# Day-6

→ Non-catalytic partial oxidation:

$$C_nH_m + n/2\,O_2 \longrightarrow nCO + m/2\,H_2 \quad (exo)$$

$$C_nH_mS_x + n/2\,O_2 \longrightarrow nCO + \left(\frac{m}{2} - x\right)H_2 + xH_2S \quad (exo)$$

$$C_nH_m + nH_2O \longrightarrow nCO + \left(n + \frac{m}{2}\right)H_2 \quad (endo)$$

$$C_nH_m + nCO_2 \longrightarrow 2nCO + m/2\,H_2 \quad (endo)\ *$$

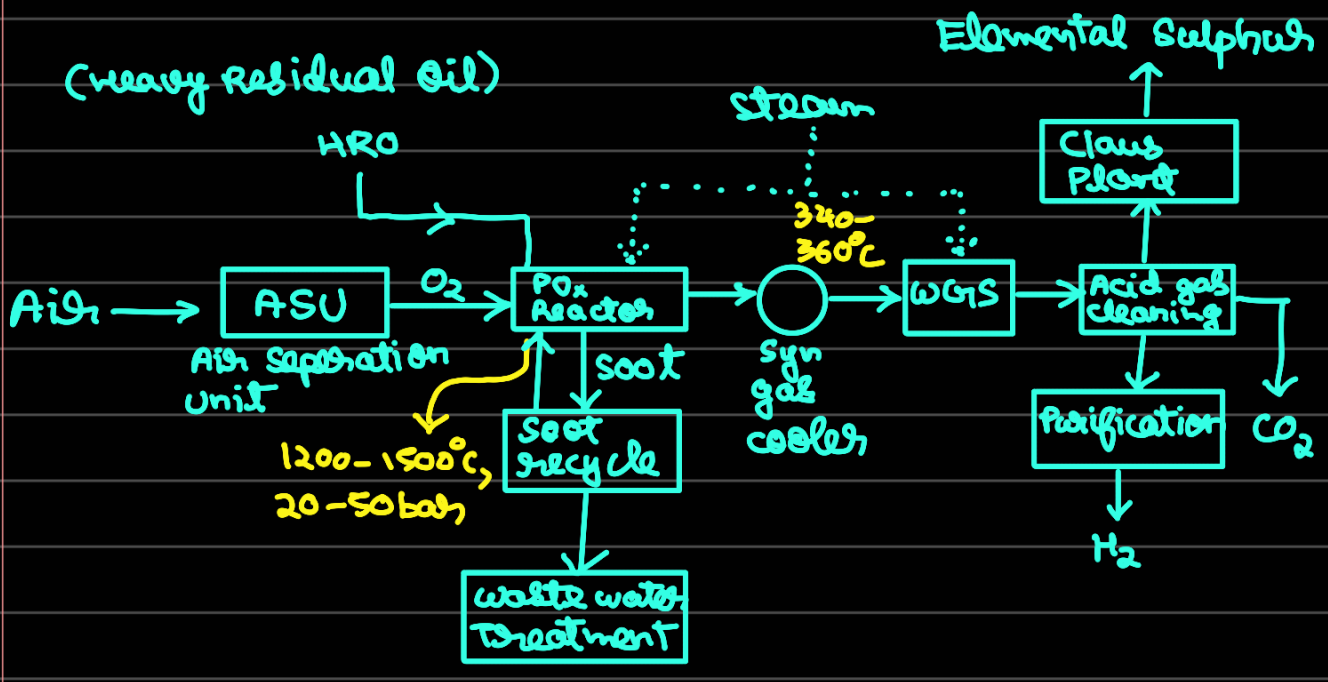
$$C_nH_m \longrightarrow (n-x)C + C_xH_y + \left(\frac{m-y}{2}\right)H_2 \quad (endo)$$

$$C + 1/2\,O_2 \longrightarrow CO \quad (exo)$$

$$C + H_2O \longrightarrow CO + H_2 \quad (endo)$$
$$CO + H_2O \longrightarrow CO_2 + H_2 \quad (exo)$$

* Dry/Stoichiometric/$CO_2$ reforming

→ Process Flow Diagram:



Why steam?

- WGS
- Soot recycle – remove the particulate matter.
- Quenching and moderation

→ Catalytic $PO_x$:

| | $\Delta H^\circ$ (kJ/mol) |
|---|---|
| $CH_4 + \frac{1}{2} O_2 \longrightarrow CO + 2H_2$ | −38 |
| $CH_4 + CO_2 \longrightarrow 2CO + 2H_2$ | 247 |
| $CO + H_2O \longleftrightarrow CO_2 + H_2$ | −41 |
| $CO_2 + C \longleftrightarrow 2CO$ | 171 |
| $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$ | −803 |
| $2CO + O_2 \longrightarrow 2CO_2$ | −294 |
| $2H_2 + O_2 \longrightarrow 2H_2O$ | −286 |

Catalysts – $Pt/Al_2O_3$, Ce/Zr (promoter)

- High cost
- Higher loading

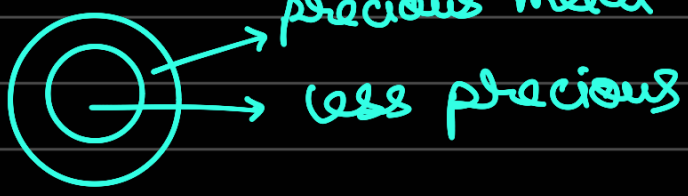
$Rh/CeO_2$ or $Rh/Al_2O_3$ (lower loading)

method of synthesis issue

$Ru/Al_2O_3$ (Low cost but less stable)

$Ni/Al_2O_3$

$Ni/CeO_2$, $Ni/La_2O_3$, $Ni/CeO_2-La_2O_3$
Cu → $Al_2O_3$, $ZrO_2$, $TiO_2$, $SiO_2$
(Low thermal stability at higher T)
Fe, Co (Bimetallic catalysts)




Perovskites : $LaXO_3$ (X = Fe, Cu, Ga, Ni, Co)