VARIOUS COMMERCIAL PROCESSES

The oldest process for the industrial production of methanol is the dry distillation of wood,but this no longer has practical importance. Other processes such as oxidation of hydrocarbons & production as a byproduct othe Fisher-Tropsh synthesis according to Synthol process,have no importance today.

Methanol is currently produced on an industrial scale exclusively by catalytic conversion of synthesis gas. Processes are classified according to the pressure used:

a. High pressure process 25-30Mpa
b. Medium pressure process 10-25Mpa
c. Low pressure process 5-10mpa

The main advantages og low pressure process are are lower investment & production cost,improved operational reliability,& greater flexibility in the choice of plant size.

Industrial methanol production can be subdivided into 3 steps.

1. Production of synthesis gas
2. Synthesis of methanol
3. Processing of crude methanol[3]

4. PRODUCTION TECHNOLOGY

1. **Reference flow sheet Fig.2**
2. **Chemical reactions :**

$CO + 2H_2 \rightarrow CH_3OH \qquad \Delta H$=-26.4 Kcal

Methanation reactions:

$CO + 3H_2 \rightarrow CH_4 + H_2O \qquad \Delta H$= -50 Kcal

$2CO + 2H_2 \rightarrow CH_4 + CO2 \qquad \Delta H$= -60.3Kcal

Side reactions to higher mol. Wt. Compounds [ignored]

Methanol decomposition:

$$2CH_3OH \rightarrow CH_3\text{-}O\text{-}CH_3 + H_2O$$

3. **Process description:** Feed gas comprising of hydrogen & carbon monoxide is compressed to 3000-5000 psi, mixed with recycle gas, 7 fed to a high pressure converter. Internal preheat is usually employed. The reactor is copper lined steel & contains a mixed catalyst of zinc,chromium,manganese, or aluminium oxides.The temperature is maintained at 300-375 °C by proper space velocity & heat exchanger design.

The ratio of hydrogen & CO in the feed gas is 1:4 to 1:8[1,5].Excess hydrogen improves catalyst effectiveness.

Exit gases from the reactor are cooled by heat exchange with reactants, then with water. Methanol condenses under full operating pressure to maximize yields-50% [3,4].The liquid methanol is depressurized, sent to a fractionator to separate ether, 7 then to another tower to minimize the water content.

Reactor design: Thick walled pressure vessels are constructed of relatively cheap steel but must be lined with Cu to avoid the formation of iron carbonyl $Fe(CO)_5$, a volatile compound which poisons the catalyst in addition to causing severe corrosion problems.

Heat exchange to control the highly exothermic reaction is accomplished by a simple design which looks like the Montecatini-Fauser design in which the combination of a circulating high pressure water & waste heat boiler acts as the principle heat control-as shown in fig.2

Catalyst fouling: Excess hydrogen over the minimum theoritical 2:1 H2/CO ratio is used to avoid fouling of catalyst with higher molecular wt. Materials which adsorbs on the catalyst under high CO partial pressures.

Earlier , synthesis gas is produced by steam reforming of natural gas which contains mainly methane.

$$CH4 + H2O \leftrightarrow CO + 3H2$$

Inert gas accumalation: In carrying high recycle loads , possibility of accumulating inert gas is avoided by maintaining a side stream purge of about 5% on recycle gas.