FIR gyaS 2014. 05. 15.

②

$D = 1{,}8\,m$

$L = 5{,}2\,m$

$r = 2400\ kJ/kg$

$\bar{W} = 6\ m^3/h$

$\bar{T}_{BE} = 10\,^\circ C$

$\bar{T}_{Ki} = 50\,^\circ C$

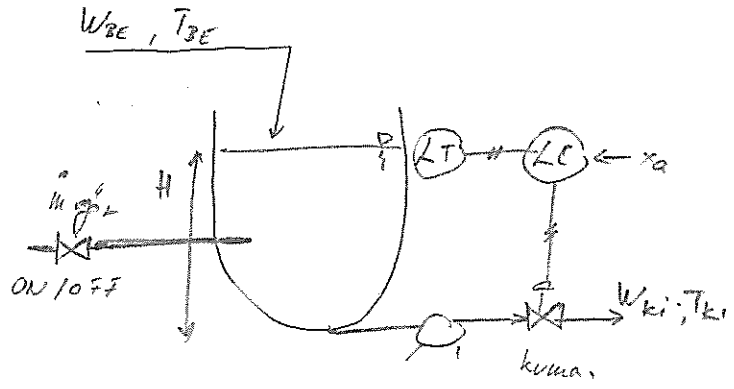
$\bar{H} = 1{,}85\,m$

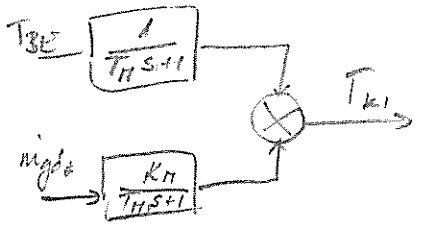
$k_{vmax} = 10\ m^3/h$

$\Delta IA = 2{,}5\,m \in [0{,}5\,m\ ;\ 3\,m]$

$\Delta p_{sz} = \Delta p_{sz} = 1{,}2\ bar$

a)



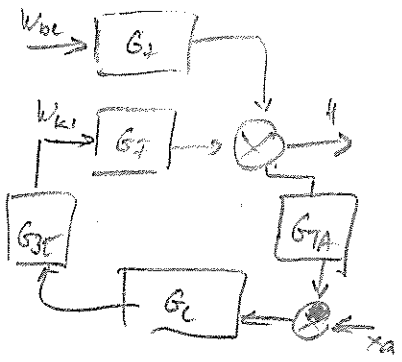


$$K_H = \frac{r}{\bar{W}\varrho c_p} = \frac{2400\ kJ/kg}{6\ m^3/h \cdot 1000\ kg/m^3 \cdot 4{,}18\ kJ/kgK} = 0{,}096\ \frac{^\circ C}{kg/h}$$

$$T_H = \frac{\bar{V}}{\bar{W}} = \frac{D^2\pi}{4} \cdot \frac{\bar{H}}{\bar{W}} = \frac{(1{,}8\,m)^2 \frac{\pi}{4} \cdot 1{,}85\,m}{6\ m^3/h} =$$

$$= 0{,}784\ h = 47\ perc$$

Szintszabályozó tag:



$$G_2 = G_T = \frac{K}{6} = \frac{1}{\frac{D^2\pi}{4} s} = \frac{1}{\frac{(1{,}8\,m)^2\pi}{4} s} = \frac{0{,}393}{s}\ \left[\frac{m}{m^3/h}\right]$$

$$G_{TA} = \frac{100\,\% - 0\,\%}{3\,m - 0{,}5\,m} = 40\ \frac{\%}{m}$$

$G_L = 1$ pc

$$G_{BE} = \frac{W_{max} - 0\ m^3/h}{100\,\% - 0\,\%}$$

$$W_{max} = k_{vmax} \sqrt{\frac{\Delta p_s / 1\,bar}{\varrho_r}}$$

$\Delta p_{sz} = \Delta p_{sz} = 1{,}2$ bar

$\varrho_r = 1$

$W_{max} = 10\ m^3/h \cdot \sqrt{1{,}2} = 10{,}95\ m^3/h$

(3 pont)

$$G_{BE} = 0{,}1095\ \frac{m^3/h}{\%}$$

b) $h = \frac{\bar{H}}{H_{max}} = \frac{\bar{W}}{W_{max}}$; $W_{max} = 10{,}95\ m^3/h$

$$h = \frac{6\ m^3/h}{10{,}95\ m^3/h} = 54{,}8\,\%$$

(1 pont)

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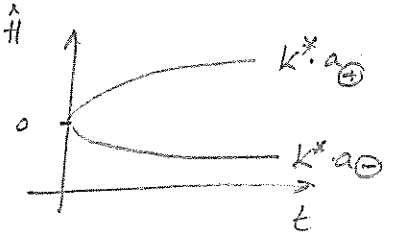
c)

$a = \pm 1 \frac{m^3}{h}$

$$G^* = \frac{G_z}{1 + G_f \cdot G_{TA} \cdot G_c \cdot G_{BE}} = \frac{K_c^*}{T_c^* s + 1}$$



$$\hat{h}(\infty) := 2cm = \lim_{s \to 0} \left[s \cdot G^* \cdot \frac{a}{s} \right]$$

Behelyettesítve:

$$0{,}02\,m = \lim_{s \to 0} \left[s \frac{\frac{0{,}393\left[\frac{m}{m^3/h}\right]}{s}}{1 + \frac{0{,}393\left[\frac{m}{m^3/h}\right]}{s} \cdot 40 \frac{\%}{m} \cdot A_{pc} \cdot 0{,}1095 \frac{kg/h}{\%}} \frac{1\,m^3/h}{s} \right]$$

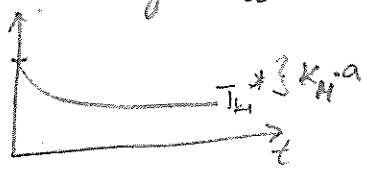
$$0{,}02 = \lim_{s \to 0} \left[\frac{0{,}393 \cdot 1}{s + 1{,}721 \cdot A_{pc}} \right]$$

$$0{,}02 = \frac{0{,}393}{1{,}721 A_{pc}} \Rightarrow A_{pc} = 11{,}4 \frac{\%}{\%}$$

(15 pont)

d) A vízáram megváltozása miatt $\bar{m}_{gőz}$ más hőm-re melegíti $\bar{T}_{BE}$-et

$$W^* = \bar{W} + 1\,m^3/h = 6\,m^3/h + 1\,m^3/h = 7\,m^3/h \Rightarrow$$



A végérték (T_{K1}^*) $\bar{m}_{gőz}$ ismeretében meghatározható.

$\bar{m}_{gőz}$ meghatározása:

$$\bar{W} \cdot \varrho \, c_p \left(\bar{T}_{K1} - \bar{T}_{BE} \right) = \bar{m}_{gőz} \cdot r \Rightarrow \bar{m}_{gőz} = \frac{\bar{W} \varrho c_p (\bar{T}_{K1} - \bar{T}_{BE})}{r}$$

$$\bar{m}_{gőz} = \frac{6\,m^3/h \cdot 1000\,kg/m^3 \cdot 4{,}18\,kJ/kg\,°C (50°C - 10°C)}{2400\,kJ/kg} = 418\,kg/h$$

Új végérték meghatározása:

$$W^* \varrho \, c_p \left(T_{K1}^* - \bar{T}_{BE} \right) = \bar{m}_{gőz} \cdot r$$

$$T_2^* = \frac{\bar{m}_{gőz} \cdot r}{W^* \cdot \varrho \cdot c_p} + \bar{T}_1 = \frac{418\,kg/h \cdot 2400\,kJ/kg}{7\,m^3/h \cdot 1000\,kg/m^3 \cdot 4{,}18\,kJ/kg\,°C} + 10°C = 44{,}28$$

$$\hat{T}_{K1}^* = T_{K1}^* - \bar{T}_{K1} = 44{,}28°C - 50°C = -5{,}7°C$$

Így: $T_2(t) = \bar{T}_2 + K_M a \left(1 - e^{-\frac{t}{T_M}} \right) = 50°C - 5{,}7°C \left(1 - e^{-\frac{t}{0{,}784h}} \right)$

(15 pont)