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17/ENG01/1007
PTE 314 :- Heat and mass transfer

Hydrogen gas is maintained at 4 bar on the opposite side of a membrane of 0.5mm thickness. At this temperature the diffusion coefficient is $8.7 \times 10^{-8} m^2/s$. Determine the mass diffusion rate of hydrogen through the membrane if the solubility of hydrogen is $1.5 \times 10^{-3} m^2/s$ bar

Solution

$C_1 = 1.5 \times 10^{-3} \times 4 = 6 \times 10^{-3}$ kgMol / m3

$C_2 = 1.5 \times 10^{-3} \times 1 = 1.5 \times 10^{-3}$ kgmol/m3

Considering Plane wall Condition

$$R = \frac{L}{DA} = \frac{0.0005}{8.7 \times 10^{-8} \times 1}$$

$$\text{Mole flux} = (6 \times 10^{-3} - 1.5 \times 10^{-3}) \Big/ \frac{0.0005}{8.7 \times 10^{-8} \times 1}$$

$$= 7.83 \times 10^{-7} \text{ kg mol/m}^2\text{s}$$

$$\text{Mass flux} = 2 \times 7.83 \times 10^{-7} \text{ kg/m}^2\text{s} = 1.566 \times 10^{-6} \text{ kg/m}^2\text{s}$$

$$= 1.566 \times 10^{-6} \text{ kg/m}^2\text{s}$$