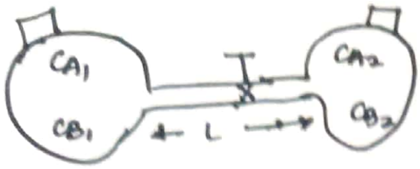
(2)



Equimolar counter diffusion as bulbs are maintained at same pressure

t, C_{A_1}, C_{A_2}

At $t=0,\ C_{A_1} = C_{A_{1_0}},\ C_{A_2} = C_{A_{20}}$

$t = t_f,\ C_{A_1} = C_{A_{f_1}},\ C_{A_2} = C_{A_{f_2}}$

$$N_A = \frac{D_{AB}}{L}\left(C_{A_1} - C_{A_2}\right) = -N_B$$

$$\frac{d}{dt}\left(V C_{A_1}\right) = -N_A a$$

$$\Rightarrow \frac{dC_{A_1}}{dt} = -\frac{a}{V_1}\frac{D_{AB}}{L}\left(C_{A_1} - C_{A_2}\right)$$

$$\frac{d}{dt}\left(V_2 C_{A_2}\right) = N_A \cdot a \quad \left[\because N_A = -N_B\right]$$

$$\frac{dC_{A_2}}{dt} = \frac{a}{V_2}\frac{D_{AB}}{l}\left(C_{A_1} - C_{A_2}\right)$$

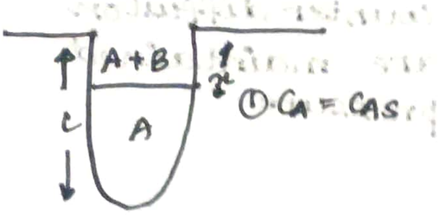
$$\frac{dC_{A_1}}{dt} - \frac{dC_{A_2}}{dt} = -a\frac{D_{AB}\left(C_{A_1} - C_{A_2}\right)}{L}\left[\frac{1}{V_2} + \frac{1}{V_1}\right]$$

$$\int \frac{d\left(C_{A_1} - C_{A_2}\right)}{\left(C_{A_1} - C_{A_2}\right)} = -\frac{a D_{AB}}{L}\left[\frac{1}{V_2} + \frac{1}{V_1}\right]\int_0^{t_f} dt$$

$$\left[\ln\left(C_{A_1} - C_{A_2}\right)\right]_{C_{A_{1_0}},\, C_{A_{20}}}^{C_{A_1},\, C_{A_2}} = -\frac{a D_{AB}}{L}\left[\frac{1}{V_2} + \frac{1}{V_1}\right] t_f$$

$$\therefore \frac{C_{A_1} - C_{A_2}}{C_{A_{1_0}} - C_{A_{20}}} = \exp\left[-\frac{a D_{AB}}{L}\left[\frac{1}{V_2} + \frac{1}{V_1}\right] t_f\right]$$

①



$A \uparrow$, $B \not\uparrow$

$N_B = 0$

$t = 0, \; x = x_1$ | $C_{A_1} = C_{As}$

$t = t_f, \; x = x_f$ | $C_{A_2} = 0$

① B shouldn't be solvable in A

② A should be in liq form

$$N_A = \frac{D_{AB}\, c}{C_{Blm}\; x} \left(C_{A_1} - C_{A_2} \right)$$

$$\frac{d}{dt}\left(a(l-x)\, \frac{\rho_A}{M_A} \right) = -N_A\, a$$

$$\frac{\rho_A}{M_A} \int_{x_1}^{x_f} x\, dx = \frac{D_{AB}\, c}{C_{Blm}} \left(C_{A_1} - C_{A_2} \right) \int_0^{t_f} dt \quad -①$$

we get this from material balance eqn, i.e,

$$\frac{\rho_A}{M_A}\, x\, dx = \frac{D_{AB}\, c}{C_{Blm}} \left(C_{A_1} - C_{A_2} \right) dt$$

On solving ①,

$$\frac{\rho_A}{2M_A} \left(x_f^2 - x_1^2 \right) = \frac{D_{AB}\, c \left(C_{A_1} - C_{A_2} \right) t_f}{C_{Blm}}$$

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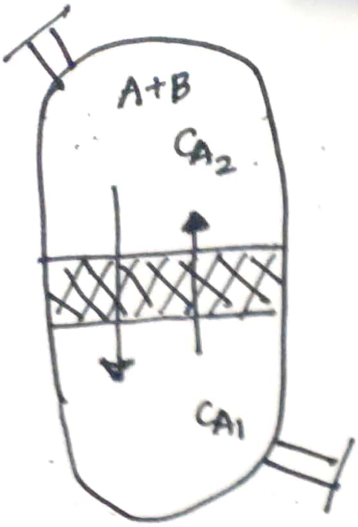

$$t = 0, \quad C_{A_1} = C_{A_{10}}, \quad C_{A_2} = C_{A_{20}}$$

$$A\uparrow \; B\downarrow$$

$$t = t_f, \quad C_{A_1}, \; C_{A_2}$$

$$N_A = -D_{AB} \frac{dC_A}{dz}$$

$$N_A = \frac{D_{AB}(C_{A_1} - C_{A_2})}{L\tau} \; ; \quad C_{A_1} > C_{A_2}$$

$L \rightarrow$ Thickness of diaghragm

$L\tau \rightarrow$ Effective length of diffusion path

$$-V_1 \frac{dC_{A_1}}{dt} = a \varepsilon N_A, \quad V_2 \frac{dC_{A_2}}{dt} = a \varepsilon N_A$$

$$-\frac{d}{dt}(C_{A_1} - C_{A_2}) = a\varepsilon \frac{D_{AB}(C_{A_1} - C_{A_2})}{L\tau} \left(\frac{1}{V_1} + \frac{1}{V_2}\right)$$

$$D_{AB} = \frac{L\tau}{a\varepsilon t_f} \left(\frac{1}{V_1} + \frac{1}{V_2}\right)^{-1} \ln\left(\frac{C_{A_{10}} - C_{A_{20}}}{C_{A_{1f}} - C_{A_{2f}}}\right)$$

$$\frac{a\varepsilon}{\tau L}\left(\frac{1}{V_1} + \frac{1}{V_2}\right) = \beta$$

$$\therefore \; D_{AB} = \frac{\cancel{\beta}\,1}{t_2 \beta} \ln\left(\frac{C_{A_{1,0}} - C_{A_{2,0}}}{C_{A_{1,f}} - C_{A_{2,f}}}\right)$$