

# ENVIRONMENTAL ALTERATION

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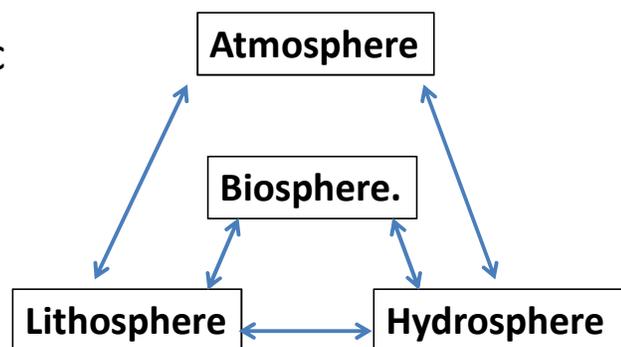
Environment may be considered as our surroundings which includes **everything around us**, i.e. i.e. non-living (abiotic) and living (biotic) environment.

The **abiotic environment** consists of **air, water and soil**, while the **biotic environment** includes all the **living organisms** (plants, animals, Microorganism) that we regular come in contact .

#### 4 Basic Component of Environment

The environment is composed of four basic components.

1. Atmosphere,
2. Hydrosphere,
3. Lithosphere,
4. Biosphere.



# Pollution

Pollution broadly refers to the presence of **undesirable substances in the environment** which are harmful to man and other organisms

## SOURCES OF POLLUTION

1. Industrial Sources
2. Agricultural Sources
3. Biogenic sources
4. Anthropogenic Sources
5. Unnatural Sources
6. Extra-terrestrial Sources

## Types of Pollution

1. Air/atmosphere pollution
2. Water Pollution
3. Land/soil pollution
4. Noise Pollution
5. Thermal pollution
6. Radio active Pollution.

**TABLE 55.1 Composition of the dry air in the lower atmosphere**

<i>Gas</i>	<i>Composition (% by volume)</i>
Nitrogen	78.08
Oxygen	20.95
Argon	0.93
Carbon dioxide	0.03
Trace gases (He, CH <sub>4</sub> , Kr, H <sub>2</sub> , CO, N <sub>2</sub> O, NO <sub>2</sub> , NH <sub>3</sub> , O <sub>3</sub> , SO <sub>2</sub> , H <sub>2</sub> S)	> 0.02

## Air Pollution

Air pollution is basically the **presence of foreign substances in the air** at a concentration that will adversely affect the health and property of the individual.

## Definition by WHO

As per the World Health Organization (WHO) criteria, air pollution refers to 'the substances put into the air by the activity of mankind into concentration sufficient to cause harmful effects to his health, vegetables, property or to interfere with the enjoyment of his property'

## Pollutant and Contaminant

- The term **pollutant** refers to a substance which increases in quantity in the air and adversely affects the environment e.g. carbon monoxide, sulfur dioxide, lead.
- On the other hand, a **contaminant** is a substance which is not present in nature, but released due to human activity e.g. methyl isocyanate. DDI malathion.
- However, this distinction is not very rigid, and most authors use the term pollutant to represent both (pollutant as well as contaminant)

### Major industrial sources of air pollution

<i>Industry</i>	<i>Major air pollutants</i>
Thermal power plants	NO <sub>2</sub> , N <sub>2</sub> O, SO <sub>2</sub> , particulates
Steel industries	Smoke, particulates, CO, fluoride
Petroleum refineries	SO <sub>2</sub> , smoke, particulates
Metal smelters	SO <sub>2</sub> , NO <sub>2</sub> , N <sub>2</sub> O, smoke, particulates
Fertilizer plants	SO <sub>2</sub> , NO <sub>2</sub> , N <sub>2</sub> O, NH <sub>3</sub> , fluoride
Acid plants	SO <sub>2</sub> , NO <sub>2</sub> , N <sub>2</sub> O
Cement plants	SO <sub>2</sub> , smoke, particulates
Soap and detergent plants	Particulates, odour
Paper mills	SO <sub>2</sub> , particulates, odour

## Classification

Air pollutants are divided into two categories, based on their origin-primary and secondary.

**Primary air pollutants:** These pollutants are directly emitted into the atmosphere and present there as such (i.e. in the form they are originally emitted). Primary air pollutants contribute to as much as 90% global air pollution. Particulates, carbon monoxide, (CO), oxides of sulfur (SO<sup>\*</sup>), oxides of nitrogen (NO<sub>x</sub>), hydrocarbons (HCs), radioactive compounds, pollen and bacteria are the major primary air pollutants.

**Secondary air pollutants :** These are produced in the air as a result of interaction among the primary pollutants, or by a reaction that occurs between a primary pollutant and a normal constituent of the atmosphere. Good examples of secondary air pollutants are ozone (O<sub>3</sub>), peroxyacetyl nitrate (PAN), formaldehyde and smog.

**TABLE 55.3 Health effects of some of the air pollutants**

<i>Pollutant</i>	<i>Effects</i>
Sulfur dioxide (SO <sub>2</sub> )	Nose and throat irritation, respiratory illness. Prolonged exposure may lead to chronic bronchitis.
Nitrogen dioxide (NO <sub>2</sub> ) and nitric oxide (NO)	Irritation of eyes, nose and throat. NO combines with O <sub>2</sub> and reduces supply of O <sub>2</sub> to tissues.
Carbon monoxide (CO)	Binds to hemoglobin and drastically reduces O <sub>2</sub> supply to tissues. May result in cardiovascular and pulmonary diseases.
Heavy metals (Pb)	Damage to liver, kidney and brain; causes anemia, neurobehavioural changes, abnormalities in fertility and pregnancy.

**TABLE 55.4 Effects of air pollutants on plants**

<i>Pollutant</i>	<i>Effects</i>
Sulfur dioxide	Bleaching of leaves and necrosis (killing of leaves)
Nitrogen dioxide	Bleaching and suppressed growth
Ozone	Bleaching and necrosis
Fluorides	Marginal necrosis
Ammonia	Leaves become dull green
Ethylene and propylene	Leaf curling and leaf dropping
Peroxyacetyl nitrate (PAN)	Suppressed growth and silvering of lower leaf surfaces
Particulates (with toxic metals)	Bleaching and necrosis

## BIOMONITORING OF AIR POLLUTION

Plants are used to monitor (biomonitoring) air pollution and such plants are referred to as indicator plants. This is based on the principle of sensitivity and response of the plants to air pollutants.

A list of the plants used for bio-monitoring and the corresponding air pollutants is given in Table 55.5. Among these, lichens and mosses are most commonly used to check the quality of air. The pattern of occurrence of patches on lichens serves as an index for biomonitoring of air Pollution.

**TABLE 55.5 Air pollutants and the plants for their biomonitoring**

<i>Air pollutant</i>	<i>Plant(s)</i>
Sulfur dioxide	Lichens, moss, white pine
Ozone	Tobacco, garden bean
Peroxyacetylnitrate (PAN)	Lettuce, bean
Ethylene	Orchids, marigold, cucumber
Fluoride	Apricot, peach
Heavy metals	Moss, lichens

## Air Pollution Control

The air pollution load particularly from industries can be reduced by several measures replacement of burning fuel by electricity or solar energy, improvement in fuel burning process, dispersion and dilution off pollutants and reduction at source by using control equipment.

These measures however, are useful only to a limited extent.

## Air Pollution Control

In the nature itself, there are certain devices, commonly referred to as atmospheric self-cleansing processes for the removal of air pollutants. These natural processes are very slow and limited, and cannot cope up with the present increased demands of pollution control. However, the artificially devised pollution control measures are based on the same principles of atmosphere self cleansing processes.

These principles include dispersion, gravitational settling, flocculation, absorption and rain out.

There are two categories of air control devices-

- **devices to control particulate pollutants, and**
- **to control gaseous pollutants**

## For Particulate Matter

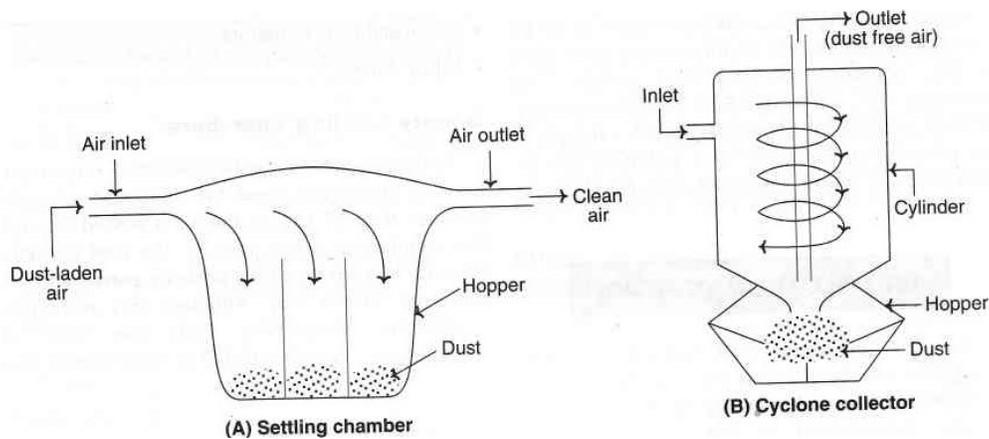
**Gravity or settling chambers:** allow large particles to fall out.

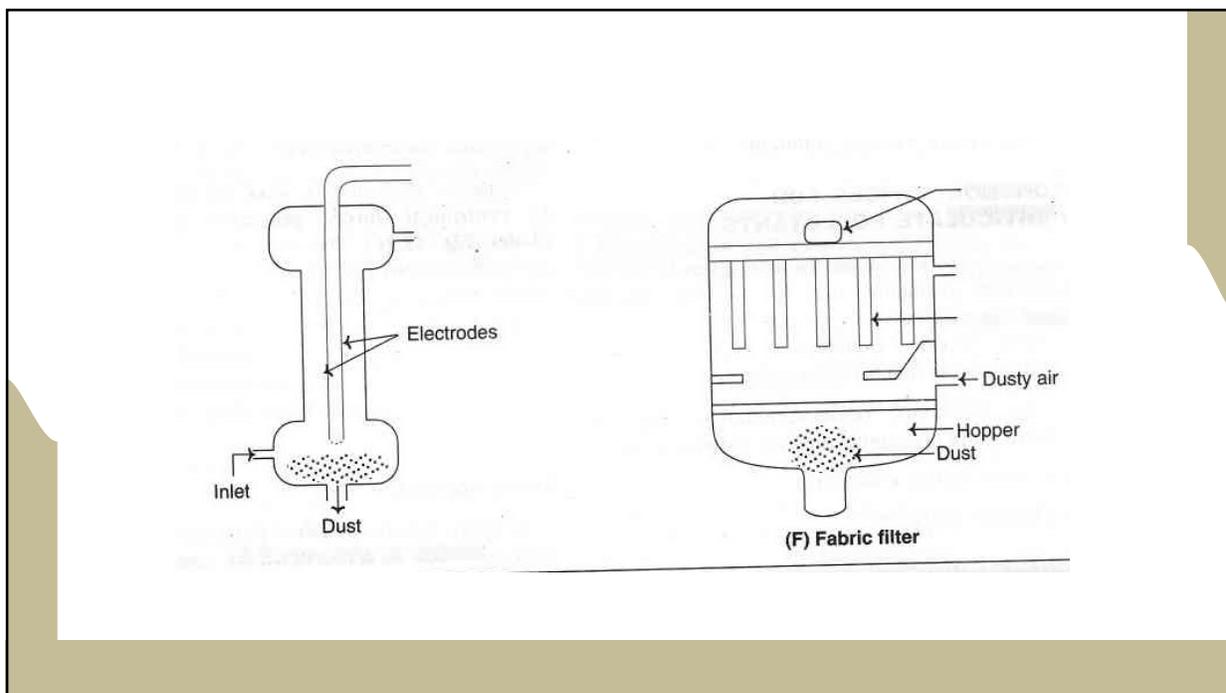
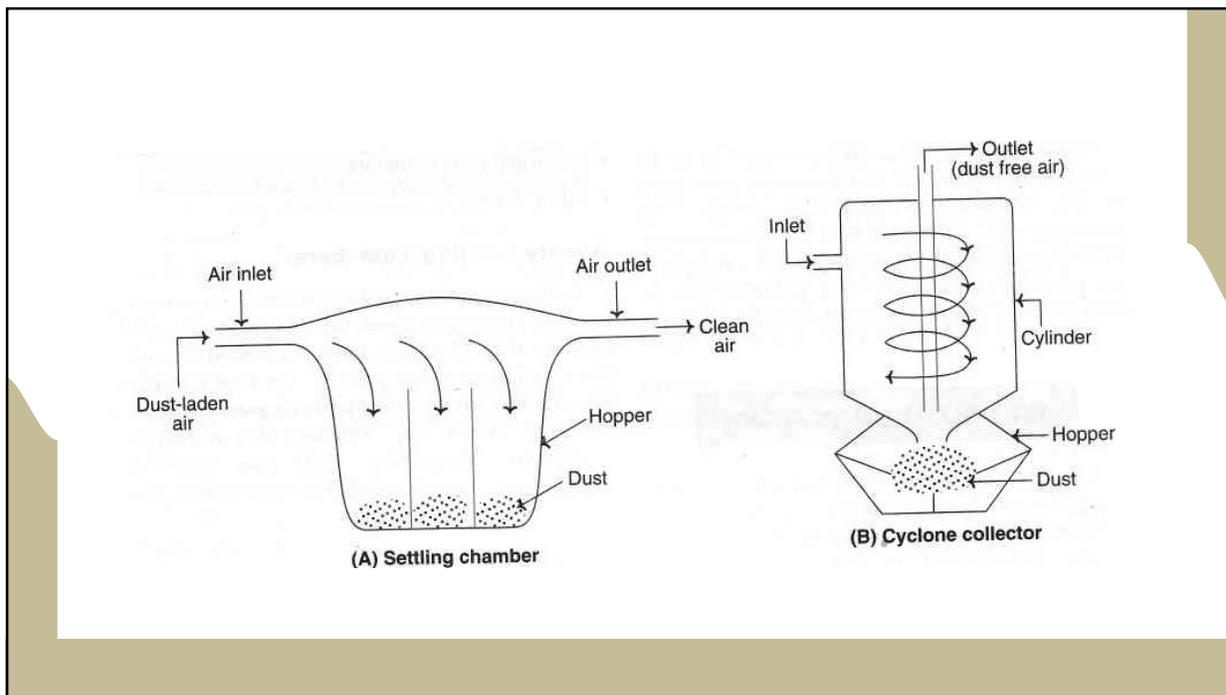
**Cyclone separators:** use inertia to separate particles from a gas stream.

**Fabric filters (baghouses):** filter dust effluent through fabric bags.

**Electrostatic precipitators:** apply an electric charge to particles and collect them on plates.

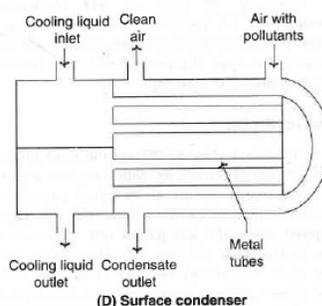
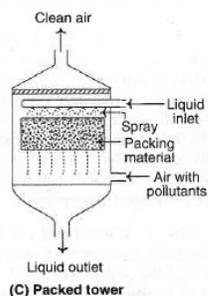
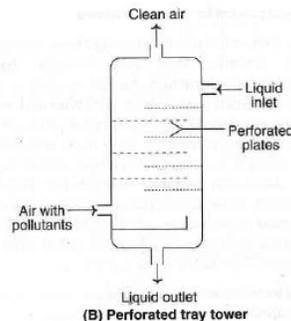
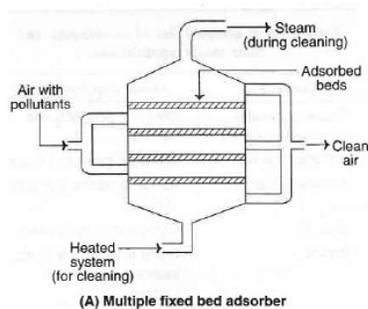
**Wet scrubbers:** use liquid spray to remove particulates and some gases.





## For Gaseous Pollutants

- **Absorption:** gas is dissolved into a liquid medium (e.g., scrubbers for  $\text{SO}_2$ ).
- **Adsorption:** gas molecules adhere to the surface of a solid medium (e.g., activated carbon).
- **Condensation:** cooling gas to liquid and removing it.
- **Combustion/oxidation:** converting a pollutant (e.g., VOCs) into less harmful substances by burning or catalytic oxidation.



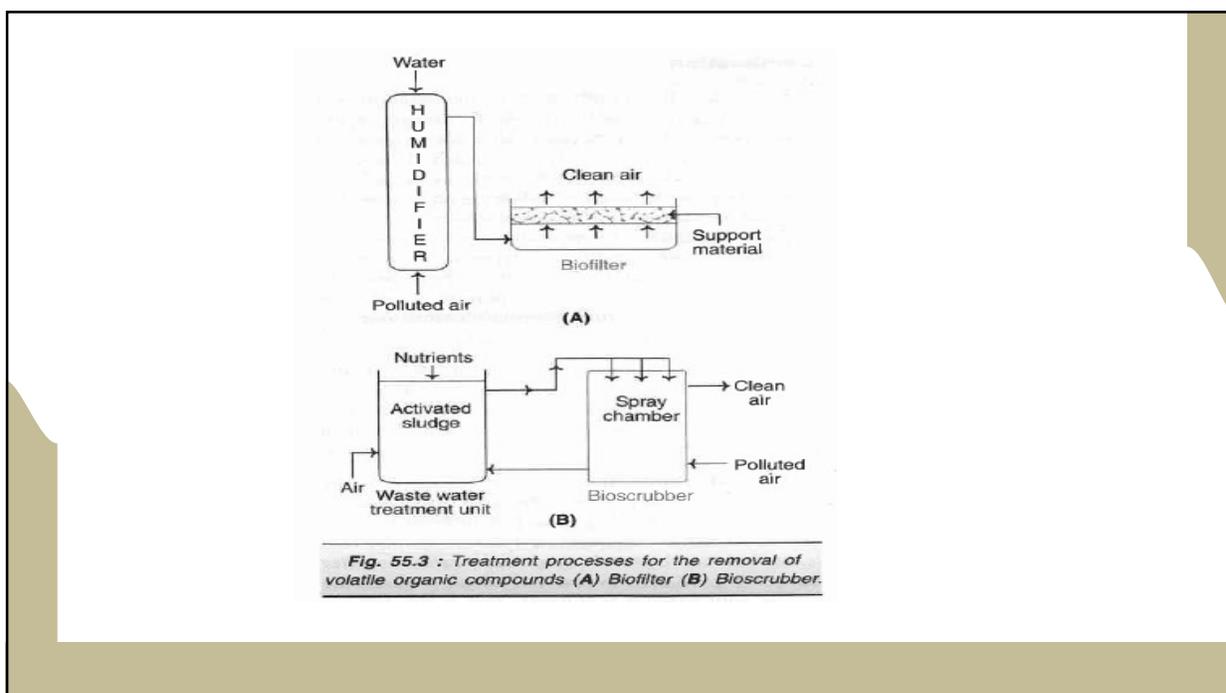
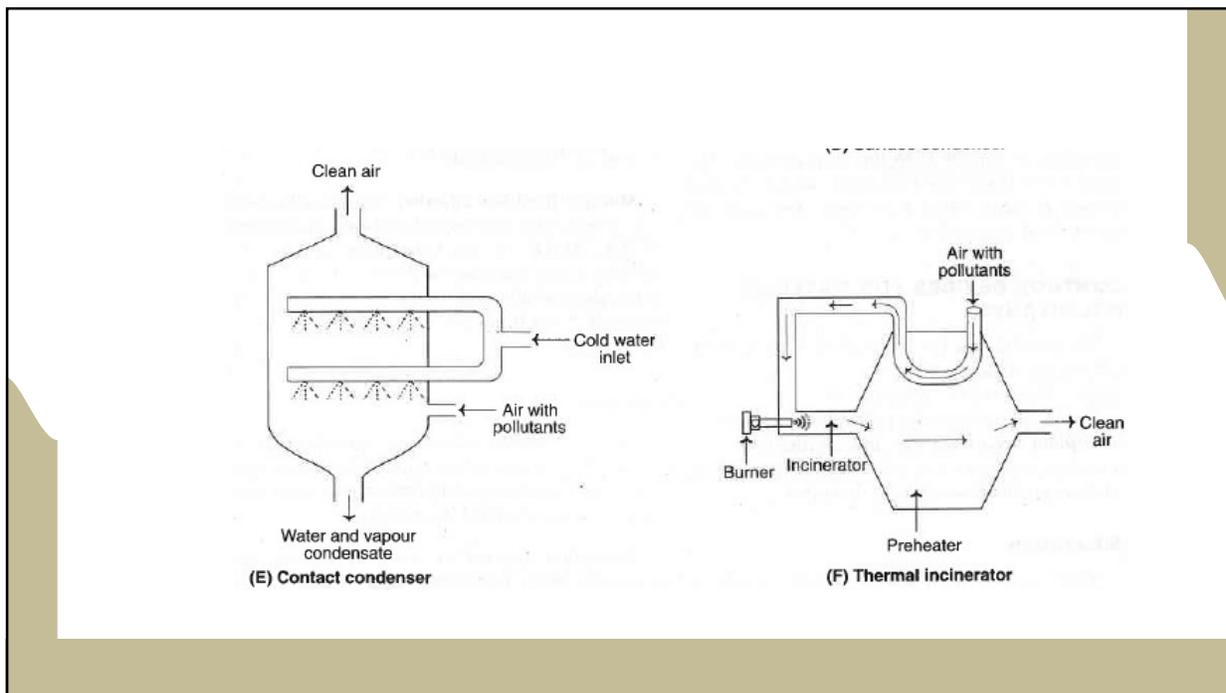


Fig. 55.3 : Treatment processes for the removal of volatile organic compounds (A) Biofilter (B) Bioscrubber.