Recap

Oct 1, 2019

Kinetic Theory

$$D_{AB} = \frac{K' T^{3/2}}{P \bar{A}} \left(\frac{1}{M_A} + \frac{1}{M_B} \right)^{\frac{1}{2}}$$

$\bar{A}$ .. average cross-sectional area of gas molecules A and B

T ... absolute temp (K)

K' proportionality constant

P total pressure, in atm ($101.3\ kN/m^2$)

M molecular weight (kg/kgmol)

Gilliland:

set $K' = 4.3 \times 10^{-9}$

$$\bar{A} = \left(V_A^{1/3} + V_B^{1/3} \right)^2$$

(see Table 2-1)

V molar volume at normal boiling point $\left[\frac{m^3}{kgmol}\right]$

Fuller et al

(better than gilliland)

replace $T^{3/2}$ with $T^{7/4}$

set $K' = 1.0 \times 10^{-9}$

$$\bar{A} = \left[(\Sigma v)_A^{1/3} + (\Sigma v)_B^{1/3} \right]^2$$

Σv sum of atomic diffusion volumes of all elements for (each molecule)

(see Table 2-2)

used for polar and nonpolar gases, predictions within 7% to exp. values

Chapman-Enskog

(in Hirschfelder)

(for non-polar gases)

set $K' = 1.85 \times 10^{-27}$

$$\bar{A} = \sigma_{AB}^2 \Omega_D$$

σ_{AB} collision diameter (Table 2-3)

Ω_D collision integral (Table 2-3 for ε and Table 2-4)