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Form factors for deformed spheroids in stokes flow, O'Brien, Vivian, **AIChE Journal, 14,** No. 6, p. 870 (November, 1968).

Key Words: A. Shape-6, Drag-7, 8, Flow-9, Stokes Flow-9, Form Factor-10, Shape Factor-10, Spheroids-9, Sedimentation-4, Computer-10.

Abstract: Stokes flow describes the slow motions of small particles. Theory for a sphere is well known, but real life particles are seldom spherical. The change in drag with change in shape from a sphere, here expressed in terms of a form factor, is discussed and compared to empirical shape factors developed from sedimentation experiments. A semi-analytical computer program has been developed for steady uniform flow past a wide variety of deformed spheroids. The results can be applied immediately to sedimentation problems, and the form factor for Stokes drag is investigated and compared to conventional shape factors.

The nonsteady flow of fluids through expansible tubes, Sheppard, Robert G., and James O. Osburn, **AIChE Journal, 14,** No. 6, p. 876 (November, 1968).

Key Words: A. Calculation-8, Flow-8, Fluid-9, Water-5, Tube-9, Expansible Tube-9, Computer-8, Pressure-8, Pulse-8, Velocity-8.

Abstract: A digital computer solution of the equations of fluid motion predicts the pressures in an expansible tube through which liquid is flowing. To obtain a stable solution, it is necessary to assume that the rate of change of area with time is proportional to the rate of change of velocity with time. This assumption is shown to be a reasonable one. Calculations for the rate of travel of pressure pulses are in good agreement with experimental results.

Effect of imperfect mixing on autorefrigerated reactor stability, Luyben, W. L., **AIChE Journal, 14,** No. 6, p. 880 (November, 1968).

Key Words: A. Mixing-6, Imperfect-0, Stability-7, 8, Reactors-9, Autorefrigerated-0, Continuous-0, Batch-0, Simulation-8, Computer-10.

Abstract: *This paper discusses* the effects of imperfect mixing on the stability of autorefrigerated chemical reactors. Mixing is shown to strongly influence stability in these evaporatively-cooled systems. Computer simulation of a typical system illustrates the occurrence of runaways and local hot-spots. Both continuous stirred tank reactors and batch reactors are considered.

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Thermodynamic Properties and Reduced Correlations for Gases, Lawrence N. Canjar and Francis S. Manning, Gulf Publishing Co., Houston, Texas (1967).

This is a compilation in tabular form and in Mollier diagrams of the thermodynamic properties of eleven light aliphatic hydrocarbons, benzene, ammonia, carbon dioxide, carbon monoxide, hydrogen, nitrogen, oxygen, sulfur dioxide, and water. Four properties [specific volume, enthalpy, entropy, and fugacity coefficient (f/P)] are tabulated in both the saturated and superheated regions. Although, for some unexplained reason the properties in the saturated region are not given for hydrogen. In the saturated region the properties are given at even values of temperature °F. and generally, but not in every case, span the region from the normal boiling point to the critical temperature.

The authors have departed from the usual practice of selecting an arbitrary reference point to be zero for the enthalpy and entropy of the compound. Instead they take as the reference state the elements at absolute zero. For enthalpy the value is taken to be zero at $T=0$ and $P=0$ but, of course, this is not possible for entropy and to circumvent this they define a property, $S—R \ln p$. It was shown that the limit of this property at $P=0$ is the entropy of the ideal gas at unit pressure (any pressure unit can be used as long as complete consistency is maintained) and is designated S^o. Values of S^o are commonly tabulated for $p=1$ atm. In Chapter I, there is considerable discussion of this reference state, referred to as *a universally consistent reference state.* It has the advantage over the usual reference state in that enthalpy and entropy changes, when chemical reactions are involved, can be obtained directly by differences since the reference state values cancel. In other words the enthalpies of compounds will include the heat of formation.

In the case of each substance, the properties are given and the sources of the data, the methods of calculation, and the uncertainty in the tabulated values are indicated. The values of enthalpy and entropy are taken from existing net works, such as those of the API, NBS, Din and others.

In order to estimate the thermodynamic properties of substances, other than the 20 included in the tabulations, the authors have included four charts giving the compressibility factor, the fugacity coefficient, the en-

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thalpy departure $\frac{(h_o-h)}{(T_c)}$, and the entropy departure $(S^o-S-R \ln p)$ as functions of P_r, T_r, and Z_c. They have reduced all the values for a given property to a single chart by including on each diagram of the property vs. P_r with lines of constant T_r, 4 lines of constant Z_c. The property charts are based on $Z_c = 0.27$ and by using the lines for the other, Z_c's as a nomograph one quickly and easily corrects the property to another value of Z_c. The suggestion is made that these reduced correlations may also be used for mixtures by employing pseudo-critical values of the three parameters. An example of such use is given which involves an estimation of the isentropic work of compression of a mixture of methane and propane.

The critical properties, formula and molecular weight of 122 elements and compounds are tabulated. T_c is given in °C. °K. and °F., P_c in atm. and V_c in cc./g. mole and cu.ft./lb. mole. Another table gives the molar ideal-gas enthalpies of 96 elements and compounds at even intervals of temperature from 0 to 1,600°K. with some gaps where data are not available. In still another table molar ideal gas absolute entropies of the same substances are also tabulated at the same absolute temperatures and for $p=1$ atm.

Everyone who has occasion to make thermodynamic calculations will be grateful to the authors for producing this new and very useful compilation.

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The Flow of High Polymers, Stanley Middleman, New York (1968). 246 pages, $

Stanley Middleman's book deals with the rheology of high polymers: the carrying out of well defined viscometric measurements in the laboratory and the correlation of these measurements with each other and with molecular parameters. To place the book in the wider context of polymer flow mechanics, one might think of three broad areas: analysis of polymer processing flows, basic theoretical and phenomenological continuum mechanics, and moleuclar rheology. The focus of this book is on the second area with some attention to the third area where possible. One hopes, of course, for the comprehensive, three-

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Chromatographic study of surface diffusion, Schneider, P., and J. M. Smith, **AIChE Journal, 14,** No. 6, p. 886 (November, 1968).

Key Words: A. Diffusivity-8, Diffusion-8, Surface-9, Ethane-9, Propane-9, *n*-Butane-9, Silica Gel-5, Chromatography-10, Adsorption-8, Pores-9.

Abstract: A new method, based upon chromatography, was used to measure surface diffusion coefficients for ethane, propane, and *n*-butane on silica gel. An advantage of this method is that the average surface coverage is very low. Thus the surface diffusion coefficients so obtained are very close to limiting values.

Two phase friction factor for para-hydrogen between one atmosphere and the critical pressure, Rogers, John D., **AIChE Journal, 14,** No. 6, p. 895 (November, 1968).

Key Words: A. Pressure Drop-8, Two Phase-0, Flow-8, Friction Factor-8, Para-Hydrogen-9, Martinelli Model-10, Critical Pressure-9.

Abstract: The Martinelli model for pressure drop in flowing two phase systems has been examined in detail for para-hydrogen from one atmosphere to its critical pressure. A method for obtaining the Martinelli Φ term, two phase friction factor, at intermediate pressures is presented.

Free convective effects on stokes flow mass transfer, Pearson, R. S., and P. F. Dickson, **AIChE Journal, 14,** No. 6, p. 903 (November, 1968).

Key Words: A. Mass Transfer-7, 8, Stokes Flow-9, Convection-6, Drops-9, Methyl Acetate-9, 2-Ethoxyethyl Acetate-9, Water-5, Spheres-9, Flow Rate-6.

Abstract: Free convective effects on forced convective mass transfer in the Stokes Flow region were studied experimentally by using a single drop in a liquid-liquid system. Liquids used to form the drops were methyl acetate or 2-ethoxyethyl acetate with distilled water as the continuous medium.

Iterative techniques in optimization. I. Dynamic programming and quasilinearization, Lee, E. Stanley, **AIChE Journal, 14,** No. 6, p. 908 (November, 1968).

Key Words: A. Solution-8, Differential Equations-9, Optimization-8, Quasilinearization-6, 10, Programming-8, Dynamic-0, Dimensionality-7, Extraction-4, Iteration-10.

Abstract: The quasilinearization technique is used to overcome the dimensionality difficulties of dynamic programming. The approach is based on the fact that if the difference or differential equations are linear, their closed forms of solution can be obtained. This solution permits the separation of the effects due to the initial state from the effects due to the control variables. Using this separation combined with quasilinearization, the dimensionality of the functional equation of dynamic programming can be reduced to one in most cases.

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