Day-4

→ Formation enthalpy, ΔH_F –

It is the value of ΔH for formation of 1 mole of a compound from its constituent elements in their natural states. [O_2, N_2, H_2 → gas ; C (s) → graphite]

Eg: $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$ ✓ (Product state doesn't matter)

$\underline{\underline{C}} + O_2 \longrightarrow CO_2$ ✗

↑ Has to be (s)

$\underline{\underline{CO}} + \frac{1}{2}O_2 \longrightarrow CO_2$ ✗

↑ Not ref. element

$2H + \underline{\underline{O}} \longrightarrow H_2O$ ✗

$\underline{\underline{O}}$ → has to be O_2

$\frac{1}{2}O_2 \longrightarrow O$ ✓

$O_2 \longrightarrow O_2$ ✓ (Strange!)

Notation: $\bar{h}^{\circ}_{F,T_{ref}}$ → standard formation enthalpy.

(S) + $O_2 \longrightarrow SO_2$ } needs discussion ??

↳ identified as ref. element ??

Ashish Sarangi Sir will think about it !!

$\bar{h}^{\circ}_F = H_P - H_R$

↳ = 0 for ref. elements

→ Using Janaf Table:

$\bar{h}^{\circ}_{F,500K} = -243822$ kJ/Kmol

$\bar{h}^{\circ}_{F,298K} = -241845$ kJ/Kmol

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$

$\bar{h}^{\circ}_{F,500} = \bar{h}^{\circ}_{F,298} + (\bar{C}_{P,H_2O} - \bar{C}_{P,H_2} - \frac{1}{2}\bar{C}_{P,O_2}) \times (500-298)$

→ Absolute enthalpy = Formation enthalpy (STP) + sensible enthalpy
(+ latent heat in case of phase change)

→ $CO + CO_2 + N_2$ at 1 atm, $x_{CO} = 0.1$, $x_{CO_2} = 0.2$, $T = 1200\,K$. Find H_{abs}.

Ans) $\bar{h}^{\circ}_{F,298,CO_2} = -393546$ kJ/Kmol

$\bar{h}^{\circ}_{F,298,CO} = -110541$ kJ/Kmol

$\bar{h}^{\circ}_{F,298,N_2} = 0$

$h_{sens.,CO}\ (1200\,K) = 28440$ kJ/Kmol

" , CO_2 " = 44488 kJ/Kmol

" , N_2 " = 28118 kJ/Kmol

$\therefore H^{\circ}_{abs} = 0.1 \times (-110541 + 28440)$
$+ 0.2 \times (-393546 + 44488)$
$+ 0.7 \times (28118)$
$= -58339.1$ kJ kmol^{-1}

→ Upper & lower heating values of n-decane(g) ($C_{10}H_{22}$) / kmol and per kg of fuel. $\Delta H^{\circ}_{latent,\ vap.} = 44010$ kJ/kmol

Ans)