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**INTERMEDIATES AND DERIVATIVES:**

**Methanol CH3OH**

**Feed: NG or associated gas**

**CO+ 2H2 ↔ CH3OH**

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**Description: (1)** Gas feedstock is compressed (if required), desulfurized (2) the optional

saturator ,where some process steam is generated. The saturator is used where

maximum water recovery is important. Further process steam is added, and the mixture

is preheated and sent to the pre-reformer (3), using the Catalytic- Rich-Gas process.

Steam raised in the methanol converter is added, along with available CO2 , and the

partially reformed mixture is preheated and sent to the reformer (4). High-grade heat in

the reformed gas is recovered as high-pressure steam (5), boiler feed water preheat, and

for reboil heat in the distillation system (6). The high-pressure steam is used to drive the

main compressors in the plant. After final cooling, the synthesis gas is compressed (7)

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and sent to the synthesis loop. The loop can operate at pressures between 70 to 100 bar.

The converter design does impact the loop pressure, with radial-flow designs enabling

low loop pressure even at the largest plant size. Low loop pressure reduces the total

energy requirements for the process.

The synthesis loop comprises a circulator (8) and the converter operates around 200°C

to 270°C, depending on the converter type. Reaction heat from the loop is recovered as

steam, and is used directly as process steam for the reformer.

A purge is taken from the synthesis loop to remove inerts (nitrogen, methane), as well

as surplus hydrogen associated with non-stoichiometric operation. The purge is used as

fuel for the reformer. Crude methanol from the separator contains water, as well as

traces of ethanol and other compounds. These impurities are removed in a two-column

distillation system (6). The first column removes the light ends such as ethers, esters,

acetone and dissolved non condensable gases. The second column removes water,

higher alcohols and similar organic heavy ends.

**Acetic acid CH3COOH**

CH3OH + CO →CH3COOH

**Feed:**. Methanol and carbon monoxide (CO) are reacted with the carbonylation

reaction using a heterogeneous Rh **catalyst**



**Description:** Fresh methanol from absorber(7) & (8)., mixed with the recycle liquid

from the recycle surge drum (6). This stream is charged to a unique bubble column

reactor (1).

Carbon monoxide is compressed and sparged into the reactor riser. **Catalyst** is an

immobilized Rh complex catalyst on solid support, which offers higher activity and

operates under less water conditions in the system due to heterogeneous system, and

therefore, the system has much less corrosivity. Reactor effluent liquid is withdrawn and

flash-vaporized in the Flasher (2).

The vaporized crude acetic acid is sent to the dehydration column (3) to remove water

and any light gases. Dried acetic acid is routed to the finishing column (4).

**Ethylene Derivatives:**

**Ethylene oxide**



**Application:** To produce ethylene oxide (EO) from the direct oxidation of ethylene

using the Dow Meteor process.

**Description:** The Meteor Process, a technology first commercialized in1994

1- is a simpler 2- safer process for the production of EO 3- having lower capital

investment requirements and 4- lower operating costs. Meteor Process

**A**-ethylene and oxygen are mixed and passed through a single-train, multi tubular

catalytic reactor (1) to selectively process is a simpler, safer technology with lower

facility investment costs. **B**- Heat is recovered from the reactor outlet gas before it

enters the EO absorber (2) where EO is scrubbed from the gas by water. The EOcontaining

water from the EO absorber is concentrated by stripping (3). the EO reactor,

is removed via activated, hot The cycle gas exiting the absorber is fed to the CO2

removal section (4,5) where CO2, which is co-produced in potassium carbonate

treatment. The CO2 lean cycle gas is recycled by compression back to the EO reactor.

**Advantages:**

Plant with one reactor work with high selectivity with low conversion for each

cycle. Reactants used with high concentration which reduced the capital cost.

**Disadvantages:**

1- The demand for additional units e.g. oxygen separation unit (high purity).

2- The need of CO2removal from recycle gas.

3- N2 must be removed from recycle gas; additional units.

However oxidation by O2 is more economic when high capacity production

is used.

**EO Uses:**

1-In production of ethylene glycol(anti freeze agent).

2-Used as surfactant. 3-In production of polyester.

4-In manufacture of Hydraulic fluid.

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Other old method utilized air for oxidation:

Two reactors and two absorber to complete oxidation of E to produce EO.

T=260-290OC, P=10-13 atm.

Cata: Ag/Al2O3 + Promotor: Ba, K + Inhibitor AgCl ,NaI ,used as

sphere to reduce pressure drop.

**Ethylene glycol :**



**Application:** To produce ethylene glycols (MEG, DEG, TEG) from ethylene oxide

(EO) using Dow’s Meteor process.

**Description:** In the Meteor Process, an EO/water mixture is preheated and fed

directly to an adiabatic reactor (1), which can operate with or without a catalyst. An

excess of water is provided to achieve high selectivities to monoethylene glycol (MEG).

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Diethylene (DEG) and triethylene (TEG) glycols are produced as co products. In a

catalyzed mode, higher selectivities to MEG can be obtained, thereby reducing DEG

production to one-half that produced in the uncatalyzed mode. Excess water from the

reactor effluent is efficiently removed in a multi effect evaporation system (2). The

concentrated water/glycols stream from the evaporation system is fed to the water

column (3) where the remaining water and light ends are stripped from the crude

glycols. The water-free crude

glycol stream is fed to the MEG refining column (3) where polyester-grade MEG,

suitable for polyester fiber and PET production, is recovered. DEG and TEG exiting the

base of the MEG refining column can be recovered as high-purity products by

subsequent fractionation.

**Uses:**

1-Polyester(fibers and films). 2- PET .3-Anti freeze agent. 4-Gas drying

**Vinyl chloride:**

**Vinylchloride monomer VCM CH(Cl)=CH2** :



**Description:** PVC slurry discharged from reactors contains significant amounts of

VCM ( >30,000 ppm) even after initial flashing. This process effectively removes the

remaining VCM so that the monomer is recovered and reused.

-The PVC slurry, containing VCM, is continuously fed to the stripping column (1). The

slurry passes counter-currently to steam, which is fed into the base of the column. All

process operations, including grade change, are automatically done in a completely

closed system.