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Liquid-liquid phase behavior of binary solutions at elevated pressures, Winnick, Jack, and J. E. Powers, **A.I.Ch.E. Journal, 12,** No. 3, p. 466 (May, 1966).

Key Words: A. Miscibility-8, 9, 7, Phase Equilibria-8, 9, 7, Phase Diagram-8, 9, 7, Isothermal-0, Liquids-9, Mixtures-9, Nonideal-0, Binary-0, Acetone-9, Carbon Disulfide-9, Pressure-6, Composition-6, Measuring-8, Predicting-8, 4, Thermodynamics-10, Calculating-10, 8, Free Energy-2, Free Energy Change of Mixing-2, 7, 8, Activity Coefficients-1, Volume Change of Mixing-1.

Abstract: Isothermal pressure elevation can cause liquid-liquid phase separation of some binary liquid mixtures. A quantitative thermodynamic analysis of this effect is made and applied to the system acetone–carbon disulfide at 0°C. on the basis of available P-V-T-X, density, and solution behavior data. Visual observations of the phase separations at pressures up to 80,000 lb./sq.in. are used to compare with the results of the analysis. There is also a discussion of criteria for qualitatively predicting which binary liquid systems will exhibit a liquid-liquid phase separation on increasing external pressure.

Axial mixing and extraction in a mechanically agitated liquid extraction tower, Bibaud, Roger E., and Robert E. Treybal, **A.I.Ch.E. Journal, 12,** No. 3, p. 472 (May, 1966).

Key Words: A. Mass Transfer-8, Separation-8, Extraction-10, 8, 9, Extractors-10, 9, Countercurrent-0, Oldshue-Rushton Column-10, 9, Liquids-1, 2, 9, *n*-Butyl Amine-1, 2, Kerosene-1, Axial Mixing-6, 9, 8, Eddy Diffusivity-6, 9, Performance-7, Rate-7, Mass Transfer Coefficients-7, Measuring-8. B. Agitation-6, Flow Rate-6, Velocity-6, Diffusion-6, Axial Mixing-7, Eddy Diffusivity-7, Columns-9, Extractors-9, Extraction-4, Separation-4, Liquids-1, 2.

Abstract: Axial mixing is measured in both phases for a countercurrent, mechanically agitated extractor of the Oldshue-Rushton design. Results in terms of an eddy axial diffusivity were correlated in terms of the variables studied. These correlations were then applied to column performance during the extraction of *n*-butyl amine from kerosene into water and the mass transfer coefficients, corrected for axial mixing, were determined. The coefficients are shown to be predictable for droplets of dispersed phase considered to be rigid spheres.

Velocity distributions and normal stresses in viscoelastic turbulent pipe flow, Astarita, Gianni, and Luigi Nicodemo, **A.I.Ch.E. Journal, 12,** No. 3, p. 478 (May, 1966).

Key Words: A. Fluid Dynamics-8, Flow-8, Turbulent Flow-8, Fluids-9, Polymers-9, Solutions-9, Viscoelastic-0, Non-Newtonian-0, Calculating-8, Measuring-8, 4, Stresses-9, Pressure-9, 1, Velocity-2, 1, 8, Velocity Distribution-2, 1, 8, Apparent-0, Momentum Balance-2, 7, 8, Momentum Average Factor-2, 7, 8, Reynolds Number-2, 6, Pitot Tubes-10, 8.

Abstract: The turbulent flow of viscoelastic fluids through circular pipes is investigated by the use of Pitot tubes. Theoretical analysis of the flow situation shows that the Pitot tube pressure readings are composed of a normal stress contribution, an integral normal stress contribution, and a kinetic contribution. The experimental data are used to calculate apparent velocities of the fluids and momentum average factors. Observed values of the relevant parameters are discussed.

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Once more, the original (incorrect) argument of James Clerk Maxwell is used to derive the Maxwell-Boltzmann velocity distribution. This has been used in numerous other textbooks and perhaps deserves to be put out to pasture after all these years.

A further criticism is the inclusion of various transport processes such as fluid flow and heat transfer. In research and design the distinction between thermodynamics and transport processes is spurious. In an introductory thermodynamics course this dichotomy is preferable.

It is necessary to judge introductory thermodynamics texts rather harshly because there are so many around and some are quite good. Although the text is well written, the impression is received that the author has not presented an original or profound treatment of introductory thermodynamics.

On another level the book is more of a success. The applications section is chock full of interesting goodies. The major emphasis is on energy conversion and thus while most of the examples may not be in chemical engineering, the chemical engineer has in interest in them. For example, the thermodvnamics of reacting mixtures is mainly concerned with burning reactions. Chapters are included on various gas cycles, turbines, refrigeration, and elementary irreversible thermodynamics with thermoelectric phenomena as examples.

Many problems are included and the student will understand most of the standard material after doing them.

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Boiling Heat Transfer and Two-Phase Flow, L. S. Tong, John Wiley and Sons, New York (1965). 242 pages, $14.00.

The author is manager of Thermal and Hydraulic Design and Development at the Atomic Power Division of the Westinghouse Electric Corporation. As such he has been involved in the heat transfer design for a number of nuclear reactors now in operation. This book evolved from evening lectures given in graduate courses taught at the Carnegie Institute of Technology over a period of three or four years.

The volume is a concise handbook which summarizes the literature in the field of boiling and two-phase flow. The four hundred references go through 1963 and include numerous domestic and foreign government reports. The

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Experimental vapor-liquid equilibrium data for propane-isobutane, Hipkin, Howard, **A.I.Ch.E. Journal, 12,** No. 3, p. 484 (May, 1966).

Key Words: A. Equilibria-8, 7, Phase Equilibria-8, 7, Propane-9, Isobutane-9, Mixtures-9, Alkanes-9, Liquid-9, Vapor-9, Isothermal-0, Binary-0, Appa-atus-8, 10, Measuring-4, 8, Pressure-9, 6, Temperature-9, 6, Composition-9, 6, Relative Volatility-7, 2, Calculating-8, Activity Coefficients-2, Fugacity Coefficients-2.

Abstract: Isothermal vapor-liquid equilibrium data for propane-isobutane solutions at five temperatures (from 20° to 250°F.) are presented. The experimental data are tabulated and plotted as pressure vs. composition and relative volatility vs. liquid composition for each temperature. Activity coefficients and fugacity ratios a e calculated for the four lower temperatures. The two different pieces of apparatus used in this study are described in detail. Sampling errors which occur in volatile systems are also discussed.

An equation of state for gas mixtures, Othmer, Donald F., and Hung Tsung Chen, **A.I.Ch.E. Journal, 12,** No. 3, p. 488 (May, 1966).

Key Words: A. Deriving-8, Equation of State-2, 10, Mixtures-4, 9, Gases-4, 9, Calculating-4, 8, Predicting-4, 8, Temperatures-1, 2, 9, Pressures-1, 2, 9, Volume-1, 2, 9, Compressibility Factors-1, 10, Computer-10. B. Deriving-8, Calculating-8, Equation of State-2, Compressibility Factors-2, Force Constants-1, 2, Pressures-1, Temperatures-1, Reduced-0, Pseudocritical Constants-1, 10, Reference Substance Technique-10.

Abstract: A theoretical model is developed in which a mixture of gasses is assumed to have the same thermodynamic properties as some pseudo gas which would have the same force constants existing between each pair of molecules in the mixture. Force constants of the gas mixtures are evaluated from pseudocritical constants which are evaluated from the critical constants of the individual components of the gas mixtures. With the use of the reference substance technique the compressibility factors for gas mixtures are calculated. The equation of state for gas mixtures developed in this paper utilizes these compressibility factors to determine pressure-volume-temperature relations. PVT data calculated using this equation are compared with experimentally determined PVT data.

Ion exchange equilibria under pressure, Hamann, S. D., and I. W. McCay, **A.I.Ch.E. Journal, 12,** No. 3, p. 495 (May, 1966).

Key Words: A. Pressure-6, Hydration-6, Concentration-7, Equilibria-7, Equilibrium Product-7, 2, Volume Change-7, 2, Absorption-7, 9, 8, Sodium Chloride-9, 1, Sodium Ions-9, 1, Chloride Ions-9, 1, Ion Exchange Resins-9, 10, Ion Exchange-9, De-Acidite M Resin-9, 10, Zeo-Karb 226 Resin-9, 10, Calculating-8.

Abstract: A study of the effects of high pressures on ion exchange equilibria is reported. Experimental data on the uptake of sodium chloride from aqueous solutions under high pressure by a mixed bed resin are also presented. Volume changes in the absorption process are studied and compared to volume changes that occur in proton transfer from a free carboxylic acid to an amine in solution.

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graphs, tables, and equations are excellent representations of published data. For example, data for the boiling crisis for water flowing along bundles of heated rods are tabulated from sixteen sources. For each source the test conditions are summarized carefully.

Unfortunately the book is often uncritical. The original opinions of the various references are presented. For example, on page 117, data are given which show that flow velocity has no effect on the heat flux during nucleate flow boiling, but on page 122 data from a different source are presented which show that velocity does have an effect. The puzzled reader is left to decide for himself. The opinions of Dr. Tong as to which data and equations on boiling and two-phase flow look good to him and which seem doubtful would have been welcome in this book.

The book contains seven chapters. The first two cover pool boiling and bubble dynamics. Taylor and Helmholz instabilities are discussed briefly. The next two chapters consider two-phase flow of water and air or steam, primarily in unheated channels. The last three chapters cover two-phase flow with boiling. The design equations used by Westinghouse, General Electric, and other builders of boiling-water-cooled nuclear reactors are given. It is clear that knowledge of boiling and two-phase flow has increased enormously in recent years but that many of the useful equations represent engineering art rather than physical analysis. Unfortunately, the term *theoretical* is applied to certain empirical correlations. This will mislead many readers.

In summary, the chief value of the book is that it is a compendium of data and references. Its principal weakness is that the relative reliability of data and equations from different sources is not pointed out. Persons working in the field of two-phase flow with boiling will feel that the volume is worth the purchase price.

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Industrial Heat Transfer, Alfred Schack (translated by I. Gutman), John Wiley and Sons, New York (1965). 456 pp.

Those engineers familiar with earlier editions of Professor Schack's treatise will find that the sixth edition has been improved considerably, not only in portions of the text, but also in the tables of the Appendix. Those unfamiliar with it will find the title misleading and the treatment of many topics too brief;