$\Delta\hat{H} = \hat{V}\Delta P$ incompressible fluids $\Delta\hat{H}\ (kJ/mol)$

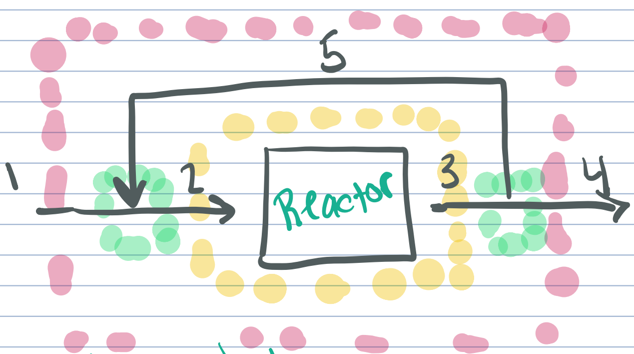
$\Delta\hat{H} = \Delta\hat{V}P$ ✱ We assume constant $\hat{V}$, constant ρ

$\Delta\hat{H} = \hat{V}\Delta P$

$\Delta\hat{H} = \hat{V}P_2 - \hat{V}P_1$

$\Delta\hat{H} = \hat{V}(P_2 - P_1) = \hat{V}\Delta P$

How to handle recycle streams in material balances + the overall balance?



Material balances

Reactor

consider 2,3

Overall

consider 1,4

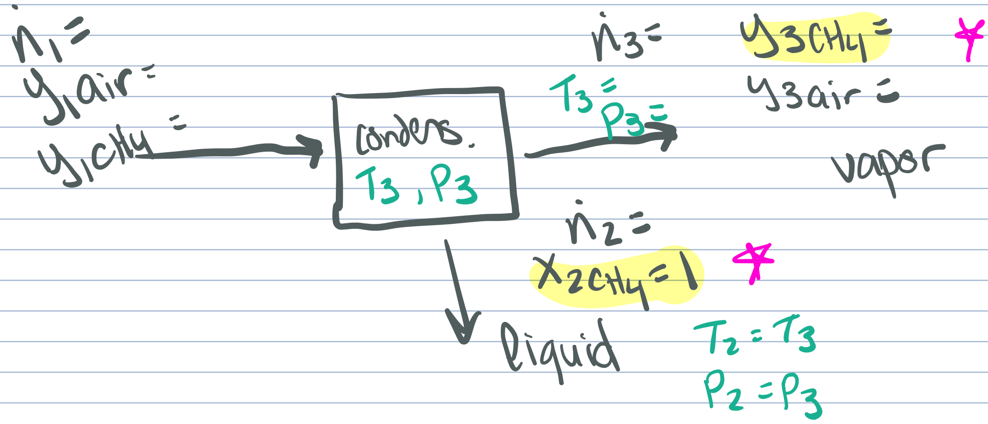
Splitting

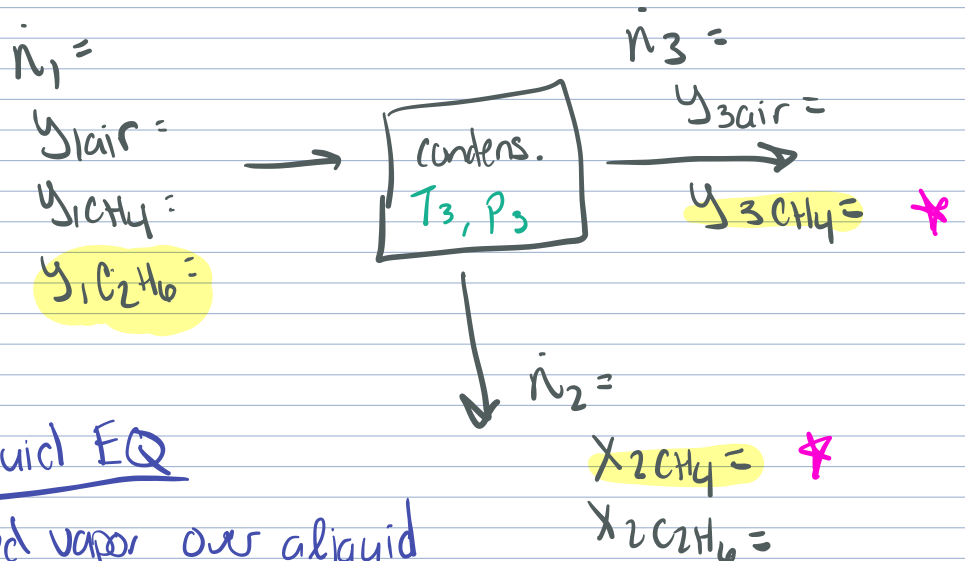
streams 3,4,5

mixing

streams 1,2,5

"One species is in VLE — what does that tell us about T, P of that condenser"





Vapor-liquid EQ

- saturated vapor over a liquid
- Constant T and P

relies on T only

If you have a saturated vapor → Antoine Eq. P_i^{sat}

If you have a saturated vapor and VLE → Raoult's Law: $y_i P = x_i P_i^{sat}$

P of the condenser

What is the best labeling scheme? All $\dot{n}_i$?, $\dot{V}_i$?

species flowrates | total + molfractions

$\dot{n}_A =$ | $\dot{n}_2 =$

$\dot{n}_{1B} =$ | $y_{2A} =$

$y_{2B} =$

$y_{2C} =$

$\dot{V}_1 = 10 \frac{L}{min}$

$P_1 = 3atm$ | $\dot{V}_2 = ?\ \frac{L}{min}$

$T_1 = 400K$

$A + 2B \rightarrow 3C \quad j = 1$

$$\text{Out} = \text{in} + \nu_i \xi_j$$

$$A: \quad \underbrace{\dot{n}_2 y_{2A}}_{\left(\frac{mol}{min}\right)\left(\frac{mol\ A}{mol}\right)} = \underbrace{\dot{n}_{1A}}_{\left(\frac{mol\ A}{min}\right)} - \underbrace{\dot{\xi}}_{\left(\frac{mol\ A}{min}\right)}$$

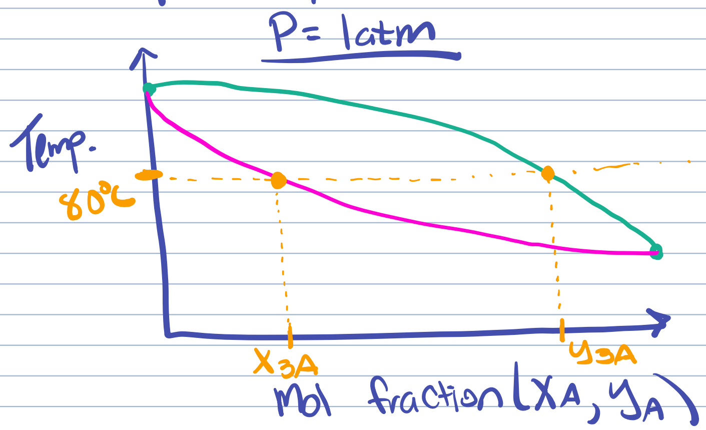
$\left(\frac{mol\ A}{min}\right)$

How do we read Txy Diagrams?

Multicomponent vapor-liquid equilibrium

A, B → liq → dist. → vap. $y_{2A} =$, $y_{2B} =$

↓ liquid $x_{3A} =$, $x_{3B} =$



You are told Distillation column operates at P= 1atm and 80°C. What is liquid-phase composition and what is the vapor phase composition?

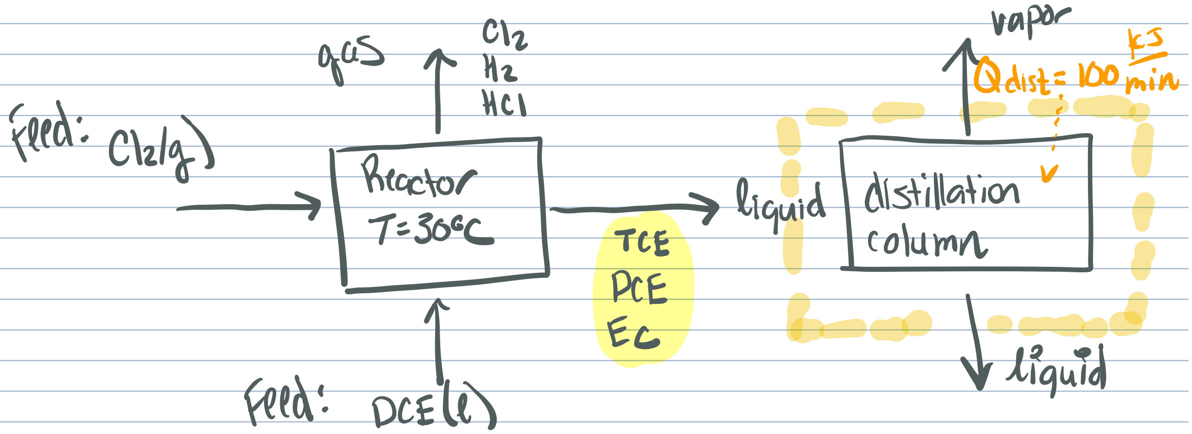
Bubble Point: $P = x_A P_A^{sat} + x_B P_B^{sat}$ *

Dew Point: $1 = \dfrac{y_A P}{P_A^{sat}} + \dfrac{y_B P_B}{P_B^{sat}}$ *

Question about 2023 final - reactor

$DCE(l) + Cl_2(g) \rightarrow TCE(l) + 2H_2(g)$ (1)

$DCE(l) + H_2(g) \rightarrow EC(l) + HCl(g)$



Non-reactive! $\dot{Q}_{distillation} = \Delta \dot{H}_{dist.} = \sum_{out} \dot{n}_i \hat{H}_i - \sum_{in} \dot{n}_i \hat{H}_i$

Distillation $\left[\; 100 \frac{kJ}{min} = \sum_{out} \dot{n}_i \hat{H}_i - \sum_{in} \dot{n}_i \hat{H}_i \right.$

Adiabatic – very well insulated $\dot{Q} = 0 = \sum_{out} \dot{n}_i \hat{H}_i - \sum_{in} \dot{n}_i \hat{H}_i$

Isobaric – pressure is equal / doesn't change

isothermal – temperature is constant

TCE
EC