If \( m \) doubles to \( m_{\text{new}} = 4.2 \text{ kg/s} \), \( T_2 \) will not be as high as it had been before.

\[
Q = m C_p \Delta T = m C_p (T_2 - T_1)
\]

- due to increase in \( U \)
- due to decrease in \( \Delta T \) in
\[ U = \frac{1}{R_1} \left( \frac{1}{\ln R_2} + \frac{1}{k} \ln \frac{R_2}{R_1} \right) + \frac{1}{h_1 R_1} \]

Turbulent flow

\[ \frac{Dh}{k} = \alpha (Re Pr D)^{\frac{1}{3}} \]

\[ m, \text{ increasing} \]

\[ \text{InCREASE Re} \]

\[ \Rightarrow h_1 \text{ goes up a bit} \]

\[ \Rightarrow U \text{ goes up a bit} \]
Q = U A ΔT_{em} F_t

SOLVE FOR A

\[ \Delta T_{em} = \frac{(T_{hi} - T_{co}) - (T_{ho} - T_{ci})}{\ln\left(\frac{T_{hi} - T_{co}}{T_{ho} - T_{ci}}\right)} \]

\[ = \frac{(201 - 105) - (153 - 25)}{\ln\left(\frac{96}{128}\right)} \]

\[ = \frac{-32}{\ln(0.75)} = 111.23 \degree C = \Delta T_{em} \]
\[ Y = \frac{T_{co} - T_{ci}}{T_{hi} - T_{ci}} = \frac{105 - 25}{201 - 25} = \frac{80}{176} = 0.45 \]

\[ Z = \frac{T_{hi} - T_{co}}{T_{co} - T_{ci}} = \frac{201 - 153}{105 - 25} = \frac{48}{80} = 0.6 \]

From Fig 4.9-4 p270 (Greekoplis' 3rd Ed)

For 1-2 heat xch

\[ F_T = 0.95 \]

\[ A = \frac{Q}{U \Delta T_{in} F_T} = \frac{34,000 \text{ W}}{(0.70 \text{ W/m}^2 \text{K})(111.23 \text{ \&})(0.95)} \]

\[ A = 1.2018 \text{ m}^2 \]

\[ A = 1.3 \text{ m}^2 \]