Week 10: Lecture 1

Non-Reacting Mixtures

Definitions

- the total mass of a mixture

$$m = m_1 + m_2 + \cdots + m_j = \sum_{i=1}^{j} m_i$$

- the relative amount of components specified in terms of mass fractions

$$Y_i = \frac{m_i}{m} \quad \Rightarrow \quad \sum_{i=1}^{j} Y_i = 1$$

- the total number of moles of a mixture

$$n = n_1 + n_2 + \cdots + n_j = \sum_{i=1}^{j} n_i$$

- the relative amount of components specified in terms of mole fractions

$$X_i = \frac{n_i}{n} \quad \Rightarrow \quad \sum_{i=1}^{j} X_i = 1$$

- m_i and n_i are related by the molecular weight $\tilde{M}_i$

$$m_i = n_i \cdot \tilde{M}_i$$

therefore

$$m = \sum_{i=1}^{j} n_i \cdot \tilde{M}_i$$

Week 10: Lecture 1

- the mixture molecular weight can be calculated as a mole-fraction average of the component molecular weights

$$\tilde{M} = \frac{m}{n} = \frac{\sum\limits_{i=1}^{j} n_i \tilde{M}_i}{n} = \sum_{i=1}^{j} X_i \tilde{M}_i$$

- X_i and Y_i are also related by the molecular weight

$$\frac{Y_i}{X_i} = \frac{m_i/m}{n_i/n} = \left(\frac{m_i}{n_i}\right)\left(\frac{m}{n}\right) = \left(\tilde{M}_i\right)\left(\frac{1}{\tilde{M}}\right)$$

therefore

$$Y_i = X_i \left[\frac{\tilde{M}_i}{\sum\limits_{i=1}^{j} X_i \tilde{M}_i}\right]$$