Natubhai V. Patel College of Pure & Applied Sciences

S. Y. B.Sc. (Industrial chemistry)

C-214: Chemical Process Industries
UNIT 5B

SYLLABUS

Agrochemical Industries

AGROCHEMICAL INDUSTRIES

5.10 INTRODUCTION

A **substance** or mixture of substances used for **killing the insects** is called an **insecticide**. Insecticides are agents or preparations used for the killing or destroying of insects. Insecticides are usually **classified into** the following **three** classes, 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 insecticides. Examples are grass hoppers, caterpillars etc.
2. **Contact or external insecticides**
   These insecticides destroy the insect simply by external bodily contact. Examples are leaf hoppers, thrips, aphids etc.
3. **Fumigants**
   These insecticides act on the insect through the respiratory system. Examples are hydrogen cyanide, carbon disulphide, nicotine, p-dichlorobenzene, BHC etc.
   The **insecticides** may be **applied as** a spray if liquid or in suspension as a dust or as a gas.

Chemically insecticides may be classified as inorganic, natural, and organic insecticides.

Stomach poisons	Contact insecticides	Fumigants
BHC, DDT, methoxychlor, lead arsenate, calcium arsenate, Paris green, NaF, fluorosilicates, compounds of P and Hg	BHC, DDT, Toxaphene, chlordane, aldrin, dieldrin, methoxychlor, nicotine, pyrethrins, rotenone, TEPP, melathion and parathion etc	BHC, HCN, CS_2, nicotine, p- dichlorobenzene, methyl bromide , ethylene oxide etc

5.11 INORGANIC INSECTICIDES

Before World War II, nearly all the **insecticides** were **inorganic compounds** of which arsenic, fluorine, sulfur and cyanide compounds were the most important. In recent years **inorganic insecticides** have been greatly **displaced by organic compounds** in many applications the major **disadvantages** of inorganic insecticides are their comparable toxicity to man and other warm blooded animals upon handling and as residues, on food products. **Some inorganic** insecticides are given below.

5.11.1 Lead Arsenate

Lead arsenate is used as an insecticide in the form of acid lead arsenate, $PbHAsO_4$. It may be **prepared by** first dissolving litharge in calculated amount of acetic acid and nitric acid and then the solutions is treated with theoretical amount of arsenic acid to precipitate out the arsenate. The precipitate of lead arsenate is separated by filtration and the waste acids in the filtrate are used again. The **yield** is about **95-97%.** The pink coloured compound contains about 31-33% arsenic trioxide.

$$3PbO + 2CH_3COOH \longrightarrow (CH_3COO)_2Pb.2PbO + H_2O$$

$$(CH_3COO)_2Pb.2PbO + 2H_3AsO_4 \longrightarrow Pb_3(AsO_4)_2 + 2CH_3COOH + 2H_2O$$

$$Pb_3(AsO_4)_2 + 2HNO_3 \longrightarrow 2PbHAsO_4 + Pb(NO_3)_2$$

$Pb(NO_3)_2 + H_3AsO_4 \longrightarrow 2PbHAsO_4 + 2HNO_3$

Lead arsenate is usually **employed** for the potato beetle and for the codling moth in apple orchards.

5.11.2 Calcium Arsenate

It is usually a **mixture** of **tricalcium arsenate** and **lime**. It is **cheaper** than lead arsenate and usually known as **Basic calcium arsenate**. It has, however, various **disadvantages**.

- It hydrolyses more rapidly.
- It may produce arsenic injury.
- It does not stick well to leaves, hence less effective.

It is **applied to** the **leaves** in the form of **dust**.

5.11.3 Paris green

Paris green is **copper aceto arsenate** $(CH_3COO)_2Cu.3Cu(AsO_2)_2$ and was previously **used** as a **green pigment**. It was first used as an insecticide 1867. The larvae of mosquitoes have been destroyed by spraying dust powder of Paris green on breeding areas.

5.11.4 Fluorine compounds

There are various fluorine compounds that have been used as insecticides. Some of the **important ones** are sodium fluoride, barium fluosilicate, sodium fluoaluminate (cryolite) etc. **Sodium fluoride** is widely used against roaches, and poultry lice. As it is too water soluble, its rapid removal by rains prohibits its use on leaves. For this reason, **other fluorine compounds**, such as fluosilicate and fluoaluninate are most suitable, because of their decreased solubility

5.11.5 Sulfur and Sulfur Components

Sulfur and its compounds are mostly employed **as contact insecticides** for the control of mites, spiders and other similar insects. They are now also **used as fungicides**. **Sulfur** is used as insecticide, either in its natural state or mixed with other materials. In the forms of its compounds, sulfur is widely used as lime sulfur, liver of sulfur and ammonium polysulphide. **Lime sulfur** can be prepared by adding water to a dry mixture of lime and sulfur. The heat of reaction from slaking of lime accelerates the reaction between $Ca(OH)_2$ and sulfur, as a result of which a self boiling lime sulfur is obtained. The **dry mixture** can be obtained by evaporating water from the boiled mixture. It is **used** for the control of scale insects and for control of diseases of tree fruits.

Finely divided **sulfur compounds** are **used** directly as natural fumigants in the form of dust or as sprays in aqueous suspension.

5.11.6 Hydrocyanic acid

It is usually **prepared** is situ by the action of sulfuric acid on sodium cyanide. It is used as an efficient for insects. **HCN** is recommended in **saving citrus fruits** and applied very carefully **because of** its strong action on human system also. But **parathion or like products** has largely replaced HCN, especially on citrus fruits.

5.12 NATURAL OR PLANT INSECTICIDES

Plant materials yield some of the most widely used insecticides and many of them, are being supplemented by the **synthetic organic insecticides**. The roots, steams, leaves of flowers may be finely ground and used as such or active parts may be **extracted** and either alone or with other toxicants and auxiliary materials. Nicotine, rotenone, allethrin etc., are well known examples of natural insecticides.

5.12.1 Nicotine

Nicotine is a volatile alkaloid **obtained** by treating stems and damaged leaves (by products of tobacco processing) with an aqueous solution of alkali followed by steam distillation. Since it is **volatile** in nature, most of the nicotine is **converted to sulfate** and sold as a **40% nicotine solution**. Nicotine solution has successfully been **applied** against aphides, leafhopper and thrips. It has also been employed as a fumigant.

Nicotine solution producing vapours of the alkaloid when poured on a hot surface fill the green house of ware house with fumes and attack the pests. It goes in through skin and respiratory system immobilizing the insect through nerve paralysis.

5.12.2 Pyrethrins

Flowers of the **pyrethrum plant** contain toxic, non nitrogenous organic **esters**, called **pyrethrins.** The compressed **flowers** are broken up, ground to a fine powder and the dried powdered flowers of the plant are then **extracted** several times with **kerosene oil** or other **organic solvent**. The extract is concentrated by removing the solvent in **vacuum** still below **60°C** and the resulting **oleoresin** is used to **prepare** the **finished insecticide**. It is a quick knock down powder **against** flies and non toxic to man as well as warm blooded animals. The activity of pyrethrins has been found to be associated with the four non nitrogenous organic esters (two pyrethrins and two cinerins).

5.12.3 Rotenone

It is **obtained** as a poisonous principal from the **roots of derris plants** and other **tropical** and **subtropical plants**. It may be obtained by the **extraction** of **ground derrits roots** with **$CHCl_3$** or **CCl_4**. The solvent is removed and residue is dissolved in acetone. They are **used** as fish poisons and effective stomach and contact poisons.

5.12.4 Allethrin

Flowers of **pyrethrum plant** contain toxic, non **nitrogenous organic esters** called **pyrethrins**. The compressed flowers are broken up, ground to a fine powder and then extracted several times with kerosene oil. The solvent is removed by vacuum distillation at 60°C and the resulting oleoresin is used to prepare the finished insecticide.

Allethrin is component of pyrethrum with almost identical insecticidal activity. Allethrin has also been found to be **effective** against **insects** resistant to D.D.T.

It is **quite effective** on files but not on other household pests. It is **used as** dust, as kerosene sprays with synergists(activators)and as aerosols containing 0.1 - 0.6% of the active principal.

5.13 <u>ORGANIC INSECTICIDES</u>

DDT, BHC, Gammaxane, melathione, dinitrophenol, methoxychlor etc. are the few examples of organic insecticides.

5.14 <u>D.D.T. (DICHLORO - DIPHENYL - TRICHLORO ETHANE)</u>

D.D.T. was first **prepared** by **O. Zeidler**, a German Ph. D student in **1874.** Its **insecticidal properties** were however, **discovered** by a Swiss chemist, **Paul Muller in 1939.**

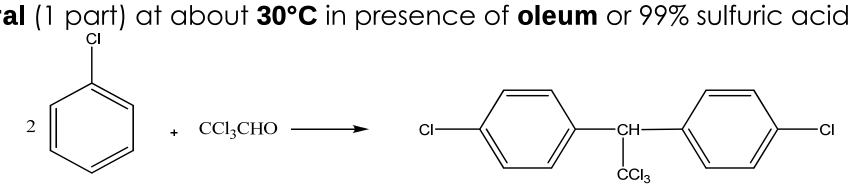
5.14.1 Raw materials

- Chlorobenzene: 2-4 parts
- Chloral: 1parts
- Oleum or sulfuric acid: 10 parts

Chloral used for the purpose is **obtained** by reaction of **ethyl alcohol** (0.75 parts) with **chlorine** (2.58 parts) in presence of **98%. H_2SO_4** (1.73 parts) in a **glass lined steel shell** provided with a jacket for temperature control (45-50°C) through brine solution. In the beginning temperature is kept at about **30° C** then raised to **45-50°C** and maintained for about **1 hour**. It is further increased to **75°C** for another **1 hour** and then raised slowly to **90°C** at the rate of 1°C per hour. The over head gases consist of excess alcohol vapours, some Cl_2 and HCl along with some ethyl chloride. From this mixture, alcohol is recovered by condensation, and transferred back to the reactor to be used again. Water absorbs HCl. The heavy liquid consisting of chloral-alcoholate is decomposed by dilute H_2SO_4 into chloral and alcohol. These are separated by fractional distillation.

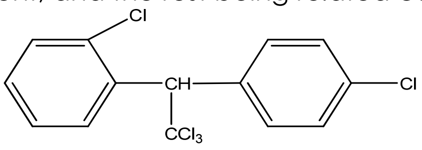
5.14.2 Manufacture

D.D.T. is manufactured by **exothermic** condensation of **chlorobenzene** (2-4 parts), with **chloral** (1 part) at about **30°C** in presence of **oleum** or 99% sulfuric acid (10 parts).

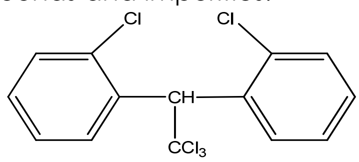


Chloral and chlorobenzene are condensed in a **glass lined reactor** in presence of 90-100% conc. H_2SO_4. The reaction takes **5-6 hours** and the temperature is maintained at **15-30°C**, by external cooling. The external cooling is done by means of brine or steam coils. The spent acid is withdrawn and the **crude D.D.T**. is removed from the top **washed with water** several times and then **neutralized** with **soda ash**. The mixture of D.D.T and unreacted chlorobenzene is then conveyed to a **dryer**, where steams melts the D.D.T. and distils any unreacted chlorobenzene, overhead. The molten D.D.T. is then passed to **casting pans** and practically pure product, thus obtained is pulverized for the market.

Actually the commercial D.D.T. is a mixture of various isomers in which the para isomers: 2, 2-bis (p-chlorophenyl)-1, 1, trichloroethane is present in 70%, the ortho-para10-15percent, and the rest being related compounds and impurities.



O-P' isomer of DDT



O-O' isomer of DDT

The purified p-p' isomer is a white crystalline solid (m.p. 100°C). DDT is generally used as a dust containing 5-10% emulsions having 25% of the material and also as aerosols.

5.14.3 Uses

D.D.T kills lice and mosquitoes which carry germs of typhus and malaria fever respectively. **D.D.T.** was the **first chemical** to have the property of **killing insects** only be means of **contact**. D.D.T. is still the backbone of many insect control programs, and is widely **used as** a household insecticide, against leaf hoppers and potatoes and in cotton insect control. Some **insects possess** an **enzyme**, which **converts D.D.T.** into a **harmless product** by eliminating HCl from the chloral residue. Hence these **enzymes are resistant to D.D.T.** Fortunately, **insects** that are **not** controlled or **killed by D.D.T**, are **killed by** gammexane, or Dieldrin. D.D.T. is a remarkably powerful and persistent insecticide and soluble in kerosene oil, petrol and ethyl alcohol but insoluble in water.

5.15 B.H.C. OR BENZENE HEXACHLORIDE

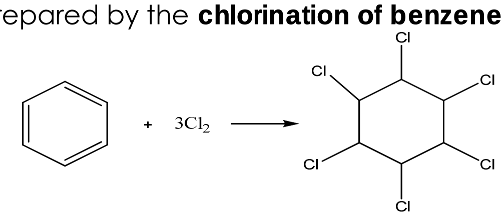
BHC or benzene hexachloride or more correctly 1,2,3,4,5,6 hexachlorocychlohexane is another important insecticide, which exists in a **number of stereoisomers**, the **gamma** being the **most toxic**.

The commercial **BHC** possesses **5 main geometrical isomers**. The percentage of each of the isomers in the commercial BHC is **alpha** (55-70%), **beta** (5-14%), **gamma** (10-13%), **delta** (6-8%), **epsilon**(3-4%). Later on various isomers were separately prepared or separated from the mixture and it was found that BHC has insecticidal property of **gamma-isomer.**

The gamma BHC is usually known as **Gammexane or Lindane.** It is refined material containing 99% of gamma isomer of BHC.

5.15.1 Manufacture

The BHC is prepared by the **chlorination of benzene** in presence of **sunlight**.



Chlorine gas in passed into benzene liquid in the presence of sunlight. The product is a mixture of **five** out of **eight** possible isomers of which the physiologically active isomer does **not exceed 18%.** The amount and formation of γ- isomer has been found to increase in presence of some substances such as sulfur, selenium, tellurium, nitrotoluenes, dialkyl peroxy dicarbonates etc. Excess of benzene is used in order to keep the products in solution and to continue the reaction under homogeneous conditions. The reaction can also be carried out in presence of r radiation of fluorine (elemental) instead of U.V. radiation.

The **manufacture** can be carried out by **batch process** or by **continuous process**.

In batch process technical grade **benzene** and **chlorine** are reacted in a **lead lined vessel** provided with cooling arrangement and **mercury vapour lamp** is used as a **U.V. source**. The temperature is kept between **15-20⁰C** and **pressure** is maintained **slightly above atmospheric pressure**, in order to minimize the loss of benzene. The reaction is continued till the **BHC** concentration attains **12-15%.** The excess of chlorine is air blown and the mother liquor is concentrated and finally fractionally crystallized to isolate the biologically active γ- isomer.

In continuous process chlorination is carried out in a **glass lined pipe chlorinator** in the central tube of which benzene is taken and **U.V. source** is **two 40 watt fluorescent lamps**. The temperature is **40-60°C** and **pressure** is **atmospheric**. The chlorination is continued till the concentration of **BHC** reaches **13-14.5%.** The chlorinated liquor is concentrated at **85-88°C** till it becomes saturated in γ - isomer and almost all the γ- and β- isomers are crystallized out. The crystals are separated by filtration and the filtrate or mother liquor is subjected to steam distillation. The molten residue in the vessel is cooled to get lumps of crude BHC containing 25% of the γ-isomer. The **isomer** is then **extracted** by solvent extraction using hexane-nitromethane solvent mixture. The ground solid is then deodorized with treatment with oleum or agitation in air with $CaCO_3$, MnO_2, Kaoline and Manganese linolate. γ-isomer of BHC is more soluble than other in most organic solvent.

5.15.2 Uses

It kills or controls insects, grass hoppers and common pests and used in the form of dust containing 5-10% of the ingredients in emulsion containing 25% of the γ-isomer and also as granules having 6-10% of the active principal.

5.16 GAMMEXANE

5.16.1 Manufacture

Crude BHC is generally **not suitable** for food crops, because of its **strong musty odour**. **Gammexane** or **Lindane**, a refined material containing 99% of the BHC, has largely overcome the odour.

99% pure BHC, called **Lindane or Gammexane** is **prepared** by its **selective crystallization** followed by repeated **solvent extraction**. It has no contact action on human system and so it is safe insecticide for domestic use. It is applied as dust emulsion, granules and as water dispersion.

5.16.2 Properties

γ-benzene hexachloride is a colourless, practically odourless crystalline solid insoluble in water, but soluble in organic solvents e.g. acetone. It is stable to air, heat and light. It is also stable to strong acids but decomposes in contact with hot alkalis.

5.16.3 Uses

Gammexane has exceptional insecticidal activity, comparable to that of DDT and may be used in food crops. Insects that are not killed by Gammexane have also been applied successfully against the common disease carrying insects, household stock, horticulture, stored food and agriculture pests. Gammexane has widely been used also as an agricultural pesticide.

5.17 MALATHION

5.17.1 Manufacture

It is phosphorodithionate and is prepared from ethyl maleate and o⁻,o⁻ dimethyl-dithiophosphate. It has low mammalian toxicity and used for nearly all fruits, vegetable, field crops and household insects. Chemically it is o⁻,o⁻ dimethyldithiophosphate of diethyl mercaptosuccinate.

5.17.2 Properties

It is an amber coloured liquid party soluble in water but completely soluble in most organic solvents. It is about 100 times less toxic then parathion to human system, but more powerful in insecticidal action.

5.17.3 Uses

It is not only a good miticide but very effective against mosquitoes, flies, and external parasites on live stock. It also acts as a **fungicide as well as rat repellent.** It is applied as dust emulsions and wettable powders.

5.18 FUMIGANTS

Fumigants are the chemical preparations whose **vapours** are **poisonous**. A number of such compounds are of great importance soil. **Examples** are chloropicrin, carbon disulphide, methyl bromide and ethylene dibromide (which is very effective in control of wire worms). **Halogenated alkanes** are the most common fumigants now a days, because **chloropicrin** is highly irritating, **CS_2** is not used because of explosive hazards and **methyl bromide** has application problems. The **ethylene dibromide** has widely been applied on crops in storage, particularly grains and seeds, which may become infected with insects, rodents and micro-organisms. The fumigants must be stored in tight containers.

HCN and **CCl_4** either alone or in combination are also used as important **fumigants.**

5.18.1 Ethylene dibromide (EDB)

It can be **prepared** by bromination of ethylene in CCl_4 solvent, followed by careful removal of the solvent.

$$C_2H_4 + Br_2 \longrightarrow C_2H_4Br_2$$

EDB is colourless, volatile, non-inflammable liquid. It is soluble in most organic solvents and used as CCl_4 solution of EDB in the form or EDB ampoules and fume tablets. It is not suitable for house hold use because it is highly toxic to humans also.

5.18.2 Ethylene dichloride (EDC)

It is **prepared** by direct chlorination of ethylene in presence of vapours of ethylene dibromide at **40-50° C**.

$$C_2H_4 + Cl_2 \longrightarrow C_2H_4Cl_2$$

The mixed vapours are passed through a condensing column, as a result of which dibromide liquefies and dichloride vapours pass out. **Ethylene dichloride** is a colourless, non corrosive gas soluble in most organic solvents. It is used as CCl_4 solution above 20°C. Its CCl_4 solution in dilute form is safe as well as noninflammable.

5.18.3 p- dichlorobenzene

It is **manufactured** by the **chlorination** of **chlorobenzene** at **150-190°C** in presence of **$FeCl_3$**, as a result of which a mixture of o- and p-dichlorobenzene is formed. The **unreacted** chlorobenzene is separated from the mixture by **distillation** and the **mixture** of o- and p-isomers is treated with **methanol**. The **o-isomer** is **selectively dissolved** leaving behind the **crystals of p-dichlorobenzene**, which are further purified by **distillation** under vacuum at **100°C**.

If the **chlorination** of the **mixture** of o- and p-dichlorobenzene is further **carried out** in presence of **$FeCl_3$**, the **o-isomer** is converted into 1, 2, 4 trichloro benzene, leaving the **p-isomer** largely **unchanged**. The mixture of 1, 2, 4 trichlorobenzene and p-dichlorobenzene can be separated by fractional distillation under vacuum, because there is a wide difference in the boiling points of the chloro derivates.

If the **mixture** of o- and p-dichlorobenzene is treated with **chlorosulphonic acid** at **15^0C**, the o- isomer is converted into the corresponding sulphonic acid but p-isomer remains unaffected and can be separated from the mixture by fractional distillation.

p-dichlorobenzene in nearly **86% yield** can also be obtained along with ortho- and some meta-isomers, when benzene is chlorinated in presence of **$SbCl_3$** and **benzene sulphonic acid** or **p-toluene sulphonic acid** as **catalyst**. The p-dichlorobenzene can be readily **separated** from the mixture by **treatment** with **cold methanol**.

p-dichlorobenzene is a white crystalline solid having strong camphor like odour. It is insoluble in water but soluble in organic. It has a **strong fumigant action** on mites and moths. It is non-staining and non corrosive.

5.18.4 Aluminum phosphide

It can be **obtained** by the reduction of aluminum phosphate with carbon. It is a white solid which undergoes decomposition in contact with moisture to from PH_3

$AlP + 3H_2O \rightleftharpoons Al(OH)_3 + PH_3$

It is **used** as tablets in conjugation with ammonium carbonate, a solid which produces NH_3 and CO_2 and thus prevents the flammability due to poisonous phosgene. It has no post fumigation hazards because of $Al(OH)_3$, being left as dust. Its action is however slow.

5.19 RODENTICIDES

Rodenticides are useful in **controlling** certain **pest animals** such as mice, rates, ground-hogs, squirrels and field rodents because of their ability to do extensive property damage and to spread disease.

Rodents are lower vertebrates with short frontal teeth and they cause much damage to fabrics, crops and property due to their gnawing habit with almost everything they come across. Rates, mice squirrels etc are the well known examples of rodents. The **chemicals** which are used to **fight rodents** are called **rodenticides**. A useful rodenticide must be tasteless and odourless at the concentration required for the bait and must be a slow initiator of the poison action followed by oral administration.

Rodenticides may be **natural** or **chemical**. **Red squill**, isolated from a plant of lily family is an example of **natural rodenticide**. The raw sqill after grinding is carefully processed in an oven and used as such for eating with food. It is used as a powder or an extract in a suitable solvent. **Chemical rodenticides** may be **anticoagulants** and **acute rodenticides**. The **anticoagulants** destroy the blood vessels by antagonizing the normal functioning of vitamin K in the blood. They interface with the complex blood clotting process and cause death of the rodent through internal bleeding. **Warfarin** is an example of anticoagulant.

5.20 FUNGIGIDES

Fungicides have been prepared **to use against** fungi, parasitic plants comprising the molds, rusts, smuts, mildews, mushrooms and allied forms capable of destroying higher plants, fabrics and even glass. They attack seeds, growing plant, plant material and may even destroy finished products such as adhesives, paints and fabrics.

Sulfur components and compounds of heavy metals such as copper and mercury have widely been used as inorganic fungicides.

5.21 ATTRACTANTS AND REPELLENTS

Attractants and repellents have been made to eliminate hazards to other froms of life endangered by potent pest killers. For example, **food baits** have been combined with toxicants and then used against specific insects, such as fire ants, cockroaches etc. A water extract of decaying wood, prepared by inoculating wood with fungi is nothing but a good **termite attractant.** Unsaturated alcohols containing 16 carbon atoms main chain have synthesized as **sex attractants** and used for gypsy and silk worm moths and for cockroaches. One of the sex-attractants is 2, 2, dimethyl-3-isopropylidenecyclopropyl propionate and it is used for cockroaches successfully. The sex lure draws male insects from a distance but some derivatives of aziridine used as **chemosterilant,** halts the reproducuction. Some **repellents** have also been against animals and insect pests. **Diethyl toluamide** is a common all purpose repellent and may be applied directly to the skin. It is commercially available as 15% aerosol spray under the name off. **Thuricide** is another as well as repellent which is neither toxic to animals nor to plants but causes diseases in certain, e.g., cabbage loppers and diamond-back moth larvae on cauliflower, cabbage and lettuce.

5.22 GROWTH REGULATORS

Plant growth regulators are used to improved yields, increases or decreases seed germination, cause early or late maturation of plant, improved quality, accelerate the ripening of fruits and grains increases yield, halt undestroyable flowering and it prevent prehaverst fruits droop. The **1st substances** to become commercially important were 3-indole acetic acid, naphthalene acetic acid etc.

These substances **use** to inhibit preharvest fruit of apples, flowering in fine apples can be includes by using as little amount of 2-chloroethyl phosphoric acid. Floral production is also controlled by spraying with succinic acid, 2-2 dimethyl hydrazine.

5.23 INDUSTRIAL BIOCIDES

The **name** is generally **applied to** product which **killed or control** microorganism bacteria, algi, fungi etc. Copper compounds and penta chlorophenol is used. It is also used as disinfection and sensitizer, paints, hospital products, wood preservative, cooling water system, paper, plastics and resin and metal working also required biocides. The new organic material includes halogenated substances, phenolic, organic compound, inorganic material and other N_2 compounds.

5.24 HERBICIDES

The fastest growth in the field of agriculture chemical is that of herbicides. It is the lowest cost methods of **controlling herbs, weeds and bushes**.

There are in general **three classes of herbicide chemicals**

1. Contact chemicals
2. Systematic chemicals
3. Soil sterilants

They may are also be considered as **selective** and **non-selective herbicides**, which can further be subdivided, depending upon the mode of application. The non-selective herbicides includes sodium chlorate, sodium arsenate, various borates, industrial waste and oil spray etc. 2,4-D (2,4-dichlorophenoxy acetic acid) is good example of selective herbicide.

According **to action of herbicides**, it may be classified as

1. Plant sex cell killer
2. A growth inhibitor
3. Plant growth regulators cum weed killers

5.25 PESTICIDES

Insects have more species (over one million already described) than any other form of animal life and are in many ways the most indestructible form. About 1 % of the species of offer hazard to humans and animals. Various misery-causing diseases are carried by insects: malaria, yellow fever, typhus and plague to name a few. When insecticides are applied widely a few of the local insects are destroyed, but the remaining ones are those most resistant to the destroying agent to kill such insects pesticides are used.

5.26 EXERCISE

1. With the help of flow diagram explain the manufacture of following
   - Phosphoric acid by using electric furnace
   - Phosphoric acid by using blast furnace
   - Phosphoric acid from phosphorus by oxidation and hydration
   - Phosphoric acid by wet process
   - Superphosphate
2. Discuss manufacture of yellow phosphorus
3. With the help of diagram explain manufacture of red phosphorus
4. Write notes on
   - Ammonium phosphate
   - Super phosphate
   - DDT
   - BHC

- Inorganic insecticide
- P-dichlorobenzene
- Rodenticides
- Attractants and Repellents
- Herbicides
- Pesticides
- Fumigants

5. Define insecticides. Write their classification according to its chemical constitution and their modes of action.

5.27 FURTHER READING

1. Industrial chemistry by B. K. Sharma
2. Shreve's chemical process industries by George T. Austin