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16/ENG07/024 C/O

PETROLEUM ENGINEERING.

PTE 314. HEAT AND MASS TRANSFER.

Assignment

Question: Hydrogen gas is maintained at 4 bar and 1 bar on the opposite sides of a membrane of 0.5mm thickness. At this temperature the diffusion coefficient is 8.7×10^{-8} m^2/s. The solubility of hydrogen in the material which depends on the pressure is 1.5×10^{-3} m^2/s bar. Determine the mass diffusion rate of hydrogen through the membrane

Solution:

$C_1 = 1.5 \times 10^{-3} \times 4 = 6 \times 10^{-3}$ kg mol/m^3

$C_2 = 1.5 \times 10^{-3} \times 1 = 1.5 \times 10^{-3}$ kg mol/m^3

Considering plane wall condition,

$$R = \frac{L}{\Delta A}$$

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

$$\text{Mole flux} = \left[6 \times 10^{-3} - 1.5 \times 10^{-3}\right] \div \frac{0.0005}{8.7 \times 10^{-8} \times 1}$$

$$= 0.0045 \times \left[\frac{8.7 \times 10^{-8} \times 1}{0.0005}\right]$$

$$= 0.0045 \times 0.00174 = 0.00000783$$

$$\Rightarrow 7.83 \times 10^{-6} \text{ kg mol/m}^2\text{s}$$

Mole flux $= 2 \times 7.83 \times 10^{-6}$ kg/m^2s $= 1.566 \times 10^{-4}$ kg/m^2s //.