

MODULE 4: Air Pollution

i. Introduction

- a) Air pollution system
- b) Air pollutants

ii. Air pollution laws

iii. Control of air pollution

- a) Source correction method
- b) Pollution control equipment

Air Pollution

Air Pollution refers to any contamination of the atmosphere that causes damage to living organisms and the environment.

Sources of Air Pollution

(i) Artificial or man-made sources (anthropogenic):

Examples

Industries

Mining operations

Construction activity

Automobiles

Nuclear explosions

Power plants

Oil and gas extraction

Sources of Air Pollution

(ii) Natural sources:

Examples

Emissions of natural gases

Volcanic eruptions

Pollen grains

Evolution of methane, ammonia, and hydrogen sulphide due to decomposition of organic matter, sulphur compounds from sulphurous material reserves of the Earth.

Dust storms

Sea-salt nuclei

Forest fires

Sources of Air Pollution

Air pollution sources can be classified as:

(i) Stationary sources:

Examples

Chimney (stack)

(ii) Mobile sources:

Automobiles

(iii) Point sources:

A single stack or chimney

(iv) Line sources:

A series of chimneys, busy highway, railway line

Air Pollutants

The compounds/materials responsible for air pollution are called pollutants. Pollutants are classified as:

Primary pollutants:

Pollutants emitted directly from identifiable sources are termed as primary pollutants.

Secondary pollutants:

The pollutants produced in the air by interaction among two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photo activation.

Air Pollutants

Primary air pollutants:

(i) Gaseous

(ii) Particulates

(iii) Radioactive compounds

Gaseous Air Pollutants

(i) Gaseous compounds of carbon:

(a) Hydrocarbons

(b) Oxides of carbon → CO_2 , CO

(ii) Gaseous compounds of sulphur:

(a) Sulphur oxides → Sulphur dioxide— SO_2 Sulphur trioxide — SO_3 ,

(b) Reduced Sulphur compounds → H_2S , mercaptans

(iii) Gaseous compounds of Nitrogen:

(a) Oxides of nitrogen → Nitrous oxide — N_2O , Nitric oxide — NO , and Nitrogen dioxide — NO_2 (These gases together are called as NO_x)

(b) Ammonia— NH_3

Gaseous Air Pollutants

(iv) Gaseous halogens:

- (a) Fluorides
- (b) Chlorine, hydrogen chloride, and chlorinated hydrocarbons
- (c) Bromine-as ethylene bromide ($C_2H_2Br_2$), lead bromide ($PbBr_2$)

(v) Ozone and oxidants

(vi) Heavy metals:

- (a) Mercury-Mercury compounds
- (b) Lead-Lead Alkyls

Particulates

Definition of particulate: It is a general term meaning ‘existing in the form of minute separate particles either solid or liquid’.

Non-viable (non-living): Particles of various sizes such as fly ash, construction dust, dust emitted by transportation activities, mining activities, and other similar particles. Chemical and liquid droplets emitted by industrial activities, automobiles, and other such activities are considered as particulate matter and generally termed as suspended particulate matter (SPM). Very fine harmless particulate matters are classified as respirable particulate matter (RPM).

Particulates

Viable (living): (i) Pollen (ii) Micro-organisms—Algae, fungi, bacteria and Virus

Dust—Solid material such as grit, coarse enough to settle rapidly is called as dust.

Causes of Air Pollution

1. **Agriculture:** Excessive use of pesticides, dust from agricultural practices, burning of fields, hydrocarbons released by plants, etc., are responsible for air pollution.
2. **Dust:** Dust storms, wind, volcanoes, automobiles, etc., add dust to the air causing pollution.
3. **Industries:** Combustion of fossil fuels like coal, petroleum, cement dusts, poisonous gases, etc., all cause air pollution.
4. **Automobiles:** Gases released by the combustion of petrol and diesel in automobiles cause air pollution.

Causes of Air Pollution

5. **Ionising radiations:** Ionising radiations like alpha particles, beta particles and gamma rays released in the air due to the testing of atomic weapons and atomic explosions cause air pollution.
6. **Chlorofluorocarbons and freon:** Cooling and filling agents used in aerosol packages and refrigerants like chlorofluorocarbons and freon cause air pollution by depleting the ozone umbrella.
7. **Aerosols:** Fine solid particles or liquid droplets suspended in the air are known as aerosols. They block the stomata of plants preventing gaseous exchange between plants and the atmosphere. Aerosols in the atmosphere are also believed to induce climatic changes in the planet.

Effects of Air Pollution

1. Death – When air is polluted by poisonous gases it is highly likely to cause death. The Bhopal gas tragedy is a good example. In Bhopal, reportedly, 3000 humans and thousands of animals were killed due to the leakage of methyl isocyanate, a poisonous gas in the air, from an insecticide plant on December 2, 1984.
2. Chlorosis – Presence of SO₂ and fluorides in the air causes insufficient production of chlorophyll in leaves. This condition is known as chlorosis.
3. Necrosis – The breaking down of cells due to the presence of SO₂, nitrogen dioxide, ozone and fluorides is known as necrosis.

Effects of Air Pollution

4. Greenhouse effect – Concentration of gases like CO₂, CH₄, N₂O and CEFs in the atmosphere increases the temperature of the earth slowly and gradually. These gases (also called greenhouse gases) absorb infrared radiations, but do not allow these radiations to reflect and return back to the earth. This is known as the greenhouse effect. Increasing temperature of the atmosphere of the earth as a result of this effect is known as global warming.

5. Destruction of crops – Smog which refers to a combination of smoke and fog, causes heavy damage to crops such as leafy vegetables, cereals, textile crops, ornamental plants, fruits, and forest trees, resulting in heavy agricultural losses.

Effects of Air Pollution

6. Respiratory disorders – Excessive ethylene accelerates respiration causing premature aging (old age) and abscission, which is the accumulation of a yellow fluid in the body. Aldehydes irritate the nasal and respiratory tracts, while H₂S causes nausea.

Effects of Air Pollution

7. Other disorders:

- SO₂ causes vomiting and headache.
- Carbonyl chloride causes cough.
- CO reduces O₂ carrying capacity of blood.
- Cadmium increases blood pressure and causes heart diseases.
- Ash, soot, smoke, nickel, chromium and radioactive elements cause cancer.
- Manganese causes pneumonia.
- Arsines induce RBC breakdown and jaundice.
- Ionising radiations induce mutation.

Effects of Air Pollution

8. Depletion of the ozone layer – Freon and chlorofluorocarbons that are being used in aerosol packages and foam plastics, destroy O₃ molecules in the ozone umbrella and pierce holes in it. UV radiations enter the earth through the pierced holes and cause skin cancer and other diseases.

9. Acid rains – In industrial areas a large amount of N₂O (nitrous oxide), NO (nitric oxide) and SO₂ (sulphur dioxide) is discharged in the air. These gases get absorbed by the rain water from the atmosphere and are poured back down on the earth in the form of acid rain. Acid rain not only destroys vegetation but is injurious to aquatic animals in water bodies such as lakes, ponds, etc.

Control of Air Pollution

Air pollution can be minimized by the following methods:

- Siting of industries after proper Environmental Impact Assessment studies.
- Using low sulphur coal in industries
- Removing sulphur from coal (by washing or with the help of bacteria)
- Removing NO_x during the combustion process.

Control of Air Pollution

- Removing particulate from stack exhaust gases by employing electrostatic precipitators, bag-house filters, cyclone separators, scrubbers etc.
- Vehicular pollution can be checked by regular tune-up of engines ; replacement of more polluting old vehicles; installing catalytic converters ; by engine modification to have fuel efficient (lean) mixtures to reduce CO and hydrocarbon emissions; and slow and cooler burning of fuels to reduce Nox emission (Honda Technology).

Control of Air Pollution

- Using mass transport system, bicycles etc.
- Shifting to less polluting fuels (hydrogen gas).
- Using non-conventional sources of energy.
- Using biological filters and bio-scrubbers.
- Planting more trees.

Environmental Legislations related to Air

1948 — The Factories Act and Amendment in 1987 was the first to express concern for the working environment of the workers. The amendment of 1987 has sharpened its environmental focus and expanded its application to hazardous processes.

1981 — The Air (Prevention and Control of Pollution) Act provides for the control and abatement of air pollution. It entrusts the power of enforcing this act to the CPCB.

1982 — The Air (Prevention and Control of Pollution) Rules defines the procedures of the meetings of the Boards and the powers entrusted to them.

1982 — The Atomic Energy Act deals with the radioactive waste.

1987 — The Air (Prevention and Control of Pollution) Amendment Act empowers the central and state pollution control boards to meet with grave emergencies of air pollution.

1988 — The Motor Vehicles Act states that all hazardous waste is to be properly packaged, labeled, and transported.