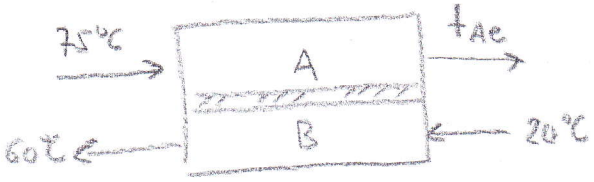
9-4

III. vjel



(mléko)

$\dot{m}_A = 2\ kg/s$ $\varrho = 1020\ kg/m^3$

$\dot{m}_B = 2\ kg/s$ $\nu = 8{,}4 \cdot 10^{-7}\ m^2/s$

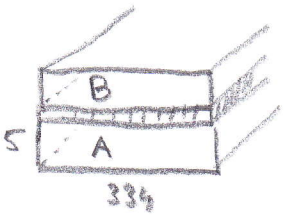
$c_p = 3850\ J/kg \cdot K$

$\eta = \nu \cdot \varrho$ $\lambda = 0{,}546\ W/m \cdot K$

Výpočet $\alpha_A = \alpha_B$

$$v = \dot{V}/S_{AB} = \frac{\dot{m}}{\varrho \cdot S_{AB}} = \frac{2\ kg/s}{1020\ kg/m^3 \cdot (334 \cdot 5 \cdot 10^{-6})\ m^2} = 1{,}1741\ m/s$$

$$Pr = \frac{c_p \eta}{\lambda} = \frac{c_p \nu \varrho}{\lambda} = \frac{3850 \cdot 8{,}4 \cdot 10^{-7} \cdot 1020}{0{,}546} = 6{,}1043$$



$$l = \frac{4 S_{AB}}{\sigma_c} = \frac{4 \cdot (334 \cdot 5 \cdot 10^{-6})}{2 \cdot (334+5) \cdot 10^{-3}} = 9{,}853 \cdot 10^{-3}\ m$$

$$Re = \frac{v \cdot l \cdot \varrho}{\eta} = \frac{v \cdot l}{\nu} = \frac{1{,}1741 \cdot 9{,}853\ 10^{-3}}{8{,}4 \cdot 10^{-7}} = 13772$$

$$Nu = 0{,}023 \cdot Re^{0{,}8} \cdot Pr^{0{,}4} = 0{,}023 \cdot (13772)^{0{,}8} \cdot (6{,}1043)^{0{,}4} = 97{,}09$$

$$Nu = \frac{\alpha \cdot l}{\lambda} \Rightarrow \alpha = \frac{Nu \cdot \lambda}{l} = \frac{97{,}09 \cdot 0{,}546}{9{,}853 \cdot 10^{-3}} = \underline{5380{,}2\ W/m^2K}$$

Výpočet K (lze zanedbat odpor vedení tepla)

$$K = \frac{1}{\frac{1}{\alpha} + 0 + \frac{1}{\alpha}} = \frac{\alpha}{2} = \frac{5380{,}2}{2} = 2690{,}1\ W/m^2K$$

Výpočet $\dot{Q}$ (ent. bilance)

$$\dot{Q} = \dot{m}_B c_{p,B} (60-20) = 2 \cdot 3850 \cdot (60-20) = \underline{311200\ W}$$

$$\dot{m}_B c_{pB} (60-20) = \dot{m}_A c_{pA} (75-t_{AK}) \Rightarrow (60-20) = (75-t_{AK}) \Rightarrow \underline{t_{AK} = 35°C}$$

Výpočet ΔT_{LS}

$$\Delta T_{LS} = \frac{(75-60)-(35-20)}{\ln \frac{75-60}{35-20}} = \frac{15-15}{\ln \frac{15}{15}} \Rightarrow \underline{15°C}$$

Plocha výměníku:

$$\dot{Q} = K \cdot A \cdot \Delta T_{LS}$$

$$\underline{A = \frac{\dot{Q}}{K \cdot \Delta T_{LS}} = \frac{311200}{2690{,}1 \cdot 15} = 7{,}7\ m^2}$$