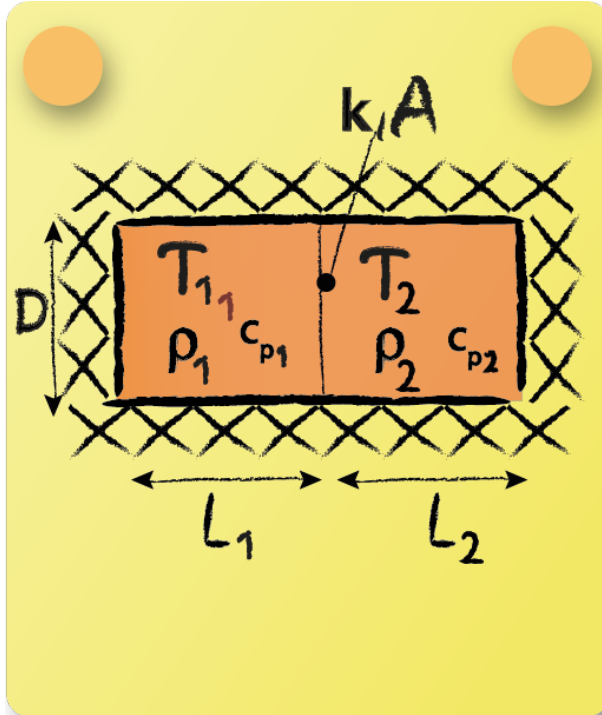# Energy Balance: Task 18

Derive an equation for the temporal development of temperature difference $2T_1 - T_2$ of two perfectly stirred tanks that are seperated by the interface with area A and heat transmission coefficient k.

To obtain an equation for the temperature difference it is suitable to set up seperate expressions for the temperatures via energy balances for each tank. Balances consist of change of internal energy that equals the heat flux through the interface:

$$\rho_1 V_1 c_{\mathrm{p}1} \frac{\partial T_1}{\partial t} = -Ak(T_1 - T_2)$$

$$\rho_2 V_2 c_{\mathrm{p}2} \frac{\partial T_2}{\partial t} = Ak(T_1 - T_2)$$

The temporal derivative of temperature difference is formed by subtracting the equations. While L_1 can be expressed as $2L_2$, area, density and specific heat capacity are equal for both tanks and therefore are written in general terms. The temporal derivative of temperature difference than reads as:

$$\frac{\partial (2T_1 - T_2)}{\partial t} = -\frac{2k}{L_2 \rho c_{\mathrm{p}}}(T_1 - T_2)$$

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