

# **INSECTICIDES**

## **(Part-I)**

**INDUSTRIAL CHEMISTRY**  
**B.SC 3<sup>RD</sup> YEAR HONOURS**  
**(STUDY MATERIAL)**

# Insecticides

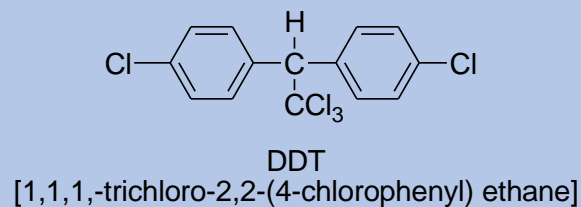
A substance or a mixture of substances used for killing the insects is called an insecticides. In other words, insecticides are agents or preparations used for the killing the insects.

Insecticides are classified into following **three categories** according to their mode of actions.

- 1. Stomach or internal insecticides:** These insecticides which are taken up by the insects are called stomach poisons or internal insecticides. e.g. grass hoppers, caterpillars are killed by BHC, DDT,  $\text{Pb}_3(\text{AsO}_4)_2$ ,  $\text{Ca}_3(\text{AsO}_4)_2$ , NaF.
- 2. Contact or external insecticides:** These insecticides destroy the insects simply by external body contact. e.g. leaf hoppers, thrips are killed by BHC, DDT, toxaphene, aldrin, malathion, partathion.
- 3. Fumigants:** These insecticides act on the insect through the respiratory system. e.g. HCN,  $\text{CS}_2$ , BHC, nicotine, ethylene oxide, methyl bromide.

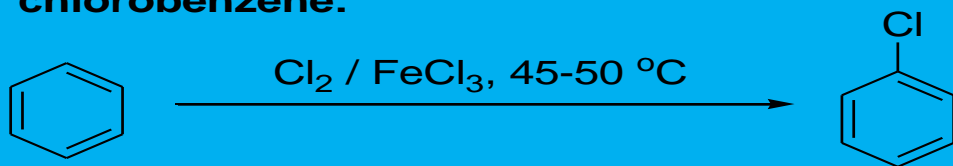
# DDT

**M.F:**  $C_{14}H_9Cl_5$ . **Colour:** White. The chemical name of DDT is dichloro diphenyl trichloro ethane.

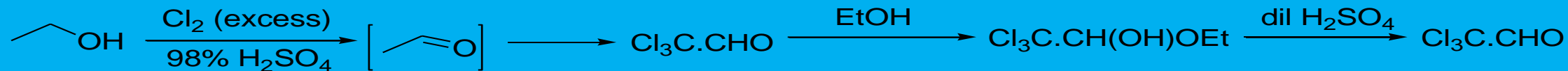


**Preparation:** It is prepared by the exothermic condensation reaction between chlorobenzene (2 equivalent) and chloral (1 equivalent) at about 20-30 °C in presence oleum or fuming sulphuric acid. At first chloral and chlorobenzene are condensed in a glass lined reactor in presence of 99-100% conc.  $H_2SO_4$ . The reaction takes about 5-6 hrs and temperature is maintained by external cooling (by means of brine or steam coils). The spent acid is withdrawn and the crude DDT is removed from the top, washed repeatedly with water and neutralised with soda ash. The mixture of DDT and unreacted chlorobenzene is then conveyed to a dryer where steam melts the DDT and unreacted chlorobenzene is distilled off. The molten DDT is then passed to a casting pan, the pure DDT thus obtained is pulverised before use. The preparation of starting materials and final product (DDT) has been shown in the following reaction scheme.

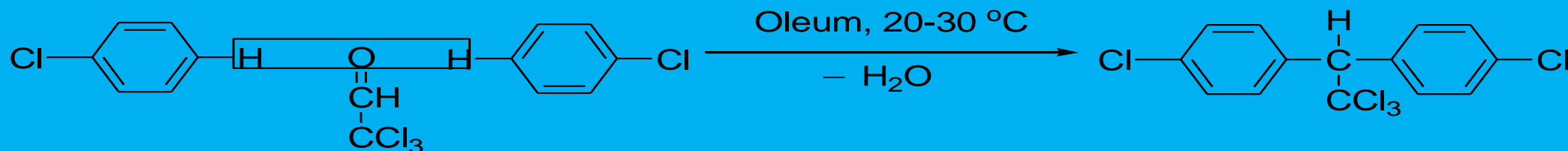
### Preparation of chlorobenzene:



### Preparation of chloral:



### Preparation of DDT

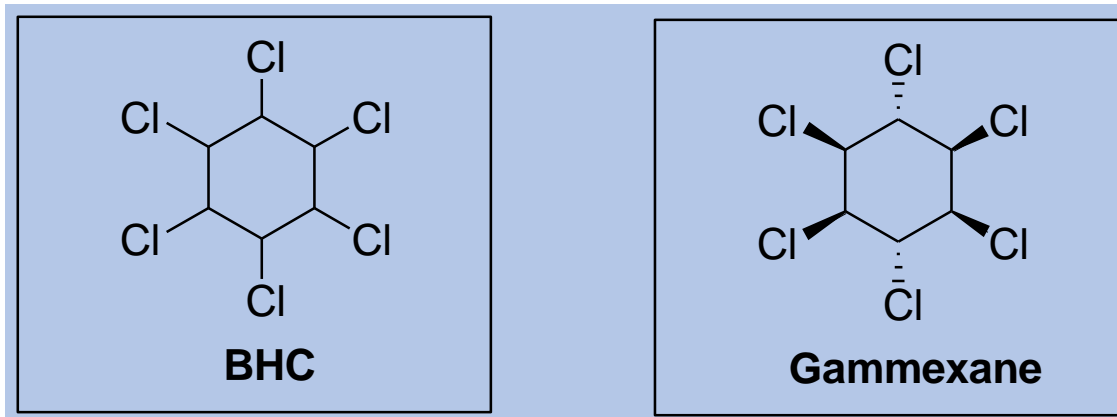


### Scheme: Preparation of DDT

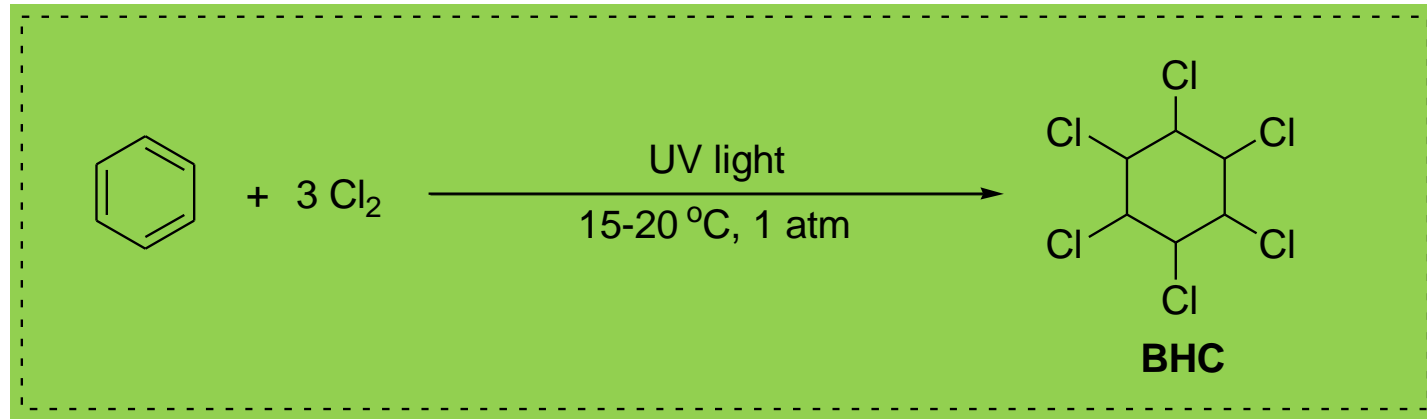
**Uses of DDT:** It is an important stomach insecticides and also used as poison in nervous system. It kills mosquitos besides other insects present in soya and cotton seeds. It is used as 25% powder or 10% emulsion. For rats the  $\text{LD}_{50}$  of DDT is 113-118 mg/kg.

# BHC

**M.F:**  $C_6H_6Cl_6$ . **Colour:** White. The chemical name of BHC is **benzene hexachloride or 1,2,3,4,5,6-hexachlorocyclohexane**, which exists in a number of stereoisomers ( $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$ ) the gamma being the most toxic which is called **gammexane**. It is  $\gamma$ -isomer of hexachlorocyclohexane and also named as lindane.



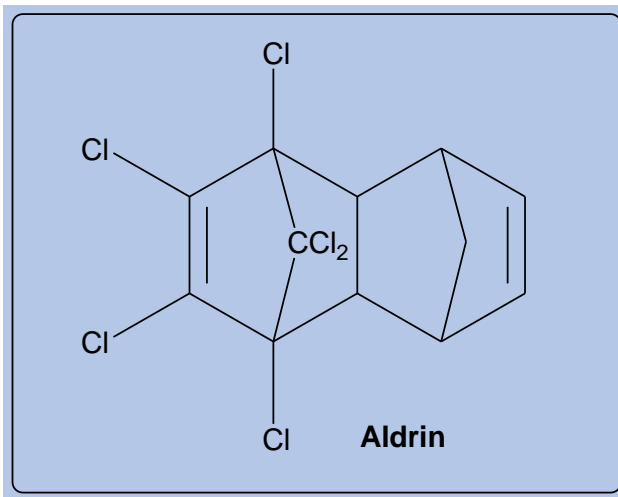
**Preparation:** BHC is prepared by the chlorination of benzene liquid in presence of sunlight in batch reactor or continuous flow reactor under 1 atm pressure at 15-20 °C temperature. The UV light is being produced from mercury vapour. The reaction is continued still the BHC concentration becomes 12-15%. The excess of  $Cl_2$  is air blown and the mother liquor is concentrated and finally fractional crystallisation followed by repeated solvent extraction ultimately afford the  $\gamma$ -isomer.



**Uses:** It has no contact action on human system and is therefore safe for domestic use. It is applied as dust, emulsion, granules and water dispersion. Gammexene is an exceptional insecticidal activity, insects that are not killed by DDT are killed by gammexane. It is successfully applied in food crops insects, common disease carrying insects, household stock, horticulture, stored food and agriculture pests.

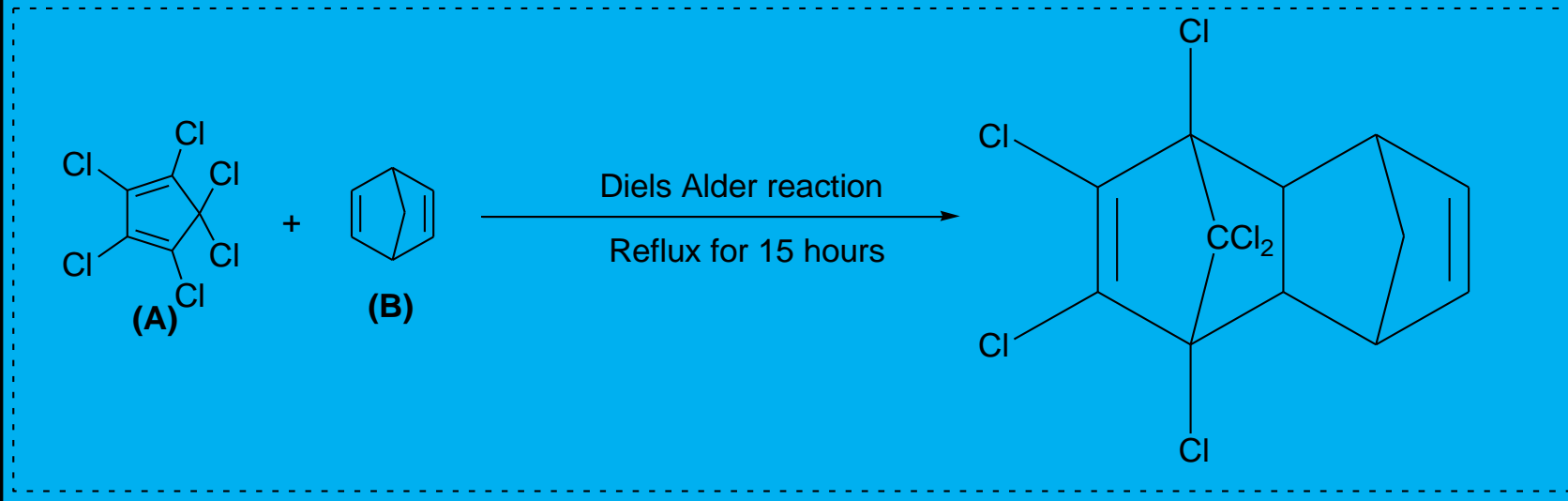
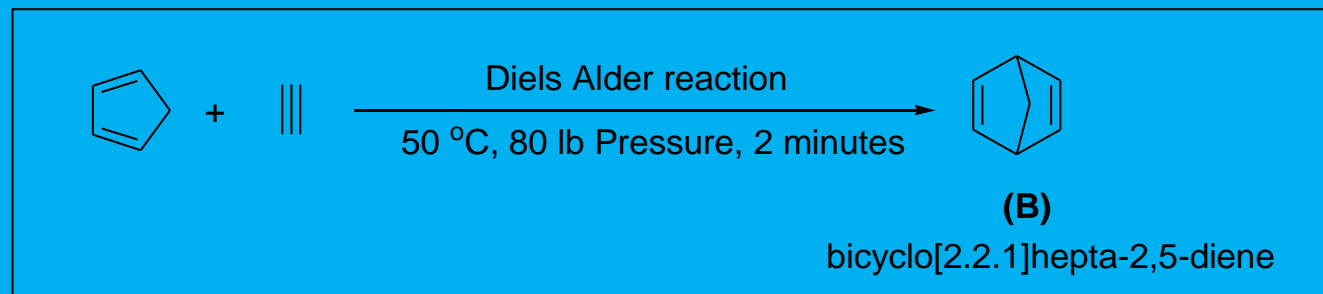
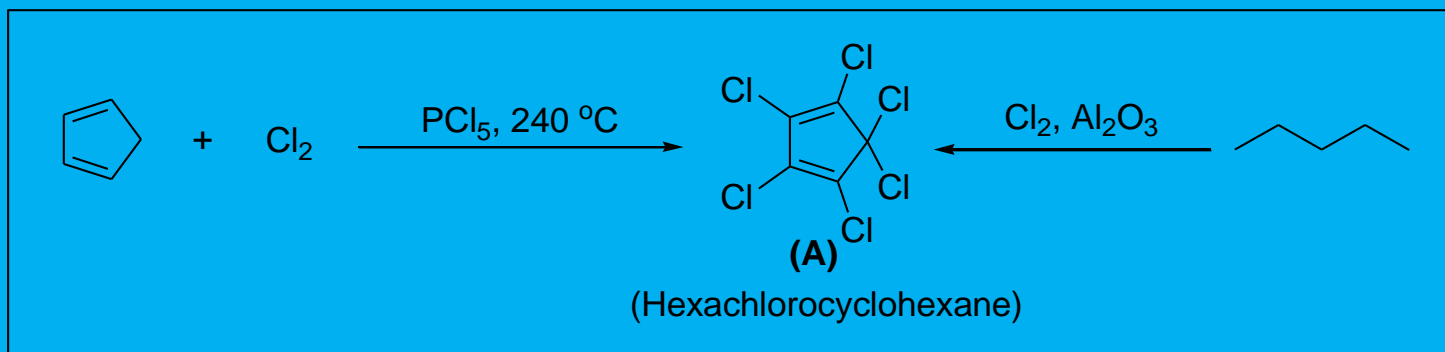
# Aldrin

**M.F.:**  $C_{12}H_8Cl_6$ . **Colour:** Brown. It is 1, 2, 3, 4, 10, 10-hexachloro-1, 4, 5, 8-endoxomethano-1, 4, 4a, 5, 8, 8a hexahydronaphthalene.



**Preparation:** It is commercially prepared by the Diels Alder reaction between **hexachlorocyclopentadiene (Hex)** and **bicyclo [2,2,1]hepta-2,5-diene**. The reactants are mixed and refluxed for 12-17 hrs. The preparation of starting materials and final product has been shown in the following reaction scheme.

**Uses:** It is used as an contact cum stomach poison and applied against grass hoppers, cotton insects, soil insects especially white ants. Aldrin is however toxic to cold and warm blooded systems.

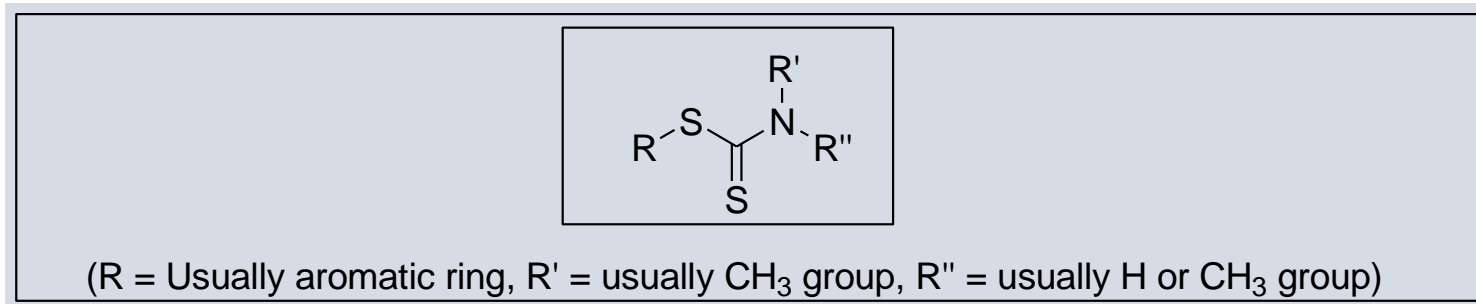
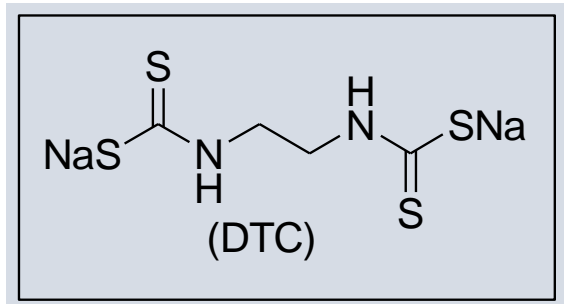


**Scheme: Preparation of Aldrin**

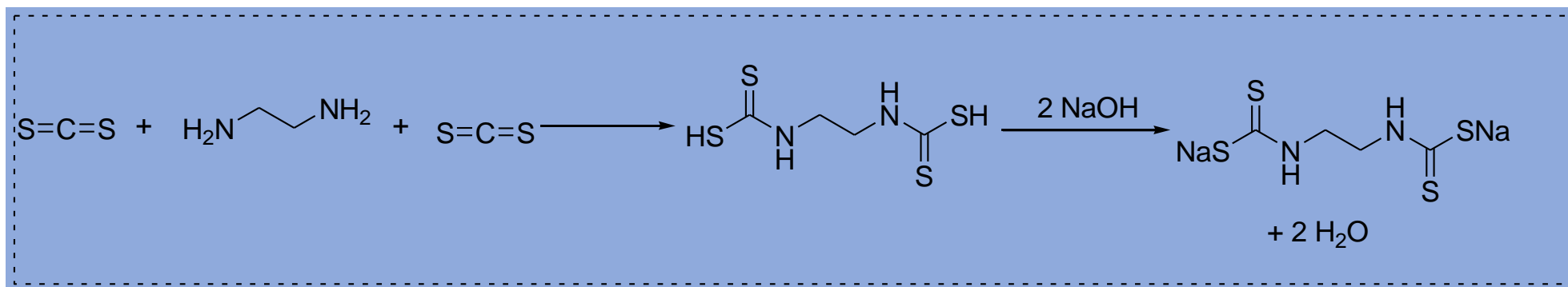


# Dithiocarbamate (DTC)

It is the disodium salt of ethylene bisdithiocarbamate (**left**). Many of the recently developed insecticides are the dithiocarbamate of the following type (**right**).



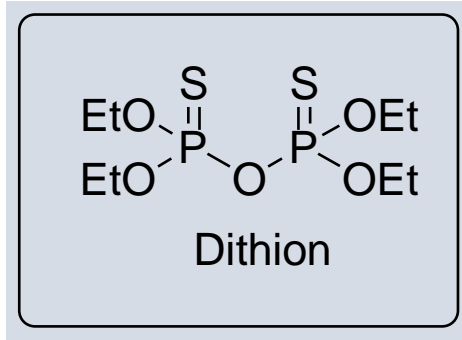
**Preparation:** It is prepared by the reaction between **ethylene diamine** two equivalent of **carbon di sulphide** followed by reaction with dilute NaOH solution.



**Uses:** It is widely used as fungicides especially to combat vegetables blights, particularly potato and tomato.

# Dithion

It is tetraethyl dithionone pyrophosphate.



**Uses:** It is a very good insecticide to kill aphids, mites, spiders, mealybugs, leafhoppers, lygus bugs, thrips, leafminers, and many other pests.