Week 12: Lecture 3

Evaluation of Entropy for Reacting Systems

- a common datum must be used to assign entropy values for each substance involved in the reaction
- an entropy of 0 for pure crystalline substances is obtained at absolute zero
- the entropy relative to this datum is called absolute entropy
- absolute entropy at 1 atm and temperature T is denoted as $s^o(T)$ or $\overline{s}^o(T)$ for a per unit mass or per mole basis (note: referred to as $\hat{\phi}$ in Reynolds and Perkins)
- the entropy at any value of T and P can be calculated as

$$\overline{s}(T,P) = \overline{s}^o(T) - \mathcal{R} \ln \left(\frac{P_i}{P_{ref}} \right)$$

- the entropy of the i'th component of an ideal gas mixture is evaluated at temperature T and the partial pressure P_i where the partial pressure is given by

$$P_i = X_i P$$

and

$$\overline{s}(T,P_i) = \overline{s}_i^o(T) - \mathcal{R} \ln \left(\frac{X_i P}{P_{ref}} \right)$$

Incomplete Combustion

- when the amount of air supplied is less than the theoretical air required the combustion is incomplete
- the usual result is carbon unites with oxygen to form carbon monoxide (CO) instead of CO_2

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Dew Point

- since water is formed when hydrocarbon fuels are burned, the mole fraction of water vapour in the form of gaseous products can be significant
- if the gaseous products of combustion are cooled at constant mixture pressure the dew point temperature is reached when water vapour begins to condense
- since corrosion of duct work, mufflers etc. can occur, the knowledge of dew point temperature is important