Diffusion in Polymeric Materials

14.27   This is a permeability problem in which we are asked to compute the diffusion flux of oxygen through a 15-mm thick sheet of low density polyethylene. In order to solve this problem it is necessary to employ Equation 14.9. The permeability coefficient of O_2 through LDPE is given in Table 14.6 as 2.2×10^{-13} (cm^3 STP)-cm/cm^2-s-Pa. Thus, from Equation 14.9

$$J = P_M \frac{\Delta P}{\Delta x} = P_M \frac{P_2 - P_1}{\Delta x}$$

and taking $P_1 = 150$ kPa (150,000 Pa) and $P_2 = 2000$ kPa (2,000,000 Pa) we get

$$= \left| 2.2 \times 10^{-13} \frac{(cm^3 \ STP)(cm)}{cm^2 - s - Pa} \right| \left(\frac{2,000,000 \ Pa \ - 150,000 \ Pa}{1.5 \ cm} \right)$$

$$= 2.7 \times 10^{-6} \frac{(cm^3 \ STP)}{cm^2 - s}$$