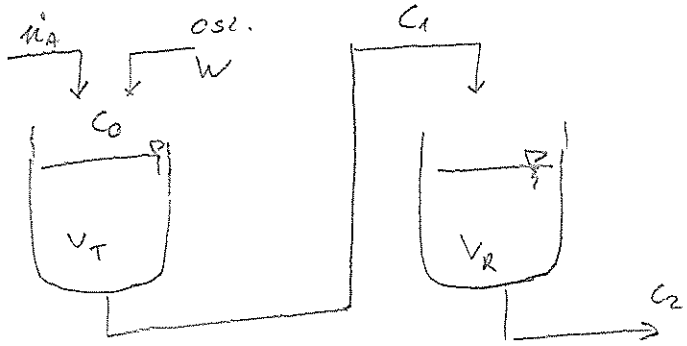
FIR számgyak 24

2014.10.06



$V_T = 30$ lit

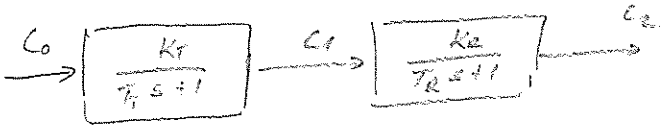
$\bar{n}_A = 0,4$ kmol/h

$W = 35$ lit/h

$\dot{n}_{A,ui} = 0,5$ kmol/h

$V_R = 25$ lit

$\bar{c}_2 = 4,5$ kmol/m³



1.1. $\frac{c_2(s)}{c_0(s)}$ átmeneti fv-e? Bell ábrázolni

$$c_2(t) = \bar{c}_2 + a \cdot K_T K_R \left[1 - \frac{1}{T_T - T_R} \left(T_T e^{-\frac{t}{T_T}} - T_R e^{-\frac{t}{T_R}} \right) \right]$$

ahol

$$\bar{c}_0 = \frac{\bar{n}_A}{W} = \frac{0,4 \text{ kmol/h}}{35 \text{ lit/h}} = 11,43 \frac{\text{kmol}}{\text{m}^3}$$

$$\bar{c}_{0,ui} = \frac{\dot{n}_{A,ui}}{W} = \frac{0,5 \text{ kmol/h}}{35 \text{ lit/h}} = 14,28 \frac{\text{kmol}}{\text{m}^3}$$

$$a = \bar{c}_{0,ui} - \bar{c}_0 = 2,86 \frac{\text{kmol}}{\text{m}^3}$$

$K_T = 1$

$$K_R = \frac{W}{W + V_R \cdot \left(\frac{dr}{dc_2} \right)_0}$$

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

$$\bar{r} = \frac{W}{V_R} \left[\bar{c}_1 - \bar{c}_2 \right] = \frac{0,035 \text{ m}^3/\text{h}}{0,035 \text{ m}^3} \left(11,43 \frac{\text{kmol}}{\text{m}^3} - 4,5 \frac{\text{kmol}}{\text{m}^3} \right)$$

$$\bar{r} = 6,93 \frac{\text{kmol}}{\text{m}^3 \text{h}}$$

$$\bar{r} = k \cdot \bar{c}_2 \Rightarrow k = \frac{\bar{r}}{\bar{c}_2} = \frac{6,93 \frac{\text{kmol}}{\text{m}^3 \text{h}}}{4,5 \frac{\text{kmol}}{\text{m}^3}} = 1,54 \frac{1}{\text{h}}$$

így

$$K_R = \frac{0,035 \text{ m}^3/\text{h}}{0,035 \text{ m}^3/\text{h} + 0,035 \text{ m}^3 \cdot 1,54 \frac{1}{\text{h}}} = 0,394$$

$$T_T = \frac{V_T}{W} = \frac{30\,\text{dl}}{35\,\text{dl/h}} = 0{,}852\,\text{h}$$

$$T_R = \frac{V_R}{W + V_R \cdot k} = \frac{0{,}035\,\text{m}^3}{0{,}035\,\text{m}^3/\text{h} + 0{,}035\,\text{m}^3 \cdot 1{,}5\,\frac{1}{\text{h}}} = 0{,}394\,\text{h}$$

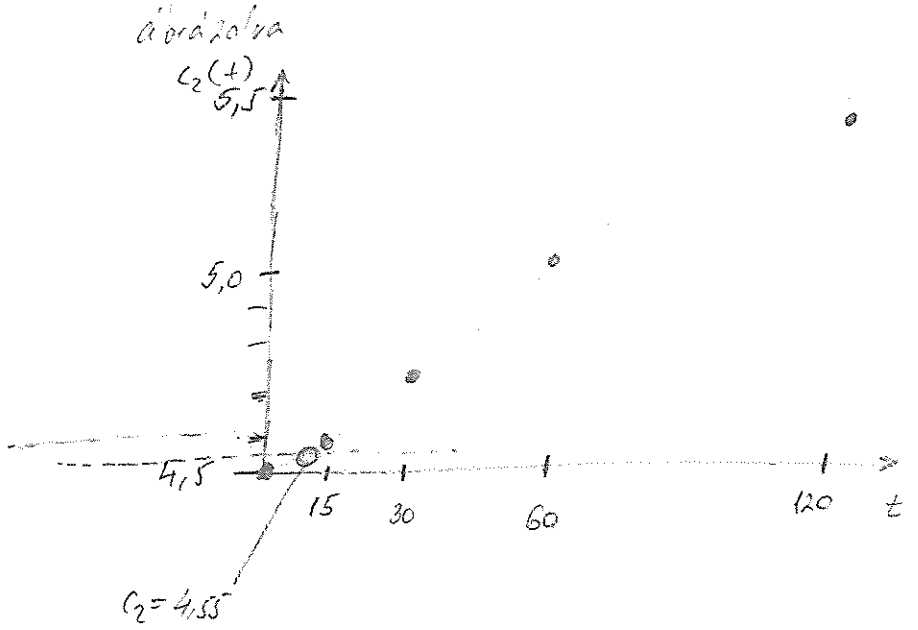
$$c_2(t) = \bar{c}_2 + a \cdot k_1 \cdot k_2 \left[1 - \frac{1}{T_1 - T_2}\left(T_1 e^{-\frac{t}{T_1}} - T_2 e^{-\frac{t}{T_2}}\right)\right]$$

$$= 4{,}5\,\text{kmol/m}^3 + 2{,}86\,\text{kmol/m}^3 \cdot 1 \cdot 0{,}394 \left[1 - \frac{1}{0{,}852\,\text{h} - 0{,}394\,\text{h}}\left(0{,}852 \cdot e^{-\frac{t}{0{,}852}} - 0{,}394\, e^{-\frac{t}{0{,}394}}\right)\right.$$

$c_2(t)$ függvény értéke néhány pillanatban

t perc	0	15	30	60	120	∞
$c_2(t)$	4,5	4,58	4,73	5,05	5,43	$a \cdot k_1 \cdot k_2 + \bar{c}_2 = 5{,}62$

ábrázolva

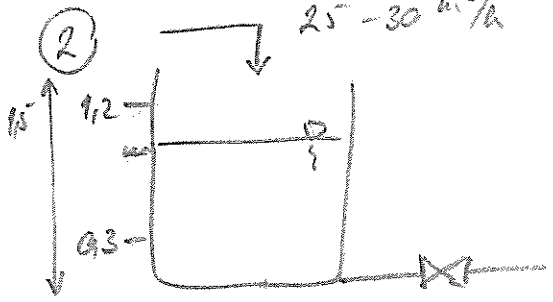


1.2 A táblázatból kiolvasható $c_2(30\,\text{perc}) = 4{,}73\,\text{kmol/m}^3$

1.3. Az ábráról leolvasható kb. 10 perc

FIR számgyak ZH

2014. 10. 06.



$\bar{w} = 28\ m^3/h \quad \Leftrightarrow \quad \bar{T_A} = 30\%$

$\Downarrow$

$\bar{H} = 0{,}3m + (1{,}2m - 0{,}3m) =$

$= 0{,}57m$

2.1. $k_{v\,max,1} = ?$

$$w_{max} = k_{v\,max,1} \cdot \sqrt{\frac{\Delta p_{sz,1}}{1\,bar}} \cdot \frac{1}{\zeta_{rel}} \qquad \zeta_{rel} = 1$$

$\Delta p_{sz,1} = 1000\,kg/m^3 \cdot 10\,m/s^2 \cdot 0{,}57m$

$= 5700\,Pa = 0{,}057\,bar$

$$\frac{\bar{w}}{w_{max}} = e^{3{,}95 - 3} \Rightarrow w_{max} = \frac{28\,m^3/h}{0{,}228} = 125\,m^3/h$$

$$\Rightarrow k_{v\,max,1} = \frac{w_{max}}{\sqrt{\Delta p_{sz}/1\,bar}} = \frac{125\,m^3/h}{\sqrt{0{,}057}} = 526\,\frac{m^3}{h}$$

2.2. Cél: 100%-os szelepállás mellett, 30 m³/h víz áram ki tudjon folyni, ha még akkor is, ha tele van a tartály

$$w_{max,2} = k_{v\,max,2} \sqrt{\frac{\Delta p_{sz,2}}{1\,bar}}$$

$\Delta p_{sz,2} = 1000\,kg/m^3 \cdot 10\,m/s^2 \cdot 1{,}2\,m = 12000\,Pa = 0{,}12\,bar$

$w_{max,2} = 30\,m^3/h$

$$k_{v\,max,2} = \frac{30\,m^3/h}{\sqrt{0{,}12}} = 87\,m^3/h$$

2.3. A nagyobb átereszthőképességű szelep kell $\left(526\,\frac{m^3}{h}\right)$