Unit - II

Environmental Pollution

2.1 INTRODUCTION

Environmental pollution may be defined as, "***the unfavorable alteration of our surroundings***". It changes the quality of air, water and land which interferes with the health of humans and other life on earth.

Pollution are of different kinds depending on the nature of pollutant generated from different sources.

Examples *Industry, automobiles, thermal power plants, farming, nuclear reactors, generate different types of pollutants causing pollution to air, water bodies and land.*

2.1.1 Types of Pollutants

1. Biodegradable pollutants: Biodegradable pollutants decompose rapidly by natural processes.

2. Non-degradable pollutants: Non-degradable pollutants do not decompose (or) decompose slowly in the environment.

The slowly decomposed materials are more dangerous because it is more difficult to remove them.

2.1.2 Classification of Pollution

The different kinds of pollution that affects the environment are,

1. Air Pollution
2. Water Pollution
3. Soil Pollution and
4. Noise Pollution

2.2 AIR POLLUTION

Definition

Air pollution may be defined as, "***the presence of one (or) more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings, plants and animals.***"

The rapid industrialization, fast urbanization, rapid growth in population, drastic increase in vehicles on the roads and other activities of human beings have disturbed the balance of natural atmosphere.

Composition of Atmospheric Air

During several billion years of chemical and biological evolution, the composition of the earth's atmosphere has varied. Today, about 99% of the volume of air we inhale consists of two gases: Nitrogen and Oxygen.

Table 2.1 Composition of atmospheric air

Constituents	%
Nitrogen	78
Oxygen	21
Argon (Ar)	< 1
CO_2	0.037
Water vapour	Remaining
O_3, He, NH_3	Traceamount

2.2.1 Sources of Air Pollution

The sources of air pollution are of two types

1. Natural sources

Examples *Volcanic eruptions, forest fires, biological decay, pollen grains, marshes, radioactive materials etc.*

These pollutants are caused by the natural sources.

2. Man-made (anthropogenic) activities

Examples *Thermal power plants, vehicular emissions, fossil fuel burning, agricultural activities etc.,*

2.2.2 Classification of Air Pollutants

Depending upon the form (origin) of pollutants present in the environment, they are classified as

(i) Primary air pollutants.

(ii) Secondary air pollutants.

1. Primary air pollutants

Primary air pollutants are those emitted directly in the atmosphere in harmful form.

Examples *CO, NO, SO_2, etc.,*

Indoor Air Pollutants

Indoor air pollutants are primary air pollutants. The most important indoor air pollutant is radon gas.

Sources (causes) of indoor air pollutants

1. Radon gas is emitted from the building materials like bricks, concrete, tiles, etc., which are derived from soil containing radium.
2. It is also present in natural gas and ground water and is emitted indoors while using them.
3. Burning of fuels in the kitchen, cigarette smoke, liberates the pollutants like CO, SO_2, formaldehyde, BAP (benzo-(a) pyrene).

2. Secondary air pollutants

Some of the primary air pollutants may react with one another (or) with the basic components of air to form new pollutants. They are called as secondary air pollutants.

Example

$$NO/NO_2 \xrightarrow{Moist} (HNO_3/NO_3) \text{ etc.,}$$

2.2.3 Common air pollutants sources (causes) and their effects

According to the World Health Organization (WHO), more than 1.1 billion people live in urban areas where outdoor air is unhealthy to breathe. Some of the common air pollutants are described below.

1. Carbon monoxide (CO)

Description

It is a colourless, odourless gas that is poisonous to air-breathing animals. It is formed during the incomplete combustion of carbon containing fuels.

$$2C + O_2 \longrightarrow 2CO$$

Human Sources (causes)

Cigarette smoking, incomplete burning of fossil fuels. About 77% comes from motor vehicle exhaust.

Health Effects

Reacts with heamoglobin in red blood cells and reduces the ability of blood to bring oxygen to body cells and tissues, which causes headaches and anemia. At high levels it causes coma, irreversible brain cell damage and death.

Environmental Effects

It increases the globe temperature.

2. Nitrogen dioxide (NO_2)

Description

It is a reddish-brown irritating gas that gives photochemical smog. In the atmosphere it can be converted into nitric acid (HNO_3).

$$NO_2 + \text{Moisture} \longrightarrow HNO_3$$

Human Sources (causes)

Fossil fuel burning in motor vehicles (49%) and power industrial plants (49%).

Health Effects

Lung irritation and damage.

Environmental Effects

Acid deposition of HNO_3 can damage trees, soils and aquatic life in lakes, HNO_3 can corrode metals and eat away stone on buildings, statues and monuments. NO_2 can damage fabrics.

3. Sulphur dioxide (SO_2)

Description

It is a colourless and irritating gas. It is formed mostly from the combustion of sulphur containing fossil fuels such as coal and oil. In the atmosphere it can be converted to sulphuric acid (H_2SO_4) which is a major component of acid deposition.

Human Sources (causes)

Coal burning in power plants (88%) and industrial processes (10%).

Health Effects

Breathing problems for healthy people.

Environmental Effects

Reduce visibility, acid deposition of H_2SO_4 can damage trees, soils and aquatic life in lakes.

4. Suspended particulate matter (SPM)

Description

It includes variety of particles and droplets (aerosols). They can be suspended in atmosphere for short periods to long periods.

Human Sources (causes)

Burning coal in power and industrial plants (40%), burning diesel and other fuels in vehicles (17%), agriculture, unpaved roads, construction etc.,

Health Effects

Nose and throat irritation, lung damage, bronchitis, asthma, reproductive problems and cancer.

Environmental Effects

Reduces visibility, acid deposition and H_2SO_4 droplets can damage trees, soils and aquatic life in lakes.

5. Ozone (O_3)

Description

Highly reactive irritating gas with an unpleasant odour that forms in the troposphere. It is a major component of photochemical smog.

Human Sources (causes)

Chemical reaction with volatile organic compounds (emitted mostly by cars and industries) and nitrogen oxides.

Environmental Effect

Moderates the climate.

6. Photochemical smog

Description

The brownish smoke like appearance that frequently forms on clear, sunny days over large cities with significant amounts of automobile traffic.

Sources (causes)

It is mainly due to chemical reactions among nitrogen oxides and hydrocarbon by sunlight.

Health Effects

Breathing problems, cough, eye, nose and throat irritation, heart diseases, reduces resistance to colds and pneumonia.

Environmental Effects

Ozone can damage plants and trees. Smog can reduce visibility.

7. Lead (Pb)

Description

Solid toxic metal and its compounds, emitted into the atmosphere as particulate matter.

Human Sources (causes)

Paint, smelters (metal refineries), lead manufacture, storage batteries, leaded petrol.

Health Effects

Accumulates in the body, brain and other nervous system damage and mental retardation (especially in children); digestive and other health problems, some lead-containing chemicals cause cancer in test animals.

Environmental Effect

Can harm wild life.

8. Hydrocarbons (aromatic and aliphatic)

Description

Hydrocarbons especially lower hydrocarbons get accumulated due to the decay of vegetable matter.

Human sources (causes)

Agriculture, decay of plants, burning of wet logs.

Health Effects

Carcinogenic.

Environmental effect

It produces an oily film on the surface and do not as such causes a serious problem until they react to form

secondary pollutants. Ethylene causes plant damage even at low concentrations.

9. Chromium (Cr)

Description

It is a solid toxic metal, emitted into the atmosphere as particulate matter.

Human Sources (causes)

Paint, smelters, chromium manufacture, chromium plating.

Health effects

Perforation of nasal septum, chrome holes, gastro intestinal ulcer, central nervous system disease and cancer.

2.2.4 Control (or) Preventive Measures of air pollution

The atmosphere has several built-in self cleaning processes such as dispersion, gravitational settling, flocculation, absorption, rain washout and so on, to cleanse the atmosphere. In terms of a long range control of air pollution, control of contaminants at their source is a more desirable and effective method through preventive (or) control technologies.

I. Source control

Since we know the substances that causes air pollution, the first approach to its control will be through source reduction. Some actions that can be taken in this regard are as follows:

1. Use only unleaded petrol.
2. Use petroleum products and other fuels that have low sulphur and ash content.

3. Reduce the number of private vehicles on the road by developing an efficient public-transport system and encouraging people to walk (or) use cycles.
4. Ensure that houses, schools, restaurants and places where children play are not located on busy streets.
5. Plant trees along busy streets because they remove particulates and carbon monoxide, and absorb noise.
6. Industries and waste disposal sites should be situated outside the city centre preferably downwind of the city.
7. Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons.

II. Control measures in industrial centers

1. The emission rates should be restricted to permissible levels by each and every industry.
2. Incorporation of air pollution control equipments in the design of the plant layout must be made mandatory.
3. Continuous monitoring of the atmosphere for the pollutants should be carried out to know the emission levels.

Equipments used to control air pollution

Air pollution can be reduced by adopting the following approaches.

(i) To ensure sufficient supply of oxygen to the combustion chamber and adequate temperature so that the combustion is complete, eliminating much of the smoke consisting of partly burnt ashes and dust.

(ii) To use mechanical devices such as scrubbers, cyclones, bag houses and electro-static precipitators, reducing particulate pollutants..

The four figures (fig 2.1) are commonly used control methods for removing particulates from the exhaust gases

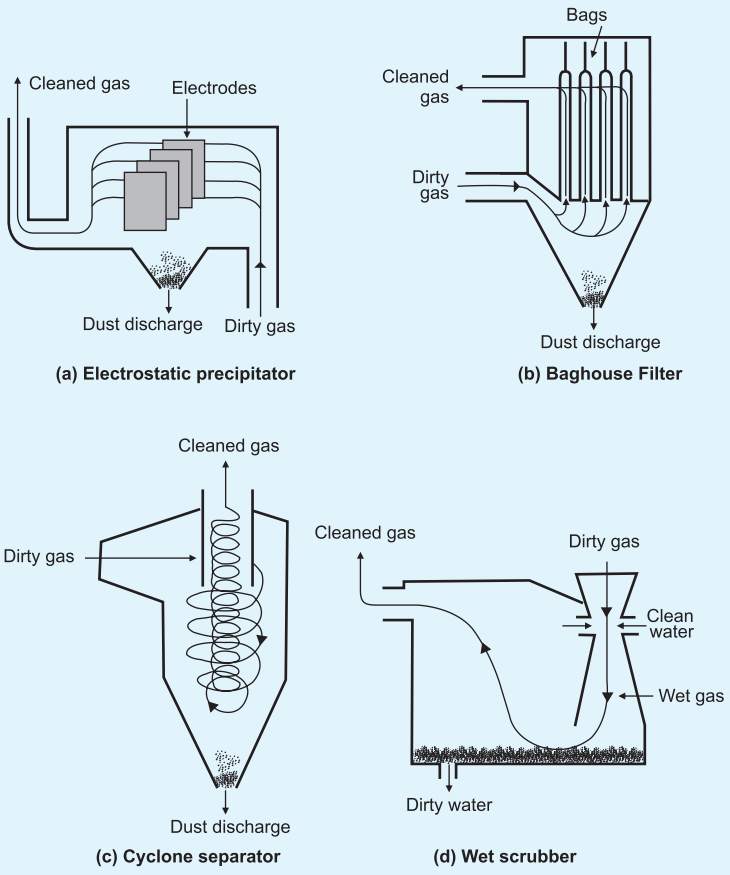


Fig. 2.1 Control methods for removing particulates from exhaust gases

of electric power and industrial plants. All these methods retain hazardous materials that must be disposed of safely. The wet scrubber can also reduce sulphurdioxide emissions.

(iii) Chemical treatment to deal with factory fumes.

The disposal of the collected air pollutants is equally important for successful control of air pollution.

2.3 WATER POLLUTION

Definition

Water pollution may be defined as, ***"the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on humans and aquatic life.***"

The pollutants include sewage, industrial chemicals and effluents, oil and other wastes. Besides, chemicals from the air dissolved in rain water, and fertilizers, pesticides and herbicides leached from the land also pollute water.

2.3.1 Types, effects and sources (causes) of water pollution

Water pollution is any chemical, biological (or) physical change in water quality that has a harmful effect on living organisms (or) makes water unsuitable for desired uses.

1. Infectious Agents

Example *Bacteria, viruses, protozoa and parasitic worms.*

Human Sources (causes)

Human and animals wastes.

Effects

Variety of diseases.

2. Oxygen Demanding Wastes (Dissolved oxygen)

Example *Organic wastes such as animal manure and plant debris that can be decomposed by aerobic (oxygen-requiring) bacteria.*

This degradation consumes dissolved oxygen in water. Dissolved oxygen (DO) is the amount of oxygen

dissolved in a given quantity of water at a particular pressure and temperature.

The saturated point of DO varies from 8-15 mg/lit.

Human Sources (causes)

Sewage, animal feedlots, paper mills, and food processing facilities.

Effects

Large populations of bacteria decomposing these wastes can degrade water quality by depleting water of dissolved oxygen. This causes fish and other forms of oxygen-consuming aquatic life to die.

3. Inorganic Chemicals

Example *Water soluble inorganic chemicals.*

(i) *acids,*

(ii) *compounds of toxic metals such as lead (Pb), arsenic (As) and selenium (Se) and*

(iii) *salts such as NaCl in ocean water and fluorides* (F^-) *found in some soils.*

Human Sources (causes)

Surface runoff, industrial effluents and household cleansers.

Effects

(i) Can make fresh water unusable for drinking (or) irrigation.

(ii) Causes skin cancers and neck damage.

(iii) Damage the nervous system, liver and kidneys.

(iv) Harm fish and other aquatic life.

(v) Lower crop yields.

(vi) Accelerates corrosion of metals exposed to such water.

4. Organic Chemicals

Examples *Oil, gasoline, plastics, pesticides, cleaning solvents, detergents.*

Human Sources (causes)

Industrial effluents, household cleansers, surface runoff from farms.

Effects

(i) Can threaten human health by causing nervous system damage and some cancers.

(ii) Harm fish and wild life.

5. Plant Nutrients

Examples *Water-soluble compounds containing nitrate* (NO_3^-), *phosphate* (PO_4^{3-}) *and ammonium* (NH_4^+) *ions.*

Human Sources (causes)

Sewage, manure, and runoff of agricultural and urban fertilizers.

Effects

(i) Can cause excessive growth of algae and other aquatic plants, which die, decay, deplete dissolved oxygen in water and kill the fish.

(ii) Drinking water with excessive levels of nitrates lower the oxygen carrying capacity of the blood and can kill urban children and infants.

6. Sediment

Examples *Soil, silt, etc.,*

Human Sources (causes)

Land erosion.

Effects

(i) Can reduce photosynthesis and cloud water.

(ii) Disrupt aquatic food webs.

(iii) Carry pesticides, bacteria, and other harmful substances.

(iv) Settle out and destroy feeding and spawning rounds of fish.

(v) Clog and fill lakes, artificial reservoirs, stream channels and harbours.

7. Radioactive Materials

Examples *Radioactive isotopes of iodine, radon, uranium, cesium, and thorium.*

Human Sources (causes)

Nuclear power plants, mining and processing of uranium and other ores, nuclear weapons production and natural sources.

Effects

Genetic mutations, birth defects, and certain cancers.

8. Heat (Thermal Pollution)

Example *Excessive heat*

Human Sources (causes)

Water cooling of electric power plants and some types of industrial plants. Almost half of all water withdrawn in United States each year is for cooling electric power plants.

Effects

(i) Lowers dissolved oxygen levels and makes aquatic organisms more vulnerable to disease, parasites and toxic chemicals.

(ii) When a power plant first opens (or) shuts down for repair, fish and other organisms adapted to a particular temperature range can be killed by the abrupt change in water temperature known as thermal shock.

9. Point and Non-point Sources of Water Pollution

(i) Point Sources

Point sources are discharged pollutants at specific locations through pipes, ditches (or) sewers into bodies of surface water.

Examples *Includes factories, sewage treatment plants, abandoned underground mines and oil tankers.*

(ii) Non-point sources

They are usually large land areas (or) air sheds that pollute water by runoff, subsurface flow (or) deposition from the atmosphere. Location of which cannot be easily identified.

Examples *Include acid deposition and runoff of chemicals into surface water from croplands, livestock feedlots, logged forests, urban street, lawn, golf courses and parking lots.*

2.3.2 Characteristics (or) Testing of river water (waste water)

1. Dissolved oxygen (DO)

Dissolved oxygen (DO) is the amount of oxygen dissolved in a given quantity of water at a particular pressure and temperature.

Significance of DO

(i) DO is vital for the support of fish and other aquatic life in river water.

(ii) It determines whether the biological changes are brought about by aerobic (or) anaerobic micro-organisms.

(iii) DO determinations serve as the means of control of river pollution.

(iv) A minimum level of DO (4 mg/lit) must be maintained in rivers so as to support the aquatic life in a healthy condition. Thus, it is necessary to ensure that the treated water must have atleast 4 mg/lit of DO before its disposal into river.

2. Biochemical Oxygen Demand (BOD)

BOD is the amount of oxygen required for the biological decomposition of organic matter present in the water.

Significance of BOD

(i) It is an important indication of the amount of organic matter present in the river water.

(ii) Since complete oxidation occurs in indefinite period, the reaction period is taken as 5 days at 20°C. For all practical purposes, it is written as BOD_5.

(iii) The rate of oxidation and demand depends on the amount and type of organic matter present in river water.

3. Chemical Oxygen Demand (COD)

COD is the amount of oxygen required for chemical oxidation of organic matter using some oxidising agent like $K_2Cr_2O_7$ and $KMnO_4$.

Significance of COD

(i) It is carried out to determine the pollutional strength of river water.

(ii) It is rapid process and takes only 3 hours.

2.3.3 Control (or) Preventive measures (methods) of water pollution

1. The administration of water pollution control should be in the hands of State (or) Central Government.
2. Scientific techniques are necessary to be adopted for the environmental control of catchment areas of rivers, ponds (or) streams.
3. The industrial plants should be based on recycling operations, because it will not only stop the discharge of industrial wastes into natural water sources but by products can be extracted from the wastes.
4. Plants, trees and forests control pollution and they acts as natural air conditioners.
5. Forests in and around big cities and industrial establishments are capable of reducing the sulphur dioxide and nitric oxide pollutants to a greater extent from the atmosphere. Hence the national goal should be "Conservation of Forests" and campaign should be "Plant more trees". The global destruction of forests should be discouraged (or) atleast minimized and afforestation should be encouraged because no one on this earth will escape from the adverse effects of a balding earth.
6. It is not advisable to discharge any type of waste, either treated, partially treated (or) untreated, into streams, rivers, lakes, ponds and reservoirs. The industries are expected to develop close-loop water

supply schemes and domestic sewage may be used for irrigation.

7. Highly qualified and experienced persons should be consulted from time to time for effective control of water pollution.
8. Public awareness regarding adverse effects of water pollution is a must. So there should be propaganda for water pollution control on radios, TVs etc.,
9. Suitable laws, standards and practices should be framed to regulate the discharge of undesirable flow of water in water bodies and such regulations should be modified from time to time in order to accommodate the changing requirements and technological advancements.
10. Basic and applied research in public health engineering should be encouraged.
11. The possible reuse (or) recycle of treated sewage effluents and industrial wastes should be emphasized and encouraged.

2.3.4 Waste Water (or) Sewage Treatment

Objectives of waste water treatment

The main objectives of waste water treatment are

(i) to convert harmful compounds into harmless compounds.

(ii) to eliminate the offensive smell.

(iii) to remove the solid content of the sewage.

(iv) to destroy the disease producing microorganisms.

Treatment process

The sewage (or) waste water treatment process involves the following steps.

I. Preliminary Treatment

In this treatment, coarse solids and suspended impurities are removed by passing the waste water through bar and mesh screens.

II. Primary treatment (or) Settling process

In this treatment, greater proportion of the suspended inorganic and organic solids are removed from the liquid sewage by settling. In order to facilitate quick settling coagulants like alum, ferrous sulphate are added. These produce large gelatinous precipitates, which entrap finely divided organic matter and settle rapidly.

$$Al_2(SO_4)_3 + 6H_2O \longrightarrow 2Al(OH)_3 \downarrow + 3H_2SO_4.$$

III. Secondary (or) Biological treatment

In this treatment, biodegradable organic impurities are removed by aerobic bacteria. It removes upto 90% of the oxygen demanding wastes. This is done by trickling filter (or) activated sludge process.

(a) Trickling filter process

It is a circular tank and is filled with either coarse (or) crushed rock. Sewage is sprayed over this bed by means of slowly rotating arms (Fig. 2.2).

When sewage starts percolating downwards, microorganisms present in the sewage grow on the surface of filtering media using organic material of the sewage as food. After completion of aerobic oxidation the treated sewage is taken to the settling tank and the sludge is removed. This process removes about 80-85% of BOD.

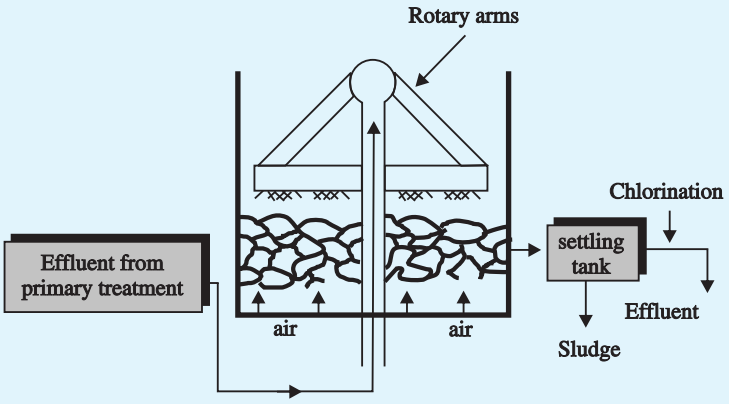


Fig. 2.2 Trickling filter

(b) Activated sludge process

Activated sludge is biologically active sewage and it has a large number of aerobic bacterias, which can easily oxidise the organic impurities.

The sewage effluent from primary treatment is mixed with the required amount of activated sludge. Then the mixture is aerated in the aeration tank (Fig. 2.3). Under these condition, organic impurities of the sewage get oxidised rapidly by the microorganisms.

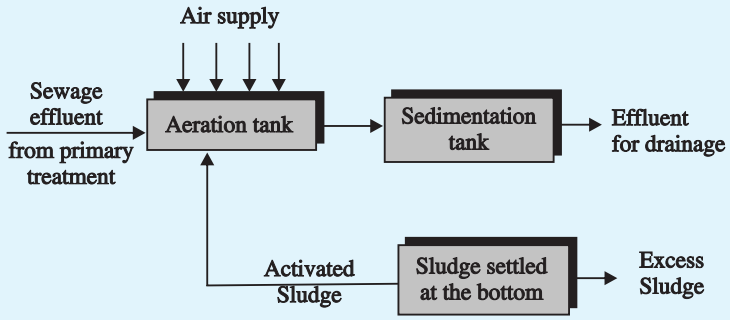


Fig. 2.3 Activated Sludge Process

After aeration, the sewage is taken to the sedimentation tank. Sludges settle down in this tank, called activated sludge, a portion of which is used for seeding fresh batch of the sewage. This process removes about 90-95% of BOD.

IV. Tertiary treatment

After the secondary treatment, the sewage effluent has a lower BOD (25 ppm), which can be removed by the tertiary treatment process.

In the tertiary treatment, the effluent is introduced into a flocculation tank, where lime is added to remove phosphates. From the flocculation tank the effluent is led to ammonia stripping tower, where pH is maintained to 11 and the $NH_4^{\oplus}$ is converted to gaseous NH_3. Then the effluent is allowed to pass through activated charcoal column, where minute organic wastes are adsorbed by charcoal. Finally the effluent water is treated with disinfectant (chlorine).

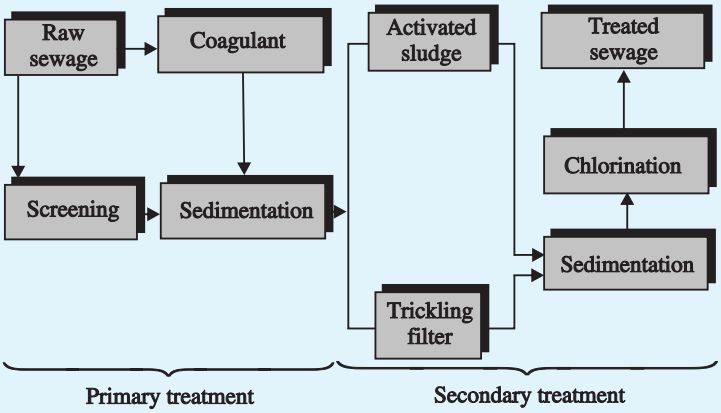
V. Disposal of sludge

This is the last stage in the sewage treatment. Sludge formed from different steps can be disposed by

(i) dumping into low-lying areas.
(ii) burning of sludge (incineration),
(iii) dumping into the sea,
(iv) using it as low grade fertilizers.

The flow sheet diagram of sewage treatment

Flow Chart



2.3.5 Specifications for Drinking Water

The common specifications recommended by the U.S Public Health for Drinking Water are given below.

(i) Water should be clear and odourless.

(ii) It should be cool.

(iii) It should be pleasant to taste.

(iv) Turbidity of the water should not exceed 10 ppm.

(v) pH of the water should be in the range of 7.0 - 8.5.

(vi) Chloride and sulphate contents should be less than 250 ppm.

(vii) Total hardness of the water should be less than 500 ppm.

(viii) Total dissolved solids should be less than 500 ppm.

(ix) Fluoride content of the water should be less than 1.5 ppm.

(x) The water must be free from disease-producing bacteria.

(xi) Water should be free from objectionable dissolved gases like H_2S.

(xii) Water should be free from objectionable minerals such as lead, chromium, manganese and arsenic salts.

2.3.6 Water Quality Standards

Water used for drinking should have certain quality. The following table 2.2 summarises several quality criteria and their standards for drinking water.

Table 2.2 Standards for drinking water

S. No.	Parameter	WHO standard in mgs/litre	ISI standard in mgs/litre.
1.	Colour, odour and taste.	Colourless, odourless and tasteless.	Colourless, odourless and tasteless.
2.	pH	6.9	6.9
3.	Total dissolved solids	1,500	-
4.	Dissolved oxygen	-	3.0
5.	Chloride	250	600
6.	Sulphate	400	1,000
7.	Nitrate	45	-
8.	Cyanide	0.2	0.01
9.	Fluoride	1.5	3.0
10.	Chromium	0.05	0.05
11.	Lead	0.05	0.1
12.	Arsenic	0.05	0.2

Significance of the parameters

1. Chlorides: Although chlorides are not considered as harmful as such, their concentrations over 250 mg/lit impart peculiar taste to water, which is unacceptable for drinking purposes.

2. Sulphates: When sulphates are present in excess amount in drinking water, they may produce a cathartic effect on the people consuming such water.

3. Nitrates: Excessive concentrations of nitrates are undesirable especially for infants. The maximum contaminant level for nitrate is 10 mg/lit.

4. Fluorides: Optimum fluoride concentrations prescribed in drinking water is in the range of 0.7 to 1.2 mg/lit. Low concentration of fluoride in drinking water causes dental problem in children. Excessive concentration causes fluorosis (discoloration and chipping of teeth).

5. Arsenic: Arsenic is a toxic heavy metal even a very small dose can result in severe poisoning. Only 0.05 mg/lit has been recommended for arsenic in drinking water.

2.4 SOIL POLLUTION

Definition

Soil pollution is defined as, ***"the contamination of soil by human and natural activities which may cause harmful effects on living beings."***

Table 2.3 Composition of soil

Components	%
Mineral matter (inorganic)	45
Organic matter	5
Soil water	25
Soil air	25

2.4.1 Types, effects and sources (causes) of soil pollution

Soil pollution mainly results from the following sources

1. Industrial wastes.
2. Urban wastes.
3. Agricultural practices.
4. Radioactive pollutants.
5. Biological agents.

1. Industrial wastes

Disposal of industrial wastes is the major problem for soil pollution.

Sources

The industrial pollutants are mainly discharged from the various origins such as pulp and paper mills, chemical industries, oil refineries, sugar factories, tanneries, textiles, steel, distilleries, fertilizers, pesticides, coal and mineral mining industries, drugs, glass, cement, petroleum and engineering industries etc.,

Effect

These pollutants affect and alter the chemical and biological properties of soil.

As a result, hazardous chemicals can enter into human food chain from the soil (or) water and disturb the biochemical process and finally lead to serious effects on living organisms.

2. Urban wastes

Urban wastes comprises both commercial and domestic wastes consisting of dried sludge of sewage. All the urban solid wastes are commonly referred to as refuse.

Constituents of urban refuse

This refuse contains garbage and rubbish materials like plastics, glasses, metallic cans, fibres, paper, rubbers, street sweepings, fuel residues, leaves, containers, abandoned vehicles and other discarded manufactured products. Urban domestic wastes though disposed off separately from the industrial wastes, can still be dangerous. This is so because they cannot be easily degraded.

3. Agricultural practices

Modern agricultural practices pollute the soil to a large extent. Today with the advancing agro-technology, huge quantities of fertilizers, pesticides, herbicides, weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry, debris, soil erosion containing mostly inorganic chemicals are reported to cause soil pollution.

4. Radioactive pollutants

Radioactive substances resulting from explosions of nuclear dust and radioactive wastes (produced by nuclear testing laboratories and industries) penetrate the soil and accumulate there by creating land pollution.

Examples

1. Radio nuclides of radium, thorium, uranium, isotopes of potassium (K-40) and carbon (C-14) are very common in soil, rock, water and air.
2. Explosion of hydrogen weapons and cosmic radiations induce neutron, proton reactions by which nitrogen (N-15) produces C-14. This C^{14} participates in the carbon metabolism of plants which is then introduced into animals and man.
3. Radioactive waste contains several radio nuclides such as Strontium-90, Iodine-129, Cesium-137 and isotopes of iron which are most injurious. Sr-90 gets deposited in bones and tissues instead of calcium.
4. Nuclear reactor produces waste containing Ruthenium-106, Iodine-131, Barium-140 and Lanthanum-140, Cesium-144 along with the primary nuclides Sr-90 and Cs-137 has a half life of 30 years while Sr-90 has 28 years. Rain water carries Sr-90 and Cs-137 to be deposited on the soil where they are held firmly with the soil particles by electrostatic forces. All these radio nuclides deposited on the soil emit gamma radiations.

5. Biological agents

Soil gets large quantities of human, animal and bird's excreta which constitute the major source of land pollution by biological agents.

Examples

1. Heavy application of manures and digested sludges could cause serious damage to plants within a few years. Because the sludges are containing more live viruses and viable intestinal worms.

2. In addition to these excreta, faulty sanitation, municipal garbage, waste water and wrong methods of agricultural practices also induce heavy soil pollution.

Table 2.4 Major physico-chemical characteristics of untreated wastes of Organic chemical industries in Soil

S. No.	Industry	Physico-chemical characteristics
1.	Pulp and paper	Suspended solids, high (or) low pH, colour, fibres, BOD, COD, high temperature, fibres.
2.	Rubber industry	Chlorides, suspended and dissolved solids, variable pH and high BOD.
3.	Oil refineries	Acids, alkalis, phenols, resinous materials and petroleum oils.
4.	Antibiotics	Toxic organics and high acidity (or) alkalinity.
5.	Synthetic drugs	High suspended and dissolved organic matter including vitamins.
6.	Distillery	Very high COD, low pH, high organic matter, high suspended and dissolved solids containing nitrogen, high potassium.
7.	Organic chemical industry	Toxic compounds, phenols, high acidity, alkalinity.

Table 2.5 Major physico-chemical characteristics of untreated wastes of Inorganic chemical industries in Soil

S. No.	Industry	Physico-chemical characteristics
1.	Thermal Power Plants	Heat, heavy metals, dissolved solids and inorganic compounds.
2.	Steel Mills	Acids, phenols, low pH, alkali, limestone, oils, fine suspended solids, cyanides, cyanates, iron salts, ores and coke.
3.	Cotton Industry	Sodium, organic matter, colour, high pH and fibres.
4.	Metal Plating	Metallics, toxic cyanides, cadmium, chromium, zinc, copper, aluminium and low pH.
5.	Iron Foundry	Coal, clay, suspended solids and iron.
6.	Pesticides	Aromatic compounds, acidity and high organic matter.
7.	Acids	Low pH and organic content.
8.	Tanneries	Calcium, chromium, high salt content, colour, dissolved and suspended matter.
9.	Explosives	Alcohol, metals, TNT and organic acids.

2.4.2 Control (or) Preventives measures of soil pollution

The pressure on intensification of farm activities increases for two reasons.

1. Population growth.
2. Decrease of the available farm land due to urbanization.

1. Control of Soil erosion

Soil erosion can be controlled by a variety of forestry and farm practices.

Example

(a) Trees may be planted on barren slopes.

(b) Contour cultivation and strip cropping may be practiced instead of shifting cultivation.

(c) Terracing and building diversion channels may be undertaken.

Reducing deforestation and substituting chemical manures by animal wastes would also help to arrest soil erosion in the long term. Maintaining soil productivity is vital and essential for sustainable agriculture.

2. Proper dumping of unwanted materials

Excess of waste products by man and animals cause chronic disposal problem. Open dumping is most commonly practiced method. Recently controlled tipping is followed for solid waste disposal. The surface so obtained then can be used for housing (or) sports field.

3. Production of natural fertilizers

Excessive use of chemical fertilizers and insecticides should be avoided. Biopesticides should be used in place of toxic chemical pesticides.

Example *Organic wastes contained in animals dung can be used for preparing compost manure and biogas rather than throwing them wastefully polluting the soil.*

4. Proper Hygienic condition

People should be trained regarding the sanitary habits.

Example *Lavatories should be equipped with quick and effective disposal methods.*

5. Public Awareness

Informal and formal public awareness programs should be imparted to educate people on health hazards by environmental pollution.

Example *Mass media, educational institutions and voluntary agencies can achieve this.*

6. Recycling and Reuse of wastes

To minimize soil pollution, the wastes such as paper, plastics, metals, glasses, organics, petroleum products and industrial effluents etc., should be recycled and reused.

Example *Industrial wastes should be properly treated at source. Integrated waste treatment method should be adopted.*

7. Ban on Toxic Chemicals

Ban should be imposed on chemicals and pesticides like DDT, BHC etc., which are fatal to plants and animals.

Nuclear explosions and the improper disposal of radioactive wastes should be banned.

2.5 NOISE POLLUTION

Definition

Noise pollution is defined as, ***"the unwanted, unpleasant (or) disagreeable sound that causes discomfort for all living beings."***

Unit of Noise (Decibel)

The sound intensity is measured in decibel (dB), which is one tenth of the longest unit Bel. One dB is equal to the faintest sound, a human ear can hear.

Noise level

Normal conversation sound ranges from 35 dB to 60 dB. Impairment of hearing takes place due to exposure to noise of 80 dB (or) more. Noise above 140 dB becomes painful.

2.5.1 Types and sources (causes) of noise

It has been found that environmental noise is doubling every 10 years. Generally noise is described as,

1. Industrial noise.
2. Transport noise.
3. Neighbourhood noise.

1. Industrial Noise

Highly intense sound (or) noise pollution is caused by many machines. There exists a long list of sources of noise pollution including different machines of numerous factories, industries and mills. Industrial noise, particularly

from mechanical saws and pneumatic drill is unbearable and is a nuisance to public.

Recently, it has been observed by the Institute of Oto-Rino Laryngology, Chennai that enormously increasing industrial pollution has damaged the hearing of about 20% workers.

Example *In the steel industry, the workers near the heavy industrial blowers are exposed to 112 dB for eight hours and suffer from the occupational pollution.*

2. Transport Noise

The main noise, comes from transport. It mainly includes road traffic noise, rail traffic noise and air craft noise. The number of road vehicles like motors, scooters, cars, motor cycles, buses, trucks and particularly the diesel engine vehicles have increased enormously in recent years.

That is why, this form of pollution is gaining importance, especially in large and over crowded towns and cities. According to experts, the noise level in most of the residential areas in metropolitan cities is already hovering on the border line because of vehicular noise pollution.

A survey conducted in metropolitan cities has shown that noise level in Delhi, Bombay and Calcutta is as high as 90 dB. Inhabitants of cities are subjected to this most annoying form of transport noise which gradually deafen them.

3. Neighbourhood Noise

This type of noise includes disturbance from household gadgets and community. Common noise makers are musical instruments, TV, VCR, radios, transistors, telephones, and loudspeakers etc., Ever since the industrial

revolution, noise in environment has been doubling every ten years.

2.5.2 Effects of Noise Pollution

1. Noise Pollution affects human health, comfort and efficiency. It causes contraction of blood vessels, makes the skin pale, leads to excessive secretion of adrenalin hormone into blood stream which is responsible for high blood pressure. Blaring sounds have known to cause mental distress, heart attacks neurological problems, birth defects and abortion.
2. It causes muscles to contract leading to nervous breakdown, tension etc.,
3. These adverse reactions are coupled with a change in hormone content of blood, which in turn increase the rate of heart beat, contraction of blood vessels, and dilation of pupil of eye.
4. It affects health efficiency and behaviour. It may cause damage to heart, brain, kidneys, liver and may also produce emotional disturbances.
5. The most immediate and acute effect of noise is the impairment of hearing which diminishes by the damage of some part of auditory system. When exposed to very loud and sudden noise acute damage occurs to the ear drum. Prolonged exposure to noise of certain frequency pattern will lead to chronic damage to the hair cells in the inner ear.
6. In addition to serious loss of hearing due to excessive noise, impulsive noise also causes psychological and pathological disorders.
7. Ultrasonic sound can affect the digestive, respiratory, cardio vascular systems and semicircular canals of the internal ear. The rate of heart beat may also be

affected. It may decrease (or) increase depending on the type of noise.

8. Brain is also adversely affected by loud and sudden noise as that of jet and aeroplane noise etc. People are subjected to Psychiatric illness.
9. Recently it has been reported that blood is also thickened by excessive noises.
10. It is quite surprising that our optical system is also a prey for noise pollution. Pupillary dilation, impairment of night vision and decrease in the rate of colour perception are some of its severe effects.

2.5.3 Control (or) Preventive measures of noise pollution

1. Source Control

This may include source modification such as acoustic treatment to machine surface, design changes, limiting the operational timings and so on.

2. Transmission Path Intervention

This may include containing the source inside a sound insulating enclosure, construction of a noise barrier (or) provision of sound absorbing materials along the path.

3. Receptor control

This includes protection of the receiver by altering the work schedule (or) provision of personal protection devices such as ear plugs for operating noisy machinery. The measure may include dissipation and deflection methods.

4. Oiling

Proper oiling will reduce the noise from the machines.

5. Planting trees around houses can also act as effective noise barriers.

6. Different types of absorptive materials can be used to control interior noise.

2.5.4 Other Preventive measures

Noise can be reduced by prescribing noise limits for vehicular traffic, ban on honking of horns in certain areas and creation of silent zones near schools and hospitals and redesigning of buildings to make them noise proof. Other measures can involve reduction of traffic density in residential areas and giving preferences to mass public transport system.

Table 2.6: Ambient Noise Level dB.

Zone	Day-time	Night-time
Silent zone	50	40
Residential zone	55	45
Commercial zone	65	55
Industrial zone	70	70

2.6 SOLID WASTE MANAGEMENT (OR) WASTE SHED MANAGEMENT

Rapid population growth and urbanization in developing countries have led to the generations of enormous quantities of solid wastes and consequential environmental degradation. An estimated 7.6 million tonnes of municipal solid waste is produced per day in developing countries. These wastes are disposed in open dumps

creating considerable nuisance and environmental problems. These are potential risks to health and to the environment from improper management of solid wastes. Management of solid waste is therefore, become very important in order to minimize the adverse effects of solid wastes.

Definition

Solid waste management is the process of collecting, treating and disposing of solid waste.

2.6.1 Types and sources of solid wastes

Depending upon the nature, solid wastes can be broadly classified into three types

1. Urban (or) Municipal wastes.
2. Industrial wastes.
3. Hazardous wastes.

I. Sources of Urban (Municipal) Wastes

Urban (or) municipal wastes include the following wastes

(a) Domestic wastes

It contains a variety of materials thrown out from the homes.

Examples *Food waste, cloth, waste paper, glass bottles, polythene bags, waste metals, etc.,*

(b) Commercial wastes

It includes the wastes coming out from the shops, markets, hotels, offices, institutions, etc.,

Examples *Waste paper, packing material, cans, bottle, polythene bags, etc.,*

(c) Construction wastes

It includes the wastes of construction materials.

Examples *Wood, concrete, debris etc.,*

(d) Biomedical wastes

It includes mostly the waste organic materials.

Examples *Anatomical wastes, infectious wastes, etc.,*

Type and characteristics of Urban (municipal) Wastes

(i) Bio-degradable wastes

The urban solid waste materials, that can be degraded by micro organisms are called biodegradable wastes.

Examples *Food, vegetables, tea leaves, egg shells, dry leaves, etc.,*

(ii) Non - Biodegradable wastes

The urban solid waste materials that cannot be degraded by micro organisms are called non-biodegradable wastes.

Examples Polythene bags, scrap metals, glass bottles, etc.,

II Source and Characteristics of Industrial Wastes

The main sources of industrial wastes are chemical industries, metal and mineral processing industries.

Examples

(i) Nuclear power plants

It generates radioactive wastes.

(ii) Thermal power plants

It produces fly ash in large quantities.

(iii) Chemical industries

It produces large quantities of hazardous and toxic materials.

(iv) Other industries

Other industries produce, packing materials, rubbish, organic wastes, acids, alkalis, scrap metals, rubber, plastic, paper, glass, wood, oils, paints, dyes, etc.,

2.6.2 Effect of Solid Wastes (or) Effect of Improper Solid Waste Management

1. Due to improper disposal of municipal solid wastes on the road side and their immediate surroundings, biodegradable materials undergo decomposition. This produces foul smell and breeds various types of insects, which spoil the land value.

2. Industrial solid wastes are the sources of toxic metals and hazardous wastes, which affect the soil characteristics and productivity of soils when they are dumped on the soil.

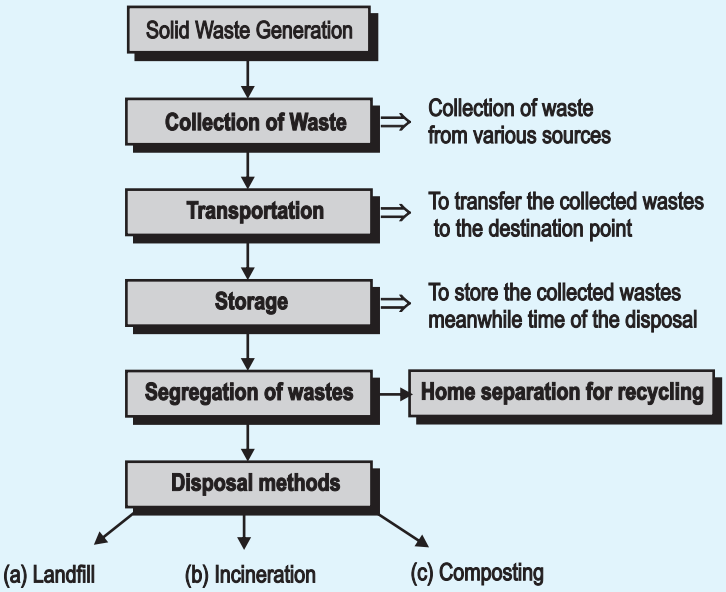
3. Toxic substances may percolate into the ground and contaminate the ground water.

4. Burning of some of the industrial wastes (or) domestic wastes (like cans, pesticides, plastics, radioactive materials, batteries) produce furans, dioxins and polychlorinated biphenyls, which are harmful to human beings.

2.6.3 Process of Solid Waste Management (or) Process of preventing solid waste generation in urban areas (or) Waste Shed Management

Solid waste management includes, the waste generation, mode of collection, transportation, segregation of wastes and disposal techniques.

Flow Chart



Steps Involved in Solid Waste Management (or) Waste Shed Management

Two important steps of solid waste (waste shed) management is

Reduce, reuse and recycle, before destruction and safe storage of wastes.

I Reduce, Reuse and Recycle (3R)

(a) Reduce the usage of raw materials

If the usage of raw materials are reduced, the generation of waste also gets reduced.

(b) Reuse of waste materials

(a) The refillable containers, which are discarded after use, can be reused.

(b) Rubber rings can be made from the discarded cycle tubes, which reduces the waste generation during manufacturing of rubber bands.

(c) Recycling of materials

Recycling is the reprocessing of the discarded materials into new useful products.

Examples

(a) Old aluminium cans and glass bottles are melted and recast into new cans and bottles.

(b) Preparation of cellulose insulation from paper.

(c) Preparation of fuel pellets from kitchen waste.

(d) Preparation of automobiles and construction materials from steel cans.

The above process saves money, energy, raw materials, and reduces pollution.

II Discarding wastes

For discarding solid wastes the following methods can be adopted.

Methods of disposal of solid waste

1. Landfill 2. Incineration (Thermal) 3. Composting

1. Landfill

Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thick refuse, covered with selected earth fill of 20 cm thickness. After two (or) three years, solid waste volume shrinks by 25-30% and the land is used for parks, roads and small buildings.

The most common and cheapest method of waste disposal is dumping in sanitary land-fills which is invariably employed in Indian cities. Land-fill structure is built either into the ground (or) on the ground into which the waste is dumped. The method involves spreading the solid waste on the ground, compacting it and then covering it with soil at suitable intervals.

Advantages

1. It is simple and economical.
2. Segregation not required.
3. Landfilled areas can be reclaimed and used for other purposes.
4. Converts low-lying, marshy waste-land into useful areas.
5. Natural resources are returned to soil and recycled.

Disadvantages

1. A large area is required.
2. Since land is available away from town, transportation cost is heavy.
3. Bad odours, if landfills are not properly managed.
4. The land filled areas will be the sources of mosquitoes and flies and hence insecticides and pesticides are to be applied at regular intervals.
5. Causes fire hazard due to the formation of methane in wet weather.

2. Incineration (or) Thermal process

It is a hygienic way of disposing solid waste. It is more suitable if the waste contains more hazardous material and organic content. It is a thermal process and is very effective for detoxification of all combustible pathogens. It is an expensive technology compared to land-fill and composting because incinerators are costly.

In this method the municipal solid wastes are burnt in a furnace called incinerator. The combustible substances such as rubbish, garbage, dead organisms and the noncombustible matter such as glass, porcelain, metals are separated before feeding to incinerators. The noncombustible materials can be left out for recycling and reuse. The left out ashes and clinkers from the incinerators may be accounted for only about 10 to 20% which need further disposal either by sanatory landfill (or) by some other means.

The heat produced in the incinerator during the burning of refuse is used in the form of steam power for generation of electricity throughout turbines. The municipal solid waste is generally wet but has a very high calorific value so it has to be dried up first before burning. The waste is dried in preheater from where it is taken into large incinerating furnace called destructors which can incinerate about 100 to 150 tonnes per hour. The temperature normally maintained in a combustion chamber is about 700°C and may be increased to about 1000°C when electricity is to be generated.

Advantages

1. The residue is only 20-25% of original weight, the clinker can be used after treatment.
2. It requires very little space.

3. Cost of transportation is not high as incinerators located within city limits.
4. Safest from hygienic point of view.
5. An incinerator plant of 300 tonnes per day capacity can generate 3MW of power.

Disadvantages

1. Its capital and operating cost is high.
2. Needs skilled personnel.
3. Formation of smoke, dust and ashes needs further disposal, due to which air pollution may be caused.

3. Composting

It is another popular method practiced in many cities in our country. In this method, bulk organic waste is converted into a fertilising manure by biological action.

The separated compostable waste is dumped in underground earthern trenches in layers of 1.5 m and is finally covered with earth of about 20 cm and left over for decomposition. Sometimes certain microorganisms such as actinomycetes are introduced for active decomposition. Within 2 to 3 days biological action starts, the organic matters are being destroyed by actinomycetes and lot of heat is liberated increasing the temperature of the compost by about 75°C and finally the refuse is converted to powdery brown coloured odourless mass known as humus and has a fertilizing value which can be used for agricultural field. The compost contains lot of nitrogen essential for plant growth apart from phosphates and other minerals.

World Health Organisation (WHO) has set up a compost plant in New Delhi in 1981 with a capacity to handle 90 to 100 tonnes of waste everyday. The prepared compost was supplied to nurseries, kitchen gardens and

horticulture department. The composting technology is widely employed in developing countries.

Advantages

1. When the manure is added to soil, it increases the water retention and ion-exchange capacity of soil.
2. A number of industrial solid wastes can also be treated by this method.
3. It can (manure) be sold thereby reducing the cost of disposing of wastes.
4. Recycling - occurs.

Disadvantages

1. The non-consumables have to be disposed separately.
2. Use of compost has not yet caught up with farmers and hence no assured market.

2.7 HAZARDOUS WASTE

It is the waste that has potential threats to public health (or) the environment.

Examples

(i) Cleaning solvents (acids and bases).

(ii) Spent acids and bases.

(iii) Metal finishing wastes.

(iv) Painting wastes.

(v) Sludges from air and water pollution control units.

(vi) Disinfectants and pesticides.

2.7.1 Types and characteristics of hazardous wastes

1. Toxic wastes

These are poisonous even in very small (or) trace amounts. They may have

(i) Acute effects

Causing death (or) violent illness

(ii) Chronic effects

Slowly causing irrseparable harm.

2. Carcinogenic waste

It causes cancer after many years of exposure.

3. Mutagenic

It causes major biological changes in the off-spring of exposed humans and wild life.

4. Reactive wastes

These are chemically unusable and react violently with air (or) water. They cause explosions (or) form toxic vapours.

5. Ignitable wastes

They burn at relatively low temperatures and cause an immediate fire hazard.

6. Corrosive wastes

These include strong acidic (or) alkaline substances. They destroy solid material and living tissue upon contact.

7. Infectious wastes

These include used bandages, hypodermic needles from hospitals (or) biological research facilities.

8. Radioactive wastes

These emit ionizing energy that can harm living organisms.

2.7.2 Hazardous waste management

Definition

It is the collection, treatment and disposal of waste materials that can cause substantial harm to human health (or) to the environment.

Improper hazardous-waste storage (or) disposal contaminates surface water and ground water supplies as harmful water pollution and land pollution. People living in homes, built near waste disposal sites, may be in a vulnerable position. The best remedy for this problem is to regulate the practice of hazardous - waste management.

2.7.3 Various steps of hazardous waste management

Hazardous waste management involves the following 4 steps

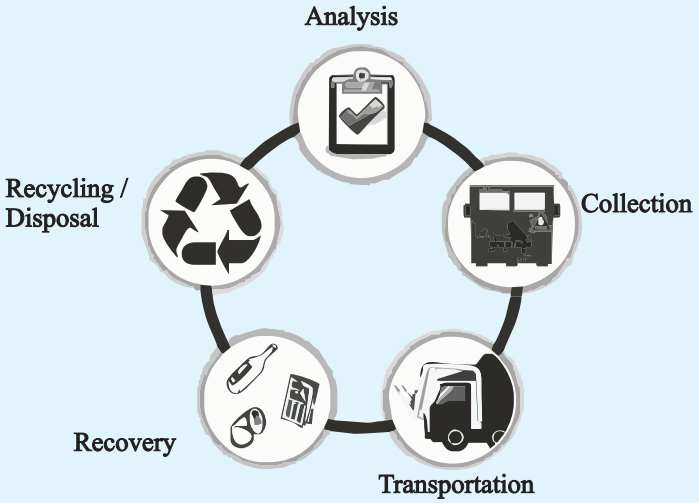


Fig 2.4 Steps of hazardous waste management

Step 1: Analysis:

Physical and chemical properties of hazardous waste must be analysed before collection and recovery of useful components. It is essential because it can be used as a fertilizer, liming material (or) soil amendment.

Step 2: Collection and transport

Hazardous waste, generated at a particular place, is generally collected and transported by truck over public highways. It can also be shipped in tank trucks, made of steel (or) aluminium alloy, with capacities upto about 34,000 litres. It can be containerized and shipped in 200 litre drums.

Step 3: Treatment (or) Recovery

Hazardous waste can be treated (or) recovered by

(i) Chemical method.
(ii) Thermal method.
(iii) Biological method.
(iv) Physical method.

1. Chemical method

It includes ion-exchange, precipitation, oxidation and reduction and neutralization.

2. Thermal method

High temperature incineration

It not only can detoxify certain organic wastes but also can destroy them.

Special type of thermal equipment

Examples

Fluidized-bed incinerator, multiple hearth furnace, rotary kiln and liquid-injection incinerator.

Problem

Hazardous-waste incineration is the source of air pollution.

3. Biological treatment

Example *Land farming*

Land farming is one method of treating hazardous waste biologically, in which waste is mixed with surface soil on a suitable land. Microbes that can metabolize the waste may be added, along with nutrients.

Bio-remediation

Microbes can also be used for stabilizing hazardous wastes on previously contaminated sites. This process is called bio-remediation.

4. Physical treatment

Example

Evaporation, sedimentation, solidification, flotation and filtration.

The above treatment concentrates, solidifies (or) reduces the volume of the waste. Solidification is achieved by encapsulating waste in concrete, asphalt (or) plastic container. Encapsulation produces a solid mass of material that is resistant to leaching.

Step 4: Storage and disposal

Hazardous wastes that are not destroyed by incineration (or) other chemical processes need to be disposed properly. This can be done by the following methods.

1. Surface storage (or) containment systems - Temporary method

It includes

(i) New waste piles

(ii) Ponds (or) lagoons.

(i) New waste piles

It is carefully constructed over an impervious base. The piles must be protected from wind dispersion, erosion and leaching. Only non-containerized solid, non-flowing waste material can be stored in a new waste pile.

(ii) Ponds (or) lagoons

It is lined with impervious clay soils and flexible membrane liners inorder to protect ground water. Leachate collection systems is installed between the liners.

2. Deep-well injection

It involves pumping liquid waste through a steel casing into a porous layer of limestone (or) sandstone. High pressure is applied to force the liquid into the pores, where it is permanently stored.

3. Land fills

It provides at least 3 metres (10 ft) of separation between the bottom of the landfill and the underlying bed rock (or) ground water table. It is also provided with two impermeable liners and leachate collection system, which pumps the collected leachate to a treatment plant.

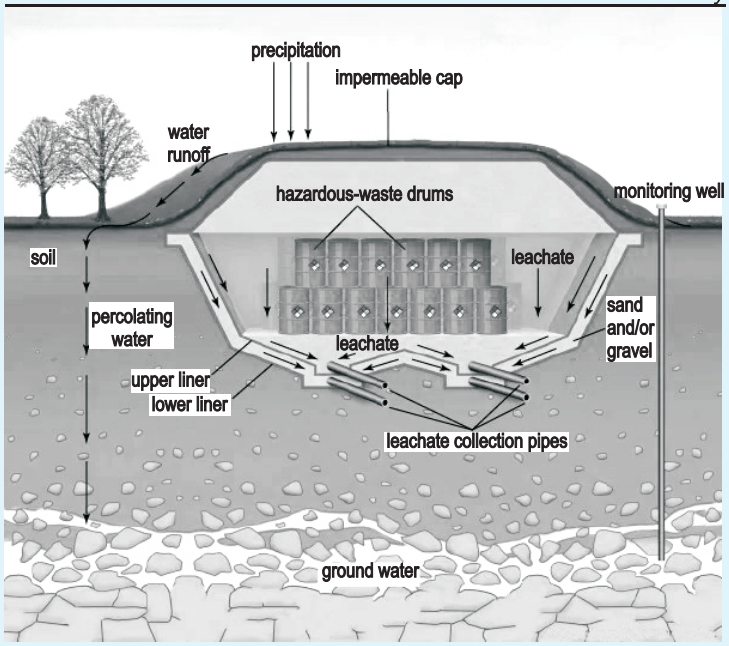


Fig. 2.5 Storage of Hazardous waste in Land fill

2.8 e - WASTE (Electronic Waste)

Definition

e-waste describes discarded electrical (or) electronic devices.

e-wastes are considered dangerous because they contain hazardous chemicals. The hazardous content of e-waste pose a threat to human health and environment.

Fig. 2.6 e-waste logo

2.8.1 Hazardous chemicals in e-wastes (or) Causes of e-wastes

Some of the hazardous chemicals present in some e-wastes are

1. Circuit boards in computer have heavy metals like lead and cadmium.
2. Batteries have cadmium.
3. Cathode ray tubes have lead oxide and barium.
4. Most of the electronic products have polyvinyl chloride.
5. Plastics have dioxins and furans.

So, if these waste electronic products are not properly disposed, they can leach hazardous elements such as lead, cadmium and other chemicals into the soil and ground water and cause severe threat to environment.

2.8.2 e-waste management

Definition

e-waste management is defined as a holistic method of cutting down e-waste from the earth to prevent its harmful toxic to deteriorate earth.

Management of e-waste should begin at the point of generation. This can be done by waste minimisation techniques and by sustainable product design.

Some e-waste management techniques

Waste management in industries involves adopting,

(a) inventory management,

(b) production process modification,

(c) sustainable product design,

(d) use of renewable raw materials.

1. Inventory management

Proper control over the materials, used in the manufacturing process, is an important way to reduce waste generation. By reducing the quantity of hazardous materials, used in the process, e-waste could be reduced.

2. Production process modification

By changing the production process e-waste generation can be minimised.

3. Sustainable product design

Efforts should be made to design a product with less amount of hazardous material.

Example

New computer designs that are lighter and more integrated.

4. Use of renewable materials

Bio based plastics are plastics made with plant based chemistry (or) plant producted polymers. Most e-waste have non-degradable polymers in them. By using these bio polymers we can reduce 'e'-wastes. Like wise bio based toners, glues and inks are new development e-wastes.

2.9 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM (OHASMS)

An occupational health and safety management system (OHASMS) is a fundamental part of an organization's risk management strategy. It enables an organization to protect its work force and others under its control.

Importance

It reduces risk (or) accidents (or) injuries by identifying and mitigating hazards.

2.9.1 Case studies on OHASMS

1. A footwear manufacturing industry in Ambur, Tamil Nadu

Objective

The main objective of this case study is to assess the status of occupational health and safety of a footwear manufacturing industry with respect to the social compliance.

Observation

We have visited Azim leather and footwear industries. Ambur, Tamil nadu. Overall occupational health and safety management practice in Azim leather and footwear industries was found to be good.

Production Process

Production process of Azim industries starts after collecting the raw materials, cutting them, assembling, joining the insole and outsole to the shoe, finishing and packing. Lots of people engaged during this production process. About 70% of total workers are female. In every section, Azim industries have employed experts to look after the work of the worker and improve the efficiency.

Some of the encouraging approaches observed in Azim industry

(i) Positive attitude of owner towards welfare of the workers.

(ii) Dedicated work force.

(iii) Experienced and professional management team.

(iv) Good relationship between management and workers.

(v) Disbursement of salary and wages to workers.

(vi) First aid box is found in all floors according to requirements of Indian labour rules.

(vii) Factory has own health centre to provide primary treatment.

(viii) Certified physician and nurse were available during the visit.

(ix) Factory has its child care centre.

(x) Factory has well maintained hygienic canteen.

(xi) Factory is conducting fire drill regularly.

(xii) Regular testing of drinking water, etc., is carried out.

Deficiency observed in Azim Industry and solution

According to environmental conservation rules, labour rules of Indian Government and International guide lines, below findings are observed during factory visit and discussed the solutions with management.

1. Management should maintain cleanliness of the area.
2. Management should place temperature and humidity measuring device in workplace because excessive heat and humidity are injurious for workers health.
3. Management should monitor and maintain sufficient and suitable lightings.
4. Factory must display material safety data sheet at all chemical storage areas.
5. Factory should confirm risk assessment for entire work place health and safety.

Report (or) Conclusion

Overall occupational health and safety management practice in Azim industries was found good. Though some deficiency were found during this visit, but commitment of top management towards occupational health and safety was impressive.

2. Fire works industry in Sivakasi, Tamilnadu

Safety and well-being is very essential for firework employees because in fireworks they are handling dangerous materials every day. So the safety measures are most important in the firework industry. They are handling chemicals which will affect their health too. According to the factories Act, safety and well-being is very necessary.

For well-being first aid kit, toilet facilities, cleanliness and medical camp are very essential.

Objectives of this study

The main objective of this study is to analyze the industrial safety and well-being of firework employees in "Kumaran fireworks" in Sivakasi.

We have visited "Kumaran fireworks" and analyzed overall occupational health and safety management practices of 257 employees and selected 30 respondents and conducted survey question regarding safety measures of the employees.

Some of the encouraging approaches observed in "Kumaran fireworks"

(i) 100% of respondent feels that adequate safety measures are taken during fire accidents.

(ii) 93.3% of respondent said limited safety materials are provided during the work.

(iii) 100% of respondent said the air circulation is perfect in the industry.

(iv) 90% of respondent said first aid box is available all the time.

(v) 80.5% of respondent felt the work place is always clean and neat.

(vi) 85% of respondent said the building and machines are maintained in proper way.

Deficiency observed in Kumaran fireworks and solution

(i) Management should conduct medical camp once in 6 months, in the industry.

(ii) Management must provide separate toilet facilities for men and women.

(iii) Proper rest room must be provided to the workers for taking rest in the break time.

(iv) Enough safety materials like gloves, face mask must be provided while they are working near chemicals and machines in the factory.

(v) More safety guards around the machines must be provided.

Report (or) Conclusion

Overall occupational health and safety management practice in "Kumaran fireworks" was found good. Though some deficiency were found during this visit, commitment of top management towards occupational health and safety was impressive.

2.10 ENVIRONMENTAL PROTECTION

Definition

Environmental protection is the practice of protecting the natural environment by individuals, organizations and governments.

Objectives

Its objectives are

(i) to conserve natural resources,

(ii) to conserve the existing natural environment,

(iii) to repair damage and reverse trends.

Due to the pressures of over consumption, population growth and technology, the biophysical environment is being degraded. This has been recognized and governments have begun placing restraints on activities that cause environmental degradation.

Importance (or) Goal of environmental protection

(i) To reduce air, water and land pollution.

(ii) To facilitate the conservation of natural resources for our future generations.

(iii) To ensure the protection of biodiversity.

(iv) To implement sustainable development.

(v) To restore the ecological balance.

(vi) To save our planet from harmful effects of global warming.

2.10.1 Environment (Protection) Act, 1986

This is a general legislation law in order to rectify the gaps and laps in the above Acts. This Act empowers the Central government to fix the standards for quality of

air, water, soil and noise and to formulate procedures and safe guards for handling of hazard substances.

Objectives of environmental act

(i) to protect and improvement of the environment,

(ii) to prevent hazards to all living creatures and property,

(iii) to maintain harmonious relationship between humans and their environment.

Important features of Environment Act

1. The Act further empowers the Government to lay down procedures and safe guards for the prevention of accidents which cause pollution and remedial measures if an accident occurs.
2. The Government has the authority to close (or) prohibit (or) regulate any industry (or) its operation, if the violation of the provisions of the Act occur.
3. The penal sections of the Act contain more stringent penalties. Any person who fails to comply (or) who contravenes any provision of the Act shall be punishable with imprisonment for a term extending to five years (or) be punishable with fine up to Rupees one lakh (or) both.
4. If the violation continues, an additional fine of Rupees five thousands per day may be imposed for the entire period of violation of rules.
5. The Act fixes the liability of the offence punishable under Act on the person who is directly in charge.

   Whether he/she is the director (or) Manager (or) Secretary (or) any other officer, unless he/she proves that it was committed without his/her knowledge (or) consent.

6. The Act empowers the officer of Central government to inspect the site (or) the plant (or) the machinery for preventing pollution and to collect samples of air, water, soil (or) other material from any factory (or) its premises for testing.

The Environment (Protection) Act is the most comprehensive legislation with powers for the central government to directly act, avoiding many regulatory authorities (or) agencies.

2.10.2 Water (Prevention and Control of Pollution) Act, 1974

This act provides for maintaining and restoring the sources of water. It also provides for preventing and controlling water pollution.

Objectives of the water act

(i) prevention and control of water pollution,

(ii) maintaining (or) restoring the wholesomeness of water,

(iii) establishing central and state boards for the prevention and control of water pollution.

Important features of Water Act

1. This Act aims at, to protect the water from all kinds of pollution and to preserve the quality of water in all aquifers.
2. The Act further provides for the establishment of Central Board and State Boards for prevention of water pollution.
3. The States are empowered to restrain any person from discharging a pollutant (or) sewage (or) effluent into any water body without the consent of the Board.

4. Any contravention of the guidelines (or) standards would attract penal action including prison sentence ranging from three months to six years.
5. The Act is not clear about the definition of pollutant, discharge of pollutant, toxic pollutant which allows scope for misinterpretation at the time of decision whether the law is violated (or) not.

The Amendment Act of 1988 requires permission to set up an industry which may discharge effluent.

State Pollution Control Board

The consent of the State Pollution Control Board is needed to

(i) Take steps to establish any industry (or) any treatment and disposal system (or) any extension (or) addition there to, which is likely to discharge (or) trade effluent into a stream (or) well (or) river (or) on land.

(ii) Use any new (or) altered outlet for the discharge of a sewage.

(iii) Begin to make any new discharge of sewage.

In the event of a violation of the conditions imposed, the State Board may serve on the offender a notice imposing any such conditions as it might establishment, such outlet (or) discharge that is a violation of the conditions.

The Act further empowers the State Board to order closure (or) stoppage of supply (or) electricity, water (or) any other services to the polluting unit. Non-compliance of the order may attract imprisonment for a term of one and half years to six years and fine which may extend to Rupees five thousand for every day, if the default continues.

2.10.3 Air (Prevention and Control of Pollution) Act, 1981

This Act was enacted in the Conference held at Stockholm in 1972. It deals with the problems relating to air pollution. It envisages the establishment of Central and State Control Boards endowed with absolute powers to monitor air quality and pollution control.

Objectives of air act are

(i) to prevent, control and abatement of air pollution,

(ii) to maintain the quality of air,

(iii) to establish a board for the prevention and control of air pollution.

Important features of Air Act

(a) The Central Board may lay down the standards for the quality of air.

(b) The Central Board co-ordinates and settle disputes between state boards, in addition to providing technical assistance and guidance to State Boards.

(c) The State Boards are empowered to lay down the standards for emissions of air pollutants from industrial units (or) automobiles (or) other sources.

(d) The State Boards are to collect and disseminate information related to air pollution and also to function as inspectorates of air pollution.

(e) The State Boards are to examine the manufacturing processes and the control of equipment to verify whether they meet the standards prescribed.

(f) The State Board can advise the State Government to declare certain heavily polluted areas as pollution control areas and can advice to avoid the burning of waste products which cause air pollution in such areas.

(g) The directions of the Central Board are mandatory on State Boards.

(h) The operation of an industrial unit is prohibited in a heavily polluted areas without the consent of the Central Board'.

(i) Violation of law is punishable with imprisonment for a term which may extend to three months (or) fine up to Rupees ten thousand (or) both.

This Act applies to all pollution industries. The Air Act, like Water Act, confers wide powers on State Boards to order closure of any industrial unit (or) stoppage (or) regulation of supply of water, electricity (or) other services, if it is highly polluting.

2.10.4 Forest (Conservation (or) Preservative) Act, 1980

This act provides conservation of forests and related aspects. This act also covers all type of forests including reserved forests, protected forests and any forested land.

This Act is enacted in 1980. It aims at to arrest deforestation.

Objectives of forest act

(i) to protect and conserve the forest,

(ii) to ensure judicious use of forest products.

Important features of Forest Act

(i) The reserved forests shall not be diverted (or) dereserved without the prior permission of the central government.

(ii) The land that has been notified (or) registered (or) forest land may not be used for non-forest purposes.

(iii) Any illegal non-forest activity within a forest area can be immediately stopped under act.

Important features of Amendment Act of 1988

(i) Forest departments are forbidden to assign any forest land 'by way of lease (or) otherwise to any private person' (or) non-government body for re-afforestation.

(ii) Clearance of any forest land of naturally grown trees for the purpose of re-afforestation is forbidden.

(iii) The diversion of forest land for non-forest uses is cognisable offence and any one who violates the law is punishable.

2.10.5 Wildlife (Protection) Act, 1972, Amended in 1983, 1986 and 1991

This act is aimed to protect and preserve wildlife. Wild life refers to all animals and plants that are not domesticated. India has rich wildlife heritage. It has 350 species of mammals, 1200 species of birds and about 20,000 known species of insects. Some of them are listed as 'endangered species' in the Wildlife (Protection) Act.

Wildlife is an integral part of our ecology and plays an essential role in its functioning. The wildlife is declining due to human actions, the wildlife products - skins, furs, feathers, ivory etc., have decimated the populations of many species.

Wildlife populations are regularly monitored and management strategies formulated to protect them.

Objectives of the wildlife act

(i) to maintain essential ecological processes and life-supporting systems,

(ii) to preserve biodiversity,

(iii) to ensure a continuous use of species.

Important features

1. The act covers the rights and non-rights of forest dwellers.
2. It provides restricted grazing in sanctuaries but prohibits in national parks.
3. It also prohibits the collection of non-timber forest.
4. The rights of forest dwellers recognized by the Forest Policy of 1988 are taken away by the Amended Wild life Act of 1991.

2.11 PART B QUESTIONS

1. Explain the effect of CO, SO_2, Hydrocarbons and chromium on human beings. *(A.U. May 2006)*
2. Discuss the major sources air pollutants and their impact and methods of controlling air pollution. *(A.U. Dec 2013, June 2016, Dec 2015)*
3. Explain the causes, effects and control measures of air pollution. *(Che AU June 2010 Dec'08 May 2015, June 2010)*
4. Explain the effects of air pollution on human health, plants and animals. *(TCY AU Dec'08)*
5. Discuss the causes and effects of
   (i) Air pollution
   (ii) Water pollution *(AU May 2008, TNV AU Dec'08)*
6. Suggest measures to control air pollution. *(Che A.U. Dec 2009)(Coim AUT May 2011, TCY AUT June 2011)*

7. Explain the causes, effects and control measure of water pollution. *(A.U. June - 2005) (TCY AUT May 2010)(Coim AUT Dec 2010)*

8. Name and discuss the effects of water pollution. Suggest the various control and remedial measures to curb water pollution. *(AU May 2016, TCY AU Dec'08)*

9. Discuss the major causes and effects of soil pollution. *(TNV AUT June 2010)*

10. Discuss the sources and effects of soil pollution. *(TCY AUT Dec. 2010)*

11. Explain the concept of source, path receiver in the control of noise pollution. *(A.U. Dec 2007)*

12. Explain the sources, effects and control of industrial noise pollution. *(TNV AUT Dec 2010, Che AU Dec 2010, Dec 2014)*

13. Explain the methods of disposal of municipal solid waste. *(A.U. Dec-2005, May 2011)(Coim AUT Dec 2010)*

14. What are the effects of improper municipal solid wastes management? State the measures recommended for proper management of the solid wastes. *(A.U. June - 2005)*

15. How will you take care of solid wastes generated in urban areas? *(A.U. Jan-2006, Dec 2012)*

16. Discuss briefly the disposal of municipal solid waste. *(A.U. Dec 2006)*

17. Discuss about the significance of hazardous waste management. *(Che AU Dec'08)*

18. Give a comparative account of urban and industrial wastes in terms of their sources, characteristics and management and disposal methods. *(Coim AUT Dec 2011, Che AU Dec'08)*

19. Write brief notes on solid waste management. *(Chen AUT June 2010, TCY AU Dec'08)*

20. Explain the Methods of disposal of municipal solid wastes. *(Coim AUT June 2010)*

21. What are the types of solid waste? Explain the concept of solid waste processing and solid waste management. *(TCY AUT June 2011)*

22. Explain the various steps involved in hazardous waste management.

23. What are e-wastes? Explain its preventive measures?

24. What is OHASMS? Explain it with any one case study.