

The Redlich-Kwong two-constant equation of state has been used for integration of the right-hand side of Equation (19):

$$P = \frac{RT}{V - b_i} - \frac{a_i}{T^{0.5} V(V - b_i)}$$

$$a_i = \frac{0.4278 R^2 T_c^{2.5}}{P_c}$$

$$b_i = \frac{0.0867 RT_c}{P_c} \quad (20)$$

After integration of Equation (19) with the Redlich-Kwong equation of state, the following expression is obtained:

$$\ln \frac{f_{i,v}}{P \cdot y_i} = (z - 1) \frac{B_i}{B} - \ln(z - BP)$$

$$- \frac{A^2}{B} \left( \frac{2A_i}{A} - \frac{B_i}{B} \right) \ln \left( 1 + \frac{BP}{z} \right)$$

$$z = \frac{PV}{RT}; \quad A_i = \frac{0.6541}{T_r^{1.25} P_c^{0.5}}; \quad B_i = \frac{0.0867}{T_r P_c} \quad (21)$$

The terms with  $i$  index refer to the single component and those without  $i$  index refer to the mixture.

$$A = \sum A_i y_i; \quad B = \sum B_i y_i;$$

The value of  $z$  can be calculated by solution of the following equation, which represents a form of the Redlich-Kwong equation:

$$z = \frac{1}{(1-h)} - \frac{A^2}{B} \left( \frac{h}{1+h} \right)$$

where

$$h = BP/z$$

#### TRIAL AND ERROR EQUILIBRIUM CALCULATION FOR NONIDEAL SYSTEM

The method of calculating the terms of Equation (9) for equilibrium of a nonideal system has been presented. As can be seen it depends upon the phase compositions, which, in turn, are the unknowns to be calculated. A trial and error solution is suggested which makes use of the system of the following nine equations.

$$y_{\text{NH}_3} = f_{\text{NH}_3,L}^{\circ} \left( \frac{y_{\text{NH}_3} P}{f_{\text{NH}_3,v}} \right) \frac{\gamma_{\text{NH}_3,L}}{P} \cdot x_{\text{NH}_3} \quad [\text{Eq. (9)}] \quad (a)$$

$$y_{\text{H}_2\text{O}} = f_{\text{H}_2\text{O},L}^{\circ} \left( \frac{y_{\text{H}_2\text{O}} P}{f_{\text{H}_2\text{O},v}} \right) \frac{\gamma_{\text{H}_2\text{O},L}}{P} \cdot (1 - x_{\text{NH}_3}) \quad [\text{Eq. (9)}] \quad (b)$$

$$y_{\text{N}_2} = N_{\text{N}_2}/G \quad (c)$$

$$y_{\text{H}_2} = N_{\text{H}_2}/G \quad (d)$$

$$y_{\text{NH}_3} + y_{\text{H}_2\text{O}} + y_{\text{N}_2} + y_{\text{H}_2} = 1 \quad (e)$$

$$f_{\text{NH}_3,L,P}^{\circ} = \phi_1(P, T) \quad [\text{Eq. (16)}] \quad (f)$$

$$f_{\text{H}_2\text{O},L,P}^{\circ} = \phi_2(P, T) \quad [\text{Eq. (16)}] \quad (g)$$

$$\gamma_{\text{NH}_3} = \phi_3(T, x_{\text{NH}_3}) \quad [\text{Eq. (10)}] \quad (h)$$

$$\gamma_{\text{H}_2\text{O}} = \phi_4(T, x_{\text{NH}_3}) \quad [\text{Eq. (11)}] \quad (i)$$

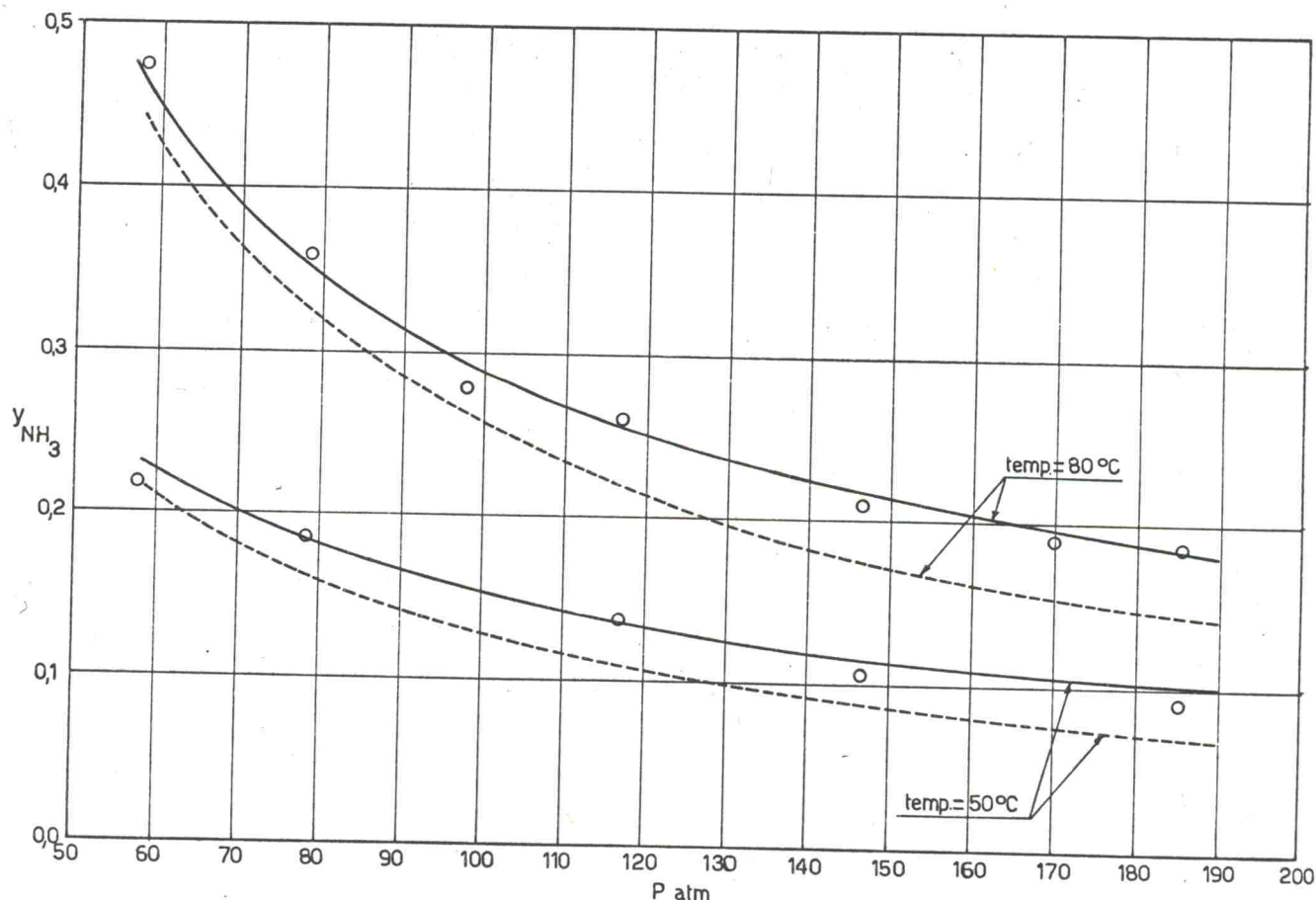


Fig. 4. Mole fraction of ammonia in vapor phase as a function of pressure. Temperatures of 50° and 80°C. Ratio hydrogen-nitrogen = 2.1 to 1.-65% by wt. of ammonia in liquid phase. ○ = experimental points; solid lines = calculated with Equation (9); dotted lines = calculated with Equation (8).