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The change in pore size distribution from surface reactions in porous media, Schechter, R. S., and J. L. Gidley, **AIChE Journal, 15,** No. 3, p. 339 (May, 1969).

Key Words: Reaction-6, Acid-6, Distribution-7, 8, Size-9, Pores-9, Mathematical Model-10, Hydrochloric Acid-1, Limestone-5, Porous Media-5, Liquid-6.

Abstract: When a porous solid is penetrated by a reactive fluid which changes the pore geometry, the macroscopic properties of that porous material may be greatly changed. A model is proposed in which the matrix is visualized as being a number of short cylindrical pores dispersed randomly throughout the solid. The change in the distribution of these cylindrical pores is then represented by an integro-differential equation which is solved for two special cases. The case considered here is that of a surface reaction which dissolves the solid thus continuously enlarging the pores. The rate of reaction is calculated theoretically using a laminar flow diffusion model and this growth rate expression is then taken as the basis for numerical calculations relating to the action of dilute hydrochloric acid on limestone.

Mathematical analysis of bubble dissolution, Duda, J. L., and J. S. Vrentas, **AIChE Journal, 15,** No. 3, p. 351 (May, 1969).

Key Words: Dissolution-8, Growth-8, Bubbles-9, Perturbation Series-10, Mathematical Model-10, Isothermal-0, Finite Difference Method-10, Determination-4, Diffusivity-9.

Abstract: A perturbation series solution is derived for isothermal bubble dissolution and bubble growth from an initially finite size. The accuracy and range of validity of the new results are investigated by comparison with finite-difference solutions of the equations governing bubble growth or dissolution. In addition, previous numerical solutions of the problem are compared to the finite-difference results of this study.

Heat transfer from a cylinder in an air-water spray flow stream, Mednick, R. Lawrence, and C. Phillip Colver, **AIChE Journal, 15,** No. 3, p. 357 (May, 1969).

Key Words: A. Heat Transfer Coefficients-8, Local-0, Cylinder-9, Temperature-6, Stainless Steel-9, Air-Water-9, Reynolds Number-6, Flow-6, Heat Transfer-8, Heat Flux-4, Velocity-6, Nusselt Number-6, Temperature Distribution-7, Resistance Heating-10, Experimental-0, Two-Phase-9, Two Component-9, Water Spray-9.

Abstract: Forced convection heat transfer from vertical cylinders normal to an air-water spray flow stream was measured over an air velocity range from 60 to 140 ft./sec. and a water spray density range from 0.03 to 0.50 $lb._m$/(min.)(sq. in.) Local heat transfer coefficients were determined at 15 deg. intervals around the circumference of both a 1.5 and a 1.0 in. diameter cylinder. It was found that the addition of 0.426 $lb._m$/(min.)(sq. in.) of water spray to a 133 ft./sec. air stream raised the stagnation point heat transfer coefficient from 45 to 1,650 B.t.u./(hr.)(sq.ft.)(°F.). Similar intensification was found for other angles around the cylinder circumference; however, the magnitude decreased with increasing distance from the stagnation point. Local heat transfer coefficients were normalized with respect to their corresponding stagnation point values and plotted parametrically as a function of angle and air velocity. These profiles showed that the normalized heat transfer coefficients decreased with increasing air velocity at angles other than the stagnation point. Average cylinder heat transfer coefficients were calculated from air-water data and two correlations were obtained relating these coefficients to the air and the water spray Reynolds number.

A thermodynamic equation relating equilibrium vapor-liquid compositions and enthalpy differences in isobaric multicomponent systems, Tao, Luh C., **AIChE Journal, 15,** No. 3, p. 362 (May, 1969).

Key Words: A. Equation-8, Thermodynamics-8, Vapor-Liquid Equilibria-8, Isobaric-0, Compositions-8, Enthalpy-4, 8, Binary-0, Multicomponent-0, Calculation-4, Ethanol-9, Water-9, Testing-4, Data-4, Toluene-9, *N*-Heptane-9, Cyclohexane-9.

Abstract: A rigorous and simple thermodynamic equation relating equilibrium vapor-liquid compositions and the phase enthalpy differences for a binary, isobaric system is extended to multicomponent systems. An analysis is made to indicate the potential applications of computing the latent heat of vaporization directly from the isobaric vapor-liquid equilibrium data and testing the consistency of phase composition and enthalpy data.

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"PVT Measurements on Petroleum Reservoir Fluids and Their Uses," R. H. Jacoby and L. Yarborough.
"Thermodynamic Excess Properties of Binary Liquid Mixtures—The Role of Empiricism," H. C. Van Ness.
"Group Contributions in Mixtures," C. H. Deal and E. L. Derr.
"Calculation of High-Pressure Vapor-Liquid Equilibria," P. L. Chueh and J. M. Prausnitz.
"The Adsorption of Gas-Mixtures—A Thermodynamic Approach," A. L. Myers.
"Physico-Chemical Measurements by Gas Chromatography," R. Kobayashi, H. A. Deans, and P. S. Chappelear.
"Thermodynamic Aspects of Capillarity," J. C. Melrose.
"The Thermodynamic Properties of Transition-Metal Alloys," J. B. Darby.
"Thermodynamic Properties of Cryogenic Fluids: Survey of Data," G. M. Wilson, R. G. Clark, and F. Hyman.
"Calculation of Complex Chemical Equilibria," F. J. Zeleznik and S. Gordon.
"A General Purpose Physical Data System for Computer Process Calculations," L. C. Yen, K. R. Cantwell, and B. L. Giles.

BARNETT F. DODGE
YALE UNIVERSITY
NEW HAVEN, CONN.

Cost Effectiveness—The Economic Evaluation of Engineered Systems, J. Morley English, Editor, John Wiley, New York (1968). 301 pages.

The editor has performed a worthwhile service by bringing into book form the lectures of a short course which he organized at U.C.L.A. The systems approach to engineering decisions received much of its original impetus from applications to weapon system operation and procurement. More recently attention has broadened to such subjects as the space program, transportation systems, waste disposal, and information handling.

In systems engineering attempts are made to measure the effectiveness of systems in terms of their costs. There is much in common with conventional engineering economics or design. The most significant difference implied in the title cost-effectiveness is in the methodology proposed for considering multiple values. This essentially involves a rating system whereby different kinds of values can be brought to a common scale. Thus for a large system, such as a river basin development, one component of the product,

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for example power, may have a market value but others such as recreation and flood risk do not. To arrive at an objective function to be maximized, it is necessary to supply a common measure of utility for each of these contributions. It is then possible to use various mathematical techniques and computational tools. There remains, of course, the basic question as to what extent ethical problems can be solved by such generalized logical analysis.

Much of the material presented will not sound familiar to chemical engineers since output as well as input of a chemical process is generally related to a market in which a dollar-value measuring system applies so that maximization of the difference or dollar profit is the object. As engineers are consulted more in government decisions involving technological developments the need for systems analysis techniques will no doubt increase.

The book consists of eleven chapters, the first seven of which, with the exception of Chapter 5, are largely concerned with system worth: the effectiveness term in cost-effectiveness. Chapter 5 is devoted to a discussion of system resource requirements or costs. Chapter 8 presents a recapitulation of erroneous or inaccurate concepts which are often encountered in cost effectiveness studies.

In order to apply the principles developed in the text an example is developed in Chapter 9. A supersonic transport study was selected because of current interest. However, this system is treated in terms of dollars so that the principles discussed in earlier chapters do not seem to be applied to any great extent.

The final two chapters serve to integrate the material previously considered. Chapter 10 is based on a luncheon address by Fred Hoffman, then Assistant Director of the Bureau of Budget. He discusses the unstable and complicated environment in which the Department of Defense must operate and the political constraints on its decisions. Chapter 11 by Dr. E. S. Quade of RAND presents a perspective of cost-effectiveness in terms of current trends and predictions for the future.

This book would hardly be considered as a text for a course in chemical engineering at any level. It is recommended as interesting background reading for those concerned with exploring trends in engineering economics and design strategy.

JOHN HAPPEL
NEW YORK UNIVERSITY
BRONX, NEW YORK

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A simple solution for boundary layer flow of power law fluids past a semi-infinite flat plate, Hsu, Chen-Chi, **AIChE Journal, 15,** No. 3, p. 367 (May, 1969).

Key Words: Flow-8, Fluids-9, Power Law Fluids-9, Plate-9, Boundary Layer-9, Laminar-0, Series Expansion-10, Velocity-6, Method of Steepest Descent-10, Shear Stress-7.

Abstract: The steady, two-dimensional, incompressible laminar boundary layer flow of power law fluids past a semi-infinite flat plate is studied analytically by the method of series expansion and the method of steepest descent. The shear stress of the fluids considered is proportional to the **n**th power of the velocity gradient.

The experimental determination of the volumetric properties and virial coefficients of the methane-ethylene system, McMath, H. G., Jr., and W. C. Edmister, **AIChE Journal, 15,** No. 3, p. 370 (May 1969).

Key Words: A. Volumetric Properties-2, 7, 8, Virial Coefficients-2, 7, 8, Measuring-8, Isochor-6, Pressure-6, Temperature-6, P.V.T. Apparatus-8, 10, Methane-Ethylene Mixtures-1, 8, 9, Equation Of State-8, 10, Generalized Methods-8, 10.

Abstract: An isochoric apparatus was used to determine compressibility factors for methane, ethylene, and four intermediate mixtures at 60, 40, and 20°F., with pressures from 260 to 2,220 lb./sq.in.abs. Second and third virial coefficients and interaction coefficients were determined from the data and compressibility factors and virial coefficients are compared with predictions made by the Benedict-Webb-Rubin equation of state.

Newtonian jet stability: The role of air resistance, Fenn, Robert W., III, and Stanley Middleman, **AIChE Journal, 15,** No. 3, p. 379 (May, 1969).

Key Words: A. Fluid Dynamics-8, Stability-7, 8, Instability-7, 8, Jets-9, Liquids-9, Newtonian-0, Laminar-0, Ambient Pressure-6, Breakup Length-2, 7, 8, 9, Measuring-8, Calculating-8, 4, Weber's Theory-10, 9, Photography-10, Correlating-4.

Abstract: The stability of high speed laminar Newtonian jets is studied as a function of ambient air pressure. For Weber numbers less than 5.3 (based on air density) air pressure has no effect on stability. Ambient viscosity, through the effect of shear stresses acting on the jet surface, gives rise to the maximum in the break-up curve. For large Weber numbers ambient pressure effects can alter, and eventually control, the appearance of the maximum.

Viscoelastic jet stability, Kroesser, F. William, and Stanley Middleman, **AIChE Journal, 15,** No. 3, p. 383 (May, 1969).

Key Words: A. Fluid Dynamics-8, Stability-7, 8, Instability-7, 8, Jets-9, Liquids-9, Viscoelastic-0, Laminar-0, Breakup Length-2, 7, 8, 9, Weber's Theory-9, 10, Photography-10.

Abstract: The breakup of a low speed horizontal jet is investigated. Weber's theory for the Newtonian jet is extended to a linear viscoelastic fluid. The theory predicts a dependence of breakup length on the elasticity number. Breakup lengths are measured for low concentration solutions of polyisobutylene in tetralin. Two molecular weights, several concentrations, and five capillary diameters were studied. A single correlation is obtained for all data which gives the breakup length as a function of the elasticity number, and the parameters of Weber's theory. At constant values of the Ohnesorge number and Weber number, the breakup length decreases with increasing elasticity number. The effect of the length of the capillary is studied. At large elasticity numbers short tubes give rise to slightly shorter breakup lengths than long tubes under identical flow conditions.

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