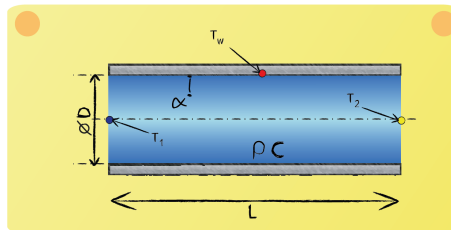


Energy Balance - Convection - Body 1

Water is flowing through a pipe. The inner temperature of the pipe is kept at a constant temperature T_w . Find an energy balance that can determine the temperature T_2 of the fluid leaving the pipe in function of the given variables.

Hint: $T_1 < T_2 < T_w$



Energy balance:

$$\dot{H}_1 - \dot{H}_2 - \dot{Q}_{\text{loss}}$$

Energy fluxes:

$$\dot{H}_1 = u \cdot \frac{\pi \cdot D^2}{4} \cdot \rho \cdot c \cdot T_1$$

$$\dot{H}_2 = u \cdot \frac{\pi \cdot D^2}{4} \cdot \rho \cdot c \cdot T_2$$

$$\dot{Q}_{\text{loss}} = \alpha \cdot \pi \cdot D \cdot L \cdot \Delta T$$

Logarithmic mean temperature difference:

$$\Delta T = \frac{\dot{m} \cdot c}{\alpha \cdot \pi \cdot D \cdot L} (T_1 - T_2) = \frac{T_1 - T_2}{\ln\left(\frac{T_1 - T_w}{T_2 - T_w}\right)}$$

Mass flow rate:

$$\dot{m} = u \cdot \frac{\pi \cdot D^2}{4} \cdot \rho$$