Reactions for Energy -

Equilibrium Combustion Thermodynamics

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Learning objectives

- Determine the adiabatic flame temperature

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Adiabatic flame temperature

If a fuel-air mixture burns adiabatically at constant pressure, the absolute enthalpy of the reactants at the initial state equals the absolute enthalpy of the products at the final state.
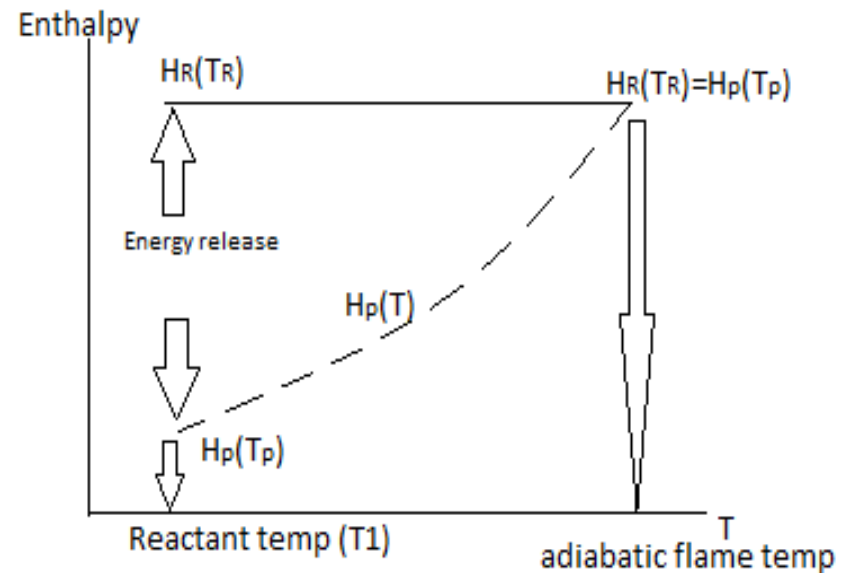
Adiabatic flame temperature

Example 1: Determine the constant pressure adiabatic flame temperature for the combustion of a stoichiometric methane-air mixture. The pressure is 1 atm and the initial reactant temperature is 298 K. Use the following assumptions.

a. Complete combustion i.e., the product mixture consists of only CO_2, H_2O and N_2.

b. The product mixture enthalpy is estimated using constant specific heats evaluated at 1200 K, where Tad is guessed to be 2100 K.

Adiabatic flame temperature (5)

Dissociation of products at high temperature at ambient pressure:

Example: The space shuttle burns H_2 and O_2 in the main engine. To estimate the maximum flame temperature, let's consider combustion of 1 mol of gaseous H_2 with ½ mol of gaseous O_2 at STP. Determine the adiabatic flame temperature. Take an initial guess of 3700 K for the adiabatic flame temperature.

Next Lecture

- **Equilibrium composition of products**