

ENGINEERING

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ABSTRACTS

The IAS Engineering Section: A Brief History. DAVID D. CHESAK, St. Joseph's College, Rensselaer, Indiana 47978.—A survey of Engineering Section activity and some of the people involved will be made.

Stress Corrosion Cracking of Sensitized Austenitic Stainless Steels in Boric Acid Solution Containing Sulfur Oxyanions. S. DHAWALE, Department of Chemistry, Indiana University East, Richmond, Indiana 47374 and G. CRANGNOLINO AND D.D. MACDONALD, Ohio State University, Columbus Ohio.—The stress corrosion cracking of Type 304 stainless steel in boric acid solution containing thiosulfate or tetrathionate at room temperature was studied using the slow strain technique. The minimum concentration of each species required for stress corrosion cracking was determined in experiments at open circuit potentials. Studies on the potential dependence of stress corrosion cracking showed that severe stress corrosion cracking occurs over a narrow range of potential near the corrosion potential. Scanning electron microscopy was used to determine the resulting corrosion morphology. No stress corrosion cracking was observed for 304 L and 316 L stainless steels under applied potential conditions.

An electrochemical method was used to study the degree of sensitization of 304 stainless steel and the effect of heat treatments.

Engineering and Science Education's Dilemma: Inadequate Science Programs in the Public School System. ANDREW HOLLERMAN, Department of Physics, Purdue University, West Lafayette, Indiana 47907.—The role of science education in today's society has been changing in the last several years. The rapid increase of technology has caused many educators to begin to doubt the quality of science training in our public educational system. The shortcomings of present science programs will be discussed. Personal experiences will be cited.

Prediction of the Variation of Azeotropic Composition Using the Gibbs-Konovalov Theorem. SCOTT OBLANDER AND W.W. BOWDEN, Department of Chemical Engineering, Rose-Hulman Institute of Technology, Terre Haute, Indiana 47803.—It has long been known that the assumption of the simple Margules equation

$$\ln \gamma_i = A X_j^2$$

γ_i = activity coefficient of component i

X_j = mole fraction of component j in liquid

A^j = empirically-determined constant

leads to the following simple equation

$$\frac{X_1(T_2) - 1/2}{X_1(T_1) - 1/2} = \frac{\frac{1}{A_2} \times \ln \frac{P_1^0(T_2)}{P_2^0(T_2)}}{\frac{1}{A_1} \ln \frac{P_1^0(T_1)}{P_2^0(T_1)}} \quad (1)$$

where

P_1^0, P_2^0 = vapor pressures of 1 and 2 at T_1, T_2

A_1, A_2 = Margules constant at T_1, T_2

This paper investigates how well the Gibbs-Konovalov theorem predicts the variation of azeotropic composition with pressure and temperature. The Gibbs-Konovalov theorem:

If a two-phase boundary curve passes through an extreme value the composition of the two phases must be identical at that point.

The equation used to determine the extreme-point is as follows:

$$P = X_1 \gamma_1 P_1^0 + X_2 \gamma_2 P_2^0 \quad (2)$$

where

P = total pressure

X_1, X_2 = mole fractions

γ_1, γ_2 = activity coefficients

P_1^0, P_2^0 = vapor pressures

The activity coefficients were assumed to be related to composition and temperature by the NRTL equation:

$$\ln \gamma_1 = X_2^2 \left[\frac{\tau_{21} G_{21}^2}{(X_1 + X_2 G_{21})^2} + \frac{\tau_{12} G_{12}}{(X_2 + X_1 G_{12})^2} \right] \quad (3)$$

$$\ln \gamma_2 = X_1^2 \left[\frac{\tau_{12} G_{12}^2}{(X_2 + X_1 G_{12})^2} + \frac{\tau_{21} G_{21}}{(X_1 + X_2 G_{21})^2} \right] \quad (4)$$

$$G_{ji} = \exp(-\alpha_{ji} \tau_{ji}) \quad (a)$$

$$\tau_{ij} = \frac{g_{ij} - g_{jj}}{RT} \quad (b) \quad (5)$$

$$\tau_{ji} = \frac{g_{ji} - g_{ii}}{RT} \quad (c)$$

The vapor pressures P_i^0 were related to temperature through the Antoine equation

$$\log P_i^0 = A_i - \frac{B_i}{C_i + t} \quad (6)$$

At a given temperature the conditions for an extremum in pressure in Equation (2)

were investigated using ISML routines available on the Rose-Hulman VAX 780. At a given pressure the conditions for an extremum in temperature in Equation (2) were investigated. Calculated and experimental results are compared.

The PVT Behavior of Compressed Liquids. DENNIS WEST AND W.W. BOWDEN, Department of Chemical Engineering, Rose-Hulman Institute of Technology, Terre Haute, Indiana 47803.—Since about 1895 the 'Tait' equation

$$V = V_s [1 - C(t) \ln \left(\frac{B(t) + P}{B(t) + P_s} \right)]$$

V = unit volume of liquid at Pressure P

V_s = unit volume of saturated liquid at P_s

$C(t)$, $B(t)$ = empirically-determined functions of temperature

has been used to correlate the PVT properties of compressed liquids. In this paper it is shown that the following simpler, more physically-meaningful equation with more easily-determined constants correlates the PVT data on 3 common liquids at least as well as the Tait equation:

$$V = V_s \left(1 - \frac{P - P_s}{P_c \bar{K}} \right)$$

$$\bar{K} = \frac{\frac{P - P_s}{V_s - V}}{\frac{P - P_s}{P_c}} = a(t) + b(t)P_r + c(t)P_r^2$$

$P_r = P/P_c$

P_c = critical pressure

a, b, c = empirically-determined functions of temperature.

