

3. ENVIRONMENTAL POLLUTION

UNIT III ENVIRONMENTAL POLLUTION

Definition – Causes, Effects and Control Measures of:- (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of Urban and Industrial Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management:- Floods, Earthquake, Cyclone and Landslides.

3.1 INTRODUCTION

- **Pollution** may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or manmade.
- The agents that pollute are called pollutants.

3.2 POLLUTANTS

Pollutants are by-products of man's action. The important pollutants are summarized below:

- **Deposited matter**—Soot, smoke, tar or dust and domestic wastes.
- **Gases**—CO, nitrogen oxides, sulphur oxides, halogens (chlorine, bromine and iodine).
- **Metals**—Lead, zinc, iron and chromium.
- **Industrial pollutants**—Benzene, ether, acetic acid etc., and cyanide compounds.
- **Agriculture pollutants**—Pesticides, herbicides, fungicides and fertilizers.
- **Photochemical pollutants**—Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.
- **Radiation pollutants**—Radioactive substances and radioactive fall-outs of the nuclear test.

3.2.1 Classification of Pollutants

3.2.1.1 Nature of disposal: On the basis of natural disposal, pollutants are of two types:

1. **Non-degradable pollutants:** These are the pollutants, which degrade at a very slow pace by the natural biological processes. These are inorganic compounds such as salts (chlorides), metallic oxides waste producing materials and materials like, aluminum cans, mercuric salts and even DDT. These continue to accumulate in the environment.
2. **Biodegradable pollutants:** These include domestic sewage that easily decomposes under natural processes and can be rapidly decomposed by natural/artificial methods. These cause serious problems when accumulated in large amounts as the pace of deposition exceeds the pace of decomposition of disposal.

3.2.1.2 Nature of form: On the basis of the form in which they persist after their release into the environment, pollutants can be categorized under two types:

- (i) **Primary pollutants:** These include those substances, which are emitted directly from some identifiable sources. This include-
- a. **Sulphur compounds:** SO₂, SO₃, H₂S produced by the oxidation of fuel.
 - b. **Carbon compounds:** Oxides of carbon (CO+CO₂) and hydrocarbons.
 - c. **Nitrogen compounds:** NO₂ and NH₃.
 - d. **Halogen compounds:** Hydrogen fluoride (HF) and hydrochloric acid (HCl).
 - e. **Particles of different size and substances:** These are found suspended in air. The fine particles below the diameter of 100 μ are more abundant and include particles of metals, carbon, tar, pollen, fungi, bacteria, silicates and others.
- (ii) **Secondary pollutants:** The secondary pollutants are produced by the combination of primary emitted pollutants in the atmosphere.
Ex: In bright sunlight, a photochemical reaction occurs between nitrogen oxides; oxygen and waste hydrocarbons from gasoline that forms peroxy-acetylene nitrate (PAN) and ozone (O₃), both of them are toxic components of smog and cause smarting eyes and lung damage.

3.3 TYPES OF POLLUTION

3.3.1 AIR POLLUTION

3.3.1.1 Introduction: Air pollution is one such form that refers to the contamination of the air, irrespective of indoors or outside. A physical, biological or chemical alteration to the air in the atmosphere can be termed as pollution. It occurs when any harmful gases, dust, smoke enters into the atmosphere and makes it difficult for plants, animals and humans to survive as the air becomes dirty.

The WHO defines **air pollution** as the presence of materials in the air in such concentration which are harmful to man and his environment. A number of ingredients find their way in the air and these are mostly gases, which rapidly spread over wide areas.

3.3.1.2 Causes of Air pollution:

1. Burning of Fossil Fuels: Sulfur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles is one of the major causes of air pollution. Pollutants emitting from vehicles cause immense amount of pollution. Carbon Monoxide produced by improper or incomplete combustion emitted from vehicles is another major pollutant along with Nitrogen Oxides that is produced from both natural and manmade processes.

2. Agricultural activities: Ammonia is a very common by product from agriculture related activities and is one of the most hazardous gases in the atmosphere. Use of insecticides, pesticides and fertilizers in agricultural activities emit harmful chemicals into the air and cause water pollution.

3. Exhaust from factories and industries: Manufacturing industries release large amount of carbon monoxide, hydrocarbons, organic compounds, and chemicals into the air thereby depleting the quality of air. Petroleum refineries also release hydrocarbons and various other chemicals that pollute the air and also cause land pollution.

4. Mining operations: Mining is a process wherein minerals below the earth are extracted using large equipments. During the process dust and chemicals are released in the air causing massive air pollution.

5. Indoor air pollution: Household cleaning products, painting supplies emit toxic chemicals in the air and cause air pollution.

6. Suspended Particulate matter: Suspended particulate matter popular by its acronym SPM, is another cause of pollution.

3.3.1.3 Types of Air Pollutants

- **Primarily air pollutants** can be caused by primary sources or secondary sources. The pollutants that are a direct result of the process can be called primary pollutants. A classic example of a primary pollutant would be the sulfur-dioxide emitted from factories
- **Secondary pollutants** are the ones that are caused by the inter mingling and reactions of primary pollutants. Smog created by the interactions of several primary pollutants is known to be as secondary pollutant.

3.3.1.4 Common air pollutants

1. **Carbon Dioxide:** CO₂ content of air has increased by 20% during the last century. CO₂ causes nausea and headache. Its increase in the air may cause green house effect, rise in the atmospheric temperature. This may melt the polar ice resulting in rise in level of oceans and flooding of coastal regions.
2. **Carbon Monoxide:** It is a very poisonous gas and is produced by incomplete combustion of fuel. If inhaled. It combines with hemoglobin and reduces its oxygen-carrying capacity. This leads to laziness, reduced vision and death.
3. **Oxides of Nitrogen:** These include NO and NO₂, which are released by automobiles and chemical industries as waste gases and also by burning of materials. These are harmful and lower the oxygen carrying capacity of blood.
4. **Oxides of Sulphur:** SO₂ and SO₃ are produced by burning of coal and petroleum and are harmful to buildings, clothing, plants and animals. High concentration of SO₂ causes chlorosis (yellowing of leaves), plasmolysis, damage to mucous membrane and metabolic inhibition. SO₂ and SO₃ react with water to form Sulphuric and sulphurous acids. These may precipitate as rain or snow producing acid rain or acid precipitation.

5. **Photochemical Oxidants:** Formed by the photochemical reactions between primary pollutants, viz. oxides of nitrogen and hydrocarbons. Nitrogen oxides in the presence of sunlight react with un-burnt hydrocarbons to form peroxyacetyl nitrate (PAN), Ozone, aldehydes and some other complex organic compounds in the air.
6. **Hydrocarbons:** These are un-burnt discharges from incomplete combustion of fuel in automobiles. These forms PAN with nitrogen oxides, which is highly toxic.
7. **Particulate Matter:** Industries and automobiles release fine solid and liquid particles into the air. Fly ash and soot from burning of coal, metal dust containing lead, chromium, nickel, cadmium, zinc and mercury from metallurgical processes; cotton dust from textile mills; and pesticides sprayed on crops are examples of particulate pollutants in the air. These are injurious to respiratory tract.
8. **Aerosols:** Aerosols are chemicals released in the air in vapor form. These include fluorocarbon (carbon compound having fluorine) present in emissions from the Jet aero planes. Aerosols deplete the ozone layer. Thinning of ozone layer results in more harmful ultraviolet rays reaching the earth, which are harmful to skin, and can lead to skin cancer also.
9. **Radioactive Substances:** These are released by nuclear explosions and explosives. These are extremely harmful for health.
10. **Fluorides:** Rocks, soils and minerals containing fluorides release an extremely toxic gas called hydrogen fluoride on heating. This gas is highly injurious to livestock and cattle.

3.3.1.5 Control measures

The atmosphere has several built-in self cleaning processes such as dispersion, gravitational settling, flocculation, absorption, rain-washout, etc to cleanse the atmosphere. However, control of contaminants at their source level is a desirable and effective method through preventive or control technologies.

1. **Source control:** Some measures that can be adopted in this direction are

1. Using unleaded petrol

2. Using fuels with low sulphur and ash content
3. Encouraging people to use public transport, walk or use a cycle as opposed to private vehicles
4. Ensure that houses, schools, restaurants and playgrounds are not located on busy streets
5. Plant trees along busy streets as they remove particulates, carbon dioxide and absorb noise
6. Industries and waste disposal sites should be situated outside the city preferably on the downwind of the city.
7. Catalytic converters should be used to help control emissions of carbon monoxide and hydrocarbons

2. Control measures in industrial centers:

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

3.3.1.6 Equipment used to control air pollution

Air pollution can be reduced by adopting the following approaches.

1. Ensuring sufficient supply of oxygen to the combustion chamber and adequate temperature so that the combustion is complete thereby eliminating much of the smoke consisting of partly burnt ashes and dust.
2. To use mechanical devices such as scrubbers, cyclones, bag houses and electrostatic precipitators in manufacturing processes. The equipment used to remove particulates from the exhaust gases of electric power and industrial plants are shown below. All methods retain hazardous materials that must be disposed safely. Wet scrubber can additionally reduce sulphur dioxide emissions.
3. The air pollutants collected must be carefully disposed. The factory fumes are dealt with chemical treatment.

3.3.2 WATER POLLUTION

3.3.2.1 Introduction: 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."

3.3.2.2 Sources of water pollution

1. Point sources: These are pollutants that are discharged at specific locations through pipes, ditches or sewers into bodies of surface waters.

Ex: Factories, sewage treatment plants, abandoned underground mines and oil tankers.

2. Non point sources: These pollutants cannot be traced to a single point of discharge. They are large land areas or air-sheds that pollute water by runoff, subsurface flow or deposition from the atmosphere.

Ex: Acid deposition, runoff of chemicals into surface water from croplands, livestock feedlots, logged forests, urban streets, lawns, golf courses and parking lots.

3.3.2.3 Types, effects and sources 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.

S.No	Pollutants	Human sources	Health Effects
1	Infectious agents Ex: Bacteria, Viruses, Protozoa, and parasitic worms.	Human and animal wastes	Variety of diseases
2	Oxygen demanding wastes (Dissolved oxygen) Ex: Organic wastes such as animal manure and plant debris	Sewage, Animal feedlots, paper mills and food processing facilities	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 Ex: Water soluble inorganic	Surface runoff, industrial effluents	<ul style="list-style-type: none">• Make freshwater unusable for drinking and irrigation

	chemicals: Acids, Compounds of toxic metals such as lead (Pb), arsenic (As) and selenium (Se) and Salts such as NaCl in oceans and fluoride (F ⁻) found in some soils.	and household cleansers	<ul style="list-style-type: none"> • Cause skin cancer and neck damage, Damage to nervous system, liver and kidneys • Harm fish and other aquatic life • Lower crop yields • Accelerate corrosion of metals exposed to such water
4	Organic chemicals Ex: Oil, Gasoline, Plastics, Pesticides, Cleaning solvents and Detergents.	Industrial effluents, household cleaners and surface runoff from farms.	<ul style="list-style-type: none"> • Can threaten human health by causing nervous system damage and some cancers. • Harm fish and wildlife.
5	Plant nutrients Ex: Water soluble compounds containing nitrate, Phosphate and Ammonium ions.	Sewage, manure and runoff of agricultural and urban fertilizers	<ul style="list-style-type: none"> • Can cause excessive growth of algae and other aquatic plants, which die, decay, deplete dissolved oxygen in water thereby killing fish • Drinking water with excessive levels of nitrates lower the oxygen carrying capacity of the blood and can kill urban children and infants.
6	Sediment Ex: Soil, silt, etc.	Land erosion	<ul style="list-style-type: none"> • Causes cloudy water thereby reducing photosynthetic activity • Disruption of aquatic food chain

			<ul style="list-style-type: none"> • Carries pesticides, bacteria and other harmful substances • Settles and destroys feeding and spawning grounds of fish • Clogs and fills lakes, artificial reservoirs, stream channels and harbors
7	<p>Radioactive materials:</p> <p>Ex: Radioactive isotopes of: Iodine, Radon, Uranium, Cesium and Thorium.</p>	<p>Nuclear power plants, mining and processing of uranium and other ores, nuclear weapon production and natural sources.</p>	<p>Genetic mutations, birth defects and certain cancers.</p>
8	<p>Heat (Thermal pollution)</p> <p>Ex: Excessive heat</p>	<p>Water cooling of electric power plants and some types of industrial plants.</p>	<ul style="list-style-type: none"> • Low dissolved oxygen levels thereby making aquatic organisms more vulnerable to disease, parasites and toxic chemicals. • When a power plant starts or shuts down for repair, fish and other organisms adapted to a particular temperature range, can be killed by an abrupt temperature change known as thermal shock.

3.3.2.4 Control measures of water pollution

1. Administration of water pollution control should be in the hands of state or central government
2. Scientific techniques should be adopted for environmental control of catchment areas of rivers, ponds or streams
3. Industrial plants should be based on recycling operations as it helps prevent disposal of wastes into natural waters but also extraction of products from waste.
4. Plants, trees and forests control pollution as they act as natural air conditioners.
5. Trees are capable of reducing sulphur dioxide and nitric oxide pollutants and hence more trees should be planted.
6. No type of waste (treated, partially treated or untreated) should be discharged into any natural water body. Industries should develop closed loop water supply schemes and domestic sewage must be used for irrigation.
7. Qualified and experienced people must be consulted from time to time for effective control of water pollution.
8. Public awareness must be initiated regarding adverse effects of water pollution using the media.
9. Laws, standards and practices should be established to prevent water pollution and these laws should be modified from time to time based on current requirements and technological advancements.
10. Basic and applied research in public health engineering should be encouraged.

3.3.3 THERMAL POLLUTION

3.3.3.1 Introduction

Thermal pollution is defined as the addition of excess of undesirable heat to water thereby making it harmful to man, animal or aquatic life. Thermal pollution may also cause no significant departures from or activities of aquatic communities.

3.3.3.2 Sources of Thermal Pollution

The following sources contribute to thermal pollution.

- 1. Nuclear power plants:** Nuclear power plants including drainage from hospitals, research institutions, nuclear experiments and explosions,

discharge a lot of heat that is not utilized along with traces of toxic radio nuclides into nearby water streams. Emissions from nuclear reactors and processing installations are also responsible for increasing the temperatures of water bodies. The operations of power reactors and nuclear fuel processing units constitute the major contributor of heat in the aquatic environment. Heated effluents from power plants are discharged at 10 C higher than the receiving waters that affect the aquatic flora and fauna.

2. **Coal-fired power plants:** Coal fired power plants constitute a major source of thermal pollution. The condenser coils in such plants are cooled with water from nearby lakes or rivers. The resulting heated water is discharged into streams thereby raising the water temperature by 15C. Heated effluent decreases the dissolved content of water resulting in death of fish and other aquatic organisms. The sudden fluctuation of temperature also leads to "*thermal shock*" killing aquatic life that has become acclimatized to living in a steady temperature.
3. **Industrial effluents:** Industries like textile, paper, pulp and sugar manufacturing release huge amounts of cooling water along with effluents into nearby natural water bodies. The waters polluted by sudden and heavy organic loads result in severe drop in levels of dissolved oxygen leading to death of several aquatic organisms.
4. **Domestic Sewage:** Domestic sewage is discharged into rivers, lakes, canals or streams with minimal treatment or without any treatment. These wastes have a higher organic temperature and organic load. This leads to decrease in dissolved oxygen content in the receiving waters resulting in the set-up of anaerobic conditions causing release of foul and offensive gases in water. Eventually, this leads to development of anoxic conditions resulting in rapid death of aquatic organisms.
5. **Hydro-electric power:** Generation of hydroelectric power sometimes leads to negative thermal loading in water systems. Apart from electric power industries, various factories with cooling requirement contribute to thermal loading.

3.3.3.3 Thermal pollution in streams by human activities

- Industries and power plants use water to cool machinery and discharge the warm water into a stream
- Stream temperature rises when trees and tall vegetation providing shade are cut.
- Soil erosion caused due to construction also leads to thermal pollution
- Removal of stream side vegetation
- Poor farming Practices also lead to thermal pollution

3.3.3.4 Effects of Thermal pollution

- 1. Reduction in dissolved oxygen:** Concentration of Dissolved Oxygen (DO) decreases with increase in temperature.
- 2. Increase in toxicity:** The rising temperature increases the toxicity of the poison present in water. A 10C increase in temperature of water doubles the toxicity effect of potassium cyanide, while 80C rise in temperature triples the toxic effects of o-xylene causing massive mortality to fish.
- 3. Interference in biological activity:** Temperature is considered to be of vital significance to physiology, metabolism and biochemical processes that control respiratory rates, digestion, excretion, and overall development of aquatic organisms. Temperature changes cause total disruption to the entire ecosystem.
- 4. Interference in reproduction:** In fishes, several activities like nest building, spawning, hatching, migration and reproduction depend on optimum temperature.
- 5. Direct mortality:** Thermal pollution is directly responsible for mortality of aquatic organisms. Increase in temperature of water leads to exhaustion of microorganisms thereby shortening the life span of fish. Above a certain temperature, fish die due to failure of respiratory system and nervous system failure.
- 6. Food storage for fish:** Abrupt changes in temperature alter the seasonal variation in the type and abundance of lower organisms leading to shortage of right food for fish at the right time.

3.3.3.5 Control measures for thermal pollution

The following methods can be adapted to control high temperature caused by thermal discharges:

1. Cooling towers: Use of water from water systems for cooling systems for cooling purposes, with subsequent return to the water way after passage through a condenser, is called cooling process. Cooling towers transfer heat from hot water to the atmosphere by evaporation. Cooling towers are of two types:

(i) Wet cooling tower: Hot water coming out from the condenser (reactor) is allowed to spray over baffles. Cool air, with high velocity, is passed from sides, which takes away the heat and cools the water.

(ii) Dry cooling tower: Here, hot water is allowed to flow in long spiral pipes. Cool air with the help of a fan is passed over these hot pipes, which cools down hot water. This cool water can be recycled.

2. Cooling ponds: Cooling ponds are the best way to cool thermal discharges. Heated effluents on the surface of the water in cooling ponds maximize dissipation of heat to the atmosphere and minimize the water area and volume. The warm water wedge acts like a cooling pond.

3. Spray ponds: The water coming out from condensers is allowed to pass into the ponds through sprayers. Here water is sprayed through nozzles as fine droplets. Heat from the fine droplets gets dissipated to the atmosphere.

4. Artificial lakes: Artificial lakes are manmade water bodies that offer once-through cooling. The heated effluents can be discharged into the lake at one end and water for cooling purposes may be withdrawn from the other end. The heat is eventually dissipated through evaporation

3.3.4 SOIL POLLUTION

3.3.4.1 Introduction

Soil pollution is defined as, "contamination of soil by human and natural activities which may cause harmful effect on living organisms".

3.3.4.2 Types, effects and sources of soil pollution

S.No	Pollutants	Sources	Health Effects
1	Industrial wastes	Industrial pollutants are mainly discharged from various origins such as pulp and paper mills, chemical fertilizers, oil refineries, sugar factories, tanneries, textiles, steel, distilleries, fertilizers, pesticides, coal and mineral mining industries, drugs, glass, cement, petroleum and engineering industries etc.	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, disturb the biochemical process and finally lead to serious effects on living organisms.
2	Urban wastes	Plastics, glasses, metallic cans, fibers, paper, rubbers, street sweepings, fuel residues, leaves, containers, abandoned vehicles and other discarded manufactured products.	Alter the constitution of soil Cause Water logging Cause biomagnifications of toxic materials through food chain
3	Agricultural practices	fertilizers, pesticides, weedicides, farm wastes, manure debris, soil erosion	Water logging, Salinisation, micronutrient imbalance, loss of fertile soil
4	Radioactive pollutants	Atomic reactor, nuclear radioactive devices, Explosion of hydrogen weapons and cosmic radiations	Mutations, changes functions of living beings, Biomagnifications, cancers, Infant mortality

5	Biological agents	The human and animal wastes, garbage, waste water	Variety of diseases Cause nutrient imbalance
6	Pesticides	chlorinated hydrocarbon insecticide Organic phosphorous pesticides	Reduces the activity of sex hormones of male and female. Causes diseases to human beings.
7	Fertilizers	Different fertilizers discharge N, Na, K, S, Nitrates etc	The nitrate causes cancer, blue baby syndrome in infants.
8	Polymer, Plastics & other water	Waste from different sources	Biomagnifications, water logging, create cancers in animals and human beings.

3.3.4.3 Control measures of soil pollution

1. **Soil erosion can be controlled** by a variety of forestry and farm practices.
Ex: Planting trees on barren slopes
2. Contour cultivation and strip cropping may be practiced instead of shifting cultivation
3. Terracing and building diversion channels may be undertaken.
4. Reducing deforestation and substituting chemical manures by animal wastes also helps arrest soil erosion in the long term.
5. **Proper dumping of unwanted materials:** Excess wastes by man and animals pose a disposal problem. Open dumping is the most commonly practiced technique. Nowadays, controlled tipping is followed for solid waste disposal. The surface so obtained is used for housing or sports field.
6. **Production of natural fertilizers:** Bio-pesticides should be used in place of toxic chemical pesticides. Organic fertilizers should be used in place of synthesized chemical fertilizers. Ex: Organic wastes in animal dung may be

used to prepare compost manure instead of throwing them wastefully and polluting the soil.

7. Proper hygienic condition: People should be trained regarding sanitary habits.

Ex: Lavatories should be equipped with quick and effective disposal methods.

8. Public awareness: Informal and formal public awareness programs should be imparted to educate people on health hazards by environmental education.

Ex: Mass media, Educational institutions and voluntary agencies can achieve this.

9. 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.

Ex: Industrial wastes should be properly treated at source. Integrated waste treatment methods should be adopted.

10. 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 improper disposal of radioactive wastes should be banned.

3.3.5 NOISE POLLUTION

3.3.5.1 Introduction

Noise is defined as, "the unwanted, unpleasant or disagreeable sound that causes discomfort to all living beings". Sound intensity is measured in decibels (dB) , that is the tenth part of the longest unit Bel. One dB is the faintest sound that a human ear can hear.

3.3.5.2 Types of noise: Environmental noise has been doubling every ten years. Noise is classified as:

1. Industrial Noise
2. Transport Noise
3. Domestic Noise

Industrial Noise:

It is sound with a high intensity sound caused by industry machines. Sources of such noise pollution are caused by machines from machines in various factories, industries and mills. Noise from mechanical saws and pneumatic drills is unbearable and a nuisance to the public. The Indian Institute of Oto-Rino Laryngology, Chennai reported that increasing industrial pollution damages the hearing ability by at least 20%. Workers in steel industry, who work close to heavy industrial blower, are exposed to 112dB for eight hours suffer from occupational pollution.

Transport Noise:

Transport noise mainly consists of traffic noise from road, rail and aircraft. The number of automobiles on roads like motors, scooters, cars, motor cycles, buses, trucks and diesel engine vehicles has increased enormously in the recent past further aggravating the problem of transport noise. Noise levels in most residential areas in metropolitan cities are hovering around the border line due to increased vehicular noise pollution. This high level of noise pollution leads to deafening in the elderly.

Domestic noise:

This type of noise includes disturbance from household gadgets and community. Common sources of noise are musical instruments, TV, VCR, Radios, Transistors, Telephones, and loudspeakers etc. Statistically ever since the industrial revolution, noise in the environment has been doubled every ten years.

3.3.5.3 Effects of Noise pollution

- Noise pollution affects both human and animal health. It leads to:
 - contraction of blood vessels
 - making skin pale
 - Excessive adrenalin in the blood stream which is responsible for high blood pressure.
 - Blaring sounds are known to cause mental distress
 - Heart attacks, neurological problems, birth defects and abortion
- Muscle contraction leading to nervous breakdown, tension, etc

- The adverse reactions are coupled with a change in hormone content of blood, which in-turn increases heart beat, constriction of blood vessels, digestive spasms and dilation of the pupil of the eye.
- Adverse affects health, work efficiency and behavior. Noise pollution may cause damage to the heart, brain, kidneys, liver and may produce emotional disturbance.
- The most immediate and acute effect of noise is impairment of hearing that diminishes some part of the auditory system. Prolonged exposure to noise of certain frequency pattern leads to chronic damage to the inner ear.
- Impulsive noise may cause psychological and pathological disorders
- Ultrasonic sound can affect the digestive, respiratory, cardiovascular system and semicircular canals of the internal ear.
- The brain is adversely affected by loud and sudden noise by jets and airplanes. People are subjected to psychiatric illness.
- Recent reports suggest that blood is thickened by excessive noise.
- The optical system of human beings is also affected by noise pollution. Severe noise pollution causes:
 - Popularity dilation
 - Impairment of night vision and
 - Decrease in rate of color perception

3.3.5.4 Control measures:

1. **SOURCE CONTROL:** This includes source modification such as acoustic treatment to machine surface, design changes, limiting operational timings, etc
2. **TRANSMISSION PATH INTERVENTION:** This includes containing the source inside a sound insulating enclosure, constructing 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 noise from the machine.

3.3.5.5 Preventive measures

1. Prescribing noise limits for vehicular traffic
2. Ban on honking (usage of horns) in certain areas
3. Creation of silence zones near schools and hospitals
4. Redesigning buildings to make them noise proof
5. Reduction of traffic density in residential areas
6. Giving preference to mass public transport system.

3.3.6 MARINE POLLUTION

3.3.6.1 Introduction

The discharge of waste substances in to the sea resulting in harm to the living resources, hazards to the human health hindrances to the fishery and impairment of quality use of sea water.

3.3.6.2 Sources

- 1. Dumping the wastes:** Dumping of untreated wastes and sewages in the oceans by coastal towns, cities and industries. Rivers on the way to sea carry huge amount of sewage garbage agricultural discharge pesticide heavy metals. Huge quantity of plastic dumped in to the sea.
- 2. Oil:** This is discharged in to the sea as crude oil and as separate fraction. Oil and it's fractions are used in houses automobiles and industries. This causes devastation of marine environment
- 3. Radioactive materials** enter the ocean from nuclear weapon testing.
- 4. Toxics:** Toxic waste is the most harmful form of marine pollution. Once toxic wastes affects an organism it quickly passes along the food chain and as sea food which cause various problems.
- 5. Marine Debris:** Garbage like plastic bags, ropes helium balloons

3.3.6.3 Effects of marine pollution

1. Heavy metals and organic pollutants damages birds by thinning of egg shells and tissue damage of egg.

2. Oil pollution causes damage to marine animals and plants including algae bird, fish etc.
3. Oil spilling in the sea causes abnormal low body temperature in birds resulting in hypothermia. During Exxon Valdez accident 150 rare species of bald eagles are affected by ingested oil.
4. Oil films are able to retard the rate of oxygen uptake by water.
5. Hydrocarbon and benzpyrene accumulate in food chain and consumption of fish by man may cause cancer.
6. Many marine birds ingest plastic that causes gastrointestinal disorders.
7. Oil spills inhibit photosynthesis and the growth of planktons. All aquatic animals depend either directly or indirectly on planktons the basis of tropic chain.

3.3.6.4 Control of marine pollution

- Nature and world conservation union suggest the principles
 1. The industrial unit on the coastal lines should be equipped with pollution control instrument.
 2. Urban growth near the coast should be regulated.
- Methods of removal of oil
 1. Physical methods.
 - skimming the oil off the surface with suction device
 - Floating oil can be absorbed using absorbing materials like poly urethane foam. Chopped straw and saw dust also used to absorbed oil from the sea water.
 2. Chemical methods like dispersion , emulsification and using chemical additives are used to coagulated the oil

3.3.6.5 Protective method

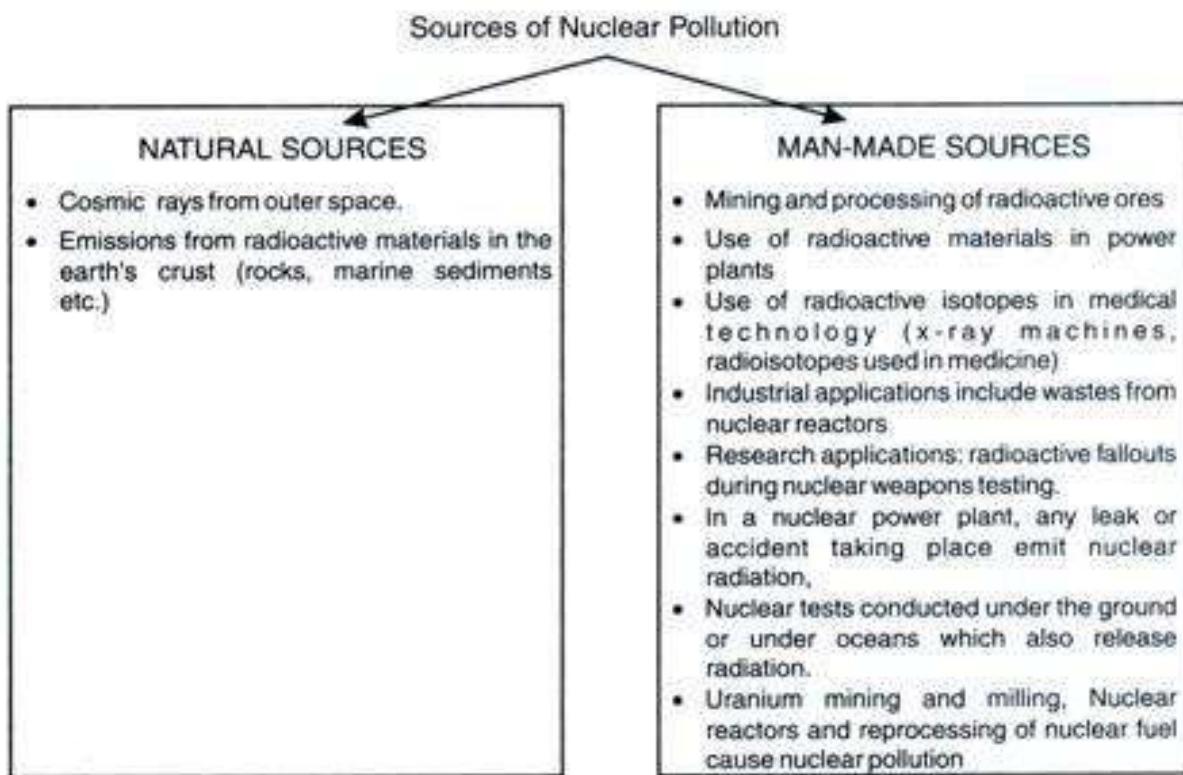
1. Municipal and industrial waste should be treated before disposing in to sea
2. Coastal waste are periodically analyzed for detecting pollution level
3. Soil erosion in the coastal land should be arrested be suitable techniques
4. Recreation beaches should be maintained to meet hygienic and aesthetic standard.

3.3.7 Nuclear Pollution

Nuclear pollution is the physical pollution of air, water and soil by radioactive materials.

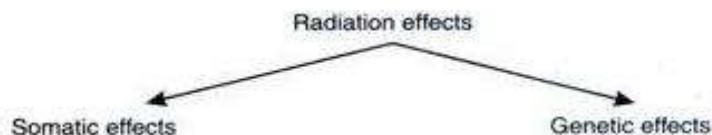
3.3.7.1 Sources of Nuclear Pollution

The sources of radioactivity include both natural and manmade.



3.3.7.2 Effects of Nuclear Pollution

Studies have shown that the health effects due to radiation are dependent on the level of dose, kind of radiation, duration of exposure and types of cells irradiated. Radiation effects can be somatic or genetic.



- 1. Somatic effects:** Somatic affects the function of cells and organs. It causes damages to cell membranes, mitochondria and cell nuclei resulting in abnormal cell functions, cell division, growth and death.
- 2. Genetic effects:** Genetic effects the future generations. Radiations can cause mutations, which are changes in genetic makeup of cells. These effects are mainly due to the damages to DNA molecules. People suffer from blood cancer and bone cancer if exposed to doses around 100 to 1000 roentgens.

3.3.7.3 Management of Radioactive Waste

- The radioactive waste which comes out from industry, nuclear reactors should be stored and allowed to decay either naturally in closed drums or in very large underground air tight cemented tanks (Delay and Decay).
- The intermediate radioactive waste should be disposed off into the environment after diluting it with some inert materials (Dilute and Disperse)
- Now-a-days small quantities of high activity wastes are converted into solids such as concrete and then it is buried underground or sea. (Concentrate and contain)

3.3.7.4 Control Measures

- Laboratory generated nuclear wastes should be disposed off safely and scientifically.
- Nuclear power plants should be located in areas after careful study of the geology of the area, tectonic activity and meeting other established conditions.
- Appropriate protection against occupational exposure.
- Leakage of radioactive elements from nuclear reactors, careless use of radioactive elements as fuel and careless handling of radioactive isotopes must be prevented.

- Safety measure against accidental release of radioactive elements must be ensured in nuclear plants.
- Unless absolutely necessary, one should not frequently go for diagnosis by x-rays.
- Regular monitoring of the presence of radioactive substance in high risk area should be ensured.
- Among the many options for waste disposal, the scientists prefer to bury the waste in hundreds of meters deep in the earth's crust is considered to be the best safety long term option.

3.3.8 SOLID WASTE MANAGEMENT

3.3.8.1 Introduction

Rapid population growth and urbanization in developing countries has led to people generating enormous quantities of solid waste and consequent environmental degradation. The waste is normally disposed in open dumps creating nuisance and environmental degradation. Solid wastes cause a major risk to public health and the environment. Management of solid wastes is important in order to minimize the adverse effects posed by their indiscriminate disposal.

3.3.8.2 Types of solid wastes

Depending on the nature of origin, solid wastes are classified into

1. Urban or municipal wastes
 2. Industrial wastes
 3. Hazardous wastes
- **Sources of urban wastes:** Domestic wastes containing a variety of materials thrown out from homes.
Ex: Food waste, Cloth, Waste paper, Glass bottles, Polythene bags, Waste metals, etc.
 - **Commercial wastes:** It includes wastes coming out from shops, markets, hotels, offices, institutions, etc.
Ex: Waste paper, packaging material, cans, bottle, polythene bags, etc.

- **Construction wastes:** It includes wastes of construction materials.
Ex: Wood, Concrete, Debris, etc.
- **Biomedical wastes:** It includes mostly waste organic materials
Ex: Anatomical wastes, Infectious wastes, etc.

3.3.8.3 CLASSIFICATION OF URBAN WASTES

urban wastes are classified into:

- **Bio-degradable wastes** - Those wastes that can be degraded by micro organisms are called bio-degradable wastes
Ex: Food, vegetables, tea leaves, dry leaves, etc.
- **Non-biodegradable wastes:** Urban solid waste materials that cannot be degraded by micro organisms are called non-biodegradable wastes.
Ex: Polythene bags, scrap materials, glass bottles, etc.

3.3.8.4 SOURCES OF INDUSTRIAL WASTES

- The main source of industrial wastes is chemical industries, metal and mineral processing industries.
Ex: Nuclear plants: It generated radioactive wastes
 - **Thermal power plants:** It produces fly ash in large quantities
 - **Chemical Industries:** It produces large quantities of hazardous and toxic materials.
 - **Other industries:** Other industries produce packing materials, rubbish, organic wastes, acid, alkali, scrap metals, rubber, plastic, paper, glass, wood, oils, paints, dyes, etc.

3.3.8.5 EFFECT OF IMPROPER SOLID WASTE MANAGEMENT

1. Due to improper disposal of municipal solid waste on the roads and immediate surroundings, biodegradable materials undergo decomposition producing foul smell and become a breeding ground for disease vectors.

2. Industrial solid wastes are the source for toxic metals and hazardous wastes that affect soil characteristics and productivity of soils when they are dumped on the soil
3. Toxic substances may percolate into the ground and contaminate the groundwater.
4. Burning of industrial or domestic wastes (cans, pesticides, plastics, radioactive materials and batteries) produce furans, dioxins and polychlorinated biphenyls that are harmful to human beings.
5. Solid waste management involves waste generation, mode of collection, transportation, segregation of wastes and disposal techniques.

3.3.8.6 STEPS INVOLVED IN SOLID WASTE MANAGEMENT

Two important steps involved in solid waste management are- Reduce, Reuse and Recycle of Raw Materials

1. Discarding wastes

- Reduce - If usage of raw materials is reduced, the generation of waste also gets reduced.
 - Reuse - Refillable containers that are discarded after use can be reused. Rubber rings can be made from discarded cycle tubes and this reduces waste generation during manufacture of rubber bands.
2. Recycle- Recycling is the reprocessing of discarded materials into new useful products
- Ex: Old aluminum cans and glass bottles are melted and recast into new cans and bottles, preparation of cellulose insulation from paper, Preparation of automobile body and construction material from steel cans. This method (**Reduce, Reuse & Recycle**), i.e, **3R's** help save money, energy, raw materials and reduces pollution.

3.3.8.7 Discarding wastes

The following methods are adopted for discarding wastes:

1. Landfill
2. Incineration and
3. Composting

1. LANDFILL: Solid wastes are placed in a sanitary landfill in which alternate layers of 80 cm thick refuse is covered with selected earth-fill of 20 cm thickness. After 2-3 years solid waste volume shrinks by 25-30% and land is used for parks, roads and small buildings. This is the most common and cheapest method of waste disposal and is mostly employed in Indian cities.

Advantages:

1. It is simple and economical
2. Segregation of wastes is not required
3. Land filled 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. Large area is required
2. Land availability is away from the town, transportation costs are high
3. Leads to bad odor, if landfill is not properly managed.
4. Land filled areas will be sources of mosquitoes and flies requiring application of insecticides and pesticides at regular intervals.
5. Causes fire hazard due to formation of methane in wet weather.

2. INCINERATION:

- It is a hygienic way of disposing solid waste. It is suitable if waste contains more hazardous material and organic content. It is a thermal process and very effective for detoxification of all combustible pathogens. It is expensive when compared to composting or land-filling.
- In this method municipal solid wastes are burnt in a furnace called incinerator. Combustible substances such as rubbish, garbage, dead organisms and non-combustible matter such as glass, porcelain and metals are separated before feeding to incinerators.

- The non-combustible materials can be left out for recycling and reuse. The leftover ashes and clinkers may account for about 10 to 20% which need further disposal by sanitary landfill or some other means.
- The heat produced in the incinerator during burning of refuse is used in the form of steam power for generation of electricity through turbines.
- Municipal solid waste is generally wet and has a high calorific value. Therefore, it has to be dried first before burning. Waste is dried in a preheated from where it is taken to a large incinerating furnace called "destructor" which can incinerate about 100 to 150 tons per hour.
- Temperature normally maintained in a combustion chamber is about 700 C which may be increased to 1000 C when electricity is to be generated.

ADVANTAGES:

1. Residue is only 20-25% of the original and can be used as clinker after treatment
2. Requires very little space
3. Cost of transportation is not high if the incinerator is located within city limits
4. Safest from hygienic point of view
5. An incinerator plant of 3000 tons per day capacity can generate 3MW of power.

DISADVANTAGES:

1. Its capital and operating cost is high.
2. Operation needs skilled personnel.
3. Formation of smoke, dust and ashes needs further disposal and that may cause air pollution.

3. COMPOSTING: It is another popular method practiced in many cities in our country. In this method, bulk organic waste is converted into fertilizer by biological action. Separated compostable waste is dumped in underground trenches in layers of 1.5m and finally covered with earth of 20cm and left for decomposition. Sometimes, Actionmycetes are introduced for active decomposition. Within 2 to 3 days, biological action starts. Organic matter is destroyed by actinomycetes and lot of heat is liberated increasing the temperature of compost by 75C and the refuse is finally converted into powdery brown

colored odorless mass called humus that has a fertilizing value and can be used in agriculture. Humus contains lot of Nitrogen essential for plant growth apart from phosphates and other minerals.

ADVANTAGES:

1. Manure added to soil increases water retention and ion-exchange capacity of soil.
2. This method can be used to treat several industrial solid wastes.
3. Manure can be sold thereby reducing cost of disposing wastes
4. Recycling can be done

DISADVANTAGES:

1. Non-consumables have to be disposed separately
2. The technology has not caught-up with the farmers and hence does not have an assured market.

3.3.9 DISASTER MANAGEMENT

3.3.9.1 FLOODS

Increased rainfall or rapid snow melting causes more flow of water in the streams. This excess water flow in a stream covering the adjacent land is called a flood. Floodplain is defined in terms of a flood frequency. Flood frequency is referred as 10-year flood, 100-year flood, etc. A 10-year flood at any point in a stream is that discharge of water which may be expected to occur on average once in 10 years. Floodplains are generally fertile, flat and easily formed.

3.3.9.1 CAUSES OF FLOOD

- Construction of buildings in a flood plain
- Removing vegetation
- Paving roads and parking areas
- Deforestation
- Heavy rainfall
- Urbanization