UNIT -II
ENVIRONMENTAL POLLUTION

2.1 INTRODUCTION

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

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

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

2.1.1 Types of Pollutants

1. Biodegradable pollutants: Biodegradable pollutants decompose rapidly by natural processes.
2. Non-degradable pollutants: Non-degradable pollutants do not decompose (or) decompose slowly in the environment.

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

2.1.2 Classification of Pollution

The different kinds of pollution that affects the environment are,

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

2.2 AIR POLLUTIONS

Definition

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

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

Composition of Atmospheric Air

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

Table 2.1 Composition of atmospheric air

Constituents	%
Nitrogen	78
Oxygen	21
Argon (Ar)	< 1

CO_2	0.037
Water vapour	Remaining
O_3, He, NH_3	Trace amount

2.2.1 Sources of Air Pollution

The sources of air pollution are of two types

1. Natural sources

Examples: Volcanic eruptions, forest fires, biological decay, pollen grains, marshes, radioactive materials etc. These pollutants are caused by the natural sources.

2. Man-made (anthropogenic) activities

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

2.2.2 Classification of Air Pollutants

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

(i) Primary air pollutants.

(ii) Secondary air pollutants.

1. Primary air pollutants

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

Examples: CO, NO, SO_2, etc.,

Indoor Air Pollutants

Indoor air pollutants are primary air pollutants. The most important indoor air pollutant is radon gas. Sources (causes) of indoor air pollutants

1. Radon gas is emitted from the building materials like bricks, concrete, tiles, etc., which are derived from soil containing radium.
2. It is also present in natural gas and ground water and is emitted indoors while using them.
3. Burning of fuels in the kitchen, cigarette smoke, liberates the pollutants like CO, SO2, formaldehyde, BAP (benzo-(a) pyrene).

2. Secondary air pollutants

Some of the primary air pollutants may react with one another (or) with the basic components of air to form new pollutants. They are called as secondary air pollutants. Example: $NO/NO_2 \xrightarrow{\text{Moist}}$ (~~HNO~~NO3) etc.,

2.2.3 Common air pollutants sources (causes) and their effects

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

1. Carbon monoxide (CO)

Description

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

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

Human Sources (causes)

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

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

Environmental Effects

It increases the globe temperature.

2. Nitrogen dioxide (NO_2)

Description

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

NO_2+ Moisture $\rightarrow\rightarrow\rightarrow$ HNO_3

Human Sources (causes)

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

Lung irritation and damage.

Environmental Effects

Acid deposition of HNO3 can damage trees, soils aquatic life in lakes, HNO3 can corrode metals and away stone on buildings, statues and monuments. NO_2 can damage fabrics.

3. Sulphur dioxide (S02)

Description

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

Human Sources (causes)

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

Health Effects

Breathing problems for healthy people.

Environmental Effects

Reduce visibility, acid deposition of H_2SO4 can damage trees, soils and aquatic life in lakes.

4. Suspended particulate matter (SPM)

Description

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

Human Sources (causes)

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

Health Effects

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

Environmental Effects

Reduces visibility, acid deposition and H_2SO4 droplets can damage trees, soils and aquatic life in lakes.

5. Ozone (O_3)

Description

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

Human Sources (causes)

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

Environmental Effect Moderates the climate.

6. Photochemical smog

Description

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

Sources (causes)

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

Health Effects

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

Environmental Effects

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

7. Lead (Pb)

Description

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

Human Sources (causes)

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

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

Environmental Effect

Can harm wild life.

8. Hydrocarbons (aromatic and aliphatic)

Description

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

Human sources (causes)

Agriculture, decay of plants, burning of wet logs. **Health Effects**

Carcinogenic.

Environmental effect

It produces an oily film on the surface and do not as such causes a serious problem until they react to form secondary pollutants. Ethylene causes plant damage even at low concentrations. **9. Chromium (Cr)**

Description

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

Human Sources (causes)

Paint, smelters, chromium manufacture, chromium plating.

Health effects

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

2.2.4 Control (or) Preventive Measures of air pollution

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

1. Source control

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

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

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

II. Control measures in industrial centers

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

Equipments used to control air pollution

Air pollution can be reduced by adopting the following approaches.

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

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

The four figures (fig 2.1) are commonly used control methods for removing particulates from the exhaust gases of electric power and industrial plants. All these methods retain hazardous materials that must be disposed of safely. The wet scrubber can also reduce sulphurdioxide emissions.

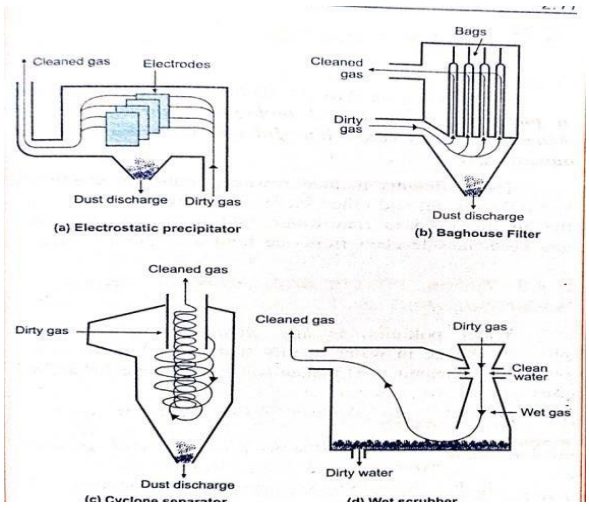

Fig. Control methods for removing particulates from exhaust gases

(iii) Chemical treatment to deal with factory fumes.

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