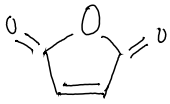
PE-704 Unit 2

Maleic Anhydride

important industrial chemical

 $C_4H_2O_3$ (2-5 Furandione)

Maleic Acid $C_4H_4O_4$ cis-butenedioic acid

Maleic Anhydride (MAH) crystallizes as Orthorhombic needles. MP = 52.85°C
BP = 202.0°C

Polymer → Polycondensation.
→ Polyaddition. polyester, alkyd resins, plasticizers, copolymers, lubricants, lacquers

→ Benzene - predominant
↘ Starting material
↓
C_4 hydrocarbon

Methyl hexa hydrophthalic Anhydride
↓
curing agent in epoxy resins

MA-Styrene (ion exchange Resins)
MA-acrylic Acid (detergent industry)

→ Benzene as starting Material

Pesticides
captan, Malathion

$C_6H_6 + \frac{9}{2}O_2 \rightarrow C_4H_2O_3 + 2CO_2 + 2H_2O$ $\Delta H = -1875\ KJ/mol$

V_2O_5 and MoO_3 on a inert carrier → 4-5 years operating loop, purity of material

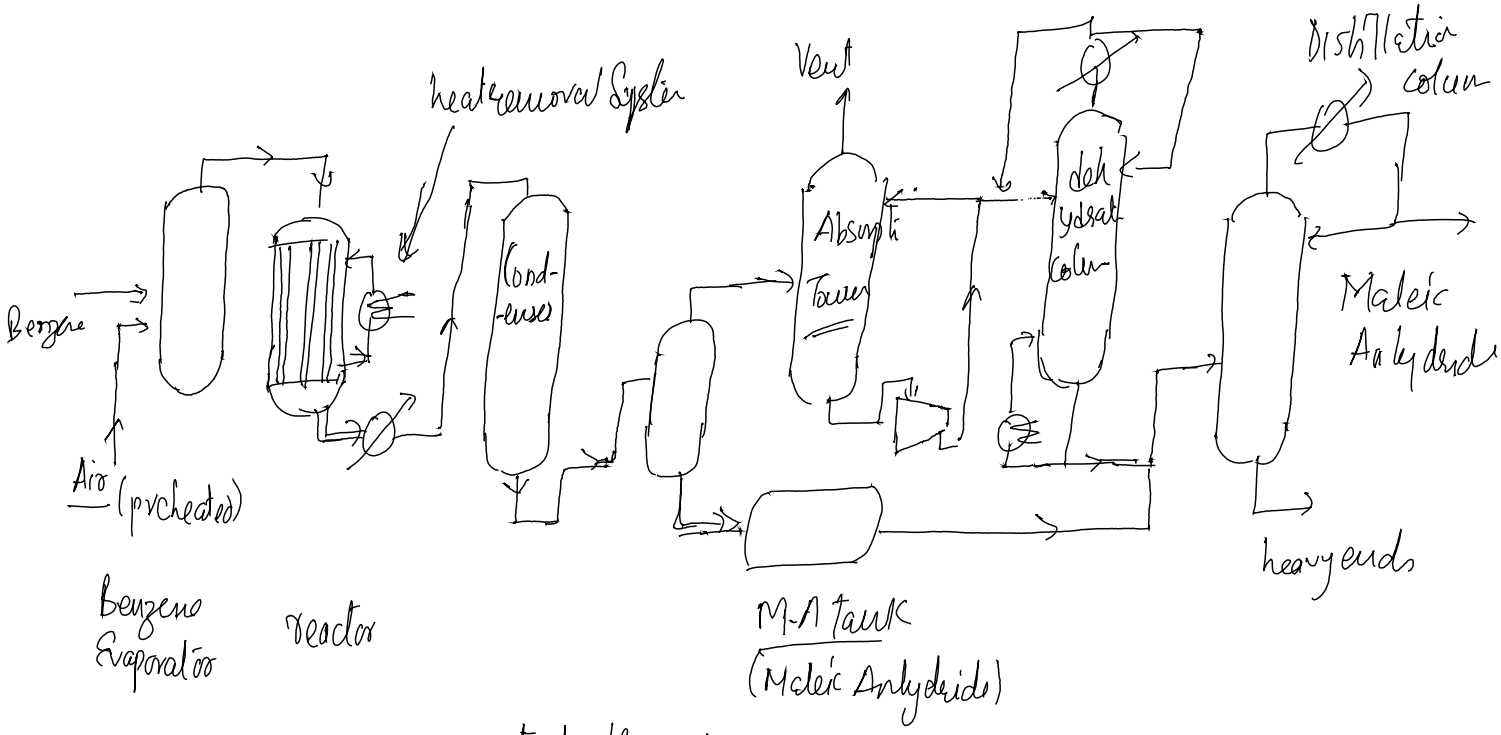
Pressure: 0.15 to 0.25 MPa, Tubular reactor,

O_2, CO, water highly exothermic reaction → hot spot formation occur in the catalyst.

Heat of reaction generated during is removed eutectic salt molten, Melt mixture circulated around the tubes. 27MJ of heat removed per ton of reacting Benzene

100 ml of Benzene → 73 mole of Maleic Anhydride
Unreacted mole of Benzene → (CO, CO_2, SH_2O)

10 ton/hr



outside the explosion limit

Air in large excess lower ignition level (3 wt% Benzene)

V_2O_5 and MoO_3 (Alumina)

$T = 350-450°C$ $P = 0.15$ to 0.25 MPa

Silver, Cobalt, Nickle salts increase the yield

1% Maleic Anhydride (reactor exit gas) → 55-65°C

60% of MA

Absorption column (scrubbing water) Absorpty remain MA in water → dehydrated

Distillation

azeotropic distillation ← O-xylene ← azeotropic distillation

into pure MA

by Vacuum Distillation

Side reaction

$C_6H_6 + 6O_2 \rightarrow 3CO_2 + 3CO + 3H_2O$

→ Oxidation of C_4 hydrocarbon n-butane, n-butane & n-butene mixture (High Paraffin Content)

→ n-butane / mixture of n-butane & n-butene — Fixed bed Reactor / fluidized bed

Fixed bed process similar to that of Benzene process (Vanadium & Phosphorous oxide as catalyst)

HC in feedgas just below the explosion limit (1.8%–1%)

$$C_4H_{10} + \frac{7}{2}O_2 \longrightarrow C_4H_2O_3 + 4H_2O \quad \Delta H = -1260\ kJ/mol$$

- fairly small amount of MA can be condensed directly from the reactor exit gases
- Mostly / Most of MA washed out as Maleic Acid (65–70%)] dehydration (high energy input) process

→ MA → absorbed in Organic solvent } 98%

Solvent + MA → fractional distilled

light boiling solvent → returned to absorption column

Maleic Anhydride from n-butane by direct Oxidation (Simplified process flow sheet)

(Fluidized bed)