CHE407: Separation Processes
Tutorial-6

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QUESTION (1)

Show that for an equilibrium relationship of the form:

$$y = \frac{\alpha_{av} x}{1+(\alpha_{av}-1)x}$$

The Rayleigh equation for the batch distillation can be written in the form:

$$\ln\frac{L_1}{L_2} = \frac{1}{(\alpha_{av}-1)}\left[\ln\frac{x_1}{x_2} - \alpha_{av}\ln\frac{(1-x_1)}{(1-x_2)}\right] \quad (1)$$

$$\frac{n_{A2}}{n_{A1}} = \left(\frac{n_{B2}}{n_{B1}}\right)^{\alpha_{av}} \quad (2)$$

QUESTION (2)

A liquid of 100 mol containing 50 mol% n-heptane and 50 mol% n-octane is distilled under differential conditions of 1.0 atm until 40 mol is distilled. What is the average composition of the total vapor distilled and the composition of the liquid left (residue)? The equilibrium data are as follows where x and y are mole fraction of n-heptane.

x	0.50	0.46	0.42	0.38	0.34	0.32
y	0.689	0.648	0.608	0.567	0.523	0.497

QUESTION (3)

A liquid of 100 mol containing 50 mol% A, 25 mol% B and 25 mol% C is distilled under differential conditions of 1.0 atm until 32.5 mol is distilled. What are the average composition of the distillate and the composition of the liquid left (residue)?. The vapor pressures are tabulated, as follows:

Substance	Vapor pressure in mmHg
A	1370
B	550
C	200

Hint:

For multicomponent system equation (2) above can be written as:

$$\frac{n_{i2}}{n_{i1}} = \left(\frac{n_{j2}}{n_{j1}}\right)^{\alpha_{ij}} \quad (3)$$