

#4-3

$$k = 1 \text{ W/m}\cdot\text{C}$$

$$T_1 = 1000 \text{ C}^\circ$$

$$T_2 = 400 \text{ C}^\circ$$

$$q'' = 2000 \text{ W/m}^2$$

$$q'' = k \frac{\Delta T}{L} \rightarrow 1000 - 400 = 600 \text{ C}^\circ$$

$$L = k \Delta T / q''$$

$$\rightarrow L = \frac{(1 \text{ W/m}\cdot\text{C})(600 \text{ C}^\circ)}{2000 \text{ W/m}^2} = 0.3 \text{ m}$$

#4-10

$$D_o = 0.02 \text{ m} \quad r_o = 0.01 \text{ m}$$

$$\delta = 0.002 \text{ m} \quad r_i = 0.01 - 0.002 = 0.008 \text{ m}$$

$$k = 115 \text{ W/m}\cdot\text{C}^\circ \quad h_o = 2000 \text{ W/m}\cdot\text{C}^\circ$$

$$h_i = 5000 \text{ W/m}\cdot\text{C}^\circ$$

$$T_{\text{steam}} = 50 \text{ C}^\circ \quad T_{\text{water}} = 20 \text{ C}^\circ$$

$$R' = R'_{\text{conv},o} + R'_{\text{cond,tube}} + R'_{\text{conv,i}}$$

$$R'_{\text{conv},o} = \frac{1}{h_o(2\pi r_o)} = \frac{1}{(2000)(2\pi)(0.01)} = 0.00796 \text{ W/m}\cdot\text{C}^\circ$$

$$R'_{\text{cond,tube}} = \frac{\ln(r_o/r_i)}{2\pi k} = \frac{\ln(0.01/0.008)}{2\pi(115)} = 0.00031 \text{ W/m}\cdot\text{C}^\circ$$

$$R'_{\text{conv,i}} = \frac{1}{h_i(2\pi r_i)} = \frac{1}{(5000)(2\pi)(0.008)} = 0.00398 \text{ W/m}\cdot\text{C}^\circ$$

$$R'_{\text{total}} = 0.00796 + 0.00031 + 0.00398 = 0.01225 \text{ W/m}\cdot\text{C}^\circ$$

(a) $Q/L = \frac{\Delta T}{R'_{\text{total}}} = \frac{50 - 20}{0.01225} = 2449 \text{ W/m}$

(b) $Q/L = \frac{50 - 20}{0.00031} = 96,774 \text{ W/m}$

alot higher - removing convection adds higher heat rate transfer