

Class 33

Adiabatic Flame Temperatures

Business

Two options for making up Dean's lectures:

1. Review DVD
 - check out from 242 CB or ChE office
 - Password-protected web site (coming)
2. Leadership lecture
 - April 2, JSB Auditorium, 11 am

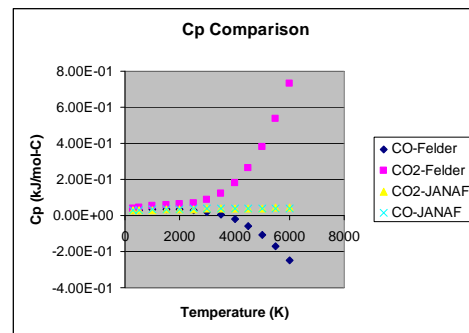
Example

- Fuel = 40% CO, 60% H₂
- What is T_{adiabatic} in stoichiometric air?
- What is T_{adiabatic} in stoichiometric O₂?

See Excel Sheet

Then set n_{N2} = 0 and redo solver.

Heat Capacity Correlations Can Go Crazy at High Temperatures!



40% CO, 60% H₂ Example

- In Air
 - T = 2649 K using Felder C_p's
 - T = 2584 K using JANAF C_p's
 - T = 2371 K using chemical equilibrium code
 - 6.10 mol% H₂
 - 0.99 mol% O₂
 - 0.11 mol% H
 - 0.07 mol% O
 - 0.61 mol% OH
 - 2.06 mol% CO
 - 0.37 mol% NO

Combined energy balance
and chemical equilibrium
calculation

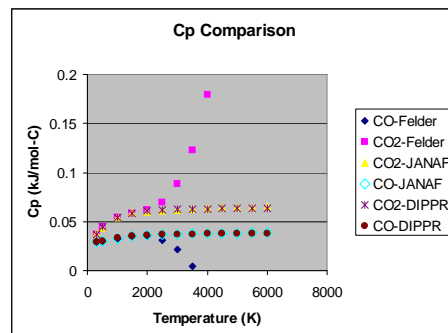
40% CO, 60% H₂ Example

- In O₂
 - T = 5047 K using Felder C_p's
 - T = 5038 K using JANAF C_p's
 - T = 3009 K using chemical equilibrium code
 - 5.84 mol% H₂
 - 8.79 mol% O₂
 - 3.91 mol% H
 - 3.44 mol% O
 - 8.37 mol% OH
 - 17.41 mol% CO
 - Trace HO₂

Message:

- If temperatures get too hot, other species (like radical species) become stable, lowering the flame temperature!
- In particular, CO is as stable as CO₂ at high temperatures (above 2700 K)

DIPPR coefficients are good as well



Changed HW (9-65)

(this is on the HW Hints page)

- I only want you to calculate the adiabatic flame temperature for this system as part (a). You do not have to derive a polynomial expression.
- For part (b), explain why this temperature is not accurate.
- In part (c), do the same calculation for air instead of pure O₂ (i.e., 30% excess air).
- Skip part (d).

Questions?

- Enthalpy
- Heat Capacities
- Heat of Formation
- Heat of Vaporization, Heat of Melting
- Heat of Combustion
- Energy Balances
- Adiabatic Flame Temperature

