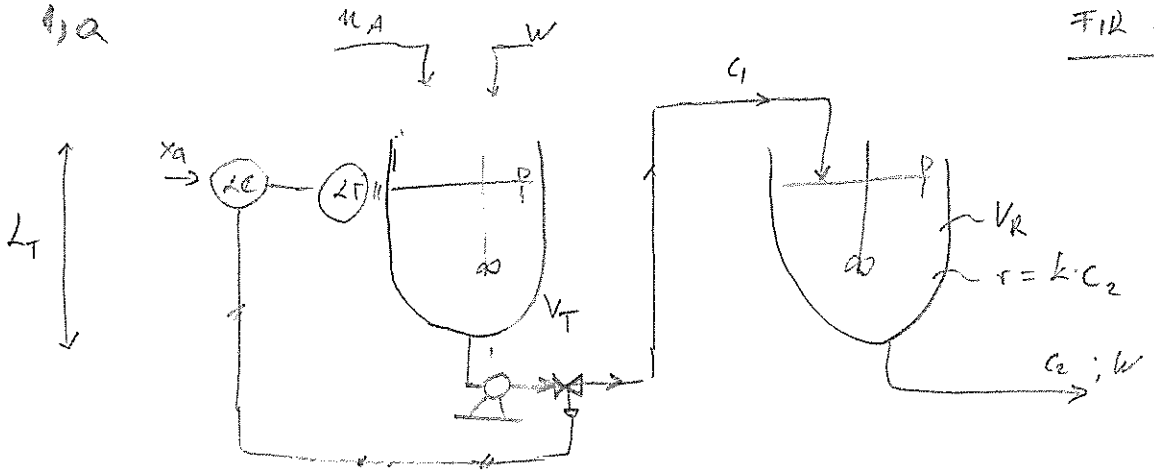
9) a

FIR számgyak 2011.05.15



$D_T = 0,4\,m$

$L_T = 1,2\,m$

$x = 42\,\%$

$V_R = 50\,l = 0,05\,m^3$

$\bar{\dot{n}}_A = 480\ mol/h$

$\bar{\dot{w}} = 550\ l/h = 0,55\ m^3/h$

$\bar{H}_T = 55\,cm = 0,55\,m$

$A_{RE} = 15\,\%$

$k_{RE} = 7\ \frac{l/h}{\%} = 7 \cdot 10^{-3}\ \frac{m^3/h}{\%}$

$\Delta TA = 0,8\,m \in [0,2\,m\ ;\ 1,0\,m]$

c_2/c_0 :

$c_0 \rightarrow \boxed{\frac{1}{T_T s + 1}} \rightarrow c_1 \rightarrow \boxed{\frac{K_R}{T_R s + 1}} \rightarrow c_2$

$$T_T = \frac{\bar{V}_T}{\bar{\dot{w}}} = \frac{D_a^2 \cdot \pi}{\bar{\dot{w}}} \cdot \bar{H}_T$$

$$= \frac{0,4^2\,m^2 \cdot \frac{\pi}{4} \cdot 0,55\,m}{0,55\,m^3/h} = 0,1256\,h$$

$$K_R = \frac{\bar{\dot{w}}}{\bar{\dot{w}} + V_R \left(\frac{dr}{dc_2}\right)_0} = \frac{550\,l/h}{550\,l/h + 50\,l \cdot 7,964\,\frac{1}{h}} = 0,580\ \frac{mol/h}{mol/h}$$

$r = k \cdot c_2 \Rightarrow \left(\frac{dr}{dc_2}\right)_0 = k$

$\bar{\dot{w}}(\bar{c}_1 - \bar{c}_2) = V_R \bar{r} = V_R \cdot k \bar{c}_2$

$$k = \frac{\bar{\dot{w}}(\bar{c}_1 - \bar{c}_2)}{V_R \cdot \bar{c}_2} = \frac{550\,l/h\,(0,873 - 0,506)\ \frac{mol}{l}}{50\,l \cdot 0,506\ \frac{mol}{l}}$$

$$k = 7,964\ \frac{1}{h}$$

$$\bar{c}_1 = \frac{\bar{\dot{n}}_a}{\bar{\dot{w}}} = \frac{480\ mol/h}{550\,l/h} = 0,873\ \frac{mol}{l}$$

$$\bar{c}_2 = (1 - x)\,\bar{c}_1 = (1 - 0,42) = 0,506\ \frac{mol}{l}$$

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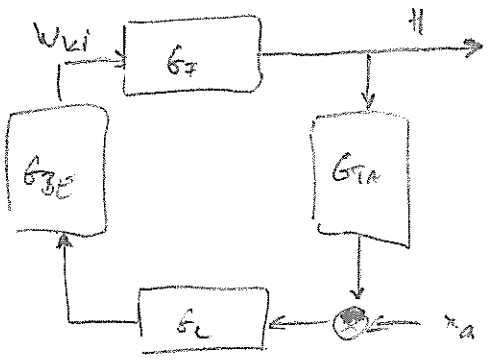
$$T_R = \frac{V_R}{\bar{W} + \bar{V}_R \cdot \left(\frac{dv}{dc_{c2}}\right)_0} = \frac{50\ l}{550\ l/h + 50\ l \cdot 7,954\ \frac{1}{h}} = 0,053\ h$$

Szintaábrából:



$$G_T = \frac{K_T}{S} = \frac{\frac{1}{R_1^2 \pi / A}}{S} = \frac{\frac{1}{(0,4m)^2 \pi / 4}}{S} = \frac{7,962\ \frac{1}{m^2}}{S} \left[\frac{h}{m^3/h}\right]$$

$$G_{TA} = \frac{100\,\% - 0\,\%}{1m - 0,2m} = 125\ \frac{\%}{m}$$

$$G_E = 15\ \frac{\%}{\%}$$

$$G_{BE} = 7 \cdot 10^{-3}\ \frac{m^3/h}{\%}$$

b) $\varepsilon = 15$ perc

$$a = \pm 5\,\% \cdot \bar{c}_0 = \pm 0,05 \cdot 0,873\ \frac{mol}{lit} = \pm 0,0436\ \frac{mol}{lit}$$

$$c_2(t) = \bar{c}_2 + a \cdot k_T \cdot k_R \left[1 - \frac{1}{T_T - T_R}\left(T_T e^{-\frac{t}{T_T}} - T_R e^{-\frac{t}{T_R}}\right)\right] \qquad t = 0,25\ h$$

$$= 0,506\ \frac{mol}{lit} \pm 0,0436\ \frac{mol}{lit} \cdot 1 \cdot 0,506 \left[1 - \frac{1}{0,1156\ h - 0,053\ h}\left[0,1156\ h\, e^{-\frac{0,25}{0,1156}} - 0,053 \cdot e^{-\frac{0,25}{0,053}}\right]\right]$$

$$= 0,506\ \frac{mol}{lit} \pm 0,020\ \frac{mol}{lit} \Rightarrow \text{megnövekedés} = \frac{\pm 0,020\ \frac{mol}{lit}}{0,506\ \frac{mol}{lit}} = \pm 3,86\,\%$$

c) új rögzítés

$$\hat{c}_2(\infty) = \lim_{s \to 0}\left[s \cdot \frac{c_2(s)}{c_0(s)} \cdot \frac{a}{s}\right] = \lim_{s \to 0}\left[\frac{K_R}{(T_T s + 1)(T_R s + 1)} \cdot a\right] = K_R\, a = 0,1380 \pm 0,0436\ \frac{mol}{lit}$$

$$= \pm 0,0253\ \frac{mol}{lit}$$

$$\text{Így } c_2(\infty) = \bar{c}_2 + \hat{c}_2(\infty) = \begin{cases} \to 0,5315\ mol/lit \\ \to 0,4809\ mol/lit \end{cases}$$

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d) $H_{új} = 0{,}8\,m$ ellátó tározó $H_{új,TA} = 0{,}8\,m - 0{,}2\,m = 0{,}6\,m$ – L 64.

$K_{TA} = 125\ \frac{\%}{m}$ $\Rightarrow$ $x_{a,új} = H_{új,TA} \cdot K_{TA} = 0{,}6\,m \cdot 125\ \frac{\%}{m} = \underline{\underline{75\,\%}}$

e) $H(t) = 0{,}75\,m$

Zavaró: alapjel megváltozása

$\bar{x}_a(55\,cm) = (0{,}55\,m - 0{,}2\,m) \cdot 125\ \frac{\%}{m} = 43{,}75\,\%$

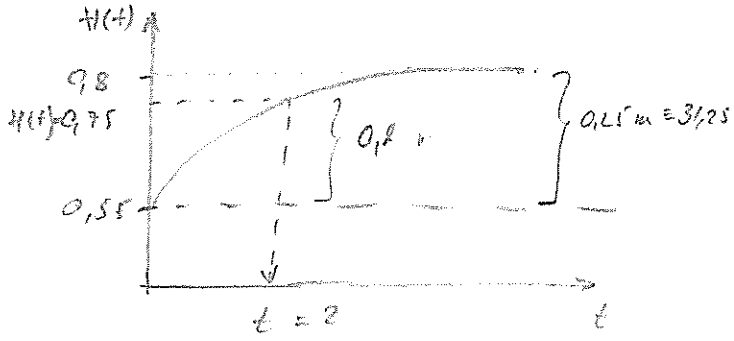
$x_{a,új}(0{,}8\,m) = (0{,}8\,m - 0{,}2\,m) \cdot 125\ \frac{\%}{m} = 75\,\%$

$\Rightarrow \hat{x}_a = 31{,}25\,\%$

$$G^* = \frac{H(s)}{x_a(s)} = \frac{G_F \cdot G_C \cdot G_{SE}}{1 + G_F \cdot G_C \cdot G_{SE} \cdot G_{MA}} = \frac{\frac{7{,}962\ \frac{l}{m^2}}{s} \cdot 15\,\% \cdot 7 \cdot 10^{-3}\ \frac{m^3/h}{\%}}{1 + \frac{7{,}962\ \frac{l}{m^2}}{s} \cdot 15\ \frac{\%}{\%} \cdot 7 \cdot 10^{-3}\ \frac{m^3/h}{\%} \cdot 125\ \frac{\%}{m}} \cdot \frac{s}{s}$$

$$= \frac{K^*}{T^* s + 1} = \frac{\frac{1}{125\ \frac{\%}{m}} \equiv 0{,}008}{\frac{1}{104{,}5}\,h\,s + 1}$$

$\frac{1}{104{,}5} = 9{,}57 \cdot 10^{-3}$



$$\Rightarrow \hat{H}(t) = \hat{x}_a \cdot K^* \left(1 - e^{-\frac{t}{T^*}}\right)$$

$$0{,}2\,m = 31{,}25\,\% \cdot \frac{1}{125\ \frac{\%}{m}} \left(1 - e^{-\frac{t}{9{,}57 \cdot 10^{-3} h}}\right)$$

$$e^{-\frac{t}{9{,}57 \cdot 10^{-3} h}} = 0{,}2$$

$$t = 0{,}015\,h \equiv 0{,}92\,perc$$