Air Pollution

Air pollution is the contamination of the environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Air pollution contains smoke, harmful gases, particulate matter, and dust, drastically affecting plants, animals, and humans.

There are many severe effects of air pollution. It can lead to ailments, infections, and deaths, impair other species such as animals and food crops, and can permanently deteriorate the environment through global warming, ozone depletion, etc.

Classification of Air Pollutants

Air Pollutants are the substances that cause Air Pollution. There are two types of Air Pollutants:

- Primary Pollutants- They directly cause air pollution.
- Secondary Pollutants- They are the result of reaction of primary pollutants and their mixing with other pollutants.

Pollutants that are a prime cause of Air Pollution include:

- **Carbon dioxide (CO_2)**- Also known as the leading pollutant or the worst climate pollutant, Carbon dioxide is a major component of the greenhouse gas.
- **Nitrogen oxides**- It particularly contains Nitrogen dioxide that is expelled from high temperature combustion,or during thunderstorms by electric discharge.
- **Sulphur oxides**- Particularly containing Sulphur dioxide (SO_2), the pollutant is produced during volcanic eruptions and during various industrial processes. When it combines with NO_2, it results in the formation of the compound known as H_2SO_4, leading to acid rain.
- **Particulate Matter**- Also known as PM, atmospheric particulate matter, or fine particles, these are tiny particles of solid or liquid suspended in a gas.
- **Chlorofluorocarbons (CFCs)**- These are released from air conditioners, refrigerators, aerosol sprays, etc. CFCs are harmful to the

ozone layer. When CFCs are released into the stratosphere, they in contact with other gases and damage the ozone layer.

- **Ozone (O_3)-** It is a key component of troposphere and is formed from NO_x and VOCs. Ozone is a is a pollutant and a constituent of smog.

Classification of Air Pollution

Air pollutants are primarily responsible for causing Air Pollution and can be categorized in the following ways:

Based on Origin

- **Primary pollutants-** Such pollutants directly contribute to air pollution. Examples are dust, sulphur and nitrogen oxides, smoke, hydrocarbons, particulate matter, etc.
- **Secondary pollutants-** Such pollutants are released into the atmosphere due to chemical interactions involving primary pollutants and environmental substances. Examples are sulfur trioxide, ketones, sulphuric acid, ozone, nitric acid, etc.

Based on Resources

- Natural resources include forest or wildfires, volcanic activity, sulfur springs, natural geysers, vegetative decays, marsh gases, cosmic dust, photochemical reactions, soil debris, and so on.
- Man-made resources include human activities in industries, factories, urban hubs, aviation, autos, mining, and power plants, nuclear tests, farming, household firewood burning, fossil fuel combustion, and deforestation.

Based on the States of Matter

- Gaseous pollutants exist in a gaseous state at standard temperatures and pressures. Examples include nitrogen dioxide, carbon dioxide, volatile organic compounds, sulphur oxides, benzene, ethylene, and other gases.
- Particulate pollutants- These particles are produced and suspended in the air due to anthropogenic activities such as automobile manufacturing, factory activities, construction activities, or through natural sources such as volcanic eruptions, natural gaseous precursors, and so on. Examples include lead, fly ash, metallic oxides, and nanoparticles.

Air Pollution: Effects and Way Forward

The effects of Air Pollution and Air Pollutants include:

- Pollutants in the air deteriorate the external paint off cars and residences and fasten the discoloration of monuments, heritage landmarks, marble statues, and other traditional and cultural places.
- It is the principal cause of global warming and ozone depletion.
- These pollutants can penetrate deeper into lung passages and the circulatory system, where they can influence the cardiac, cerebrovascular, and respiratory systems.
- Numerous types of vegetation damage are caused by air pollution. Sulphur dioxide can harm field crops like alfalfa and trees like pines, particularly during the growing season.

Combating air pollution is a matter of public interest and is every individual's duty. As a result, organized and collaborative efforts with active participation from all stakeholders are required to identify, measure, and curb the causes of air pollution. It should involve the government, municipalities, and society as a whole. Furthermore, a policy that envisions a sustainable transition to renewable energy and sound urban planning changeover is the need of the hour.

What is Particulate Matter?

Particulate Matter is the general term for a mixture of solid particles and liquid droplets found in the air. They can cause tremendous harm to the human respiratory system and are generally the result of some anthropogenic processes. Particulate Matter pollutants range from 0.001 to 500 micrometers (μm) in diameter.

The Central Pollution Control Board (CPCB) declares PM 2.5 particles (2.5 μm or less) as one of the most harmful particulate pollutants.

The major components of Particulate Matter are:

- Lead
- Fly Ash
- Metallic Oxides
- Nanoparticles