PRIMER PARCIAL

$$\frac{dm_{cv}}{dt} + \Delta(\rho u A)_{fs} = 0$$ **Ecuación de continuidad**

Ecuación de Virial

$$z = 1 + \frac{B}{V} + \frac{C}{V^2} + \frac{D}{V^3} + ...$$ $$z = 1 + B^{'}P + C^{'}P^2 + D^{'}P^3$$

Correlación de Pitzer

$$z = z^0 + \omega z^1$$

Correlación para el segundo coeficiente de virial

$$z^0 = 1 + B^0 \frac{P_r}{T_r}$$ $$B^0 = 0{,}083 - \frac{0{,}422}{T_r^{1,6}}$$

$$z^1 = B^1 \frac{P_r}{T_r}$$ $$B^1 = 0{,}139 - \frac{0{,}172}{T_r^{4,2}}$$

Ecuación de estado cúbica genérica

$$P = \frac{RT}{V-b} - \frac{a(T)}{(V+\varepsilon b)(V+\sigma b)}$$

$$a(T) = \psi \frac{\alpha(T_r) R^2 T_c^2}{P_c}$$ $$b = \Omega \frac{RT_c}{P_c}$$

Vapor y las raíces de la ecuación de estado cúbica genérica

$$V = \frac{RT}{P} + b - \frac{a(T)(V-b)}{P(V+\varepsilon b)(V+\sigma b)}$$

$$z = 1 + \beta - q\beta \frac{(Z-\beta)}{(Z+\varepsilon\beta)(Z+\sigma\beta)}$$

$$\beta = \Omega \frac{P_r}{T_r}$$ $$q = \psi \frac{\alpha(T_r)}{\Omega T_r}$$

Líquido y las raíces de la ecuación de estado cúbica genérica

$$V = b + (V+\varepsilon b)(V+\sigma b)\left[\frac{RT + bP - VP}{a(T)}\right]$$

$$z = \beta + (Z+\varepsilon\beta)(Z+\sigma\beta)\left(\frac{1+\beta-Z}{q\beta}\right)$$

Parámetros de la ecuación de estado

Ecuación	$\alpha(T_r)$	σ	ε	Ω	ψ	Z_c
vdW	1	0	0	1/8	27/64	3/8
RK	$T_r^{-1/2}$	1	0	0,08664	0,42748	1/3
SRK	$\alpha_{SRK(Tr;\omega)}$	1	0	0,08664	0,42748	1/3
PR	$\alpha_{PR(Tr;\omega)}$	$1+\sqrt{2}$	$1-\sqrt{2}$	0,07780	0,45724	0,30740

$$\alpha_{SRK}(T_r,\omega)=\left[1+(0{,}480+1{,}574\omega-0{,}176\omega^2)(1-T_r^{1/2})\right]^2$$

$$\alpha_{PR}(T_r,\omega)=\left[1+(0{,}37464+1{,}5422\omega-0{,}26992\omega^2)(1-T_r^{1/2})\right]^2$$

Ecuación de Racket

$$V^{sat}=V_c Z_c^{(1-Tr)^{0,2857}}$$

Proceso adiabático reversible para gases ideales (Cp=cte)

$$PV^{\gamma}=cte$$

$$W=\frac{RT_1}{\gamma-1}\left[\left(\frac{P_2}{P_1}\right)^{(\gamma-1)/\gamma}-1\right]$$

Proceso politrópico para gases ideales (Cp=cte)

$$PV^{\delta}=cte$$

$$W=\frac{RT_1}{\delta-1}\left[\left(\frac{P_2}{P_1}\right)^{(\delta-1)/\delta}-1\right] \qquad Q=\frac{(\delta-\gamma)RT_1}{(\delta-1)(\gamma-1)}\left[\left(\frac{P_2}{P_1}\right)^{(\delta-1)/\delta}-1\right]$$

Coeficiente de expansión volumétrica

$$\beta=\frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$$

Compresibilidad isotérmica

$$\kappa=-\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$$

Propiedades fundamentales

$$dU=TdS-PdV \qquad dA=-PdV-SdT$$

$$dH=TdS+VdP \qquad dG=VdP-SdT$$

Ecuaciones de Maxwell

$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V \qquad \left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P \qquad \left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T \qquad \left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$$

Prop. Para líquidos

$$dH = C_p dT + (1-\beta T)VdP \qquad dS = \frac{C_p}{T}dT - \beta VdP$$

Prop. Residuales

$$\frac{G^R}{RT} = \int_0^P (Z-1)\frac{dP}{P} \qquad (T = cte)$$

$$d\left(\frac{G^R}{RT}\right) = \frac{V^R}{RT}dP - \frac{H^R}{RT^2}dT$$

Ecuación de Clapeyron

$$\frac{dP^{sat}}{dT} = \frac{\Delta H^{\alpha\beta}}{T\Delta V^{\alpha\beta}}$$

Ecuación Clausius – Clapeyron

$$\frac{d\ln P^{sat}}{d(1/T)} = -\frac{\Delta H^{\alpha\beta}}{R}$$

SEGUNDO PARCIAL

Ecuación de Antoine

$$\ln P_i^{sat} = A - \frac{B}{C+T}$$

Iteración con Ley de Roult

$$T = x_i T_i^{sat} + (1 - x_i) T_i^{sat}$$

$$\alpha = \exp[A_i - A_2 - \frac{B_1}{C_1 + T} + \frac{B_2}{C_2 + T}$$

$$P_2^{sat} = \frac{P}{x_1 \alpha + x_2}$$

$$P_i^{sat} = P(y_i + y_2 \alpha)$$

Balance de masa

$$z_i = x_i L + y_i V$$

$$\frac{G^E}{RT} = \Sigma x_i \ln \gamma_i \qquad \Sigma x_i d \ln \gamma_i = 0$$

Modelos para la energía de Gibbs de exceso

$$\frac{G^E}{x_1 x_2 RT} = A \qquad \ln \gamma_1 = A x_2^2 \qquad \ln \gamma_2 = A x_1^2$$

Margules

$$\frac{G^E}{x_1 x_2 RT} = A_{21} x_1 + A_{12} x_2 \qquad \ln \gamma_1 = x_2^2 [A_{12} + 2(A_{21} - A_{12}) x_1] \qquad \ln \gamma_2 = x_1^2 [A_{21} + 2(A_{12} - A_{21}) x_2]$$

Coeficiente de Fugacidad

$$\ln \phi_1 = \int_0^P (Z - 1) \frac{dP}{P}$$

$$\phi_1 = \exp\left[\frac{P_r}{T_r} \left(B^0 + \omega B^1 \right) \right] \qquad B^0 = 0{,}083 - \frac{0{,}422}{T_r^{1,6}} \qquad B^1 = 0{,}139 - \frac{0{,}172}{T_r^{4,2}}$$

$$\ln\hat{\phi}_1 = \frac{P}{RT}\left(B_{11} + y_2^2\delta_{12}\right) \qquad \ln\hat{\phi}_2 = \frac{P}{RT}\left(B_{22} + y_1^2\delta_{12}\right)$$

$$\delta_{12} = 2B_{12} - B_{11} - B_{22}$$

Fugacidad de un líquido puro

$$f_i = \phi_i^{sat} P_i^{sat} \exp\left[\frac{V_i^{sat}(P - P_i^{sat})}{RT}\right]$$

$$d(nG) = (nV)dP - (nS)dT + \sum \mu_i dn_i$$

Ecuación de Gibbs/Duhem:

$$\left(\frac{\partial M}{\partial P}\right)_{T,x} dP + \left(\frac{\partial M}{\partial T}\right)_{P,x} dT - \sum_i x_i d\overline{M}_i = 0$$

$$\overline{M}_1 = M + x_2 \frac{\partial M}{\partial x_1} \qquad \overline{M}_2 = M - x_1 \frac{\partial M}{\partial x_1}$$

Entalpía, Entropía y Enegía Libre de Gibbs

$$H^{id} = \sum y_i H_i \qquad S^{id} = \sum y_i S_i - R\sum y_i \ln y_i$$

$$G^{id} = \sum y_i G_i + RT\sum y_i \ln y_i$$

Propiedades fundamentales

$$d\left(\frac{nG}{RT}\right) = \frac{1}{RT} nVdP - \frac{nH}{RT^2} dT + \sum_i \frac{\overline{G}_i}{RT} dn_i$$

$$d\left(\frac{nG^R}{RT}\right) = \frac{nV^R}{RT} dP - \frac{nH^R}{RT^2} dT + \sum_i \frac{\overline{G}_i^R}{RT} dn_i \qquad d\left(\frac{nG^E}{RT}\right) = \frac{nV^E}{RT} dP - \frac{nH^E}{RT^2} dT + \sum_i \frac{\overline{G}_i^E}{RT} dn_i$$