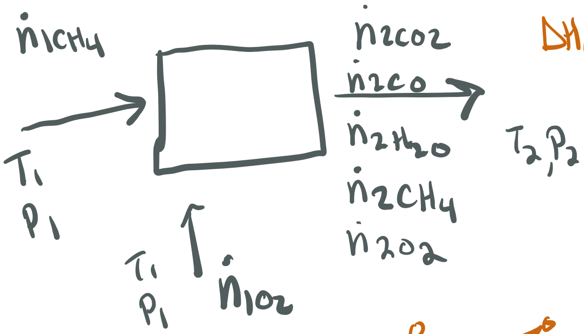

$\Delta H^\circ_{c,CH_4} = $ ___ $CH_4^{(g)} + 2O_2^{(g)} \rightarrow CO_2^{(g)} + 2H_2O^{(g)}$ 1

$CH_4 + \frac{3}{2}O_2 \rightarrow CO + 2H_2O$ 2

$$\dot{Q} - \cancel{\dot{W}_s}^{\,0} = \cancel{\Delta \dot{E}_k}^{\,0} + \cancel{\Delta \dot{E}_p}^{\,0} + \Delta \dot{H}$$

no moving no Δv no Δ position

open

Heat of rxn method*

$\Delta \dot{H} = \sum_j \xi_j \Delta H_{rxn,j} + \sum_{out} \dot{n}_i \hat{H}_i - \sum_{in} \dot{n}_i \hat{H}_i$

Convenient for single rxns when you know ΔH_{rxn}

Ref state has to be the Conditions ΔH_{rxn}

Heat of Formation

$$\dot{Q} = \Delta \dot{H} = \sum_{out} \dot{n}_i \hat{H}_i - \sum_{in} \dot{n}_i \hat{H}_i$$

$$= \left[\dot{n}_{2CO_2}\hat{H}_{2CO_2} + \dot{n}_{2CO}\hat{H}_{2CO} + \dot{n}_{2H_2O}\hat{H}_{2H_2O} + \dot{n}_{2CH_4}\hat{H}_{2CH_4} + \dot{n}_{2O_2}\hat{H}_{2O_2}\right]$$

$$- \left[\dot{n}_{1CH_4}\hat{H}_{1CH_4} + \dot{n}_{1O_2}\hat{H}_{1O_2}\right]$$

material balances $\dot{n}_{out} = \dot{n}_{in} + \sum \nu_{ij} \xi_j$

Ref state:

C (25°C, 1atm, s)
H_2 (25°C, 1atm, g)
O_2 (25°C, 1atm, g)

For non-reactive systems we can chose the ref. State to be anything (inlet condition)

Outlet

$$\underline{\hat{H}_{2CO_2}} = \Delta H^\circ_{f_{CO_2}} + \int_{25^\circ C}^{T_2} Cp_{CO_2,g}\, dT + 0$$

for ideal gas
$\Delta H = 0$ for ΔP

$C(25^\circ C, 1atm, s)$
$O_2(25^\circ C, 1atm, g)$] Ref. states

ⓐ ↓

$CO_2(25^\circ C, 1atm, g)$

ⓑ ↓

$CO_2(T_2, 1atm, g)$

ⓒ ↓

$CO_2(T_2, P_2, g)$ process condition stream 2

$\Delta H^\circ_{f_{CO_2}} = \underline{-393}$ kJ/mol

$$Cp_{CO_2,g} = 36.11\times10^{-3} + 4.233\times10^{-5}T + -2.887\times10^{-8}T^2 + 7.464\times10^{-12}T^3$$

$$\underline{\hat{H}_{2CO}} = \Delta H^\circ_{f_{CO}} + \int_{25^\circ C}^{T_2} Cp_{CO,g}\, dT + 0$$

$C(25^\circ C, 1atm, s)$
$O_2(25^\circ C, 1atm, g)$] Ref. state

↓

$CO(25^\circ C, 1atm, g)$

↓

$CO(T_2, 1atm, g)$

↓

$CO(T_2, P_2, g)$

Side note: For non-reactive systems, make your life easy + set inlet conditions as ref. $\hat{H}_{1i} = 0$

$$\hat{H}_{2i} = \underbrace{\quad}_{\Delta P}\ \underbrace{\quad}_{\Delta T}\ \underbrace{\quad}_{\Delta phase}$$