○Notations :

On notera la concentreation: $n(M,t)$ en particule $\cdot\, m^{-3}$

Vecteur densité de courant de particule: $\vec{j_{diff}}$ en particules $\cdot\, s^{-1}\ \cdot\, m^{-2}$

$$\text{debit de particule: } \Phi_{diff} = \iint_{\text{Section}} \vec{j_{diff}}\ \cdot\ d\vec{S}$$

○Loi de Fick :

$$\vec{j_{diff}} = -D \cdot \vec{grad}(n(M,t)) \text{ avec } D \text{ en } m^2 \cdot s^{-1}$$

○Equation de diffusion (Cas 1D) :

$$\begin{aligned}\delta^2 N &= \vec{j_{diff}}(x,t) \cdot d\vec{S} \cdot dt \ - \ \vec{j_{diff}}(x+dx,t) \cdot d\vec{S} \\ &= -\frac{\partial \vec{j_{diff}}}{\partial x}(x,t)\ \cdot\ dx\ \cdot\ d\vec{S}\ \cdot\ dt \\ \partial^2 N_{prod} &= v_{prod}(x,t)\ \cdot\ S\ \cdot\ dx\ \cdot\ dt \\ \partial^2 N_{abs} &= v_{abs}(x,t)\ \cdot\ S\ \cdot\ dx\ \cdot\ dt\end{aligned}$$

d'autre part on as aussi:

$$\begin{aligned}d\delta N &= n(x,t+dt)\ \cdot\ dx\ \cdot\ d\vec{S}\ -\ n(x,t)\ \cdot\ dx\ \cdot\ d\vec{S} \\ &= \frac{\partial n}{\partial t}(x,t)\ \cdot\ dt\ \cdot\ dx\ \cdot\ d\vec{S}\end{aligned}$$

et comme:

$$\delta^2 N + \partial^2 N_{prod}\ - \partial^2 N_{abs} = d\delta N$$

$$-\frac{\partial \vec{j_{diff}}}{\partial x}(x,t) + v_{prod}(x,t) - v_{abs}(x,t) = \frac{\partial n}{\partial t}(x,t)$$

$$D\frac{\partial^2 n}{\partial x^2}(x,t) + v_{prod}(x,t) - v_{abs}(x,t) = \frac{\partial n}{\partial t}(x,t)$$

○Résistance de diffusion :

en régime permanent et sans production ni absorpiton: $\frac{\partial n}{\partial t}(x,t) = 0$

$$\frac{\partial n}{\partial x}(x,t) = A = -\frac{j_{diff}}{D}; n(x_2) - n(x_1) = A(x_2 - x_1)$$

$$S(n(x_2) - n(x_1)) = S\ \cdot\ \ -\frac{j_{diff}}{D}\ \cdot\ (x_2 - x_1) = -\frac{\Phi_{diff}}{D}\ \cdot\ l$$

$$R_{diff} = \frac{n(x_1) - n(x_2)}{\Phi_{diff}} = \frac{l}{D\ \cdot\ S}$$

○Cas de la 3D :

$$\text{Forme locale : } -div\vec{j}_{diff}(M,t)\ \cdot\ d\tau\ +\ v_{prod}\ \cdot\ d\tau\ -\ v_{abs}\ \cdot\ d\tau = \frac{\partial n}{\partial t}(M,t)\ \cdot\ d\tau$$

$$-div\vec{j}_{diff}(M,t)\ +\ v_{prod}\ \ -\ v_{abs}\ = \frac{\partial n}{\partial t}(M,t)$$

$$D\ \cdot\ \Delta n(M,t)\ +\ v_{prod}\ \ -\ v_{abs}\ = \frac{\partial n}{\partial t}(M,t)$$

$$\text{Forme intégral : } \Phi(t) + v_{prod} - v_{abs} = \frac{dN_{int}(t)}{dt}$$