



ENVIRONMENTAL POLLUTION

Developmental activities such as construction, transportation and manufacturing not only deplete the natural resources but also produce large amount of wastes that leads to pollution of air, water, soil, and oceans; global warming and acid rains. Untreated or improperly treated waste is a major cause of pollution of rivers and environmental degradation causing ill health and loss of crop productivity. In this lesson you will study about the major causes of pollution, their effects on our environment and the various measures that can be taken to control such pollutions.



OBJECTIVES

After completing this lesson, you will be able to:

- *define the terms pollution and pollutants;*
- *list various kinds of pollution;*
- *describe types of pollution, sources, harmful effects on human health and control of air pollution, indoor air pollution, noise pollution;*
- *describe water pollution, its causes and control;*
- *describe thermal pollution;*
- *describe soil pollution, its causes and control;*
- *describe radiation pollution, sources and hazards.*

10.1 POLLUTION AND POLLUTANTS

Human activities directly or indirectly affect the environment adversely. A stone crusher adds a lot of suspended particulate matter and noise into the atmosphere. Automobiles emit from their tail pipes oxides of nitrogen, sulphur dioxide, carbon dioxide, carbon monoxide and a complex mixture of unburnt hydrocarbons and black soot which pollute the atmosphere. Domestic sewage and run off from agricultural fields, laden with pesticides



and fertilizers, pollute water bodies. Effluents from tanneries contain many harmful chemicals and emit foul smell. These are only a few examples which show how human activities pollute the environment. **Pollution** may be defined as addition of undesirable material into the environment as a result of human activities. The agents which cause environmental pollution are called **pollutants**. A pollutants may be defined as a physical, chemical or biological substance unintentionally released into the environment which is directly or indirectly harmful to humans and other living organisms.

10.2 TYPES OF POLLUTION

Pollution may be of the following types:

- Air pollution
- Noise pollution
- Water pollution
- Soil pollution
- Thermal pollution
- Radiation pollution



10.3 AIR POLLUTION

Air pollution is a result of industrial and certain domestic activity. An ever increasing use of fossil fuels in power plants, industries, transportation, mining, construction of buildings, stone quarries had led to air pollution. **Air pollution** may be defined as the presence of any solid, liquid or gaseous substance including noise and radioactive radiation in the atmosphere in such concentration that may be directly and indirectly injurious to humans or other living organisms, plants, property or interferes with the normal environmental processes. Air pollutants are of two types (1) suspended particulate matter, and (2) gaseous pollutants like carbon dioxide (CO_2), NO_x etc. Some of the major air pollutants, their sources and effects are given in table 10.1.

Table 10.1: Particulate air pollutants, their sources and effects

Pollutant	Sources	Effects
Suspended particulate matter/dust	Smoke from domestic, industrial and vehicular soot	Depends on specific composition Reduces sunlight and visibility, increases corrosion, Pneumoconiosis, asthma, cancer, and other lung diseases.
Fly ash	Part of smoke released from chimneys of factories and power plants	Settles down on vegetation, houses. Adds to the suspended particulate matter (SPM) in the air. Leachates contain harmful material



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10.3.1 Particulate pollutants

Particulate matter suspended in air are dust and soot released from the industrial chimneys. Their size ranges from 0.001 to 500 μm in diameter. Particles less than 10 μm float and move freely with the air current. Particles which are more than 10 μm in diameter settle down. Particles less than 0.02 μm form persistent aerosols. Major source of SPM (suspended particulate matter) are vehicles, power plants, construction activities, oil refinery, railway yard, market place, industries, etc.

• **Fly ash**

Fly ash is ejected mostly by thermal power plants as by products of coal burning operations. Fly ash pollutes air and water and may cause heavy metal pollution in water bodies. Fly ash affects vegetation as a result of its direct deposition on leaf surfaces or indirectly through its deposition on soil. Fly ash is now being used for making bricks and as a land fill material.

• **Lead and other metals particles**

Tetraethyl lead (TEL) is used as an anti-knock agent in petrol for smooth and easy running of vehicles. The lead particles coming out from the exhaust pipes of vehicles is mixed with air. If inhaled it produces injurious effects on kidney and liver and interferes with development of red blood cells. Lead mixed with water and food can create cumulative poisoning. It has long term effects on children as it lowers intelligence.

Oxides of iron, aluminum, manganese, magnesium, zinc and other metals have adverse effect due to deposition of dust on plants during mining operations and metallurgical processes. They create physiological, biochemical and developmental disorders in plants and also contribute towards reproductive failure in plants.

Table 10.2: Annual average concentration of pollutants in ambient air in residential and industrial areas (year 2000) mg/m^3 in 24 hours

SPM permissible- residential 140 – 200 mg/m^3 , industrial 360 – 500 mg/m^3

City	Residential area	Industrial area
Agra	349	388
Bhopal	185	160
Delhi	368	372
Kanpur	348	444
Kolkata	218	405
Nagpur	140	157



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10.3.2 Gaseous pollutants

Power plants, industries, different types of vehicles – both private and commercial use petrol, diesel as fuel and release **gaseous pollutants** such as carbon dioxide, oxides of nitrogen and sulphur dioxide along with particulate matter in the form of smoke. All of these have harmful effects on plants and humans. Table 10.3 lists some of these pollutants, their sources and harmful effects.

Table 10.3: Gaseous air pollutants: their sources and effects

Pollutant	Source	Harmful effect
Carbon compound (CO and CO ₂)	Automobile exhaust burning of wood and coal	<ul style="list-style-type: none"> • Respiratory problems • Green house effect
Sulphur compounds (SO ₂ and H ₂ S)	Power plants and refineries volcanic eruptions	<ul style="list-style-type: none"> • Respiratory problems in humans • Loss of chlorophyll in plants (chlorosis) • Acid rain
Nitrogen Compound (NO and N ₂ O)	Motor vehicle exhaust atmospheric reaction	<ul style="list-style-type: none"> • Irritation in eyes and lungs • Low productivity in plants • Acid rain damages material (metals and stone)
Hydrocarbons (benzene, ethylene)	Automobiles and petroleum industries	<ul style="list-style-type: none"> • Respiratory problem • Cancer causing properties
SPM (Suspended Particulate Matter) (Any soild and liquid) particles suspended in the air, (flush, dust, lead)	Thermal power plants, Construction activities, metalurgical processes and automobiles	<ul style="list-style-type: none"> • Poor visibility, breathing problems • Lead interferes with the development of red blood diseases and cancer. • Smoge (skoke & fog) formation leads to poor visibility and aggravates asthma in patients
Fibres (Cotton, wool)	Textiles and carpet weaving industries	<ul style="list-style-type: none"> • Lung disorders

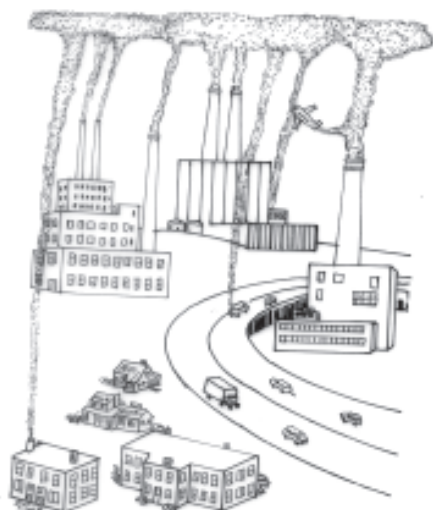


Fig. 10.1: A chimney billowing smoke- Diesel vehicle (bus/truck) showing exhaust smoke



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10.3.3 Prevention and control of air pollution**(i) Indoor air pollution**

Poor ventilation due to faulty design of buildings leads to pollution of the confined space. Paints, carpets, furniture, etc. in rooms may give out volatile organic compounds (VOCs). Use of disinfectants, fumigants, etc. may release hazardous gases. In hospitals, pathogens present in waste remain in the air in the form of spores. This can result in hospital acquired infections and is an occupational health hazard. In congested areas, slums and rural areas burning of firewood and biomass results in lot of smoke. Children and ladies exposed to smoke may suffer from acute respiratory problems which include running nose, cough, sore throat, lung infection, asthma, difficulty in breathing, noisy respiration and wheezing.

(ii) Prevention and control of indoor air pollution

Use of wood and dung cakes should be replaced by cleaner fuels such as biogas, kerosene or electricity. But supply of electricity is limited. Similarly kerosene is also limited. Improved stoves for looking like smokeless chullahs have high thermal efficiency and reduced emission of pollutants including smoke. The house designs should incorporate a well ventilated kitchen. Use of biogas and CNG (Compressed Natural Gas) need to be encouraged. Those species of trees such as baval (*Acacia nilotica*) which are least smoky should be planted and used. Charcoal is a comparatively cleaner fuel. Indoor pollution due to decay of exposed kitchen waste can be reduced by covering the waste properly. Segregation of waste, pretreatment at source, sterilization of rooms will help in checking indoor air pollution.

(iii) Prevention and control of industrial pollution

Industrial pollution can be greatly reduced by:

- (a) use of cleaner fuels such as liquefied natural gas (LNG) in power plants, fertilizer plants etc. which is cheaper in addition to being environmentally friendly.
- (b) employing environment friendly industrial processes so that emission of pollutants and hazardous waste is minimized.
- (c) installing devices which reduce release of pollutants. Devices like filters, electrostatic precipitators, inertial collectors, scrubbers, gravel bed filters or dry scrubbers are described below:
 - (i) **Filters** – Filters remove particulate matter from the gas stream. The medium of a filter may be made of fibrous materials like cloth, granular material like sand, a rigid material like screen, or any mat like felt pad. Baghouse filtration system is the most common one and is made of cotton or synthetic fibres (for low temperatures) or glass cloth fabrics (for higher temperature up to 290°C).
 - (ii) **Electrostatic precipitators (ESP)**- The emanating dust is charged with ions and the ionized particulate matter is collected on an oppositely charged surface. The particles



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are removed from the collection surface by occasional shaking or by rapping the surface. ESPs are used in boilers, furnaces, and many other units of thermal power plants, cement factories, steel plants, etc.

(iii) **Inertial collectors** – It works on the principle that inertia of SPM in a gas is higher than its solvent and as inertia is a function of the mass of the particulate matter this device collects heavier particles more efficiently. ‘Cyclone’ is a common inertial collector used in gas cleaning plants.

(iv) **Scrubbers** – Scrubbers are wet collectors. They remove aerosols from a stream of gas either by collecting wet particles on a surface followed by their removal, or else the particles are wetted by a scrubbing liquid. The particles get trapped as they travel from supporting gaseous medium across the interface to the liquid scrubbing medium.

Gaseous pollutants can be removed by absorption in a liquid using a wet scrubber and depends on the type of the gas to be removed e.g. for removal of sulphur dioxide alkaline solution is needed as it dissolves sulphur dioxide. Gaseous pollutants may be absorbed on an activated solid surface like silica gel, alumina, carbon, etc. Silica gel can remove water vapour. Condensation allows the recovery of many by products in coal and petroleum processing industries from their liquid effluents.

Apart from the use of above mentioned devices, other control measures are-

- increasing the height of chimneys.
- closing industries which pollute the environment.
- shifting of polluting industries away from cities and heavily populated areas.
- development and maintenance of green belt of adequate width.

(iv) **Control of vehicular pollution**

- The emission standards for automobiles have been set which if followed will reduce the pollution. Standards have been set for the durability of catalytic converters which reduce vehicular emission.
- In cities like Delhi, motor vehicles need to obtain Pollution Under Control (PUC) certificate at regular intervals. This ensures that levels of pollutants emitted from vehicle exhaust are not beyond the prescribed legal limits.
- The price of diesel is much cheaper than petrol which promotes use of diesel. To reduce emission of sulphurdioxide, sulphur content in diesel has been reduced to 0.05%.
- Earlier lead in the form of tetraethyl lead was added in the petrol to raise octane level for smooth running of engines. Addition of lead in petrol has been banned to prevent emission of lead particles with the vehicular emission.



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Alternate fuels like CNG is being encouraged for use in public transport vehicles.



INTEXT QUESTIONS 10.1

1. Define pollutant and pollution.

2. Name any three devices that control pollution.

3. State two means of controlling indoor air pollution.

4. What is a PUC certificate?

10.4 OZONE HOLE-CAUSES AND HARM DUE TO OZONE DEPLETION

The stratosphere has an ozone layer which protects the earth’s surface from excessive ultraviolet (UV) radiation from the Sun. Chlorine from chemicals such as chlorofluorocarbons (CFCs) used for refrigeration, air conditioning, fire extinguishers, cleaning solvents, aerosols (spray cans of perfumes, medicine, insecticide) cause damage to ozone layer chlorine contained in the CFCs on reaching the ozone (O₃) layer split the ozone molecules to form oxygen (O₂). Amount of ozone, thus gets reduced and cannot prevent the entry of UV radiation. There has been a reduction of ozone umbrella or shield over the Arctic and Antarctic regions. This is known as **ozone hole**. This permits passage of UV radiation on earth’s atmosphere which causes sunburn, cataract in eyes leading to blindness, skin cancer, reduced productivity of forests, etc. Under the “Montreal Protocol” amended in 1990 it was decided to completely phase out CFCs to prevent damage of ozone layer.

10.5 GLOBAL WARMING AND GREENHOUSE EFFECT

Atmospheric gases like carbondioxide, methane, nitrous oxide, water vapour, and chlorofluorocarbons are capable of trapping the out-going infrared radiation from the earth. Infra-red radiations trapped by the earth’s surface cannot pass through these gases and to increase thermal energy or heat in the atmosphere. Thus, the temperature of the global atmosphere is increased. As this phenomenon of increase in temperature is observed in

green houses, in the botanical gardens these gases are known as green house gases and the heating effect is known as green house effect. If greenhouse gases are not checked, by the turn of the century the temperature may rise by 5°C. This will melt the polar ice caps and increase the sea level leading to coastal flooding, loss of coastal areas and ecosystems like swamps and marshes, etc.



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10.6 NOISE POLLUTION

Noise is one of the most pervasive pollutant. A musical clock may be nice to listen during the day, but may be an irritant during sleep at night. Noise by definition is “sound without value” or “any noise that is unwanted by the recipient”. Noise in industries such as stone cutting and crushing, steel forgings, loudspeakers, shouting by hawkers selling their wares, movement of heavy transport vehicles, railways and airports leads to irritation and an increased blood pressure, loss of temper, decrease in work efficiency, loss of hearing which may be first temporary but can become permanent in the noise stress continues. It is therefore of utmost importance that excessive noise is controlled. Noise level is measured in terms of decibels (dB). W.H.O. (World Health Organization) has prescribed optimum noise level as 45 dB by day and 35 dB by night. Anything above 80 dB is hazardous. The table 10.4 gives the noise intensity in some of the common activities.

Table 10.4: Sources of some noises and their intensity

Source	Intensity	Source	Intensity
Quiet Conversation	20-30dB	Radio Music	50-60 dB
Loud Conversation	60 dB	Traffic Noise	60-90 dB
Lawn Mower	60-80 dB	Heavy Truck	90-100 dB
Aircraft Noise	90-120 dB	Space Vehicle	140-179 dB
Beat Music	120 dB	Launch	
Motor Cycle	105 dB	Jet Engine	140 dB

10.6.1 Sources of noise pollution

Noise pollution is a growing problem. All human activities contribute to noise pollution to varying extent. Sources of noise pollution are many and may be located indoors or outdoors.

Indoor sources include noise produced by radio, television, generators, electric fans, air coolers, air conditioners, different home appliances, and family conflict. Noise pollution is more in cities due to a higher concentration of population and industries and activities such as transportation. Noise like other pollutants is a by product of industrialization, urbanization and modern civilization.



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Outdoor sources of noise pollution include indiscriminate use of loudspeakers, industrial activities, automobiles, rail traffic, aeroplanes and activities such as those at market place, religious, social, and cultural functions, sports and political rallies. In rural areas farm machines, pump sets are main sources of noise pollution. During festivals, marriage and many other occasions, use of fire crackers contribute to noise pollution.

10.6.2 Effects of noise pollution

Noise pollution is highly annoying and irritating. Noise disturbs sleep, causes hypertension (high blood pressure), emotional problems such as aggression, mental depression and annoyance. Noise pollution adversely affects efficiency and performance of individuals.

10.6.3 Prevention and control of noise pollution

Following steps can be taken to control or minimize noise pollution-

- Road traffic noise can be reduced by better designing and proper maintenance of vehicles.
- Noise abatement measures include creating noise mounds, noise attenuation walls and well maintained roads and smooth surfacing of roads.
- Retrofitting of locomotives, continuously welded rail track, use of electric locomotives or deployment of quieter rolling stock will reduce noises emanating from trains.
- Air traffic noise can be reduced by appropriate insulation and introduction of noise regulations for take off and landing of aircrafts at the airport.
- Industrial noises can be reduced by sound proofing equipment like generators and areas producing lot of noise.
- Power tools, very loud music and land movers, public functions using loudspeakers, etc should not be permitted at night. Use of horns, alarms, refrigeration units, etc. is to be restricted. Use of fire crackers which are noisy and cause air pollution should be restricted.
- A green belt of trees is an efficient noise absorber.



INTEXT QUESTIONS 10.2

1. What is noise and in which units it is measured?

2. State two harmful effects of noise pollution.

3. State two important indoor and two outdoor sources of noise pollution? Mention method of control for each of them.

10.7 WATER POLLUTION

Addition or presence of undesirable substances in water is called **water pollution**.

Water pollution is one of the most serious environmental problems. Water pollution is caused by a variety of human activities such as industrial, agricultural and domestic. Agricultural run off laden with excess fertilizers and pesticides, industrial effluents with toxic substances and sewage water with human and animal wastes pollute our water thoroughly. Natural sources of pollution of water are soil erosion, leaching of minerals from rocks and decaying of organic matter. Rivers, lakes, seas, oceans, estuaries and ground water sources may be polluted by point or non-point sources. When pollutants are discharged from a specific location such as a drain pipe carrying industrial effluents discharged directly into a water body it represents **point source pollution**. In contrast **non-point sources** include discharge of pollutants from diffused sources or from a larger area such as run off from agricultural fields, grazing lands, construction sites, abandoned mines and pits, roads and streets.

10.7.1 Sources of water pollution

Water pollution is the major source of water born diseases and other health problems. Sediments brought by runoff water from agricultural fields and discharge of untreated or partially treated sewage and industrial effluents, disposal of fly ash or solid waste into or close to a water body cause severe problems of water pollution. Increased turbidity of water because of sediments reduces penetration of light in water that reduces photosynthesis by aquatic plants.

(i) Pollution due to pesticides and inorganic chemicals

- Pesticides like DDT and others used in agriculture may contaminate water bodies. Aquatic organisms take up pesticides from water get into the food chain (aquatic in this case) and move up the food chain. At higher trophic level they get concentrated and may reach the upper end of the food chain.
- Metals like lead, zinc, arsenic, copper, mercury and cadmium in industrial waste waters adversely affect humans and other animals. Arsenic pollution of ground water has been reported from West Bengal, Orissa, Bihar, Western U.P. Consumption of such arsenic polluted water leads to accumulation of arsenic in the body parts like blood, nails and hairs causing skin lesions, rough skin, dry and thickening of skin and ultimately skin cancer.
- Pollution of water bodies by mercury causes **Minamata disease** in humans and **dropsy** in fishes. Lead causes **displexia**, cadmium poisoning causes **Itai – Itai disease** etc.
- Oil pollution of sea occurs from leakage from ships, oil tankers, rigs and pipelines. Accidents of oil tankers spill large quantity of oil in seas which kills marine birds and adversely affects other marine life and beaches.



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(ii) Thermal pollution

Power plants- thermal and nuclear, chemical and other industries use lot of water (about 30 % of all abstracted water) for cooling purposes and the used hot water is discharged into rivers, streams or oceans. The waste heat from the boilers and heating processes increases the temperature of the cooling water. Discharge of hot water may increase the temperature of the receiving water by 10 to 15 °C above the ambient water temperature. This is **thermal pollution**. Increase in water temperature decreases dissolved oxygen in water which adversely affects aquatic life. Unlike terrestrial ecosystems, the temperature of water bodies remain steady and does not change very much. Accordingly, aquatic organisms are adopted to a uniform steady temperature of environment and any fluctuation in water temperature severely affects aquatic plants and animals. Hence discharge of hot water from power plants adversely affects aquatic organisms. Aquatic plants and animals in the warm tropical water live dangerously close to their upper limit of temperature, particularly during the warm summer months. It requires only a slight deviation from this limit to cause a thermal stress to these organisms.

Discharge of hot water in water body affects feeding in fishes, increases their metabolism and affects their growth. Their swimming efficiency declines. Running away from predators or chasing prey becomes difficult. Their resistance to diseases and parasites decreases. Due to thermal pollution biological diversity is reduced. One of the best methods of reducing thermal pollution is to store the hot water in cooling ponds, allow the water to cool before releasing into any receiving water body

10.7.2 Ground water pollution

Lot of people around the world depend on ground water for drinking, domestic, industrial and agricultural uses. Generally groundwater is a clean source of water. However, human activities such as improper sewage disposal, dumping of farm yard manures and agricultural chemicals, industrial effluents are causing pollution of ground water.

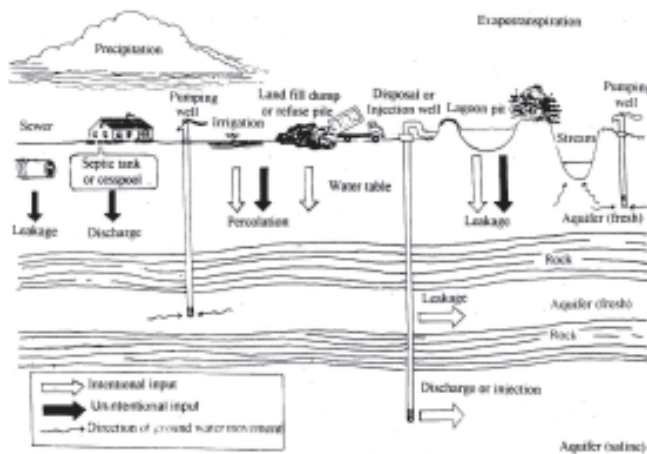


Fig. 10.2: Figure showing how the ground water gets polluted



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10.7.3 Eutrophication

- ‘Eu’ means well or healthy and ‘trophy’ means nutrition. The enrichment of water bodies with nutrients causes eutrophication of the water body.

Discharge of domestic waste, agricultural surface runoff, land drainage and industrial effluents in a water body leads to rapid nutrients enrichment in a water body. The excessive nutrient enrichment in a water body encourages the growth of algae duckweed, water hyacinth, phytoplankton and other aquatic plants. The biological demand for oxygen (BOD) increases with the increase in aquatic organisms. As more plants grow and die, the dead and decaying plants and organic matter acted upon by heterotrophic protozoans and bacteria, deplete the water of dissolved oxygen (DO). Decrease in DO result in sudden death of large population of fish and other aquatic organisms including plants, releasing offensive smell and makes the water unfit for human use. The sudden and explosive growth of phytoplankton and algae impart green colour to the water is known as water bloom, or “algal blooms”. These phytoplankton release toxic substances in water that causes sudden death of large population of fishes. This phenomenon of nutrient enrichment of a water body is called **eutrophication**. Human activities are mainly responsible for the eutrophication of a growing number of lakes and water bodies in the country

10.7.4 Methods for control of water pollution and water recycling

Control water pollution

Waste water from domestic or industrial sources or from garbage dumps is generally known as **sewage**. It may also contain rain water and surface runoff. The sewage water can be treated to make it safe for disposal into water bodies like rivers, lakes etc. The treatment involves three stages: primary, secondary and tertiary. This includes 1. sedimentation, 2. coagulation/flocculation, 3. filtration, 4. disinfection, 5. softening and 6. aeration. The first four steps are of primary treatment. The first three steps are involved in primary treatment remove suspended particulate matter. Secondary treatment removes organic solids, left out after primary treatment, through their microbial decomposition. Effluents after secondary treatment may be clean but contain large amounts of nitrogen, in form of ammonia, nitrates and phosphorous which can cause problem of eutrophication upon their discharge into a receiving water body such as river, lake or pond. The tertiary treatment is meant to remove nutrients, disinfect for removing pathogenic bacteria, and aeration removes hydrogen sulphide and reduce the amount of carbon dioxide and make water healthy and fit for aquatic organisms. This treatment of waste water or sewage is carried out in effluent treatment plants especially built for this purpose. The residue obtained from primary treatment one known as sludge.

10.7.5 Water recycling

With increasing population the requirement for water is increasing rapidly. However, the availability of water is limited but an ever increasing water withdrawal from different sources

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such as rivers, lakes and ground water is depleting these sources and deteriorating their water quality. Therefore, it is essential to utilize the available water with maximum economy. This involves recycling of waste water for certain uses with or without treatment. Recycling refers to the use of waste-water by the original user prior to the discharge either to a treatment system or to a receiving water body. Thus the waste water is recovered and repetitively recycled with or without treatment by the same user.

10.7.6. Control of water pollution

The following measures can be adopted to control water pollution:

- The water requirement should be minimized by altering the techniques involved.
- Water should be reused with or without treatment.
- Recycling of water after treatment should be practiced to the maximum extent possible.
- The quantity of waste water discharge should be minimized.

**INTEXT QUESTIONS 10.3**

- Name the metals which when in excess in drinking water cause Minamata and Itai itai diseases.

- When fertilizers and sewage enter a water body phytoplankton and algae grow rapidly. What is this phenomenon called.

- What is primary treatment? What is removed from water effluents during primary treatment.

- The water used for cooling purposes in industries may be drained industrial into rivers. To what extent does this raise the water temperature of the river?

- What effect does thermal pollution have on the swimming efficiency of fish?

- What effect does thermal pollution have on metabolism of aquatic animals?

- State the term for residue left after primary treatment of waste water.

10.8 SOIL POLLUTION

Addition of substances which adversely affect the quality of soil or its fertility is known as **soil pollution**. Generally polluted water also pollute soil. Solid waste is a mixture of plastics, cloth, glass, metal and organic matter, sewage, sewage sludge, building debris, generated from households, commercial and industries establishments add to soil pollution. Fly ash, iron and steel slag, medical and industrial wastes disposed on land are important sources of soil pollution. In addition, fertilizers and pesticides from agricultural use which reach soil as run-off and land filling by municipal waste are growing cause of soil pollution. Acid rain and dry deposition of pollutants on land surface also contribute to soil pollution.

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Fig. 10.3: A pile of plastic bags along with leftovers- a cow eating them

10.8.1 Sources of soil pollution

Plastic bags – Plastic bags made from low density polyethylene (LDPE), is virtually indestructible, create colossal environmental hazard. The discarded bags block drains and sewage systems. Leftover food, vegetable waste etc. on which cows and dogs feed may die due to the choking by plastic bags. Plastic is non biodegradable and burning of plastic in garbage dumps release highly toxic and poisonous gases like carbon monoxide, carbon dioxide, phosgene, dioxine and other poisonous chlorinated compounds.

Industrial sources – It includes fly ash, chemical residues, metallic and nuclear wastes. Large number of industrial chemicals, dyes, acids, etc. find their way into the soil and are known to create many health hazards including cancer.

Agricultural sources – Agricultural chemicals especially fertilizers and pesticides pollute the soil. Fertilizers in the run off water from these fields can cause eutrophication in water bodies. Pesticides are highly toxic chemicals which affect humans and other animals adversely causing respiratory problems, cancer and death.

10.8.2 Control of soil pollution

Indiscriminate disposal of solid waste should be avoided.



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To control soil pollution, it is essential to stop the use of plastic bags and instead use bags of degradable materials like paper and cloth. Sewage should be treated properly before using as fertilizer and as landfills. The organic matter from domestic, agricultural and other waste should be segregated and subjected to vermicomposting which generates useful manure as a by product. The industrial wastes prior to disposal should be properly treated for removing hazardous materials. Biomedical waste should be separately collected and incinerated in proper incinerators.



INTEXT QUESTIONS 10.4

1. Define soil pollution.

2. Why are plastic bags a big environmental nuisance?

3. Vermicomposting degrades organic waste into a useful substance. What is this substance used for?

10.9 RADIATION POLLUTION: SOURCES AND HAZARDS

Radiation pollution is the increase in over the natural background radiation. There are many sources of radiation pollution such as nuclear wastes from nuclear power plants, mining and processing of nuclear material etc. The worse case of nuclear pollution was the cherdoyl disaster in Russia occurred in 1986 but the effects still longer today.

10.9.1 Radiation

Radiation is a form of energy travelling through space. The radiation emanating from the decay of radioactive nuclides are a major sources of radiation pollution. Radiations can be categorized into two groups namely the non-ionizing radiations and the ionizing radiations.

Non-ionizing radiations are constituted by the electromagnetic waves at the longer wavelength of the spectrum ranging from near infra-red rays to radio waves. These waves have energies enough to excite the atoms and molecules of the medium through which they pass, causing them to vibrate faster but not strong enough to ionize them. In a microwave oven the radiation causes water molecules in the cooking medium to vibrate faster and thus raising its temperature.

Ionizing radiations cause ionization of atoms and molecules of the medium through which they pass. Electromagnetic radiations such as short wavelength ultra violet radiations (UV),



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X-rays and gamma rays and energetic particles produced in nuclear processes, electrically charged particles like alpha and beta particles produced in radioactive decay and neutrons produced in nuclear fission, are highly damaging to living organisms. Electrically charged particles produced in the nuclear processes can have sufficient energy to knock electrons out of the atoms or molecules of the medium, thereby producing *ions*. The ions produced in water molecules, for example, can induce reactions that can break bonds in proteins and other important molecules. An example of this would be when a gamma ray passes through a cell, the water molecules near the DNA might be ionized and the ions might react with the DNA causing it to break. They can also cause chemical changes by breaking the chemical bonds, which can damage living tissues. The ionizing radiations cause damage to biological systems and are, therefore, pollutants.

10.9.2 Radiation damage

The biological damage resulting from ionizing radiations is generally termed as **radiation damage**. Large amounts of radiation can kill cells that can dramatically affect the exposed organism as well as possibly its offspring. Affected cells can mutate and result in cancer. A large enough dose of radiation can kill the organism.

Radiation damage can be divided into two types: (a) **somatic damage** (also called *radiation sickness*) and (b) **genetic damage**. Somatic damage refers to damage to cells that are not associated with reproduction. Effects of somatic radiation damage include reddening of the skin, loss of hair, ulceration, fibrosis of the lungs, the formation of holes in tissue, a reduction of white blood cells, and the induction of cataract in the eyes. This damage can also result in cancer and death. Genetic damage refers to damage to cells associated with reproduction. This damage can subsequently cause genetic damage from gene mutation resulting in abnormalities. Genetic damages are passed on to next generation.

10.9.3 Radiation dose

The biological damage caused by the radiation is determined by the intensity of radiation and duration of the exposure. It depends on the amount of energy deposited by the radiation in the biological system. In studying the effects of radiation exposure in *humans*, it is important to realize that the biological damage caused by a particle depends not only on the total energy deposited but also on the rate of energy loss per unit distance traversed by the particle (or “linear energy transfer”). For example, alpha particles do much more damage per unit energy deposited than do electrons.

Radiation effects and radiation doses

A traditional unit of human-equivalent dose is the **rem**, which stands for *radiation equivalent in man*.

At low doses, such as what we receive every day from background radiation ($< 1 \text{ m rem}$), the cells repair the damage rapidly. **At higher doses (up to 100 rem), the cells might**



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not be able to repair the damage, and the cells may either be changed permanently or die. Cells changed permanently may go on to produce abnormal cells when they divide and may become cancerous.

At even higher doses, the cells cannot be replaced fast enough and tissues fail to function. An example of this would be “radiation sickness.” This is a condition that results after high doses is given to the whole body (>100 rem).

Nuclear explosions and accidents in nuclear reactors are a serious source of radiation hazard. The effects of atomic explosions in Nagasaki and Hiroshima are still not forgotten. The nuclear reactor accident at Chernobyl in 1986 led to deaths of many reactor personnel and a very large release of radionuclide to the environment causing a long term radiation damage to the people living in the neighboring regions.

Accidents at nuclear power plants

Nuclear fission in the reactor core produces lot of heat which if not controlled can lead to a meltdown of fuel rods in the reactor core. If a meltdown happens by accident, it will release large quantities of highly dangerous radioactive materials in the environment with disastrous consequences to the humans, animals and plants. To prevent this type of accidents and reactor blow up, the reactors are designed to have a number of safety features.

Inspite of these safety measures two disasters in the nuclear power plants are noteworthy- namely at ‘Three Mile Island’ in Middletown (U.S.A.) in 1979, at Chernobyl (U.S.S.R.) in 1986. In both these cases a series of mishaps and errors resulted in over heating of the reactor core and lot of radiation was released into the environment. The leakage from Three Mile Island reactor was apparently low and no one was injured immediately. However, in case of Chernobyl the leakage was very heavy causing death of some workers and radiation spread over large areas scattered all over Europe. People of the city had to be evacuated to safer places and the plant had to be closed down. These two disasters are a reminder that nuclear power reactors require a constant up gradation of safety measures. Accidents with nuclear submarines also points to the same.



INTEXT QUESTIONS 10.5

1. Which type of radiations are produced in a microwave oven?

2. State the use of absorbed dose of radiation.

3. How much of radiation can damage internal organs upon its exposure for a few days.



WHAT YOU HAVE LEARNT

- Nature's components such as air, water, soil, forest and fisheries are resources exploited by humans and their pollution are by-product of urbanization and industrialization.
- Pollution in effect is an undesirable byproduct of industrialization and urbanization.
- The agents directly or indirectly responsible for the pollution of the environment are known as pollutants.
- There are six types of pollutions: air pollution, water pollution, noise pollution, soil pollution, thermal pollution, radiation pollution etc.
- Air pollution is a result of industrial and certain domestic activity.
- Air pollutants are of two types (1) suspended particulate matter, and (2) gases like carbon dioxide CO₂, NO_x etc.
- Use of cleaner fuels such as biogas, CNG and electricity prevent air pollution.
- Segregation of waste, pretreatment at source, sterilization of rooms will help in checking indoor pollution.
- Prevention and control of industrial pollution can be reduced by using cleaner fuels, filters, electrostatic precipitators, inertial collectors, scrubbers etc.
- Use of chlorofluorocarbons cause damage of ozone layer which has resulted in its thinning over the Arctic and Antarctic regions, is known as ozone hole.
- Increase in global temperature or heating effect by green house gases (CO₂, methane) is known as green house effect.
- Noise like other pollution is a by product of industrialization, urbanization and modern civilization.
- Indoor sources include noise produced by radio, television and outdoor source includes indiscriminate use of loudspeakers, industrial activities, automobile, rail traffic and aeroplanes etc.
- Addition of undesirable substances in water is called water pollution.
- Natural sources of water pollution are soil erosion, leaching of minerals from rocks and decaying of organic matter.
- Power plants and various industries used lot of water for cooling purposes and hot water is discharged into rivers, streams or oceans. This waste heat increases the temperature of the cooling water upto 10-15°C this is thermal pollution.



Notes

MODULE - 4

Environmental Science Senior Secondary Course

Contemporary Environmental Issues



Notes

- Improper sewage disposal, dumping of farm yard manures and agricultural chemicals, industrial effluents are causing pollution of ground water.
- Nutrient enrichment of a water body is called eutrophication.
- Waste water from domestic or industry or garbage dump is generally known as sewage.
- Addition of substances which adversely affect the quality of soil or fertility is known as soil pollution.
- Sources of soil pollution are plastic bags, industrial sources, agricultural sources etc.
- Radiation is a form of energy traveling through space. Radiation can be grouped into non-ionizing radiation and the ionizing radiations.



TERMINAL EXERCISE

1. Define the terms pollution and pollutant.
2. List the environmental problems faced by women inside the rural households. Suggest measures to reduce or eliminate them.
3. Why was CNG introduced as a fuel for automobiles in a city like Delhi? Has it made any difference?
4. Manufacture of chlorofluorocarbons is to be phased out as per 'Montreal protocol'. Why?
5. Describe an environmental friendly method to profitably dispose off human waste and cattle waste.
6. Chemical fertilizers are useful to crops. In which way they cause environmental pollution?
7. What steps can be taken to reduce pollution due to particulate matter from industries?
8. What is a PUC certificate? Is it necessary and for whom? In your opinion is it really useful?
9. What is a medical waste? Why it is called hazardous waste? What is the safe way to dispose medical waste.
10. Suggest the way to improve the water quality it has undergone primary treatment?
11. What are the causes and effects of thermal pollution on the life of aquatic animals like fish? What measures you would suggest to prevent thermal pollution?
12. What are ionizing and non-ionizing radiations? Give examples.
13. List the possible damages caused to humans by radiation pollution.



14. How can cancer be caused by radiation?

15. Briefly describe soil pollution, its causes and methods of control.



ANSWER TO INTEXT QUESTIONS

10.1

- (a) Agents which cause environmental pollution are called pollutants.
(b) Addition to undesirable materials into the environment as a result of human activities.
- Filters, electrostatic precipitators, inertial collector, scrubbers (any three)
- Refer to text
- Pollution Control Certificate that ensures the levels of certain pollutants are not released in the exhaust of vehicles beyond the legal limits.

10.2

- Decibels (Db)
- Disturb sleep, emotional problems, annoyance (any two)
- Better designing and proper maintenance of vehicle, use of noise abatement measures, appropriate insulation and introduction of noise regulation for take off aircrafts, use of electric locomotives, using of sound proofing equipment.

10.3

- Mercury and cadmium
- Eutrophication
- Primary treatment removes suspended particulate matter and floating materials.
- Increase in water temperature upto 10 to 15°C above the ambient water temperature.
- Swimming efficiency of fish declines.
- Metabolism of aquatic animals increase and affect their growth.
- Sludge

10.4

- Addition of substances which adversely affect the quality of soil or fertility is known as soil pollution.
- Plastic bags are indestructible and create colossal environmental hazard.

MODULE - 4

Contemporary
Environmental Issues



Notes

3. This substance is manure and used in agriculture.

10.5

1. Non-ionizing radiations
2. Absorption of radiation to be the amount of energy deposited in the region of the body divided by the mass of the portion of the body that absorbed the radiation.
3. Higher dozes (up to 100 rem) can damage internal organs upon exposure of it.



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