Øving 2 - Prosessteknikk

1)

① $p_T = 1\ \text{bar} = 10^5\ \text{Pa}$
$T_T = 298\ \text{K}$
Strømningsrate $S_T = 100\ m^3/h$
② $p_W = 3168\ \text{Pa}$

a) $x_3 = \frac{n_W}{n_{tot}} = \frac{p_W V/RT}{p_{tot} V/RT} = \frac{p_W}{p_{tot}} = \frac{3168\ \text{Pa}}{(10^5 + 3168)\ \text{Pa}} = 0{,}031$

Antar ideell gasslov $pV = nRT \Rightarrow n = \frac{pV}{RT}$

$p_{tot} = p_{luft} + p_W = 10^5 + (3168)\ \text{Pa}$

$x_3 = 0{,}031$ (3 for strøm 3)

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b) Vet at molfraksjon for vann blir slik; $x_1 = 0$ (0% luft), $x_2 = 1$, $x_3 = 0{,}031$ (fra a)

$n_T + n_W = n_F$ — ingen rx → konstant mol

For vann $x_1 n_T + x_2 n_W = x_3 n_F$

For luft $(1 - x_1) n_T + (1 - x_2) n_W = (1 - x_3) n_F$ (dette stemmer fordi det er komponenter som blandes uten rx)

(1) $n_T + n_W = n_F$

(2) $x_1 n_T + x_2 n_W = x_3 n_F$

(3) $(1 - x_1) n_T + (1 - x_2) n_W = (1 - x_3) n_F$

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c) $S_T = 100\ m^3/h \Rightarrow V = 100\ m^3$, $p = p_T$, $T_T = 298\ \text{K}$

ideell gasslov $n_T = \frac{pV}{RT} = \underline{4036{,}2\ \text{mol}}$

(3) $(1 - x_1) n_T + (1 - x_2) n_W = (1 - x_3) n_F$ $\quad x_2 = 1 \Rightarrow (1 - x_2) = 0$

$n_T = (1 - x_3) n_F$ $\quad x_1 = 0 \Rightarrow (1 - x_1) = 1$

$n_F = \frac{n_T}{(1 - x_3)} = \frac{4036{,}2\ \text{mol}}{(1 - 0{,}031)} = \underline{4164{,}1\ \text{mol}}$

(1) $n_T + n_W = n_F \Rightarrow n_W = n_F - n_T = (4164{,}1 - 4036{,}2)\ \text{mol} = 127{,}9\ \text{mol}$

$\Rightarrow$ Strøm luft: $n_T = 4036{,}2\ \text{mol/h}$

Strøm vann: $n_W = 127{,}9\ \text{mol/h}$

Strøm fuktig luft: $n_F = 4164{,}1\ \text{mol/h}$

d) $M_m(H_2O) = 18{,}016$ g/mol

$S_w = 127{,}9$ mol/h $m = n \cdot M_m$

i g: $S_w = 127{,}9$ mol/h $\cdot$ 18,016 g/mol $= 2304$ g/h

i kg: $S_w = 2{,}3$ kg/h

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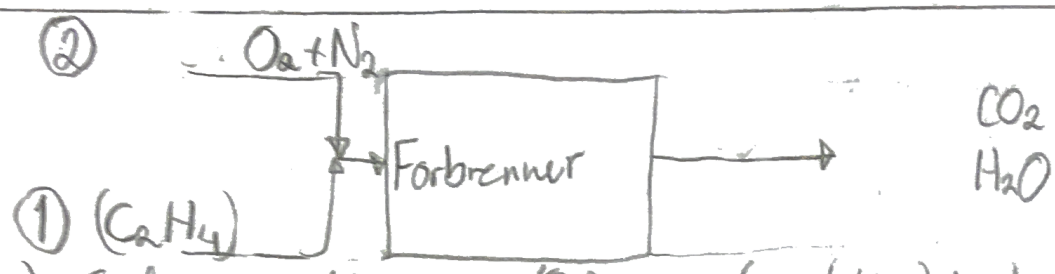
2)



a) Siden rx-likning lar n(O_2) og n(produkter) bestemmes av n i $(C_2H_4)_n$ kjeder, kan vi regne antall mol eten og bruke dette som n

Vet at $n_{O_2} = n_{C_2H_4} \cdot 3 = 3 \cdot \frac{10^6}{(12{,}01)\cdot 2 + 4\cdot(1{,}008)} = 106944$ mol

Finner mol luft ved: $\frac{n_{O_2}}{x_{O_2}} = n_2 = 5{,}09 \cdot 10^5$

$pV = nRT$

$V = \frac{nRT}{P} \Rightarrow V_2 = \frac{5{,}09 \cdot 10^5 \cdot 8{,}314 \cdot 298}{10^5}$

$V_2 = 126178\ m^3$

b) 1 mol C_2H_4 $\leftrightarrow$ 2 mol CO_2 + 2 mol H_2O $\Rightarrow$ 4 mol avgass$_{rx}$

$n_{C_2H_4} = \frac{10^6\,(m)}{28{,}052\,(M_m)} = 35648$ mol $\Rightarrow 142592$ mol avgass$_{rx}$

Antar ideell gasslov: $pV = nRT \Rightarrow V = \frac{nRT}{P}$

$p = 0{,}9 \cdot 10^5$ Pa

$T = (900 + 273)$ K $= 1173$ K

Må ta med nitrogen:

n_2 = luft, $n_{n_2} = n_2 \cdot x_{n_2} = 5{,}09 \cdot 10^5 \cdot 0{,}79 = 402110$

$n_{avgass} = n_{avgass_{rx}} + n_{N_2} = (142592 + 402110)$ mol $= 544702$ mol

$V_{avgass} = \frac{544702 \cdot 8{,}314 \cdot 1173}{0{,}9 \cdot 10^5} = 59023\ m^3$

$V_{avgass} = 59023\ m^3$