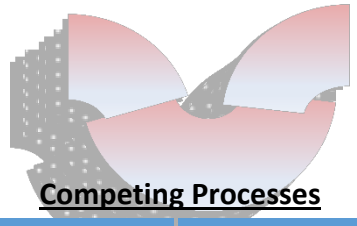

Competing Processes

STEAM CRACKING

- The reactions are principally bond breaking in the presence of steam

$$RCH_2CH_2CH_2R' \rightarrow RCH_2CH_2 + R'CH_2$$

$$RCH_2CH_2 \rightarrow R + CH_2{=}CH_2$$

- Advantages:

-Well established technology

-Ratio of ethylene and propylene can be manipulated.

-Less capital intensive in comparison of alternative processes.

- Disadvantages:

-Limited Resources

-Energy Intensive

-Less environmental friendly

OXIDATIVE COUPLING OF METHANE

- In oxidative coupling of methane, unlike MTO and Fisher-Tropsch synthesis direct conversion takes place from methane to high hydrocarbons and ethylene.

Oxidative coupling of methane to ethylene:

$$2CH_4 + O_2 \rightarrow C_2H_4 + 2H_2O$$

- Advantages:

-OCM catalysts at elevated temperatures have high stability

-Direct route from methane to olefins

- Disadvantages:

-OCM gives low yields of ethylene

-OCM is highly exothermic (making it less practical for larger scale)

FISHER-TROPSCH SYNTHESIS

- FTS process converts syngas into petrochemicals and fuel-range hydrocarbons.

Methane:

$$CO + 3H_2 \rightarrow CH_4 + H_2O$$

Paraffins:

$$(2n+1)H_2 + nCO \rightarrow C_nH_{2n+2} + nH_2O$$

Olefins:

$$2nH_2 + nCO \rightarrow C_nH_{2n} + nH_2O$$

Water gas shift:

$$CO + H_2O \rightarrow CO_2 + H_2$$

- Advantages:

-Offers diversity in the market to natural gas resource holders

- Disadvantages:

-Expensive Technology

-Low selectivity with broad carbon range concerning the product spectra.

-Not environmentally friendly

CATALYTIC DEHYDROGENATION

- Catalytic dehydrogenation gives a higher chance of high selectivity for a single olefin product.

Thermal Dehydrogenation:

$$C_2H_6 \leftrightarrow C_2H_4 + H_2$$

Oxidative dehydrogenation:

$$C_2H_6 + \tfrac{1}{2}\, O_2 \leftrightarrow C_2H_4 + H_2O$$

Partial Oxidation:

$$C_3H_8 + 2O_2 \leftrightarrow CH_3{=}CH\text{-}COOH + 2H_2O$$

- Advantages:

-An abundant supply of cheap light alkanes from shale gas

-High profits because of the low propane prices compared with propylene

- Disadvantages:

- There is no scope for improvement

- Need to increase the energy efficiency

CHOSEN SOLUTION: MTO

- MTO process is a suitable alternative to produce Olefins from environmentally friendly resources.
- Highly Exothermic Reaction

  $2CH_3OH \rightarrow CH_3OCH_3 + H_2O$

  $CH_3OCH_3 \rightarrow C_2H_4 + H_2O$

  $3CH_3OCH_3 \rightarrow 2C_3H_6 + 3H_2O$

- Advantages:
  - High ratios of Propylene and Ethylene (High Selectivity)
  - Offers diversity in the market
  - Environmental friendly
  - Cheaper raw material
- Disadvantages:
  - Expensive Technology
  - less stability of catalyst