Day – 10

→ C_8H_{18} + air ($\phi = 1.2$). Products: $CO_2 + H_2O + CO + H_2$ (at 1700 K)

Use WGS: $CO_2 + H_2 \longrightarrow CO + H_2O$)

Ans) $1.2C_8H_{18} + 12.5(O_2 + 3.76N_2)$
$\longrightarrow a\,CO_2 + b\,H_2O + c\,CO + d\,H_2 + 12.5\times3.76N_2$

$a + c = 1.2 \times 8 = 9.6$
$2(b+d) = 1.2\times18 = 21.6$
$\Rightarrow b + d = 10.8$

$2a + b + c = 12.5 \times 2 = 25$
$\Rightarrow a + b = 25 - 9.6 = 15.4$

$CO_2 + H_2 \longrightarrow CO + H_2O$ (1700 K)

$$K_p = \exp\left(\frac{-396414 + 0 - (-260711 - 152963)}{8.314 \times 1700}\right)$$

≈ 3.391

Now, $3.391 = \dfrac{bc}{ad}$

$$= \frac{(15.4-a)(9.6-a)}{a(10.8-b)}$$
$$= \frac{(15.4-a)(9.6-a)}{a(a-4.6)}$$
$\Rightarrow 3.391a^2 - 15.6a = 147.84 - 25a + a^2$
$\Rightarrow 2.391a^2 + 9.4a - 147.84 = 0$

$$\Rightarrow a = \frac{-9.4 + \sqrt{(9.4)^2 + 4 \times 2.391 \times (47.84}}{2 \times 2.391}$$

$$\approx 6.14$$

$b = 9.26$
$c = 3.46$
$d = 1.54$

For per mole fuel,

$$a' = \frac{a}{1.2} = 5.1167$$

$$b' = \frac{b}{1.2} = 7.7167$$

$$c' = \frac{c}{1.2} = 2.883$$

$$d' = \frac{d}{1.2} = 1.283$$

→ Softwares :

1.) CEA (Chemical Equilibrium with Applications)

2.) STANJAN (Stanford Jamaf)

3.) GASEQ (Gas Equilibrium)

→ T_{ad} at constant V —

$$\cancel{dQ}^{\,0} = dU + \cancel{PdV}^{\,0}$$

$$\Rightarrow dU = 0$$

$$\Rightarrow U_R(T_R) = U_P(T_{ad})$$

$$\Rightarrow H_R(T_R) - P_R V = H_P(T_P) - P_P V$$

$P_R V \rightarrow n_R R_u T_R$

$P_P V \rightarrow n_P R_u T_{ad}$

$$\Rightarrow H_R - \Sigma N_R R_U T_R = H_P - \Sigma N_P R_U T_{Ad}$$

Rest of the process is same.