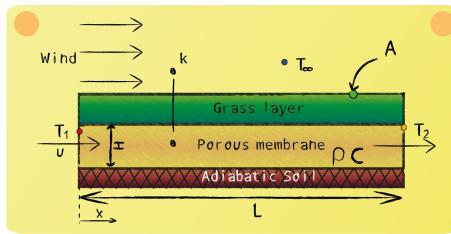


# Energy Balance - Convection - Body 2

A project consists to heat up the grass layer (width  $W$ , length  $L$ ) by pumping warm water through a porous membrane. Derive an energy balance to calculate the exit temperature  $T_2$ .

**Hint:**

The overall heat transfer coefficient  $k$  fulfils a similar function as the convection heat transfer coefficient  $\alpha$ .



Energy balance:

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

Energy fluxes:

$$\dot{H}_1 = \dot{m} \cdot c \cdot T_1$$

$$\dot{H}_2 = \dot{m} \cdot c \cdot T_2$$

$$\dot{Q}_{\text{loss}} = k \cdot W \cdot L \cdot \Delta T$$

Logarithmic mean temperature difference:

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

Mass flow rate:

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