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Analysis of heterogeneous catalytic reactions by nonlinear estimation, Lapidus, Leon, and T. I. Peterson, **A.I.Ch.E. Journal, 11,** No. 5, p. 891 (September, 1965).

Key Words: A. Analysis-8, Reactions-8, 9, Catalyst-10, Heterogeneous-0, Langmuir-Hinshelwood Models-10, Models-10, Dehydration-8, Ethanol-1, Nonlinear Estimation-10, Reaction Kinetics-8, 9, Determination-8, Parameters-9.

Abstract: Integral conversion catalytic data have been studied by nonlinear estimation to determine whether the Langmuir-Hinshelwood heterogeneous catalytic models are more valid than the simpler noncatalytic forms and whether it is possible to discriminate among models. The experimental system chosen for this study was the vapor phase dehydration of ethanol. The results suggest that only in the absence of obscuring effects is the complex catalytic model warranted.

Interaction model for critical temperatures of multicomponent mixtures of methane-free aliphatic hydrocarbons, Ekiner, Okan, and George Thodos, **A.I.Ch.E. Journal, 11,** No. 5, p. 897 (September, 1965).

Key Words: A. Critical Temperature-8, 9, Aliphatic Hydrocarbons-9, Hydrocarbons-9, Mixtures-9, Interaction Model-10, Multicomponent Systems-9, Calculation-8.

Abstract: A mathematical treatment based on an interaction model has yielded an expression capable of establishing the critical temperatures of multicomponent mixtures of aliphatic hydrocarbons. This model postulates an infinite-series expansion for the difference between the actual critical temperature and its corresponding pseudocritical value. For methane-free aliphatic hydrocarbon mixtures, this infinite series has been truncated beyond the third-order interactions. This interaction model has been applied to one hundred-sixteen different compositions of binary, ternary, quaternary, and quinary aliphatic hydrocarbon systems to produce an overall average deviation of 0.35%. Due to the different interaction behavior of methane, systems containing methane have not been included in this study.

Mathematical models for mass transfer accompanied by reversible chemical reaction, Huang, Chen-Jung, and Chiang-Hai Kuo, **A.I.Ch.E. Journal, 11,** No. 5, p. 901 (September, 1965).

Key Words: A. Mathematical Model-8, Mass Transfer-9, 8, 7, Chemical Reaction-8, 9, 6, Reversible-0, Rate-7, Liquid Phase-9, Interface-9, Diffusion-8, Diffusivity-9, Ratio-6.

Abstract: Based on the film-penetration theory, the film theory, and the surface renewal theory, theoretical equations are obtained for the rate of interphase mass transfer accompanied by a first-order reversible reaction. The equation based on the film-penetration theory can be reduced to those obtained on the basis of simpler postulations. An approximate rate equation is also proposed for mass transfer with a high order reversible reaction.

Falling cylinder viscometer for non-Newtonian fluids, Ashare, Edward, R. Byron Bird, and Jaime A. Lescarboura, **A.I.Ch.E. Journal, 11,** No. 5, p. 910 (September, 1965).

Key Words: A. Viscometer-8, 10, Viscosity-8, Non-Newtonian Fluids-9, 4, Annular Flow-4, Falling Cylinder Viscometer-8, 10, Rheology-8, Corrections-8, Curvature-9, Power-Law Fluid-9, Ellis Fluid-9, Ostwald-deWaele Fluid-9, Carboxymethylcellulose-9, Polymers-9.

Abstract: It is shown how previous analyses of the falling cylinder viscometer for Newtonian fluids can be extended to non-Newtonian fluids. Specific relations are given for the velocity of descent for several simple non-Newtonian viscosity functions. A differentiation procedure is presented whereby the non-Newtonian viscosity for a fluid can be deduced from velocity of fall measurements. In the course of the development, some useful approximate expressions for axial non-Newtonian flow in annuli are developed. Finally, a comparison of the Ellis and power law models is made by an analysis of the axial annular flow data of Fredrickson and of McEachern.

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tor design and analysis. The various tools of reactor analysis are described in enough detail that they can be used by the reader for his own problems, and the author has distinguished among the various techniques so that the reader can choose the ones which are most suitable for his problem.

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Thermodynamics, William C. Reynolds, McGraw-Hill, New York (1965). 458 pages, $9.50.

Another textbook of thermodynamics added to the long list of those already in existence. One can't help wondering whether another is justified. After reading this one I concluded that it was not just another ordinary text, but a text with many new ways of presenting old ideas and concepts. One may not always feel that the new ways are any improvement over the older, but at least the different approach is refreshing.

The first four chapters present and develop the basic concepts in a sensible and easily followed manner without getting lost in a maze of semantics which seems to characterize some of the modern texts. In an attempt to define concepts and to state the laws very precisely some books only succeed in making me completely confused about things which previously I had thought I understood, at least well enough to apply the principles to the solution of problems. Although this book presents many of the basic ideas in a way that is different from the treatment in what one might call the "standard" texts, yet I found it clear and easy to follow.

Chapter 5 illustrates the first law by making energy balances on a wide variety of systems. In making these analyses the author lays great stress on what he calls the "control volume" and the "control mass." As near as I can determine this just amounts to giving new names to the methods most of us have used for a long time. Perhaps this may result in some clarification for the student; I am not sure. I do applaud the many numerical examples worked out and the clear statement of the assumptions in each case.

In Chapter 6 entropy and the second law are introduced entirely through the methods of statistical mechanics rather than the classical methods of Carnot, Clausius, Kelvin, and Planck. This is not the method by which the reviewer was introduced to the subject but I am willing to admit that this more modern approach to the second law probably does give the student a better comprehension of the meaning of the law and of entropy. The simplified treatment of statistical thermodynamics in this chapter is about the best I have encountered.

Chapter 7 deals with various applications—"consequences" as the author calls them—of the second law. This is concerned mainly with the thermodynamic definition of temperature and pressure, reversible and irreversible processes, entropy changes in processes, and various energy-conversion systems. There are several things in this chapter which seem to me not clearly explained and some with which I would disagree. It would take too much space to go into details. I will cite just one example: "The second law deals with an entity which can only be produced and can never be destroyed." This seems to mean that entropy can increase in a change but never can decrease, which is certainly not true in general. I consider this one of the less satisfactory chapters of the book, though certain parts of it are very well done.

Chapter 8 deals with the thermodynamics of state and presents the usual differential equations relating proper-

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Vapor-liquid equilibrium in the methane-*n*-hexane-nitrogen system, Poston, Robert S., and John J. McKetta, **A.I.Ch.E. Journal, 11,** No. 5, p. 917 (September, 1965).

Key Words: Vapor-Liquid Equilibrium-8, 7, Equilibria-8, 7, Phase Equilibria-8, 7, Methane-9, Hexane-9, Alkanes-9, Nitrogen-9, 6, Temperature-6, Pressure-6.

Abstract: Results of a quantitative investigation which shows how the K values of methane and n-hexane change when varying amounts of nitrogen are added to mixtures of the two hydrocarbons are presented. Analyses of equilibrium phases at different conditions of temperature and pressure in order to completely describe the phase equilibria of the system are presented.

Correlations of selectivity parameters for separations extractions of hydrocarbons with fluorochemicals, Munson, M. S. B., **A.I.Ch.E. Journal, 11,** No. 5, p. 920 (September, 1965).

Key Words: Liquid-Liquid Extraction-8, Extraction-8, Hydrocarbons-2, Fluorochemicals-5, Selectivity-8, Separation Factors-8, Selectivity Parameters-8, 9, Correlation-8, Heats of Vaporizations-9, Group Contribution-9.

Abstract: The equation $\ln \beta^1{}_2 = \epsilon^1{}_2 x_s{}^2/T$ adequately represents the variation of the separation factors for the extraction of hydrocarbon mixtures with fluorochemicals. With a given solvent it is possible to develop a correlation between $\epsilon^1{}_2$ for pairs of hydrocarbons and the heats of vaporization of these hydrocarbons. A group contributions method is also successful in correlating the selectivity parameters.

Isothermal activity coefficients for system cyclohexane-*n*-heptane-toluene at 25°C., Katayama, Takashi, Edmond K. Sung, and Edwin N. Lightfoot, **A.I.Ch.E. Journal, 11,** No. 5, p. 924 (September, 1965).

Key Words: Activity Coefficients-8, Isothermal-0, Cyclohexane-9, Allyl Cyclic Compounds-9, Heptane-9, Alkanes-9, Toluene-9, Aromatic Hydrocarbons-9, Hydrocarbons-9, Vapor-Liquid Equilibrium-8, Phase Equilibria-8, Equilibrium-8, Nitrogen-5, Gas Chromatography-10, Binary-0, Ternary-0.

Abstract: Isothermal vapor-liquid equilibrium data at 25°C. for the ternary and binary systems containing cyclohexane, n-heptane, and toluene are presented. These data were obtained by static equilibration in the presence of diluent nitrogen using chromatographic analysis of the saturated vapor. The data obtained were of at least comparable accuracy to those available at the normal boiling point, and the procedure appears to offer several substantial advantages.

An application of adaptive control to a continuous stirred tank reactor, Crandall, Edward D., and William F. Stevens, **A.I.Ch.E. Journal, 11,** No. 5, p. 930 (September, 1965).

Key Words: Control-8, Adaptive Control-8, Closed-Loop-0, Automatic-0, Feedback-10, Computer-10, Performance-8, Plant-9, Reactor-9, Tank-9, Stirred-0.

Abstract: This is a report on an investigation of the effect of adaptive control on a closed-loop chemical plant. The plant controlled was a simple closed-loop feedback system, the elements of which were a proportional controller and an elementary continuous stirred tank reactor. The adaptive control system yielded excellent results. For all disturbances, the output of the adaptive controlled plant remained much closer to the reference model output than did the output of the simply controlled plant.

ties to the variables of state with a brief excursion into the simplified kinetic theory of gases. The only equations of state given are those of the ideal gas, the Van der Waals, and the Beattie-Bridgeman. A very brief treatment of corresponding states is presented. Sections of this chapter are devoted to an equation of state for an incompressible liquid, the thermodynamics of the simple magnetic substance, the equation of state for a Curie substance, and thermal radiation. This chapter is very well done although the chemical engineer might prefer a more detailed treatment of nonideal systems.

Chapter 9 is devoted to the analysis of many thermodynamic systems, mainly thermal power cycles, direct energy-conversion systems, refrigeration cycles, and rocket propulsion devices. A large amount of information is packed into this one chapter, but it is well presented.

Chapter 10 is concerned with mixtures and phase equilibria and is much too "skimpy" to suit the chemical engineer. Incidentally, what most of us call the "chemical potential" is here referred to as the "electrochemical potential." No reason is given for this change from well-established practice.

Chemical-reaction equilibrium is well treated in Chapter 11 and the only criticism is that it is briefer than a chemical engineer would wish but probably entirely adequate from the viewpoint of the mechanical engineer.

Chapters 12 and 13 present an excellent, condensed treatment of statistical thermodynamics and the last chapter gives an introduction to so-called "irreversible thermodynamics." I suppose any serious student of thermodynamics should be acquainted with these subjects but I do not see that they contribute much to practical applications which are the main concern of the engineer. To this reviewer they provide some nice mathematical manipulations which are of little practical utility. Incidentally, the term "irreversible thermodynamics" has always seemed to me to be very misleading. It does not deal with the ordinary irreversible effects that accompany all real processes but rather with coupled steady state flow processes, such as the coupled electron and thermal fluxes in a thermocouple.

The appendix gives thermodynamic properties of a number of substances in the form of diagrams and tables.

Each chapter ends with a list of problems to be solved by the student. They seem to be well chosen to illustrate the principles and their applications. I should also mention that the many illustrations throughout the book are excellent and add much not only to the appearance of the book but to the clarity of the treatment.

On the whole I found this to be a very stimulating and refreshing treatment of thermodynamics from the point of view of the engineer, and remarkably free from error.

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ERRATA

In "The Effect of Shape and Density on the Free Settling of Particles at High Reynolds Numbers" by E. B. Christiansen and Dee H. Barker (Vol. 11, No. 1, pp. 145-151), the first exponent in Equation (4) should be n instead of $(1 + n)$. Also, the definition of d_{max} in the Notation should read, "maximum length through the centroid of the area described under d_{min}, cm."

In "The Prediction of the Viscosity of Multicomponent, Nonpolar Gaseous Mixtures at Atmospheric Pressure" by Mailand R. Strunk and Gary D. Fehsenfeld (Vol. 11, No. 3, pp. 389-390), Equation (1) should read

$$\eta_{mix} = \frac{266.93 \times 10^{-7}\sqrt{TM_{mix}}}{\sigma^2_{mix}\ \Omega^{(2,2)*}_{mix}} \quad (1)$$

In "Deposits Formed Beneath Bubbles During Nucleate Boiling of Radioactive Calcium Sulfate Solutions" by Narayan B. Hospeti and Russell B. Mesler (Vol. 11, No. 4, pp. 662-665), Equation (4) in the Appendix should read

$$\delta_{corrected} = \frac{c_o - b}{c - b}(\delta) = 32.0 \text{ microinches} \quad (4)$$