CEN 3313

MASS TRANSFER

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Fick's Law of Diffusion

- For transfer of species A in a binary mixture of A&B

$$J_A^* = -cD_{AB}\nabla x_A$$ (molar flux of species A)

$$J_A^* = -cD_{AB}\frac{dx_A}{dx}$$ (1D molar flux of species A)

D_{AB}; Mass diffusivity or binary diffusion constant

j_A: Amount of A transferred per unit time per unit area ⊥ to the direction of transfer and it is proportional to mixture mass concentration

Fick's Law of Diffusion

- For transfer of species A in a binary mixture of A&B

$$j_A = -\rho D_{AB} \nabla m_A$$ (mass flux of species A)

$$j_A = -\rho D_{AB} \frac{dm_A}{dx}$$ (1D mass flux of species A)

D_{AB}; Mass diffusivity or binary diffusion constant

j_A: Amount of A transferred per unit time per unit area ⊥ to the direction of transfer and it is proportional to mixture mass concentration

J_A^*: Molar flux of species A.

It is proportional to C= C_A+C_B and gradient in x_A

when ρ and C = constant

$$j_A = -D_{AB}\frac{d\rho_A}{dx}$$

$$J_A^* = -D_{AB}\frac{dC_A}{dx}$$

Your Turn:

Molecular Diffusion of Helium in Nitrogen

A mixture of He and N_2 gas is contained in a pipe at 298 K and 1 atm total pressure which is constant throughout. At one end of the pipe at point 1 the pressure p_{A1} of He is 0.6 atm and the other hand 0.2 m (20 cm) p_{A2} = 0.2 atm. Calculate the flux of at steady state if D_{AB} of the He-N_2 mixture is 0.687 x 10^{-4} m^2/s.

References

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