

## Day-6

→ Steady flow energy equation-



$$\dot{W}_{in} + \dot{Q}_{in} + \dot{H}_{in} + \dot{K.E}_{in} + \dot{P.E}_{in}$$

$$= \dot{W}_{out} + \dot{Q}_{out} + \dot{H}_{out} + \dot{K.E}_{out} + \dot{P.E}_{out}$$

For practical combustion devices,

$$\begin{array}{c} \dot{Q}_{in} + \dot{H}_{in} = \dot{Q}_{out} + \dot{H}_{out} \\ \quad \uparrow \qquad \qquad \uparrow \\ \quad H_R \qquad \qquad H_P \end{array}$$

$$\dot{Q}_{in} \sim 0 \quad (\text{generally})$$

If  $\dot{Q}_{out} = 0 \Rightarrow$  Products are at highest temperature

$$\Rightarrow H_R = H_P$$

→ General reaction:



$c_i \longrightarrow$  Any species

$n_i' \longrightarrow$  no. of moles of reactants

$n_i'' \longrightarrow$  " " " " products



Not necessarily a stoichiometric reaction may

happen)

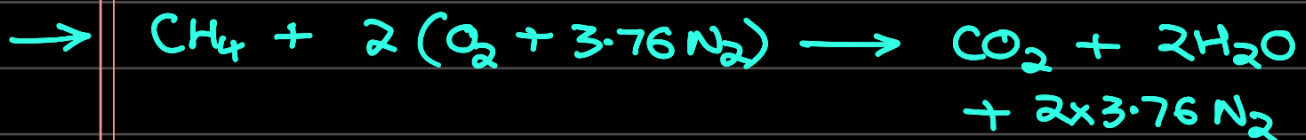
$$\text{We want } H_R(T_R) = H_P(T_P)$$

$$\text{LHS} = \sum n_i' [\bar{h}_f^\circ + (\bar{h}^\circ - \bar{h}_{f,298}^\circ)]$$

$$\text{RHS} = \sum n_i'' [\bar{h}_f^\circ + (\bar{h}^\circ - \bar{h}_{f,298}^\circ)]$$

$$= \sum n_i'' [\bar{h}_f^\circ + \bar{C}_p (T_{\text{ad.}} - 298)]$$

$\downarrow$   
 $\rightarrow 298 \text{ K}$



$$\begin{aligned} H_R(298) &= 1 \times (-74831) \\ &= -74831 \text{ kJ} \end{aligned}$$

Assuming  $T_{\text{ad}} = 2100 \text{ K}$

Take  $C_p$  at ~~298~~  $\frac{300 + 2100}{2} = 1200 \text{ K}$

$$H_P(T) = 1 \times (-393546) + 1 \times 56.205(T - 298)$$

$$+ 2 \times (-241845) + 2 \times 43.874(T - 298)$$

$$+ 7.52 \times 33.707(T - 298)$$

$$= -877236 + (T - 298) \times 397.43$$

$$H_R = H_P$$

$$\Rightarrow -74831 = -877236 + 397.43(T - 298)$$

$$\Rightarrow T = 298 + \frac{877236 - 74831}{397.43}$$

$$= 2316.98 \text{ K}$$