

Vlakke plaat - 0^{de} orde

1) Transiente massabalans

$$Adz \frac{\partial C_A}{\partial t} = D_{Ac} A \frac{\partial C_A}{\partial z} + D_{Ac} A \left(\frac{\partial C_A}{\partial z} + \frac{\partial}{\partial z} \left(\frac{\partial C_A}{\partial z} \right) dz \right) - Adz q_A$$

$$\Leftrightarrow \frac{\partial C_A}{\partial t} = D_{Ac} \frac{\partial^2 C_A}{\partial z^2} - q_A$$

$$\frac{\partial C_A}{\partial t} = 0$$

$$\Rightarrow \frac{d^2 C_A}{dz^2} - \frac{q_A}{D_{Ac}} = 0$$

2) Concentratieprofiel 0^{de} Orde

$$q_A = R_0$$

$$\frac{d^2 C_A}{dz^2} - \frac{R_0}{D_{Ac}} = 0$$

$$\Leftrightarrow \frac{d^2 C_A}{dz^2} = \frac{R_0}{D_{Ac}}$$

$$\Leftrightarrow \int \frac{d}{dz} \left(\frac{dC_A}{dz} \right) = \int \frac{R_0}{D_{Ac}} dz$$

$$\Leftrightarrow \frac{dC_A}{dz} = \frac{R_0}{D_{Ac}} z + C_1$$

$$\Leftrightarrow \int dC_A = \int \left(\frac{R_0}{D_{Ac}} z + C_1 \right) dz$$

$$\Leftrightarrow C_A = \frac{R_0}{2D_{Ac}} z^2 + C_1 \cdot z + C_2$$

Randvoorwaarden: $\frac{dC_A}{dz} = 0$ bij $z=0$ v $C_A = C_{Ag}$ bij $z=b$

$$\textcircled{1} \frac{dC_A}{dz} = 0 \text{ bij } z=0$$

$$\frac{dC_A}{dz} = \frac{R_0}{D_{Ac}} z^2 + C_1 = 0$$

$$\Leftrightarrow C_1 = -\frac{R_0 \cdot 0}{D_{Ac}} = 0$$

$$\Rightarrow C_A = \frac{R_0}{2D_{Ac}} z^2 + C_2$$

$$\textcircled{2} C_A = C_{Ag} \text{ bij } z=b$$

$$C_{Ag} = \frac{R_0}{2D_{Ac}} b^2 + C_2$$

$$\Leftrightarrow C_2 = C_{Ag} - \frac{R_0}{2D_{Ac}} b^2$$

$$\Rightarrow C_A = \frac{R_0}{2D_{Ac}} z^2 + C_{Ag} - \frac{R_0}{2D_{Ac}} b^2 = C_{Ag} + \frac{R_0}{2D_{Ac}} (z^2 - b^2)$$

3) Waargenomen reactiesnelheid

$$R_{A,obs} = V R_0 = A \cdot b \cdot R_0 \quad (\text{indien } C_A \rightarrow 0 : A \cdot R_0 (b - b_0))$$

4) Interne effectiviteitsfactor

$$R_{A,obs} = R_{As}^*$$

$$\Rightarrow \eta_{i,0} = 1$$

$$(\text{indien } C_A \rightarrow 0 : (1 - \frac{b_0}{b}) = \eta_{i,0})$$

5) Externe effectiviteitsfactor

$$\eta_{e,0} = 1 \quad \text{indien } C_{As} \text{ en } C_{Ab} > 0$$

6) Totale effectiviteitsfactor

$$\eta_T = \eta_i \eta_e = 1$$

$$(\text{indien } C_A \rightarrow 0 : (1 - \frac{b_0}{b}) = \eta_T)$$