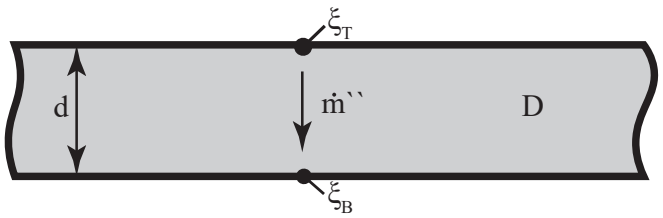
Section V

Mass transfer exercises

Exercise V.1: (Wet wood ⋆⋆)

The mass fraction of water at the top of an indefinitely wide wooden plate is ξ_T. A Mass flux $\dot{m}''$ of water is passing through the wood each second and is led away at the bottom.



Given parameters:

- Coefficient of diffusion of water in wood: $D = 1.2 \cdot 10^{-9}\ \frac{\mathrm{m}^2}{\mathrm{s}}$
- Total density of the moist wood: $\rho = 650\ \mathrm{kg/m^3}$
- Thickness of the wooden plate: $d = 0.1\ \mathrm{m}$
- Mass fraction of water at the top: $\xi_T = 0.2$
- Led away water mass flux: $\dot{m}'' = 1.4 \cdot 10^{-6}\ \mathrm{kg/m^2 s}$

Hints:

- Assume that the total density ρ of the moist wood is constant.
- Assume steady-state one-dimensional mass transport in the direction of the thickness of the wooden plate.

Tasks:

a) Sketch the mass fraction profile within the wet wood.

b) Determine the value of the mass fraction ξ_B at the bottom of the plate.

c) Derive the mass fraction distribution within the wet wood from the mass transport equation.