ZADATAK 2:

$$T_{cijevi} = 167\ °C = 440{,}16\ K$$

$$T_{okoline} = 25°C = 298{,}16\ K$$

$$d_1 = d_{cijevi} = 167\ mm = 0{,}167\ m$$

$$l = 65\ m$$

$$d_2 = d_{izolacije} = 35\ mm = 0{,}035\ m$$

$$\alpha = 0{,}04\,\frac{W}{mK}$$

$$br_s = 5\ h$$

$$br_d = 150\ dana$$

$$\varepsilon = 0{,}8$$

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a) $Q_{konvekcijom}$, $Q_{zračenjem}$

$d = d_1 + 2d_2 = 0{,}167 + 2*0{,}035 = 0{,}237$ m

$S = d*\pi*l = 0{,}237 * \pi * 65 = 48{,}396\ m^2$

$$\boldsymbol{Q_{kon} = \frac{a}{b + c}}$$

$$\boldsymbol{a} = (\boldsymbol{T_{cijevi} - T_{okoline}}) * \boldsymbol{l} * \boldsymbol{br_s} * \boldsymbol{br_d} = (440{,}16 - 298{,}16) * 65 * 5 * 150 = 6922500\ [Kmh]$$

$$\boldsymbol{b} = \frac{\boldsymbol{ln\frac{d}{d_1}}}{\boldsymbol{2\pi\alpha}} = \frac{\ln\frac{0{,}237}{0{,}167}}{2\pi * 0{,}04} = 1{,}393\ \left[\frac{mK}{W}\right]$$

$$\boldsymbol{c} = \frac{\boldsymbol{1}}{\boldsymbol{5\pi * d}\left(\frac{\boldsymbol{T_{cijevi} - T_{okoline}}}{\boldsymbol{T_{okoline} * d}}\right)^{\boldsymbol{0{,}25}}} = \frac{1}{5\pi * 0{,}237 * \left(\frac{440{,}16 - 298{,}16}{298{,}16 * 0{,}237}\right)^{0{,}25}} = 0{,}226\ \left[\frac{mK}{W}\right]$$

$$\boldsymbol{Q_{kon}} = \frac{a}{b + c} = \frac{6922500}{1{,}393 + 0{,}226} = 4275787{,}523\ [Wh] * 0{,}0036 = \boldsymbol{15392{,}835}\ [\boldsymbol{MJ}]$$

$$\begin{aligned}\boldsymbol{Q_{zrač}} &= \boldsymbol{5{,}67 * 10^{-8} * \varepsilon * \left(T_{cijevi}^{\ 4} - T_{okoline}^{\ 4}\right) * S * br_s * br_d * 0{,}0036} \\ &= 5{,}67 * 10^{-8} * 0{,}8 * (440{,}16^4 - 298{,}16^4) * 48{,}396 * 5 * 150 * 0{,}0036 \\ &= \boldsymbol{175635{,}865}\ [\boldsymbol{MJ}]\end{aligned}$$

$$\boldsymbol{Q_{uk} = Q_{kon} + Q_{zrač}} = 15392{,}835 + 175635{,}865 = \boldsymbol{191028{,}7}\ [\boldsymbol{MJ}]$$

b) v= 3 [m/s]

$$\boldsymbol{Q_{zrač} = 5,67 * 10^{-8} * \varepsilon * \left(T_{cijevi}{}^{4} - T_{okoline}{}^{4}\right) * S * br_s * br_d * 0,0036}$$
$$= 5,67 * 10^{-8} * 0,8 * (440,16^4 - 298,16^4) * 48,396 * 5 * 150 * 0,0036$$
$$= \boldsymbol{175635,865\ [MJ]}$$

$$\boldsymbol{Q_{kon} = \frac{a}{b + c}}$$

$$\boldsymbol{a = (T_{cijevi} - T_{okoline}) * l * br_s * br_d} = (440,16 - 298,16) * 65 * 5 * 150 = 6922500\ [Kmh]$$

$$\boldsymbol{b = \frac{ln\frac{d}{d_1}}{2\pi\alpha}} = \frac{\ln\frac{0,237}{0,167}}{2\pi * 0,04} = 1,393\ \left[\frac{mK}{W}\right]$$

$$\boldsymbol{c = \frac{1}{\pi * d * \frac{\left(4,65 + 0,35 * \frac{T_{okoline}}{100}\right) * \left(\frac{v * 273,16}{T_{okoline}}\right)^{0,61}}{d^{0,39}}}}$$
$$= \frac{1}{\pi * 0,237 * \frac{\left(4,65 + 0,35 * \frac{298,16}{100}\right) * \left(\frac{3 * 273,16}{298,16}\right)^{0,61}}{0,237^{0,39}}} = 0,073\ \left[\frac{mK}{W}\right]$$

$$\boldsymbol{Q_{kon}} = \frac{a}{b + c} = \frac{6922500}{1,393 + 0,073} = 4722032,742 * 0,0036 = \boldsymbol{16999,318\ [MJ]}$$

$$\boldsymbol{Q_{uk} = Q_{kon} + Q_{zrač}} = 16999,318 + 175635,865 = \boldsymbol{192635,183\ [MJ]}$$