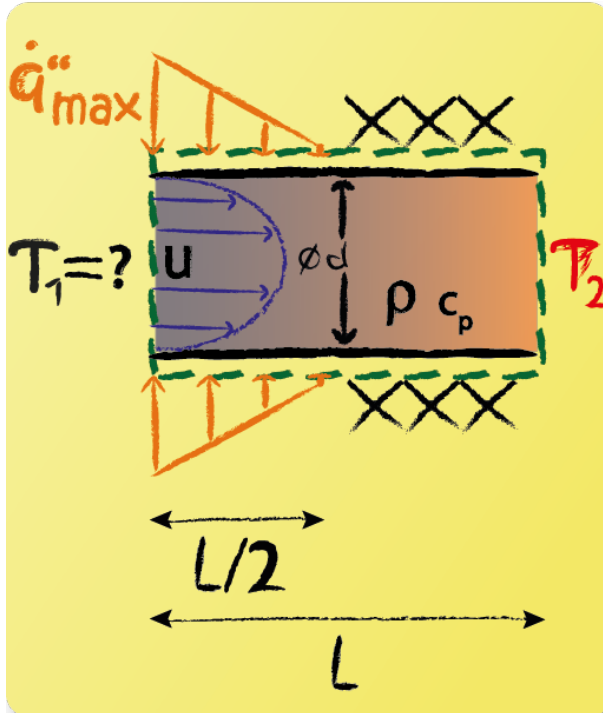# Energy Balance: Task 15



Derive an equation to determine $T_1$

An energy balance of the entire pipe section is suitable to determine $T_1$. The steady energy balance consists of energy fluxes due to heating with $\dot{q}''(x)$, incoming water with temperature $T_1$ and outgoing flux of water with increased temperature $T_2$. To obtain an expression for the heat flux induced at the pipe's wall the specific heat flux needs to be integrated over the surface area which yields:

$$\dot{Q} = \tfrac{1}{4}\dot{q}''_{\max}\pi d L$$

The energy balance is than given by:

$$0 = \rho u \pi \tfrac{d^2}{4} c_{\mathrm{p}}(T_1 - T_2) + \tfrac{1}{4}\dot{q}''_{\max}\pi d L$$

and rearranged for the inlet temperature:

$$T_1 = T_2 - \frac{\dot{q}_{\max}L}{\rho u d c_{\mathrm{p}}}$$