INFORMATION RETRIEVAL*

Stability of batch catalytic fluidized beds, Luss, Dan, and Neal R. Amundson, **AIChE Journal, 14,** No. 2, p. 211 (March, 1968).

Key Words: A. Stability-7, 8, Reactor-8, 9, Fluidized Bed-10, Control-4, Steady State-0, Temperature-6, Catalyst-9, Start Up-6, Mathematical Model-10.

Abstract: This work is a study of the stability of a batch fluidized bed with a simple model. It is shown that multiple steady states can occur with all catalyst particles at the same temperature, some of these states being unstable. The analysis demonstrated that the initial temperature of the catalyst particles may be a predominate factor in determining the kind of steady state obtained.

Bubble-driven fluid circulations, de Nevers, Noel, **AIChE Journal, 14,** No. 2, p. 222 (March, 1968).

Key Words: A. Circulation-7, 8, Bubbles-9, Flow-8, Fluids-9, Mass Transfer-8, Bubble Columns-4, Gas Lifts-4, Pool Boiling-4, Baffles-6. B. Circulation-6, Bubbles-9, Holdup-7, Residence Time-7, Vapors-9, Mass Transfer-7, Efficiency-7, Bubble Columns-9.

Abstract: Bubble-driven fluid circulations are present in bubble columns, gas lifts, pool boiling, etc. Their mechanism is shown to be quite similar to the mechanism of natural convection but with much larger driving forces. These circulations are stable in many baffled systems but unstable and rapidly changing in size, shape, and orientation in unbaffled systems. The effect of these circulations in bubble columns is to lower holdup and vapor residence time, thus, decreasing the mass-transfer efficiency of the column.

Measurement of the velocity of gases with variable fluid properties, Wasan, D. T., R. M. Davis, and C. R. Wilke, **AIChE Journal, 14,** No. 2, p. 227 (March, 1968).

Key Words: A. Velocity-7, 8, Gases-9, Mass Transfer-6, Composition-6, Temperature-6, Hot Wire Anemometry-10, Convection-6, Properties-6, Injection-6, Suction-6.

Abstract: This paper describes the experimental measurements of the time-averaged velocities of gases in a field of variable composition and temperature. The conventional theory of hot wire anemometry is extended to include the effects of both natural and forced convection to gases having variable fluid properties.

Mass transfer between immiscible liquid metals, Pasternak, Alan D., and Donald R. Olander, **AIChE Journal, 14,** No. 2, p. 235, (March, 1968).

Key Words: A. Extraction-8, Lanthanum-2, Barium-2, Uranium-1, Chromium-1, Magnesium-5, Mass Transfer-8, Liquid Metals-9, Drops-9, Reprocessing-4, Fuel-9, Reactors-10.

Abstract: The object of this work was to investigate extraction kinetics in a typical uranium-bearing liquid metal-immiscible solvent metal system in order to determine whether the sizeable background on extraction in low temperature, aqueous-organic systems could be applied to liquids with markedly different characteristics. The extraction of lanthanum and barium from single falling drops of the uranium-chromium eutectic into magnesium was studied.

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* For details on the use of these Key Words and the AIChE 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, AIChE, 345 East 47 St., N. Y., N. Y., 10017. Price quotations for volume quantities on request.

(Continued on page 365)

(Continued from page 210)

York State hospitals since 1955. Chemical processing is made more meaningful with the new approach.

The format has changed, too. The print is smaller but clear; the type has changed. The new flow charts are clearer and easier to follow than those which are repeated, having been taken directly from the earlier edition. The result would, perhaps, have been more even had the latter, as for example that for distilled liquors, been redrawn and given the new look.

Perusal has netted few errors, but a rather bad one may be discovered under the Girbotol aliphatic amine absorption process for gas purification, the quantities for which are referred to as being found in Table 6.5. Unfortunately, Table 6.5, four pages beyond, deals with the breakdown of cycle time on a carbureted water-gas machine, instead of the equivalent of Table 5 on page 113 of the second edition.

Overall, the new edition will continue to maintain its proper place in the Chemical Engineering Series, but this does not necessarily mean that the engineer should discard the book this is supposed to replace. There are still some helpful facts in the 1956 edition which here have been omitted because of their lesser present-day significance, but one never knows when older methods and systems may be encountered.

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An Introduction to Fluid Dynamics, G. K. Batchelor, Cambridge University Press, Massachusetts (1967). 615 pages, $13.50.

Written by the well-known senior editor of the *Journal of Fluid Mechanics*, this treatise presents a unified introduction to the fundamental dynamics of real fluids. Despite its high mathematical level for an introductory book, the analysis is firmly grounded in experimental research results gleaned over the past fifty years. From the viewpoint of the applied mathematician, the order of development departs from the traditional sequence: dynamics (stress) is considered before kinematics; and the classical hydrodynamics of inviscid fluids is considered last, after a thorough treatment of viscous fluid motion. Such an approach will obviously appeal to engineers, for whom viscous effects are of signal importance.

(Continued on page 365)

(Continued from page 364)

Graphical viscosity correlation for hydrocarbons, Gonzales, M. H., and A. L. Lee, **AIChE Journal, 14,** No. 2, p. 242 (March, 1968).

Key Words: A. Viscosity-7, Correlation-8, Reduced Temperature-6, Reduced Pressure-6, Hydrocarbons-9.

Abstract: A graphical correlation for predicting the viscosity behavior of pure hydrocarbons, their mixtures and natural gases containing nonhydrocarbons has been developed. To use this correlation, the only information needed are the composition and the reduced properties. This correlation is tested with neopentane, methane-*n*-butane mixtures and four natural gases for temperatures from 100° to 460°F. and pressures from 14.7 to 10,000 lb./sq. in. abs. and the maximum deviation is ±5%.

Promotion of drop-by-drop condensation of steam from sea water on a vertical copper tube, Bromley, L. A., J. W. Porter and S. M. Read, **AIChE Journal, 14,** No. 2, p. 245 (March, 1968).

Key Words: A. Condensation-8, 9, Drops-2, Steam-1, Sea Water-1, Conversion-4, Tubes-9, Copper-9, Vertical-0, Promotion-8, Tetrakis Octadecyl Thio Silane-10, Cleaning-8, Heat Transfer-8.

Abstract: A limited number of tests were made of condensation promoters. The best promoter found to date is tetrakis octadecyl thio silane. The method of application, and corrosion resistance of the promoter were also studied. These studies have future application in the design of sea water conversion plants.

Transient natural convection in a vertical cylinder, Evans, L. B., R. C. Reid, and E. M. Drake, **AIChE Journal, 14,** No. 2, p. 251 (March, 1968).

Key Words: A. Convection-7, 8, 10, Cylinders-9, Vertical-0, Heat Transfer-7, 8, Liquids-6, 9, Mathematical Model-10, Temperature-8, Depth-6, Heat Flux-6.

Abstract: An experimental and analytical study was made of transient natural convection in a vertical cylinder. For the experiments a cylinder was partially filled with liquid and subjected to a uniform heat flux at the walls. Thermocouples were used to measure the unsteady temperature field within the liquid; dye tracers were used to study flow patterns. Parameters that were varied included the test liquid, the liquid depth, and the wall heat flux.

Mass transfer and wake phenomena, Magarvey, R. H., and C. S. MacLatchy **AIChE Journal, 14,** No. 2, p. 260 (March, 1968).

Key Words: A. Fall-7, 8, Drops-9, Liquids-9, Vortex-8, Wake-8, Mass Transfer-7, 8, Flow-6, 7, 8, Size-6, Density-6, Reynolds Number-6.

Abstract: The external velocity field associated with the fall of a single drop through a quiescent liquid phase is discussed. The delineation of the flow patterns behind the drop gives some indication of the manner in which the external flow contributes to the mass transfer coefficients.

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(Continued on page 366)

(Continued from page 364)

The book, explicitly designed to be self-contained, is intended as an introductory text for undergraduate and beginning graduate students in applied mathematics and engineering. It has evolved from courses taught by the author at the University of Cambridge. The length of the book, its mathematical level, and the lack of many worked-out problems or problems for home solution will mitigate against its use in undergraduate engineering courses taught in this country. Its breadth and masterly exposition should, however, make it useful as a primary text at the first- and second-year graduate level. However, for discussions of stability, turbulence, non-Newtonian flow, compressible flow, and multiphase flow, the student will have to look elsewhere.

The first three chapters provide the basic scientific concepts which govern the subject namely, the properties of fluids, the dynamics and kinematics of flow, and the general equations of motion. With the confidence of the deductive scientist, Professor Batchelor presumes that the Navier-Stokes and continuity equations completely describe the motion of a fluid, and that the realm of fluid-dynamical phenomena, complicated though it may be, is implicitly contained within the governing equations, initial and boundary conditions.

The remaining two-thirds of the first portion of the book is concerned with the laminar motion of a viscous incompressible fluid, which the author regards as the heart of the matter by virtue of both its fundamental nature and practical importance.

Chapter 4 considers viscous flows for situations where the Reynolds number does not exceed 100. Only 24 pages are devoted to solving the equations of motion for cases where inerital forces are negligible, including lubrication theory, percolation through porous media, the viscosity of suspensions of particles, (including an original treatment of the bulk viscosity of a dispersion of gas bubbles in a viscous liquid), the motion of particles of arbitrary shape, including droplets, and a variety of other topics. Curiously, though the translational resistance tensor for an arbitrarily shaped particle is introduced, no mention is made of its symmetry or positive-definiteness. What is presented is excellent, but more space could profitably have been devoted to low Reynolds number flow phenomena to place it in proper proportion relative to fluid dynamics as a whole.

Laminar flow at large Reynolds numbers is discussed in Chapter 5. The

(Continued on page 366)

(Continued from page 365)

Kinetics of reaction and crystallization in condensed phases: the aqueous potassium dipicylamine system, Savage, H. R., John B. Butt, and John A. Tallmadge, **AIChE Journal, 14,** No. 2, p. 266 (March, 1968).

Key Words: A. Crystallization kinetics-8, Coupled Reaction and Crystallization-8, Liquid Phase-5, Temperature-6, Concentration-6, Potassium Dipicylamine-9, Batch Crystallization Apparatus-10, Burton-Cabrera-Frank theory-10.

Abstract: An apparatus and experimental technique were developed for the study of the kinetics of relatively rapid reaction and subsequent crystallization in condensed phases. The method employs batch experiments to establish the integral of crystallization rate over ranges of pertinent external variables.

The crystallization of potassium dipicrylamine from aqueous solution, a system of potential interest in application to potassium recovery from brines, was studied experimentally. It is shown that both reaction and crystallization rate parameters may be determined from the data on the basis of the consecutive rate model developed; application of the Burton-Cabrera-Frank theory of crystal growth to this system is demonstrated.

On certain unsteady torsional flows of simple fluids, Johns, L. E., Jr., **AIChE Journal, 14,** No. 2, p. 275 (March, 1968).

Key Words: A. Flow-8, Torsional-0, Curvilineal-0, Fluids-9, Non-Newtonian-0, Viscoelastic-0, Equation of Motion-8, 10, Cone & Plane Viscometer-10, Parallel Disk Viscometer-10, Torsional Viscometer-10.

Abstract: This paper presents an investigation of the equations of motion to find the conditions under which these equations admit exact viscometric solutions for certain unsteady torsional flows of incompressible simple fluids.

An investigation of absorption-reaction of carbon dioxide in liquid diethanolamine by the direct chromatographic perturbation method, Barrere, C. A., and H. A. Deans, **AIChE Journal, 14,** No. 2, p. 280 (March, 1968).

Key Words: A. Absorption-8, Carbon Dioxide-1, Diethanolamine-5, Chromatography-10, Perturbation-10, Equilibrium-8, Heat of Reaction-8, Ionization Heat-8.

Abstract: The purpose of this investigation was to extend the use of direct chromatographic methods to chemically reactive gas-liquid systems. Physical and chemical equilibrium in the carbon dioxide-diethanolamine system was studied by the direct chromatographic method.

Laminar liquid jet diffusion studies, Duda, J. L., and J. S. Vrentas, **AIChE Journal, 14,** No. 2, p. 286 (March, 1968).

Key Words: A. Diffusivity-8, Carbon Dioxide-9, Oxygen-9, Argon-9, Nitrous Oxide-9, Ethylene-9, Propylene-9, Water-5, Gases-9, Mass Transfer-8, Absorption-8, Jets-10, Liquids-9.

Abstract: A rigorous analysis of jet hydrodynamics is used to develop a technique for determining diffusion coefficients from laminar liquid jet absorption experiments, and the influence of the jet fluid mechanics on the absorption process is clarified. The new technique is used to determine the diffusivities of carbon dioxide, oxygen, argon, nitrous oxide, ethylene, and propylene in water.

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(Continued on page 367)

(Continued from page 365)

author notes that in the history of fluid mechanics it was assumed that viscous forces could be neglected in comparison with inertial forces at sufficiently high Reynolds numbers. However, the flow of a real fluid at very large Reynolds numbers cannot be regarded as synonymous with the flow of fluid devoid of viscosity, except in rather special circumstances. Boundary-layer theory and its implications are carefully developed in this context.

Chapters 6 and 7, occupying the remaining third of the book, are concerned with the flow of incompressible fluids in which the direct effects of viscosity may be neglected. Both irrotational flow and the flow of an effectively inviscid fluid possessing vorticity are considered, together with a number of interesting applications ranging from meteorology to aerodynamic design.

A welcome feature of the book is the inclusion of a large number of aesthetically pleasing and informative photographs of various flow fields. These serve to illustrate the correspondence between observation and the various conceptual models developed in theoretical fluid dynamics.

This book can be highly recommended as a useful graduate-level text in theoretical fluid mechanics. Applied research workers will also find it a convenient and critical compilation of many classical results. Our only major criticism of the book as a general text is the inadequacy of secondary references. The original references given are, for the most part, only of historical interest.

It is to be hoped that the reception accorded this book will be warm enough to encourage Professor Batchelor to follow his inclination to write a sequel covering other important areas not touched upon in this introductory volume.

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