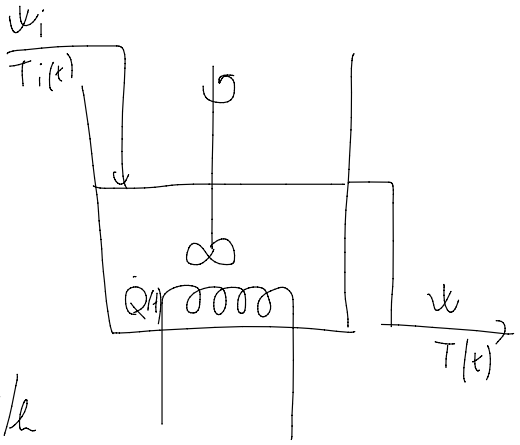
Example 5.1 p. 78

mercoledì 18 marzo 2020 15:23



ASSUNZIONE

$\bar{w}_i = 1000 \ kg/h$

$V = cost = 2 \ cum$

$\Rightarrow \bar{w}_i = \bar{w} = 1000 \ kg/h$

$\rho = cost = 900 \ kg/cum$

$c_p = cost = 1 \ \frac{cal}{g°C} = 1 \ \frac{kcal}{kg \ K}$

$M c_p \approx 0$

$\bar{T}_i = 100 °C \quad \bar{T} = 130 °C$

$\bar{T}_i = T_i(0) \quad \bar{T} = T(0)$

$$T'(s) = \frac{\frac{1}{w c_p}}{\frac{\rho V}{w} s + 1} \dot{Q}'(s) + \frac{1}{\frac{\rho V}{w} s + 1} T_i'(s)$$

$G_1(s) \rightarrow$ HEAT $\qquad G_2(s) \rightarrow$ INLET T

① $\bar{\dot{Q}}$? K ? τ ?

$$\bar{\dot{Q}} = w c_p (\bar{T} - \bar{T}_i) = 1000 \cdot 1 (30) = 30000 \ \frac{kcal}{h}$$

$$G_1(s) = \frac{\frac{1}{w c_p}}{\frac{\rho V}{w} s + 1} \Rightarrow K = \frac{1}{w c_p} = \frac{1}{1000} = 0{,}001 \ \frac{1}{\frac{kg}{h} \cdot \frac{kcal}{kg \ K}}$$

$$= 0{,}001 \ \frac{K}{\frac{kcal}{h}}$$

$\times \uparrow 1°C$ be T $\Leftarrow = 1000 \ \frac{kcal}{hr}$

τ di $900 \cdot 2 \quad 1 \ 0 \quad kg \quad cm \quad n$

$$\tau = \frac{\rho V}{w} = \frac{900 \cdot 2}{1000} = 1{,}8 \; \frac{\frac{kg}{cm} \cdot cm}{\frac{kg}{l}} = h$$

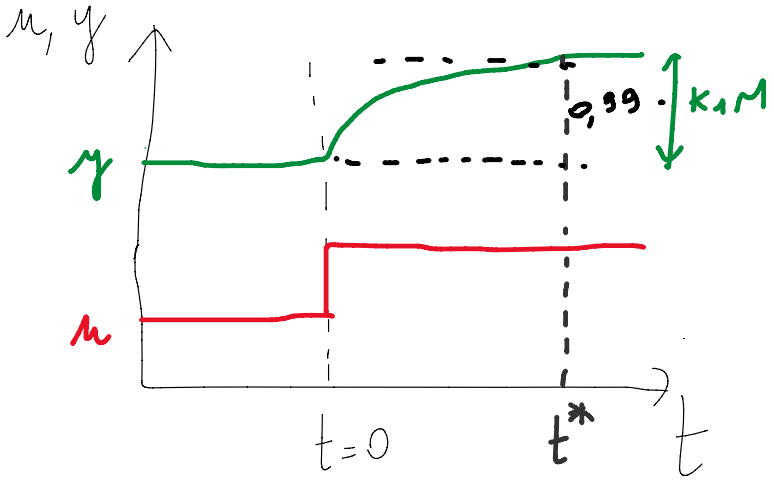
$$\tau = 1{,}8\ h$$

$$G_1(s) = \frac{K_1}{\tau s + 1} = \boxed{\frac{9{,}001}{1{,}8 s + 1}}$$

$$5 \cdot s = (4-5)\tau \approx 8\ h$$

$$\Delta Q = 0{,}3 \qquad Q_2 = 1{,}3\, Q_1$$

$$u \hat{=} Q_2 - Q_1$$



$$U(s) = \frac{M}{s} = \frac{30000 \cdot 0{,}3}{s} = \frac{9000}{s}$$

$$G_1(s) = \frac{K_1}{\tau s + 1} = \frac{T'(s)}{\dot{Q}'(s)}$$

$$T'(s) = G_1(s) \cdot \dot{Q}(s)$$

$$\hat{=} \frac{K_1}{\tau s + 1} \cdot \frac{M}{s}$$

$$T'(t) = K_1 M \left(1 - e^{-\frac{t}{\tau}}\right)$$

$$T'(t) = T(t) - \overline{T}$$

$$\lim T'(t) = K_1 M \qquad \rightarrow t^* \Rightarrow T(t) = 0{,}99 K_1 M$$

$t \to \infty$

$$0{,}99 K_1 M = K_1 M \left(1 - e^{-\frac{t^*}{\tau}}\right)$$

$$0{,}99 K_1 M = K_1 M - K_1 M e^{-\frac{t^*}{\tau}}$$

$$K_1 M (0{,}99 - 1) = -K_1 M e^{-\frac{t^*}{\tau}}$$

$$0{,}001 = e^{-\frac{t^*}{\tau}}$$

$$\ln(0{,}001) = -\frac{t^*}{\tau} \Rightarrow$$

$$t^* = -\tau \ln(0{,}001) = 6{,}3\ h$$

$\uparrow 1{,}8$