CHAPTER 18

ENVIRONMENTAL CHEMISTRY

1. ENVIRONMENTAL POLLUTION

Pollution may be defined as the excessive discharge or addition of undesirable substances into the environment.

A **pollutant** may be defined as an unwanted or undesirable substance added to environment.

TYPES OF POLLUTANTS

Pollutants can be classified in two different ways as follows:

(a) Primary pollutants are those which after their formation enter the environment and remain as such.

(b) Secondary pollutants are those harmful materials which are formed by chemical reactions between the primary pollutants in the atmosphere or hydrosphere.

BIODEGRADABLE AND NON-BIODEGRADABLE POLLUTANTS

(a) Biodegradable pollutants are materials such as domestic sewage, cow-dung etc. which are easily decomposed by the microorganisms either by the nature itself or by suitable treatment and thus are not harmful but if these are present in excess in the environment they do not undergo degradation completely and thus pollutants.

(b) Non-biodegradable pollutants are materials such as mercury, aluminium, DDT etc. which do not undergo degradation or degrade very slowly but their presence even in very small amounts in the environment is very harmful for the humans as well as plants. They may react with other compounds present in the environment and produce even more toxic compounds.

2. ATMOSPHERIC POLLUTION

Atmospheric pollution may be defined as the excessive discharge of undesirable foreign substances into the atmospheric air

GASES WHICH FREELY MIX WITH AIR, WITHOUT SETTLING DOWN

These gases are:

(i) **Sulphur dioxide (SO_2).** Main contributors of emissions of SO_2 are thermal power plants, in which sulphur-containing coal and diesel are burnt.

(ii) **Sulphur trioxide (SO_3)** is formed by the oxidation of sulphur dioxide under the influence of sunlight.

$$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$$

(iii) **Hydrogen sulphide** enters the decomposition of sewage water or organic matter, and from various industries. It is more poisonous than carbon monoxide and blackens lead paints and causes corrosion of metals.

(iv) **Oxides of Nitrogen.** The dry air at sea level contains nearly 78% nitrogen and 20% oxygen by volume. However, these gases do not react with each other at ambient temperature. They combine only at high temperatures (> 1210ºC) to form significant quantities of nitrogen oxide (nitric oxide, NO).

(v) **Carbon monoxide (CO)** is released by the partial combustion of fuels in automobiles, industries and oil-refineries.

(vi) **Carbon dioxide** is released into the atmosphere by burning of fuels such as coal, wood and petroleum products.

(vii) **Hydrogen fluoride** is discharged from phosphate fertilizer industry, aluminium industry, metallurgical processes and brick-kiln

(viii) Hydrocarbons. High concentration (5,000–10,000 ppm) of hydrocarbons effects lungs and cause swelling when they enter the lungs.

PARTICULATE

Particulates are the tiny solid or liquid particles suspended in air. Some important particulate pollutants are:

(i) Dust. Dust consists of fine particles produced during crushing, grinding and attrition of solid materials.

(ii) Smoke is composed of tiny particles of carbon, ash, oil etc. The major sources of smoke emissions are locomotives, domestic wood, coal-grates, industrial power plants, open fires, refuge incinerators, automobile engines, furnaces etc.

(iii) Mists are produced by particles of spray liquids and condensation of vapours in air.

(iv) Fumes are condensed vapours. Fumes of metals like mercury, cadmium etc, are well known particulates.

(v) Smog is a mixture of smoke and fog in suspended droplet form.

Effects of impurities in water

Suspended Impurities	Their Effects

1. Suspended mater 2. Bacterias 3. Parasitic worms 4. Viruses 5. Algae	Water is murky and not acceptable. Cause cholera, dysentery, typhoid, etc. Cause round–worm, and hook-worm infections. Cause enteroviral infections. Cause turbidity, foul odour and interfere with filtration in the water treatment plants.

Dissolved Impurities	**Their Effects**
1. Hardness 2. Sulphates 3. Sodium carbonate and bicarbonate 4. Fluorides 5. Sodium chloride 6. Iron and manganese	Laxative effect and corrosion. Highly–sulphonated water containing Na^+, K^+ and Mg^+ ions cause diarrhea. Alkalinity Above 1 mg/L cause fluorosis, rotting of teeth-enamel; nervous and skeleton disorders.

7. Lead (may came from lead water pipes)	Indicates water pollution by human sewage. High chloride content imparts bad taste to water.
8. Mercury compounds	Stain fabrics during washing, cause bad taste &odour, modify colours in dyeing. Mn causes paralysis lower limbs.
9. Zinc	A cumulative poison, causing loss of appetite, constipation, abdominal pain, mental retardation, and finally, nervous disorder and brain damages.
10. Arsenic	Concentration in fish on ingestion may cause nervous and brain damage and paralysis, followed by death.
11. Anionic detergents (e.g., alkyl benzene sulphonate)	Higher level causes dizziness, vomiting and diarrhea.
12. Phosphates (from fertilizers)	Very poisonous, can cause cramps, paralysis, and even death
13. Polychlorinated biphenyls (PCBs)	Foaming (in turbulent water), which interferes with self-purification of water in lakes and rivers.

	Promotes algae growth, which later decays and pollutes the water. Skin disorders in humans, carcinogenic.

4. LAND POLLUTION

The unfavorable alteration of soil by addition or removal of substances and factors which decrease soil productivity and adversely affects the quality of plant and animal life is called soil or land pollution.

(i) **Insecticides** are chemical substances used for the control of insects to curb disease (e.g., malaria, yellow fever etc.) and protect crops.

(ii) **Herbicides** are used to kill weeds. Sodium chlorate, $NaClO_3$ and sodium arsenite, Na_3AsO_3 were commonly used as herbicides in the first half of 20th century.

(iii) **Fungicides** are used to counter the growth of fungi. Fungi are plants without chlorophyll.

5. STRATEGY FOR CONTROL OF ENVIRONMENTAL POLLUTION

The Management of Waste

The production and improper disposal of waste are causes for a great deal of environmental pollution.

Recycling

When materials are recycled, there are several benefits, apart from saving on the cost of raw materials, waste disposal costs are reduced.

Sewage Treatment

Sewage is the liquid waste which includes human and household waste waters, industrial wastes, ground wastes, street washings and storm waters.