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Oppg. 1)

$X_A = 0,7$

$$r_A = \frac{F_{A0} - F_A}{V} \rightarrow V = \frac{F_{A0} X_A}{r_A} \quad (I)$$

II) $r_A = k_1 C_A$, $k_1 = \exp\left(17,2 - \frac{E_1}{RT}\right)$, $E_1 = 11600 \frac{cal}{mol}$

$\Delta_{rx} H = -18000 \frac{cal}{mol}$

III) $\Delta T = \frac{-X_A \Delta_{rx} H}{C_p}$, når $\Delta_{rx} C_p = 0$

$$C_p = 1000 \frac{kcal}{m^3 K} \cdot \frac{1}{3} \frac{m^3}{kmol} = \frac{1000}{3} \frac{cal}{mol \cdot K}$$

$\Delta T = 37,8 K \rightarrow T_{rx} = 57,8 °C = 330,8 K$

II) $k_1 = 0,639 \, min^{-1}$, $R = 1,987 \frac{cal}{mol \cdot K}$

$r_A = k C_A = k C_{A0} (1 - X)$

II) $r_A = 0,575 \frac{kmol}{m^3 min}$

I) $V = 7,3 \, m^3$

Uppg. 2)

Anntar at hydrolysmedlet har konstant temp.

$A = 100\ m^2 \quad U = 10 \frac{kcal}{m^2\ K\ min} \quad T_a = 10°C$

Energibalans:

$$Q + H_{inn} - H_{ut} = 0$$

$$UA(T_a - T) + \sum F_{i0}\, a_f H_i - \sum F_i (a_f H_i + C_{p,i}(T - T_0)) = 0$$

$$UA(T_a - T) + \sum F_{A0}\theta_i a_f H_i - \sum F_{A0}(\theta_i + \nu_i X_A)(a_f H_i + C_{p,i}(T - T_0)) = 0$$

$$\frac{UA}{F_{A0}}(T_a - T) + X_A a_{rx} H - \sum \theta_i C_{p,i}(T - T_0) - \underbrace{a_{rx} C_p}_{=0}(T - T_0) = 0$$

$$X_A a_{rx} H = \frac{UA}{F_{A0}} T_a - T\left(\frac{UA}{F_{A0}} + C_{p,A}\right) + T_0 C_{p,A}$$

$\theta_A = 1, \quad \theta_R = 0$

$$T = \frac{\frac{UA}{F_{A0}} T_a + T_0 C_{p,A} - X_A a_{rx} H}{\frac{UA}{F_{A0}} + C_{p,A}}$$

$$T = 314{,}9\ K \rightarrow k_1 = 0{,}262$$

$$r_A = \frac{X_A F_{A0}}{V_{rx}} = k_1 C_{A0}(1 - X_A)$$

$$X_A\left(\frac{F_{A0}}{V_{rx}} + k_1 C_{A0}\right) = k_1 C_{A0}$$

$$X_A = 0{,}489$$

Opg. 3)

$$\left.\begin{aligned} r_A &= k_1 C_A - k_2 C_R \\ C_A &= C_{A0}(1-x_A) \\ C_R &= x_A C_{A0} \end{aligned}\right\} \quad r_A = C_{A0}\left(k_1(1-x_A) - k_2\right) \quad \text{(I)}$$

II) $k_1 = A_1 \exp\left(-\frac{E_1}{RT}\right)$ III) $k_2 = A_2 \exp\left(-\frac{E_2}{RT}\right)$

$$\frac{dr_A}{dT} = C_{A0}\left(\frac{dk_1}{dT}(1-x_A) - \frac{dk_2}{dT}\right)$$

$$\frac{dk_i}{dT} = \frac{A_i E_i}{RT^2} \exp\left(-\frac{E_i}{RT}\right)$$

$$\frac{dr_A}{dT} = 0 \rightarrow \frac{A_1 E_1}{RT^2} \exp\left(\frac{-E_1}{RT}\right)(1-x_A) = \frac{A_2 E_2}{RT^2} \exp\left(-\frac{E_2}{RT}\right)$$

$$\exp\left(\frac{E_2 - E_1}{RT}\right) = \frac{A_2 E_2}{A_1 E_1 (1-x_A)} = 3{,}7 \cdot 10^{11}$$

$$T = \frac{E_2 - E_1}{R \ln(3{,}7 \cdot 10^{11})}$$

$$T = 340\,K$$

$$r(340\,K) = 0{,}56 \frac{kmol}{m^3 min}$$