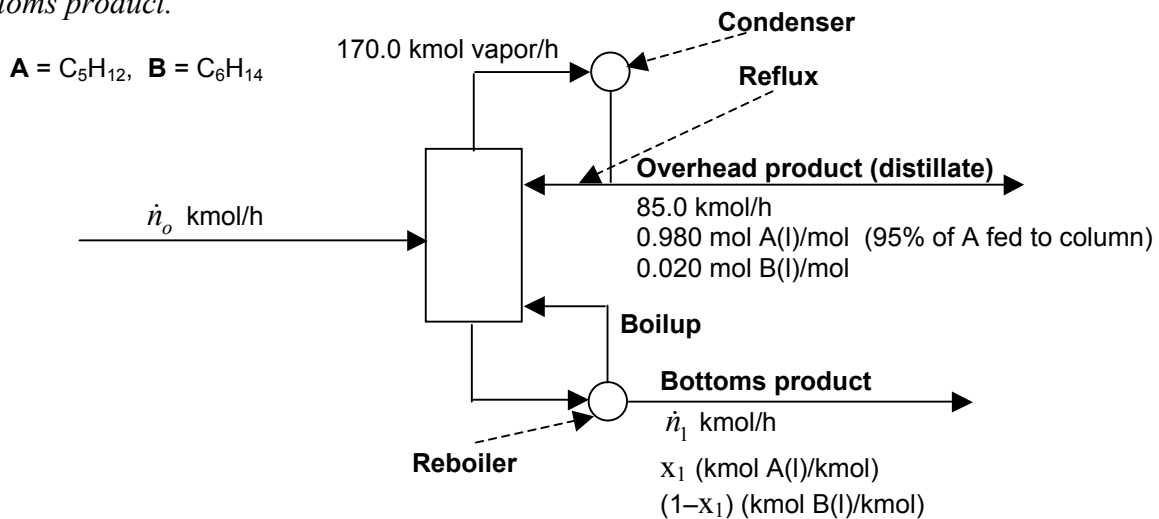


PROBLEM 6.60

The feed to a distillation column is a 45.0 mole% *n*-pentane – 55.0 mole% *n*-hexane liquid mixture. The vapor stream leaving the top of the column, which contains 98.0 mole% pentane and the balance hexane, goes to a total condenser (one in which all the vapor is condensed). Half of the liquid condensate is returned to the top of the column as *reflux* and the rest is withdrawn as overhead product (*distillate*) at a rate of 85.0 kmol/h. The distillate contains 95.0% of the pentane fed to the column. The liquid stream leaving the bottom of the column goes to a *reboiler*. Part of the stream is vaporized; the vapor is recycled to the bottom of the column as *boilup*, and the residual liquid is withdrawn as *bottoms product*.



- (a) Calculate the molar flow rate of the feed stream and the molar flow rate and composition of the bottoms product stream.

Solution

(6.60-1)

DEGREE-OF-FREEDOM ANALYSIS		
UNKNOWN AND INFORMATION		JUSTIFICATION/CONCLUSION
+ ___ unknowns	_____	
- ___ balances	_____	
- 1 (95% of A fed goes to distillate)		
0 DOF		Problem is solvable

95% of A fed goes to distillate

$$\left(85.0 \frac{\text{mol}}{\text{h}}\right) \left(0.980 \frac{\text{mol A}}{\text{mol}}\right) = 0.950(\text{_____}) \Rightarrow \dot{n}_0 = 195 \text{ kmol/h} \quad (6.60-2)$$

Total mole balance

$$\text{_____} \Rightarrow \dot{n}_1 = \text{_____} \text{ kmol/h} \quad (6.60-3)$$

Pentane balance

$$\text{_____} \Rightarrow x_1 = \underline{0.0405 \text{ mol A/mol}} \quad (6.60-4)$$