JQ.2.34.Setup

September 23, 2014

(2.34) Polyacrylonitrile (C_3H_3N) burns to form vapor, carbon dioxide and nitrogen. The heat of formation of the polyacrylonitrile is 15.85 kcal/(g mol). Use data from Tables 2.1 and 2,2. Use specific heat values at 1000K.

(a) Write the balanced chemical equation for the stocihiometric combustion in oxygen.

(b) Determine the heat of combustion of the polyacrylonitrile.

(c) write the balanced chemical equation for the stocihiometric combustion in air.

(d) Determine the adiabatic flame temperature if teh fuel burns stocihiometricallin in air.

Setup

Recall that a 1 gram-mol is the same as 1 mole. There is a typo $1cal = 4.18J$ and not $4.18kJ$.

You've done all these steps in previous problems. For part (a):

balance the chemical reaction using elemental balances:

$$C_mH_nN + aO_2 \rightarrow bCO_2 + dH_2O + fN2$$
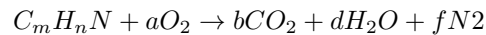
Find the stoichiometric coefficients a, b,& d.

Use equation 2.25 to express the heat of combustion in terms of the heats of formation

$$\Delta\tilde{h}_c = \left(\sum_i \nu_i \Delta\tilde{h}^o_{f,i}\right)_{React} - \left(\sum_j \nu_j \Delta\tilde{h}^o_{f,j}\right)_{Prod}$$

Assume that the reactants are at 25^oC.

$$T_P = 25 + \frac{m_F}{m_T}\frac{\Delta h_c}{\bar{c}} = 25 + Y_F\frac{\Delta h_c}{\bar{c}}$$