical application. Optimality is achieved in an instantaneous sense, and it is argued that overall optimality is well approximated for many cases of practical interest. The criterion is applied to the transient control of a stirred-tank reactor. Numerical examples are given and the results are compared with those obtained by alternative methods.

Optimality and computational feasibility in transient control: Part II. Feedback control of a disturbed parameter process, Paradis, W. O., and D. D. Perlmutter, **A.I.Ch.E. Journal, 12,** No. 5, p. 883 (September, 1966).

Key Words: A. Optimality-8, Feasibility-8, Application-8, Criterion-9, 8, Optimization-4, 8, Transient Control-4, Process-9, Disturbed Parameter Process-9, Tubular Reactor-9, Mathematical Model-10, Nonlinear Analysis-10.

Abstract: A criterion previously developed by the authors is applied to the problem of transient control of a disturbed parameter process. Computational difficulties prevalent in most optimization techniques are largely avoided, suggesting applicability to computer control of large transients. The use of such a control to improve the transient performance of a tubular reactor model is examined in detail. Numerical examples are given to demonstrate the criterion for control and the results are discussed.

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heavily on the comprehensive treatises of Schlichting and the lucid elementary treatment of Prandtl and Tietjens, which are probably familiar to most readers. In the chapter on turbulent flow main emphasis is necessarily on empirical theories. The Prandtl mixing-length hypothesis and the eddy-viscosity concept are developed with references to recent research conducted in this field. The presentations should serve as an adequate introduction of these subjects to the student.

The final chapter on non-Newtonian fluids treats a subject often not included in chemical engineering courses. Emphasis is given to a means for predicting velocity distributions, flow rates, and pressure gradients for the steady, uniform flow of certain types of non-Newtonian fluids in conduits. Useful procedures for handling practical problems are presented.

The book gives a good introductory summary of the state of knowledge in fluid mechanics in most areas of interest to chemical engineers. It will not serve as a reference for anyone desiring to do advanced research in this field except for special topics. It should find acceptance as a beginning graduate text in curricula where other, more advanced courses are also available.

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