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of the old edition which have not been revised are now rather badly out of date, such as the treatment of liquid agitation and mechanically stirred extractors. In some cases, revision has been limited to addition to the bibliography with only passing reference to a few of the new entries.

Of course, it must be recognized that many of the subjects have remained astonishingly static for years, and modernization of these is then really impossible. And in a work of this size, covering in two volumes (the Preface promises a third) a great expanse of engineering knowledge, the extent and emphasis of revision understandably must reflect to some degree the particular interests of the authors.

The book is basically design oriented, much more so than the revised first volume, and on the whole relatively more elementary in its treatment. The explanations, mathematical derivations, and descriptions are exceptionally clear, supplemented by a great many good photographs and line drawings. Literature references and tables of notation have been put at the end of each chapter, rather than in groups as in the earlier edition. There are several more worked examples than before; 170 problems for student practice, 53 of them new; and a good index. Printing and format are first-rate. On the whole, this is a welcome and useful addition to any chemical engineer's library.

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An Introduction to Engineering and Engineering Design, Second Edition, Edward V. Krick, John Wiley & Sons, Inc., New York, $7.50. 220 pages.

Although this second edition follows the same general pattern and develops the same ideas as the first, it has been largely rewritten. Many of the examples and illustrations are also new. The number of pages in the second edition is practically the same as in the first but the larger page size made it possible to increase the content somewhat without increasing the pages.

Since many who might read this review are probably not familiar with the first edition, it seems in order to present a brief picture of the contents. The book is addressed primarily to students who might be contemplating engineering as a career and to students already enrolled in an engineering curriculum. In my opinion almost anyone

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INFORMATION RETRIEVAL

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Mass transport in porous materials under combined gradients of composition and pressure, King, C. Judson, and Robert D. Gunn, **AIChE Journal, 15,** No. 4, p. 507 (July, 1969).

Key Words: A. Porous Media-5, 8, Diffusion-8, Mass Transfer-8, Mass Transport-8, Helium-5, 9, Argon-5, 9, Nitrogen-5, 9, Slip Flow-8, Transition Flow-8, Knudsen Flow-8, Dusty Gas Model-8, Pressure-6.

Abstract: An expression is derived for the analysis of gas-phase mass transport in porous media in the presence of gradients in pressure and mole fraction. The behavior of porous media is contrasted with that of capillary tubes. A continuous-flow diffusion and permeation apparatus was employed for studies of mass transport in a fritted glass diaphragm. Measurements were obtained at varying levels of pressure and cover both isobaric binary diffusion and the permeation of pure gases and gas mixtures. These experimental results and previous data obtained by Hewitt and Sharratt and by Mason, et al. bear out the form of the equation and successfully provide independent checks of the three constants necessary to characterize a given porous medium.

Adsorption of carbon monoxide-nitrogen, carbon monoxide-oxygen and oxygen-nitrogen mixtures on synthetic zeolites, Danner, R. P., and L. A. Wenzel, **AIChE Journal, 15,** No. 4, p. 515 (July, 1969).

Key Words: A. Adsorption-8, Equilibrium-0, Separation-4, 8, Gases-1, Mixtures-1, Binary-0, Oxygen-1, Nitrogen-1, Carbon Monoxide-1, Molecular Sieves-5, Low Temperature-0, Composition-6, Adsorption Mechanism-10.

Abstract: Experimental results for the adsorption of the binary gas mixtures oxygen-nitrogen, oxygen-carbon monoxide and nitrogen-carbon monoxide on two synthetic zeolites are reported. In all these experiments the temperature was —200°F. and the total pressure was 1 atm. Also reported are the isotherms for the three pure gases on the two zeolites at —200°F. The results indicate that these zeolites have a surface selectivity which is independent of any sieving effect based on the size of the adsorbed molecules. It does not appear that the strong separations obtained can be explained in terms of the van der Waals forces which are generally believed to be dominant in physical adsorption. The available methods of predicting binary adsorption data from the pure gas isotherms have been examined.

A drop dispersal model for rinsing, Tallmadge, John A., and Sik U. Li, **AIChE Journal, 15,** No. 4, p. 521 (July, 1969).

Key Words: A. Mass Transfer-8, Film Distribution-8, Rinsing-8, Removal-8, Diffusion-8, Water-5, Drop Dispersal-8, Solutions-5, Transport-8, Mechanism-8, Time-6, Drop Volume-8, Diffusivity-6.

Abstract: A new theory for convection-free rinsing of flat plates was developed to include the drop dispersal mechanism as well as the previously considered diffusion mechanism. Cases where carry-over is unequal to dragout were also included in the model. Based on film distribution data, the model offers better agreement with rinse data. The effect of drain time on film distribution and bottom drop volume was also investigated.

The effect of surfactants on the flow characteristics of falling liquid films, Strobel, W. J., and Stephen Whitaker, **AIChE Journal, 15,** No. 4, p. 527 (July, 1969).

Key Words: A. Flow-7, 8, Liquids-9, Length-7, 8, Velocity- 7, 8, Waves-9, Falling Films-9, Valeric Acid-6, 9, Hexanoic Acid-6, 9, Surfactants-6.

Abstract: Experimental values of the wave length and wave velocity have been obtained for dilute solutions of valeric and hexanoic acid for a vertical falling liquid film. The wave length was unaffected by the surfactants for Reynolds numbers in the range 5 to 100; however, the wave velocity was decreased for increased surface concentrations of the two acids. The free surface velocity is greatly retarded by the adsorption of the surface agents.

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Creeping flow past a fluid globule when a trace of surfactant is present, Wasserman, Melvin L., and John C. Slattery, **AIChE Journal, 15,** No. 4, p. 533 (July, 1969).

Key Words: A. Bubble-8, Droplet-8, Galerkin-10, Mass Transfer-8, Perturbation-10, Surface-Active-8, Surface Tension-8, Surfactant-8.

Abstract: The effects of a trace quantity of a surface-active agent on creeping flow past a bubble or droplet were investigated. The equations describing mass and momentum transfer were simultaneously solved by a perturbation technique, consistent with the jump mass and momentum balances at the phase interface. The stream function for the velocity distribution was evaluated as an infinite series of spherical harmonics. Galerkin's method, which reduces the partial differential equation of continuity to a set of ordinary differential equations, was used to evaluate the concentration distribution of surfactant.

A sample calculation was carried out for relative motion between an air bubble and an infinite body of water which contains a trace of isoamyl alcohol. The relative velocity of the water at an infinite distance from the bubble was found to be highly sensitive to small changes in surfactant concentration from zero, although the bubble varies imperceptibly from a spherical shape.

Low reynolds number developing flows, Atkinson, Bernard, M. P. Brocklebank, C. C. H. Card, and J. M. Smith, **AIChE Journal, 15,** No. 4, p. 548 (July, 1969).

Key Words: A. Point Velocity-8, Liquids-9, Aqueous Glycerol-9, Flow-9, Laminar-0 Optics-10, Photography-10, Numerical Analysis-10, Entrance Length-2. B. Finite Element Method-10.

Abstract: Equations are given that relate the entrance length to Reynolds number for pipe and channel geometries with a flat velocity profile as the initial condition. These equations are linear combinations of the creeping flow and boundary layer solutions. The former is obtained by minimization of the viscous dissipation using the Finite Element Method. The equation for the pipe entrance is shown to be in good agreement with experimental data.

Experimental and theoretical investigation of purification in a column crystallizer of material with impurities of the eutectic forming type, Albertins, Rusins, and J. E. Powers, **AIChE Journal, 15,** No. 4, p. 554 (July, 1969).

Key Words: A. Operation-8, Crystallizer-9, Crystallization-7, 8, 10, Purification-7, 8, Benzene-2, Cyclohexane-3, Mass Transfer-6, Backmixing-6, Eutectic Mixture-9, Schildknecht Column Crystallizer-9.

Abstract: A theoretical analysis of the operation of a Schildknecht type column crystallizer is presented and simplified to three special cases. Experimental determinations were made of concentration profiles established during the purification of benzene with cyclohexane as impurity under steady state, batch conditions of operation.

Drying polymers during screw extrusion, Coughlin, R. W., and G. P. Canevari, **AIChE Journal, 15,** No. 4, p. 560 (July, 1969).

Key Words: A. Drying-4, 8, 7, 10, Methanol-1, 3, 5, 9, Throughput-6, Design Method-2, 4, Extrusion-4, 8, 10, Polypropylene-1, 5, 9, Channel Depth-6, Xylene-1, 3, 5, 9, Solvent-6, Correlation-2, 4.

Abstract: Partial removal of adsorbed solvent from polymers can be accomplished during the process of screw extrusion. This paper shows how two simple transport models based either on an effective diffusivity or on an empirical mass transfer coefficient can be combined with the fluid mechanical equations which describe polymer flow during screw extrusion. In this way, the drying of solvent from a polymer during extrusion can be correlated in terms of the design and operating parameters of the extruder screw and a mass-transfer coefficient or an effective diffusivity. This approach is illustrated employing data obtained using two extruders of different size and two different solvent-polymer systems. Furthermore, it is pointed out how the results can be used to predict the extent of drying during screw extrusion as well as how modifications in extruder-screw design can permit more extensive drying of polymers during the extrusion process.

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concerned with engineering would profit from reading it. I recommend it as required reading for university administrators some of whom seem woefully ignorant of what engineering is all about.

Although the book does not have much direct bearing on the kind of design practiced by chemical engineers, it presents, with the aid of many case studies, an interesting and clear picture of the nature of engineering and how it differs from science. The author continually emphasizes the creative nature of engineering design which, as he notes, is the most characteristic function of the engineer and clearly distinguishes him from the technician. Engineering is still, in many of its areas, more of an art than a science. Of course it uses science whenever it is possible and useful but few, if any engineering problems, (and the engineer is primarily a problem solver) were ever solved by science alone. There is a big gap between basic scientific principles and practical, useful devices and it is the engineer's job to bridge this gap. The engineer relies heavily on many empirical facts and relationships, on his creative imagination and the exercise of judgment. The author points out that many important engineering projects were carried out successfully long before any science was available.

The story of a number of important engineering projects such, for example, as the Chesapeake Bay Bridge Tunnel, is related in an interesting, but of course, superficial manner, with the aid of diagrams and photographs.

Considerable space is devoted to explaining the general procedure for solving an engineering-design problem. The author leads one through the various steps beginning with definition of the problem, through the steps of detailed analysis, the search for alternative solutions, evaluation and comparison of the various alternatives to select the best solution, and to the final detailed documentation of the chosen solution. Each of these steps is clearly and concisely illustrated.

The author dispels the common image of the engineer as a person who works mainly with things; on the contrary he works mainly with information —gathering facts, analyzing, computing, communicating—with ideas and with people. Although the result of his efforts is something tangible, the actual work of constructing is done by technicians. Since most engineering design is done by teams it is clear that a large

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portion of the engineer's time is devoted to dealing with people.

Many other topics are treated in a general but thought-provoking manner and I can mention only a few: the question of the education of the engineer, the roots of engineering going back to Roman times, the highly challenging aspect of engineering, the engineer's deep involvement with social needs, the close parallel between the evolution of engineering and that of medicine, the use of models and of computers, optimization, awareness of cost, opportunities and challenges awaiting the engineers of the future, etc.

In an appendix is a list of suggested readings, a brief discussion of seven major branches of engineering, an illustration of simulation by a computer, and a short introduction to analysis of a problem with several variables and restrictions imposed on them.

In conclusion, I would say that I found this to be a very readable, well written and informative book and anyone with an interest in engineering would get both pleasure and profit from it.

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Second International Conference on Molecular Sieve Zeolites

The Second International Conference on Molecular Sieve Zeolites will be held at Worcester Polytechnic Institute, Worcester, Massachusetts, September 8 to 11, 1970. The sessions will include invited and submitted papers on the following topics: structure; mineralogy; synthesis; adsorption; catalysis; modifications and general properties including ion exchange. The conference is cosponsored by the American Chemical Society Division of Colloid and Surface Chemistry and Division of Petroleum Chemistry, and Worcester Polytechnic Institute. Co-Chairmen for the Conference are Dr. L. B. Sand and Miss Edith M. Flanigen.

Abstracts (200 words) of papers for consideration should be submitted to Miss Edith M. Flanigen, Union Carbide Corporation, Linde Division, P.O. Box 44, Tonawanda, New York 14150 before August 15, 1969. Complete manuscripts will be required by January 1, 1970. For registration information contact Dr. L. B. Sand, Department of Chemical Engineering, Worcester Polytechnic Institute, Worcester, Massachusetts 01609. Registration will be limited to 500 participants.

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A phenomenological interpretation and correlation of drag reduction, Astarita, Gianni, Guido Greco, and Luigi Nicodemo, **AIChE Journal, 15,** No. 4, p. 564 (July, 1969).

Key Words: A. Reduction-7, 8, Drag-7, 9, Fluid-9, Viscoelastic-0, Polymer-9, Diameter-6, Flow-6, 9, Turbulent-0, Pressure Drop-7, 8, Friction Factor-7, 8, Reynolds Number-6, Correlation-8, Deborah Number-6.

Abstract: Drag reduction data for five concentrations of a water-soluble polymer and three tube diameters are presented. The data are correlated by a single curve relating two dimensionless parameters; these have been obtained from a phenomenological analysis of the mechanism of drag reduction.

Packed distillation columns and absorbers at steady state operation, Rubac, R. E., Ronald McDaniel, and C. D. Holland, **AIChE Journal, 15,** No. 4, p. 568 (July, 1969).

Key Words: A. Mass Transfer-8, Mass Transfer Coefficients-8, Distillation-8, Absorption-8, Distillation Columns-10, Packed Columns-10, Absorbers-10, Packing-10, Steady State-0, Efficiency-8. B. Relationship-8, Distillation Columns-9, Absorbers-9, Packing-10, Plates-10.

Abstract: In this paper the concept of a mass transfer section is applied to problems involving packed distillation columns and packed absorbers. When this concept is employed, the resulting equations required to describe packed distillation columns and packed absorbers are identical in form to those required to describe distillation columns and absorbers with plates. Data from the results of two field tests are presented and analyzed.

Copolymerization and Terpolymerization in continuous, nonideal reactors, Szabo, T. T., and E. B. Nauman, **AIChE Journal, 15,** No. 4, p. 575 (July, 1969).

Key Words: A. Polymerization-7, 8, Copolymerization-7, 8, Terpolymerization-7, 8, Reactors-10, Nonideal-0, Recycle Loop Reactors-10, Segregation-6, Styrene-1, Acrylonitrile-1, Alpha-Methyl Styrene-1, Composition-7, 8, Mixing-6.

Abstract: This paper is aimed at the development of industrially feasible techniques for the production of homogeneous co- and terpolymers. Styrene, acrylonitrile, and alpha-methyl styrene were used in the experiments. A simple means for predicting composition distributions in copolymers was used to illustrate the strong influence of segregation effects in the reactor. A recycle loop reactor can be used to produce uniform copolymers by narrowing the macroscopic composition distribution, but there is a limiting microscopic distribution which results from probabilistic effects.

Heat transfer and pressure drop for nitrogen flowing in tubes containing twisted tapes, Kidd, George J., Jr., **AIChE Journal, 15,** No. 4, p. 581 (July, 1969).

Key Words: A. Heat-Transfer Coefficient-7, Friction Factor-7, Heat Transfer-8, Pressure Drop-8, Heat-Transfer Promoters-6, 9, Twist Ratio-6, Channel Length-6, Wall-to-Bulk Temperature Ratio-6, Twisted Tape Insert-4, Nitrogen-9, Tube-9, Electric Heating-10.

Abstract: Heat transfer and pressure-drop studies were made on a series of electrically heated tubes containing full-diameter full-length twisted tapes. The A nickel tubes had a nominal inside diameter of 0.4 in. (10.1 mm.) and a heated length of 12 in. (30.5 mm). Nitrogen at 200 lb./sq.in. guage (14.6 atm.) was the working fluid, and the tests covered the Reynolds number range from 20,000 to 200,000. Twist ratios, defined as the ratio of the tube length per 180 deg. twist to the tube diameter, were varied from 2.5 to 14. The effect of tube wall-to-gas temperature ratio was studied for values of up to 1.8 and the heat flux was varied from 10^4 to 10^5 B.t.u./hr.·sq. ft. (3×10^4 to 3×10^5 w/m^2).

The results were compared with the results of previous heat transfer and pressure-drop studies and were generally found to be in good agreement. An empirical correlation was developed for the heat-transfer results that accounts for the effects of twist ratio, wall-to-gas temperature ratio, and tube length and includes most of the previous single-phase results.

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