Chapter 3 deals with applications of the entropy concept. The point of view varies from classical to statistical. Since Professor Fast is a metallurgist, it is perhaps not surprising to find emphasis on applications involving solids (including polymeric materials). However, this should not detract in any way from the value of the book, for it is just in these areas where the chemical engineer could well benefit from a broadening of scope.

These first three chapters make up just over half of the book. They are written to stand alone and to provide a basic treatment for those with very limited time for study. Most chemical engineers, however, would be well advised to press on, at least through Chapter 4. As already mentioned, this chapter deals with the principles of quantum mechanics and quantum statistics. The author comments, "This chapter is scarcely more complicated or difficult than the preceding ones." This turns out, surprisingly, to be true. But this does not mean that topics with a reputation for being difficult have been avoided; their treatment is just beautifully done. Here we find the material of "modern" physics—Heisenberg's uncertainty principle, Schrödinger's equation, Bose-Einstein and Fermi-Dirac statistics, etc.

The last two chapters deal rather thoroughly with the entropy calculations for monatomic and diatomic gases. Few with any real interest in the subject of statistical thermodynamics will want to stop short of these chapers, which provide examples of the use of the principles so carefully developed earlier. The treatment is uniformly excellent to the very end.

Those who continue to avoid acquiring a workable knowledge of the statistical concepts in thermodynamics will now have to find an excuse other than the unavailability of a suitable book for self-teaching.

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New Chemical Engineering Separation Techniques, edited by H. M. Schoen, John Wiley and Son, New York. 439 pages. $14.50.

This book is a collection of separate reviews of 6 separation processes distinguished mainly because chemical engineers are not as familiar with them as with distillation, extraction, etc. All 6 processes have potentialities beyond their present uses, both in the laboratory and in industry; and the purpose of the book is to stimulate their wider use and to inform a wider audience of uses and future possibilities.

Each section is independent of the others and is written by people familiar

Determination of constants for the Benedict-Webb-Rubin-Friend equation of state from limited data, Griskey, Richard G., and Harold H. Beyer, **A.I.Ch.E. Journal, 9,** Vol. 4, p. 507 (July, 1963).

Key Words: Benedict-Webb-Rubin-Friend Equation-1, Equation Of State-1, Compressibility Data-2, Critical Data-2, 3 Methylpentane-8, 2, 2 Dimethylbutane-8, 2, 3 Dimethylbutane-8, 2, 2, 4 Trimethylbutane-8.

Abstract: Two techniques have been developed to determine constants of the Benedict-Webb-Rubin-Friend equation of state from limited data. Constants for 3-methylpentane, 2, 2-dimethylbutane, 2, 3-dimethylbutane and 2, 2, 4-trimethylpentane were determined using these techniques. Pressures calculated using these constants deviated by 0.43% on the average from experimental values. Calculated critical pressures differed by 0.33 atm. on the average from observed data.

Effect of sublimation on stagnation-point heat transfer, Short, W. W., and T. A. Dana, **A.I.Ch.E. Journal, 9,** No. 4, p. 509 (July, 1963).

Key Words: Carbon Dioxide-1, Vapor-2, Turbulence-3, Radiation-3, Air Stream-5, Stagnation Point-5, Boundary Layer-5, Reynolds Number-6, Velocity-6, Temperature-6, Nusselt Number-7, Stanton Number-7, Ablation-8, Sublimation-8, Mass Transfer-8, Heat Transfer-8, Transpiration Cooling-8, Convection-8, Wind Tunnel-10, Calorimeter-10.

Abstract: The reduction of heat transfer to carbon dioxide models caused by the subliming solid was measured experimentally. Heat transfer coefficients were obtained for 0.7-cm-diam. copper and carbon dioxide hemisphere cylinders in air at 500° to 800°K. with velocities up to 300 cm./sec. The ratios of the heat transfer coefficients with sublimation to that without sublimation are compared with several theories. At 0.0084 g./sq. cm.-sec., which was the highest mass transfer rate obtained, the stagnation-point heat transfer coefficient was reduced by 65%.

Measurement of diffusivity in a high-viscosity liquid, Hollander, Martin V., and James J. Barker, **A.I.Ch.E. Journal, 9,** No. 4, p. 514 (July, 1963).

Key Words: Diffusivity-7, Sodium Chloride-1, Glycerol-5, Radioactive Isotope-10, Diaphragm Cell-10, Fick's Law-10, Viscosity-6.

Abstract: A technique to measure diffusivity in high-viscosity liquids was investigated using a modified diaphragm cell. The concentration buildup in the cell owing to a gradient in the diaphragm was monitored using a radioactive tracer for times up to 25 hr. The data concurred with the mathematical model. The specific system studied was sodium chloride in glycerol at 32°C., and the resulting diffusivity is reported as $18.36 \pm 0.36 \times 10^{-8}$ sq. cm./sec.

Fluid flow and convective-radiative energy transfer in a parallel plate channel under free-molecule conditions, Sparrow, E. M., and V. K. Jonsson, **A.I.Ch.E. Journal, 9,** No. 4, p. 516 (July, 1963).

Key Words: Duct-5, Heat Transfer-7, Mass Flow-7, Gas-5, Low Density-6, Pressure Level-6, Temperature Level-6, Radiation-6, Convection-6, Molecular Flow-5, Analysis-10.

Abstract: The flow of a highly rarefied gas in a parallel-plate channel and the transfer of heat owing to simultaneous thermal radiation and free-molecule convection has been investigated analytically. The analysis is facilitated by analogies which exist between the processes. The mass throughflow has been determined as a function of the temperatures and pressures of the system and of the channel dimensions. From the heat transfer analysis, it was found that at temperature levels corresponding to room temperature and above, the results for the combined convective-radiative transport differed little from those for a purely radiative transport.

Vapor-liquid equilibrium constants of binary methane systems for the subcritical, critical, and retrograde regions, Dastur, Soli P., and George Thodos, **A.I.Ch.E. Journal, 9,** No. 4 p. 524 (July, 1963).

Key Words: Vapor-Liquid Equilibrium Constants-8, Binary System-5, Methane-4, Retrograde Region-8, Critical Region-8.

Abstract: Experimental data available in the literature for five binary methane systems have been utilized to develop correlations for the prediction of vapor-liquid equilibrium constants for systems whose components have a normal boiling point ratio of $1.00 < \tau < 2.80$. These correlations enable the calculation of K values for binary systems for the subcritical, critical, and retrograde regions. For the five systems investigated, an average deviation of 2.33% for 340 points resulted for K values obtained from these correlations. These correlations were also found to be applicable to five additional nonmethane systems.

Forced convection in three-dimensional flows: I. Asymptotic solutions for fixed interfaces, Stewart, Warren E., **A.I.Ch.E. Journal, 9,** No. 4, p. 528 (July, 1963).

Key Words: Laminar Flow-8, Heat Transfer-8, Mass Transfer-8, Forced Convection-8, Boundary Layer-5, Three-Dimensional Flow-5, Non-Newtonian Flow-5, Prandtl Number-6, Schmidt Number-6, Velocity Distribution-6, Temperature Distribution-6, Concentration Distribution-6, Density Variation-6, Geometry-6.

Abstract: The boundary-layer energy and diffusion equations are solved in the limit of high Prandtl or Schmidt number for steady laminar flows with boundaries of arbitrary shape. Heat and mass transfer rates are predicted for the nonseparated regions of the boundary layer, with position-dependent interfacial temperature or composition. Solutions are also given for the effects of rapid mass transfer under certain boundary conditions. Constant physical properties are assumed, except in the diffusional solutions where a composition-dependent density is included. The results hold for non-Newtonian flow when the heat effects of deformation can be neglected.

Solids mixing and circulation in gas fluidized beds, Talmor, Eliyahu, and Robert F. Benenati, **A.I.Ch.E. Journal, 9,** No. 4, p. 536 (July, 1963).

Key Words: Fluidized Beds-8, Gas-9, Solids-9, Solids Mixing-7, Solids Circulation Rates-7, Solids Circulation Ratio-7, Tracer-10, Fluidization-8, Particle Size-6, Gas Flow Rate-6, Circulation Model-10, Physical Properties-6, Bed Diameter-6.

Abstract: Unsteady state solids mixing data were obtained by the batch air fluidization of two region beds one of which was chemically traced. Steady state solids circulation rates were evaluated from the unsteady mixing data with the help of a simplified circulation model. Some available data in the literature were reinterpreted and all data combined for correlation purposes.

The results show that the factors affecting the superficial mass solids circulation rates in gas fluidized beds are the mean particle size and the excess of the superficial mass air flow rate over the minimum required for fluidization.

Evaluation of the performance of thermal diffusion columns separating xenon isotopes, Blumkin, Samuel, and Edward Von Halle, **A.I.Ch.E. Journal, 9,** No. 4, p. 541 (July, 1963).

Key Words: Thermal Diffusion-8, Isotope Separation-8, Thermogravitational Column-8, 10, Hot-Wire-10, Xenon-9, Multicomponent-9, Steady State-9, Unsteady State-9, Thermal Diffusion Factor-6, Column Transport Coefficients-8, Shape Factors-6, Correlation-8, Performance-8, Separative Work-8, Lennard-Jones 6-12 Potential-6, Inverse Power Repulsion Law-6.

Abstract: A correlation and analysis have been made of the equilibrium and transient data obtained from hot wire type of thermal diffusion columns separating xenon isotopes. Equations representing the steady and unsteady state for a multicomponent separation and the methods of analyses of the data are presented. Theoretical predictions of column performance, based on three sets of shape factors, are compared with each other and with the observed performance. The use of shape factors based on the inverse power repulsion law combined with empirical information on the temperature dependence of the thermal diffusion constant provides the best estimate of column performance.

with the field. The quality of the presentations is generally good and gives a rather complete picture of the subject for the nonspecialist. Each section has its own nomenclature and references and the same general format. The book is worth owning even if only one of the six processes is of interest.

1. Thermal Diffusion—by J. E. Powers (97 pages + 94 ref.)

History, theory, design, and possible future of the thermal diffusion process are covered. The theory starts with elementary principles and extends to include the statistical mechanical theory of thermal diffusion and then gives the phenomenological description of operating equipment. There is a long section of design of laboratory and large-scale equipment.

2. Fixed Bed Separations—by E. N. Lightfoot, R. J. Sanchez-Palama, and D. O. Edwards (83 pages + 62 ref.)

This is a well organized discussion of the literature on chromatography, ion exchange, adsorption, ion exclusion, and other processes carried out batchwise in fixed beds. There is a description of simple models and more complex ones extended only to the point where solutions to the equations can be found. Both linear and nonlinear equilibria are covered and models include mass transfer and axial dispersion terms. The entire treatment is a mathematical description of bed operation. Physical design and equipment selection are not covered.

3. Zone Melting—by W. D. Lawson and S. Nielsen (73 pages + 164 ref.)

This is a detailed description with theory, applications, design, equipment, and limitations of zone melting covered.

4. Adductive Crystallization — by R. A. Findley (60 pages + 63 ref.)

This is a process adaptable to the separation of isomers which have similar physical and chemical properties and are thus difficult to separate by conventional means. Separation is possible here because of geometrical differences in the molecules.

The general principles of the formation of adducts, clathrates and addition compounds are covered at length, and the remainder of the section is devoted to (1) analysis of the general flow schemes by which separations may be made, (2) design and economic studies, and (3) a description of 8 existing industrial adduct processes.

INFORMATION RETRIEVAL

Mass transfer in the laminar radial wall jet, Scholtz, M. T., and Olev Trass, **A.I.Ch.E. Journal, 9,** No. 4, p. 548 (July, 1963).

Key Words: A. Free Jet-1, Laminar Radial Wall Jet-2, Nozzle-4, Flat Plate-4, Water-5, Point Mass Transfer Coefficient-7, Mass Transfer-8, Impinging-. B. Mass Transport Equation-1, Integral Mass Balance-1, Exact Solution-2, Approximate Solution-2, Boundary Layer Theory-8. C. Acetanilide-4, Benzoic Acid-4, Carboxymethylcellulose-5, Reynolds Number-6, Schmidt Numbers-6, Mass Transfer Coefficient-7, Coatings-9, Thickness Decrease-10. D. Separation-3, Toroidal Vortex-3.

Abstract: Data are reported for mass transfer from a flat plate under the influence of a laminar, radial wall jet initiated by a free jet of water. An exact solution of the mass transport equation was obtained as well as an approximate solution of the integral mass balance equation. Point mass transfer data were obtained by measuring the thickness decrease of coatings of acetanilide and benzoic acid. In the Reynolds number and Schmidt number range studied, data were in good agreement with theory. Boundary-layer separation and the formation of a toroidal vortex were observed at lower Reynolds numbers.

5. Foam Separation—by E. Rubin and E. L. Gaden, Jr. (66 pages + 135 ref.)

A brief discussion of surface phenomena in liquids, adsorption, and the physical chemistry of foams is followed by a practical discussion of methods of preparing and using foams and the types of equipment usable to concentrate solutes in a foam phase for industrial use. An extensive table of examples of useful separations made by this technique is included with references. An engineering type model of a foam separation system is presented which is intended to assist in design and in the interpretation of data.

6. Electrophoresis—by R. K. Finn (43 pages + 50 ref.)

The difference in rates of migration of particles in a fluid under the influence of an electric field may be used to separate constituents of mixture under certain conditions. This less familiar phenomena and process are discussed very briefly from a theoretical standpoint, and a more extensive treatment of the various types of equipment used in the laboratory and in large-scale practice follows. Some useful general directions are given to those wishing to investigate electrophoresis for applications or research.

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ERRATUM

In Equation (5) of the article "Drying of Air by Fixed Bed Adsorption with Molecular Sieves" by J. I. Nutter and George Burnet, which appeared on page 204 of the March, 1963, issue of the *A.I.Ch.E. Journal*, there should not be a minus sign before the right-hand side of the equation.