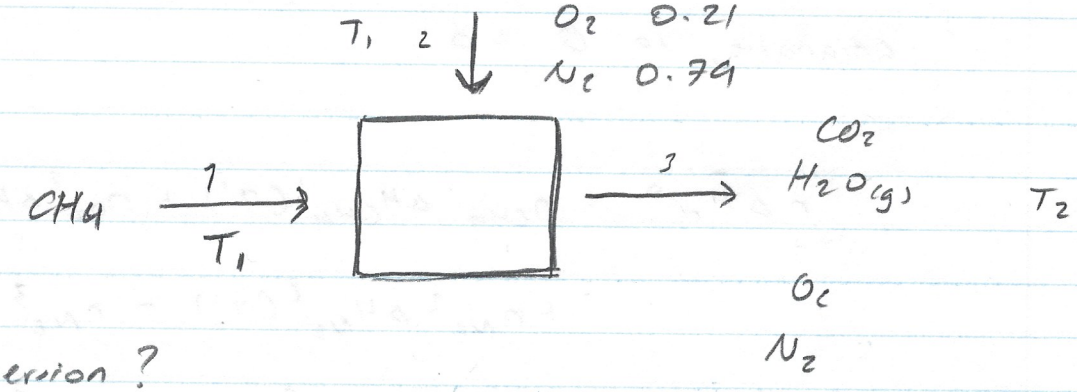
1. $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O_{(g)}$



- complete conversion ?

(SR 1) EA = 30%

$\rightarrow n_{O_2}^{2} = 1.3\, n_{O_2}^{th}$

$= 1.3\,(2\, n_{CH_4}^{1})$

DoF = 7 # SV
+ 7 # ER
− 5 # MB
− 1 # SSV
− 1 # SR
= 1
− 1 (basis)
= 0

per mole of CH_4 $\rightarrow n_{N_2}^{2} = n_{N_2}^{3} = 9.78$

let n^1 = 1 mol/h $\Rightarrow n_{O_2}^{2} = 2.60$ mol/h

(CH_4) $n_{CH_4}^{1} - r = 0 \Rightarrow r = n_{CH_4}^{1} = 1$

(O_2) $n_{O_2}^{2} - n_{O_2}^{3} - 2r = 0 \Rightarrow n_{O_2}^{3} = 0.6$

(CO_2) $-n_{CO_2}^{3} + r = 0 \Rightarrow n_{CO_2}^{3} = 1$

(H_2O) $-n_{H_2O}^{3} + 2r = 0 \Rightarrow n_{H_2O}^{3} = 2$

$$0 = \sum n_j^{1} \bar{h}_j^{1} + \sum n_j^{2} \bar{h}_j^{2} - \sum n_j^{3} \bar{h}_j^{3} - r\Delta\bar{H}_r^{\circ} + \dot{Q}$$

· adiabatic, so $\dot{Q} = 0$

$$r\Delta\bar{H}_r^{\circ} = n_{CH_4}^{1}\Delta\bar{H}_{CH_4}^{1}(T') + n_{O_2}^{2}\bar{h}_{O_2}^{2}(T') + n_{N_2}^{2}\bar{h}_{N_2}^{2}(T') - n_{N_2}^{3}\bar{h}_{N_2}^{2}(T^2) - n_{O_2}^{3}\bar{h}_{O_2}^{2}(T^2) - n_{CO_2}^{3}\bar{h}_{CO_2}^{3}(T^2) - n_{H_2O}^{3}\bar{h}_{H_2O}^{3}(T^2)$$

$$\Delta\bar{H}_r^{\circ} = \sum \sigma_j^{3}\bar{h}_{f,j}^{3} - \sum \sigma_j^{2}\Delta\bar{H}_{f,j}^{2} - \sum \sigma_j^{1}\Delta\bar{H}_{f,j}^{1}$$

$$= \Delta\bar{H}_{f,CO_2}^{3} + 2\bar{h}_{f,H_2O}^{3} - \bar{h}_{f,CH_4}^{3} - \Delta\bar{H}_{f,O_2}^{3}$$

$$= -802.3 \text{ kJ/mol}$$

→ MATLAB

$$T_2 = 2066.02 \text{ K}$$

Janaf Check:

$T = 2000$

$$802.3 \frac{kJ}{mol} - 9.78(56.137 - 0) - 0.6(59,174 - 0)$$

$$- (91.450 - 0) - 2(72.789 - 0)$$

$$= -19.25226$$

$T = 1900$

$$802.3 \frac{kJ}{mol} - 9.78(52.547 - 0) - 0.6(55.413 - 0)$$

$$- (85.429 - 0) - 2(67.705 - 0)$$

$$= 34.30354$$

→ interpolate

$$0 = \frac{-19.25226 - 34.30354}{2000 - 1900}(T - 1900) + 34.30354$$

$$0 = -0.53556 (T - 1900) + 34.30354$$

$$T = 1964.03 \text{ K}$$