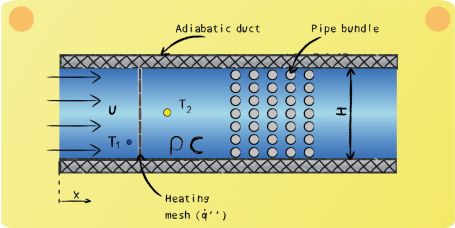
Energy Balance - Convection - Body 3

Water flows through a rectangular duct (height H, width W) with a velocity u and inlet temperature T_1. The water is heated with a wire mesh (heating power per surface $\dot{q}''$), located at the beginning of the duct. Behind the mesh a heat exchanger in a pipe bundle configuration is mounted perpendicularly to the flow. Provide the energy balance to determine the water temperature T_2 directly after the wire mesh.



Energy balance:

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

Energy fluxes:

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

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

$$\dot{Q}_{\text{mesh}} = H \cdot W \cdot \dot{q}''$$

Mass flow rate:

$$\dot{m} = u \cdot H \cdot W \cdot \rho$$