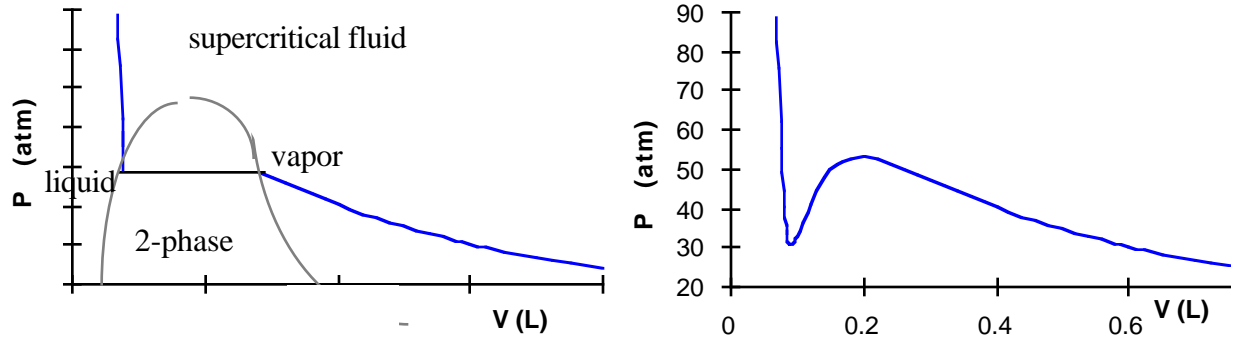


Van der Waals Liquifaction



$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

$$I. \left(\frac{\partial^2 P}{\partial V^2}\right)_T = 0 \quad P_c = \frac{RT_c}{V_c - b} - \frac{a}{V_c^2}$$

$$II. \left(\frac{\partial P}{\partial V}\right)_T = -\frac{RT_c}{(V_c - b)^2} + \frac{2a}{V_c^3} =$$

$$III. \left(\frac{\partial^2 P}{\partial V^2}\right)_T = \frac{2RT_c}{(V_c - b)^3} - \frac{6a}{V_c^4} =$$

$$IV. -\frac{2RT_c}{(V_c - b)^3} + \frac{4a}{(V_c - b)V_c^3} = \quad \text{multiply II by } \frac{2}{(V_c - b)}$$

$$IV + III = V. \quad \frac{4a}{(V_c - b)V_c^3} - \frac{6a}{V_c^4} =$$

$$VI. \frac{2}{(V_c - b)} - \frac{3}{V_c} =$$

$$V_c = 3b \quad V_c \rightarrow II: \quad T_c = \frac{8a}{27bR}$$

$$V_c, T_c \quad \rightarrow \quad P_c = \frac{RT_c}{V_c - b} - \frac{a}{V_c^2} = \frac{a}{27b^2}$$

$$Z = \frac{P_c V_c}{RT_c} = \frac{\frac{a}{27b^2} \cdot 3b}{\frac{8a}{27bR}} = \frac{3}{8}$$

compressibility factor

3/8 = 0.375
Z(He) = 0.306
Z(benzene) = 0.274