

# Environmental Pollution

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# Air Pollution

Environmental Engineering and Management by Dr. S. K. Dhameja

Sources of air pollution:

- There are two principal sources of air pollution namely natural and man-made or anthropogenic.

Natural sources:

- Natural sources lead to large scale pollution which is not controllable by human beings.
- Natural contaminants generally present in the air are Fungi, pollen, cysts, marsh-gas and bacteria.

- Methane ( $\text{CH}_4$ ) or marsh gas is a hydrocarbon which is formed through decay of vegetable matter in marshy places (i.e. anaerobic decomposition).
- Carbon monoxide formed through breakdown of methane, release of many gases and volcanic ash through volcanic eruptions, release of smoke and harmful trace gases through forest fires, production of harmful chemicals through solar flares and electric storms, salt spray from oceans and dust storms are some examples of natural sources of air pollutants.

## Man made or anthropogenic sources:

- Man made or anthropogenic sources of air pollution cause severe problems enough to endanger property and life.
- Rapid industrialization, deforestation, automobile revolution are the inevitable effects of over population.
- Industries are source of large variety of air pollutants such as  $\text{SO}_2$  gas,  $\text{NO}_2$ ,  $\text{NH}_3$ ,  $\text{HCL}$  gas and  $\text{H}_2\text{S}$  gas apart from dust, tar, fumes etc.
- Automobiles too result in emission of hazardous pollutants as by products of fossil fuel combustion.

- Advance agricultural methods such as spraying of crops for weed and pest control, which releases pollutants such as chlorinated hydrocarbons, arsenic, organic phosphates and lead etc.
- In the race for power, man involves in widespread usage of radioactive materials. Nuclear explosives used in war and nuclear explosion lead to radioactive fallout consisting of radioactive pollutants such as cesium-137, strontium-90, iodine-131 etc, all of which have very long range impacts.

# Classification of Pollution Sources

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- The man made or anthropogenic sources are mainly categorized into three classes.
- Stationary or point sources: These are best illustrated by industries as these add pollutants to the air at specific points through their high elevation chimneys. These impact only restricted areas.
- Mobile or line sources: Automobiles are the line or mobile sources of air pollution and these add air pollutants along narrow belts over long distances.

- Area sources: Cities and towns add smoke and gases over large areas and so qualify as area sources of air pollution.

Classification of air pollutants according to origin:

- As per origin, air pollutants are classified in two distinct classes namely primary pollutants and secondary pollutants.
- Primary pollutants are directly emitted from the sources and found in atmosphere in the form in which they were released and thus these are called as primary pollutants. Examples of primary pollutants are Nitrogen oxides, Sulphur oxides, hydrocarbons, smoke, ash, dust, mist, fumes, sprays, radioactive compounds etc.

- Secondary pollutants: These are formed in the atmosphere through the chemical interaction amongst primary pollutants and atmospheric constituents and thus these are known as secondary pollutants. These are formed by a photochemical reaction or by hydrolysis (chemical breakdown of a compound because of reaction with water) or oxidation (a process in which a chemical substance changes due to the addition of oxygen) reactions in the atmosphere. Examples of secondary pollutants are ozone, sulphur trioxide, peroxyacynitrate (PAN), ketones (byproducts of the breakdown of fatty acids) and aldehydes (an organic compound containing the group  $\text{—CHO}$ , formed by the oxidation of alcohols).



## Classification of air pollutants as per state of matter:

- As per state of matter, air pollutants are classified into two main classes namely gaseous air pollutants and particulate air pollutants.
- Gaseous air pollutants: these are occurring in gaseous state at normal pressure and temperature. Examples of gaseous pollutants are nitrogen oxides ( $\text{NO}_2$ ), carbon dioxide ( $\text{CO}_2$ ), Sulphur oxides ( $\text{SO}_x$ ), photochemical oxidants and hydrocarbons.
- Particulate air pollutants: all atmospheric substances which may be solid particles, suspended droplets or mixture of these two are known as particulates. Examples of particulate pollutants are aerosols, dust, smoke, fumes, mist etc.

# Effects of Air Pollutants

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Effects on human health:

- Irritation of the respiratory track.
- Irritation of nose, eye and throat.
- Lead particulates cause lead poisoning resulting in delirium (serious disturbance in mental abilities that results in confused thinking and reduced awareness of the environment), convulsions (an episode in which you experience rigidity and uncontrolled muscle spasms along with altered consciousness), coma and even death.
- Cadmium particulates cause kidney, cardiovascular diseases, damage liver and can cause even death.
- Nickel particulates cause respiratory damage.

- Mercury lead to nerve, kidney and brain damage.
- Radioactive fallout causes somatic (relating to the body, especially as distinct from the mind) and genetic defects on future generations.

## Effects on plants:

- SO<sub>2</sub> bleaches (cause a material to become white or much lighter by a chemical process or by exposure to sunlight) the leaf surface and lead to chlorosis (loss of the normal green coloration of plant leaves) specifically in leafy vegetables.
- NO<sub>2</sub> causes premature leaf fall and suppressed growth which lead to decrease in crop yields.
- Ozone lead to necrosis (dead areas on a leaf structure) and damage leaves.
- PAN damages leafy vegetable through premature fall of leafy vegetables, curling and discoloration of sepals.

## Effects on Materials:

- $\text{SO}_2$ , acid rains and aerosols spoil the building materials.
- Paints are discolored by  $\text{SO}_2$ ,  $\text{H}_2\text{S}$  and particulates.
- Metals undergo tarnishing (dullness of color; loss of brightness) and corrosion by  $\text{SO}_2$  and acid gases.
- Paper becomes brittle and leather undergo disintegration by  $\text{SO}_2$  and acid gases.
- Ozone,  $\text{SO}_2$ ,  $\text{NO}_2$  and acid gases discolor, reduce and deteriorate the tensile strength of textiles.

## Effect on Climate:

- Due to fossil fuel combustion in industries and automobile and deforestation, CO<sub>2</sub> content of the atmosphere is increasing.
- This will increase the temperature of the earth, which will lead to melting of glaciers, polar ice etc which will consequently cause flooding of coastal towns. Pattern of rainfall if altered will impact agricultural productivity.
- The thinning of ozone layer in the stratosphere by the action of aerosols will increase the penetration of harmful UV rays to earth and this will cause sunburn, blindness, inactivation of protein, DNA and RNA.

## Effect on aesthetic beauty

- Aesthetic beauty of the nature is not visible in haze formed by dust and smoke in the air. Industries, automobiles, sewage and garbage heaps emit foul odors causing further loss of aesthetic beauty.