FIR gyak 2014.05.15.

(B)

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

$L = 3{,}5\,m$

$\rho = 2400\ kg/m^3$

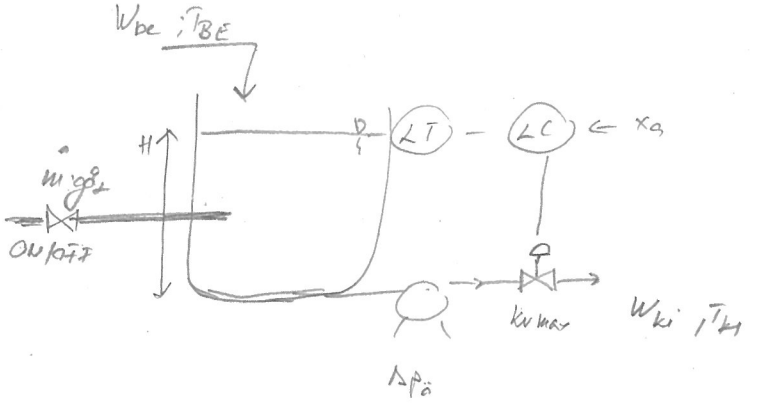
$\bar{W} = 4{,}5\ m^3/h$

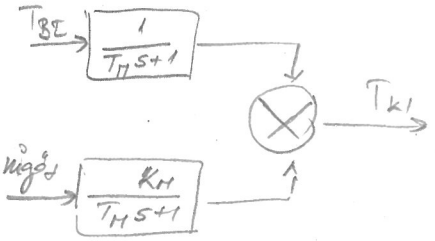
$\bar{H} = 1{,}5\,m$

$k_{v\,max} = 12\ m^3/h$

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

$\Delta p_{ö} = \Delta p_{sz} = 0{,}8\ bar$





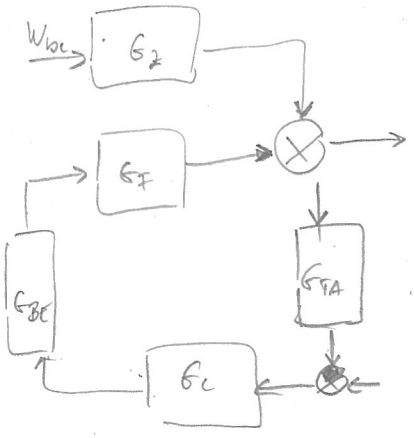
$$K_H = \frac{\tau}{W \varrho c_p} = \frac{2400\ kJ/kg}{4{,}5\ m^3/h \cdot 1000\ kg/m^3 \cdot 4{,}18\ kJ/kg}$$

$$K_H = 0{,}128\ \frac{°C}{kg/h}$$

$$T_H = \frac{\bar{V}}{\bar{W}} = \frac{\frac{D^2\pi}{4} \cdot \bar{H}}{\bar{W}} = \frac{\frac{(1{,}8m)^2\pi}{4} \cdot 1{,}5m}{4{,}5\ m^3/h}$$

$$= 0{,}848\ h = 50{,}9\ perc$$

Szintszabályzó kör:



$$G_Z = G_A = \frac{K_L}{s} = \frac{1}{\frac{D^2\pi}{4} s} = \frac{1}{\frac{1{,}8^2\pi}{4} s} = \frac{0{,}393}{s} \left[\frac{m}{m^3/h}\right]$$

$$G_{TA} = \frac{100\% - 0\%}{3{,}2m - 0{,}2m} = 33{,}3\ \frac{\%}{m}$$

$G_L = A_{PL}$

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

$$W_{max} = k_{v\,max} \sqrt{\frac{\Delta p_{sz}/1\,bar}{\varrho_r}}$$

$\Delta p_{sz} = 0{,}8\ bar$

$\varrho_r = 1$

$$G_{BE} = \frac{12\ m^3/h \cdot \sqrt{98}}{100\%} = 0{,}107\ \frac{m^3/h}{\%}$$

(30 pont)

b) $$\frac{W}{W_{max}} = \frac{H}{H_{max}} = h$$

$$h = \frac{\bar{W}}{W_{max}} = \frac{4{,}5\ m^3/h}{12\ m^3/h \cdot \sqrt{0{,}8}} = 42\%$$

(10 pont)

FIR gyak 2014. 05. 15. (B)

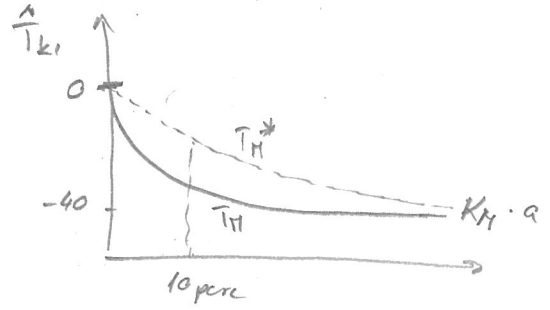
c)

Zavarás: a, ugrás =>

$T_{ki}T_H^* = \frac{V^*}{\bar{W}} = \frac{\frac{D^2\pi}{4}\cdot H^*}{\bar{W}} = ?$

$\hat{T}_{ki}(t) = K\cdot a\left(1 - e^{-\frac{t}{T^*}}\right)$

$K = -40\,^\circ C$



$\hat{T}_{ki}(10\text{perc}) := -5\,^\circ C = -40\,^\circ C\left(1 - e^{-\frac{10\text{perc}}{T^*}}\right)$ 18

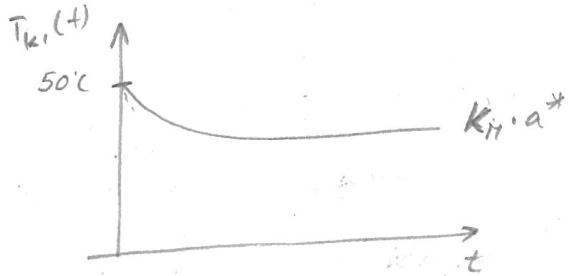
$e^{-\frac{10\text{perc}}{T^*}} = 0{,}875 \Rightarrow \boxed{T^* = 74{,}9\text{ perc} = 1{,}25\text{ h}}$

$H^* = \frac{T^*\cdot\bar{W}}{\frac{D^2}{4}T} = \frac{1{,}25\text{h}\cdot 4{,}5\,m^3/h}{(1{,}8m)^2\frac{\pi}{4}} = 2{,}2\text{ m}$

(15 pont)

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

$W^* = \bar{W} + 0{,}5\,m^3/h = 5\,m^3/h$



$T_{ki}(t) = \bar{T}_{ki} + K_H\cdot a^*\left(1 - e^{-\frac{t}{T_H}}\right)$

Az új steady-state hőmérséklet számolható a hőmérlegből, amihez ismerni kell $\bar{m}_{gőz}$-t

c) feladatból (vagy az eredeti rendszer hőmérlegéből)

$\hat{T}_{ki}(\infty) = K\cdot a$

$-40\,^\circ C = 0{,}128\,\frac{^\circ C}{kg/h}\cdot a \Rightarrow a = -312{,}5\,kg/h \Rightarrow \bar{m}_{gőz} = 312{,}5\,kg/h$

Ennyi gőz W^* mennyiségű az alábbi hőm-re fűti:

$\bar{m}_{gőz}\cdot r = W^*\varrho\, c_p\left(T_{ki}^* - \bar{T}_{3E}\right) \Rightarrow T_{ki}^* = \frac{\bar{m}_{gőz}\, r}{W^*\varrho\, c_p} + \bar{T}_{3E}$

$T_{ki}^* = \frac{312{,}5\,kg/h\cdot 2400\,kJ/kg}{5\,m^3/h\cdot 1000\,kg/m^3\cdot 4{,}18\,kJ/kg\,^\circ C} + 10\,^\circ C = 45{,}9\,^\circ C \Rightarrow \hat{T}_{ki}^*(\infty) = 45{,}9 - 50\,^\circ C = -4{,}1\,^\circ C$

$\boxed{T_{ki}(t) = 50\,^\circ C - 4{,}1\,^\circ C\left(1 - e^{-\frac{t}{0{,}848\text{h}}}\right)}$

(15 pont)