Module-2 Environmental Pollution

Contamination of the environment by harmful substances is called environmental pollution

1. Pollutants

The harmful substances which cause pollution are called pollutants. Some common pollutants are CO_2, SO_2, Lead, Mercury, Cadmium, Arsenic, Dust particles, plastic, smoke, pesticides, fertilizers, radio active substances etc.

2. Air pollution

It is the addition of undesirable substances (pollutants) into the atmosphere which are harmful to the life of human beings, animals and plants

Sources of air pollution

Air pollution may be due to human activities and natural activities.

Air pollution due to thermal power plants, emissions from chemical industries, automobile emissions, petroleum refineries, domestic combustion etc are examples of human activities causing air pollution

Air pollution due to volcanic activity, forest fire etc are examples for natural activities causing air pollution.

The common gaseous pollutants are SO_2, CO, H_2S, NO, NO_2 , Chloro fluoro carbon etc.

There are two types of air pollutants. ie, primary pollutant and secondary pollutant

Primary pollutants

These are the pollutants that are directly emitted into the atmosphere. eg:- CO, NO, SO_2 etc.

Secondary pollutants

Such pollutants are produced from primary pollutants by chemical reaction in atmosphere. eg:- SO_3, NO_2, H_2SO_4, HNO_3

3. Particulate pollutants

Suspension of microscopic solids and liquids particles present in the form of droplets floating in the air or atmosphere refers to as Particulate pollution. Particulate pollution/ particulate matter/ atmospheric particulate matter is called PM. The source of the particle can either be natural or anthropogenic. Particulate matter pollution or particulate pollution is one of the deadliest types of air pollution in India and on a global level. Major sources of particulate matter emission are factories, power stations, incinerators, industries, automobiles, and diesel generators.

Particulate matter present in the air is mainly of two types- Viable particles and non-viable particles.

Viable Particulate Matter: These particles include lower living organisms such as algae, bacteria, molds, fungi, etc. They are dispersed into the air. Human beings are allergic to these microorganisms and they can also cause different types of diseases in plants and animals.

Non-Viable Particulate Matter: We can classify these particles on the basis of size and their nature. These particulates include smoke, dust, mists, and fumes.

Effects of particulate pollution

- Lung cancer
- Asthma
- Cardiovascular problems
- Birth defects and failed pregnancy
- Retardation of photosynthesis process in plants
- Climate change

Control of particulate pollution

1. Cyclone separator

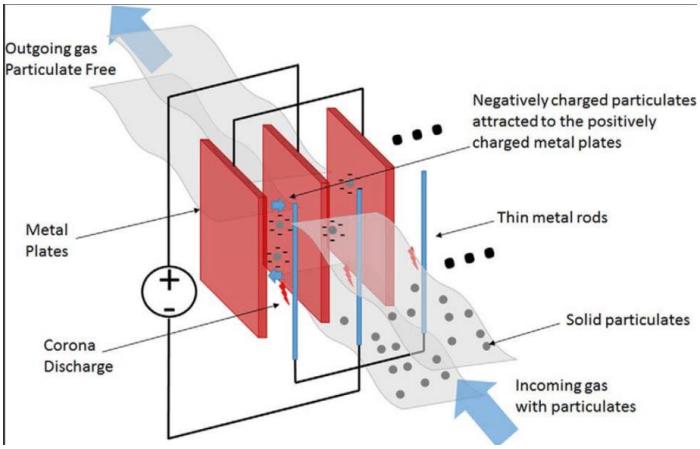
A cyclone removes particulates by causing the dirty airstream to flow in a spiral path inside a cylindrical chamber. Dirty air enters the chamber from a tangential direction at the outer wall of the device, forming a vortex as it swirls within the chamber. The larger particulates, slide down the wall into a conical dust hopper at the bottom of the cyclone. The cleaned air swirls upward in a narrower spiral through an inner cylinder and emerges from an outlet at the top. Accumulated particulate dust is periodically removed from the hopper for disposal.

Cyclones are best at removing relatively coarse particulates. They can routinely achieve efficiencies of 90 percent for particles larger than about 20 micrometres. They are typically used as pre-cleaners and are followed by more efficient air-cleaning equipment such as electrostatic precipitators and baghouses.

2. Electrostatic precipitator

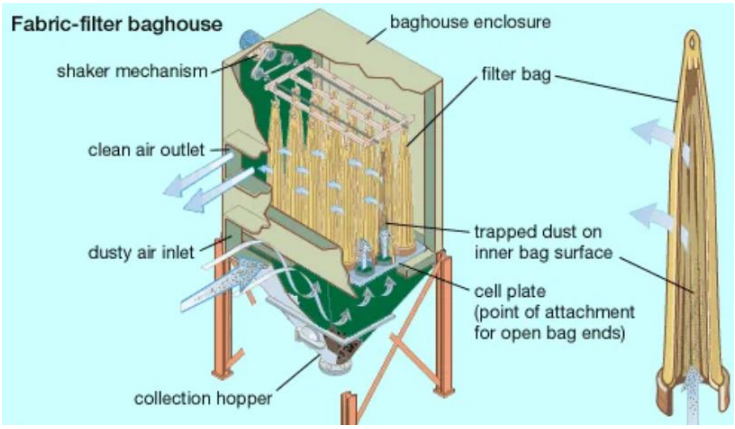
In an electrostatic precipitator, particles suspended in the airstream are given an electric charge as they enter the unit and are then removed by the influence of an electric field. The precipitation unit comprises discharge and collection electrodes, a dust clean-out system, and collection hoppers. A high voltage of direct current (DC), as much as 100,000 volts, is applied to

the discharge electrodes to charge the particles, which then are attracted to oppositely charged collection electrodes, on which they become trapped.



An electrostatic precipitator can remove particulates as small as 1 μm with an efficiency exceeding 99 percent. The effectiveness of electrostatic precipitators in removing fly ash from the combustion gases of fossil-fuel furnaces accounts for their high frequency of use at power stations.

3. Baghouse filter



One of the most efficient devices for removing suspended particulates is an assembly of fabric-filter bags, commonly called a baghouse. A typical baghouse comprises an array of long, narrow bags—each about 25 cm (10 inches) in diameter—that are suspended upside down in a large enclosure. Dust-laden air is blown upward through the bottom of the enclosure by fans. Particulates are trapped inside the filter bags, while the clean air passes through the fabric and exits at the top of the baghouse. A fabric-filter dust collector can remove very nearly 100 percent of particles as small as 1 μm.

4. Control of gaseous pollution

a) Absorber

Absorption involves the transfer of a gaseous pollutant from the air into a contacting liquid, such as water. The liquid (absorber) must be able either to serve as a solvent for the pollutant or to capture it by means of a chemical reaction.

Ex: Ammonium sulphate, sodium sulphite etc can be used to absorb SO_2

Water, sodium hydroxide etc can be used to absorb HF

b) Catalytic converter

Catalytic converter is a device used to convert toxic exhaust emissions from an internal combustion engine into non-toxic substances.

5. **Water pollution**

Causes of water pollution

(a) Industrial waste

Industries produce a tremendous amount of waste, which contains toxic chemicals and pollutants, causing air pollution and damage to our environment and us. They contain harmful chemicals, including lead, mercury, sulfur, nitrates, asbestos, and many others. Many industries, not having a proper waste management system, drain the waste in the freshwater, which goes into canals, rivers, and later into the sea.

The toxic chemicals may change the color of water, increase the number of minerals, called eutrophication, change the temperature of the water, and pose a severe hazard to water organisms.

(b) Sewage & waste water

The sewage and wastewater that is produced in each household are sometimes released into the sea along with fresh water. The sewage water carries pathogens, a typical water pollutant, other harmful bacterias, and chemicals that can cause serious health problems and thereby diseases.Microorganisms in water are known to cause some of the very deadly diseases.

(c) Mining activities

Mining is the process of crushing the rock and extracting coal and other minerals from the underground. These elements, when extracted in the raw form, contain harmful chemicals and can increase the number of toxic elements when mixed up with water, which may result in health problems. Mining activities emit a large amount of metal waste and sulphides from the rocks, which is harmful to the water.

(d) Marine dumbing

The garbage produced by households in the form of paper, plastic, food, aluminium, rubber, glass, is collected and dumped into the sea in some countries. These items take 2 weeks to 200 years to decompose. When such things enter the sea, they not only cause water pollution but also harm animals in the sea.

(e) Oil leakage

Oil spill poses a huge threat to marine life when a large amount of oil spills into the sea and does not dissolve in water. It causes problems for local marine wildlife, including fish, birds, and sea otters.

(f) Chemical fertilizers & pesticides

Chemical fertilizers and pesticides are used by farmers to protect crops from insects and bacteria's. They are useful for the plant's growth. However, when these chemicals are mixed up with water, they produce harmful pollutants for plants and animals. Also, when it rains, the chemicals mix up with rainwater and flow down into rivers and canals, which pose serious damages for aquatic animals.

(h) Global warming

An increase in the earth's temperature results in global warming due to the greenhouse effect. It increases the water temperature and results in the death of aquatic animals and marine species, which later results in water pollution.

(i) Animal waste

The waste produced by animals washed away into the rivers when it rains. It then gets mixed up with other harmful chemicals and causes various water-borne diseases like cholera, diarrhea, dysentery, jaundice, and typhoid.

(j) Acid rain

Acid rain is essentially water pollution caused by air pollution. When the acidic particles released in the atmosphere by air pollution mix with water vapor, it results in acid rain.

Effects of water pollution

- **Destruction of biodiversity.** Water pollution depletes aquatic ecosystems.
- **Contamination of the food chain.** Fishing in polluted waters and the use of waste water for livestock farming and agriculture can introduce toxins into foods which are harmful to our health when eaten.

- **Lack of potable water.** The UN says that billions of people around the world have no access to clean water to drink or sanitation, particularly in rural areas.

- **Disease.** The WHO estimates that about 2 billion people have no option but to drink water contaminated by excrement, exposing them to diseases such as cholera, hepatitis A and dysentery.

- **Infant mortality.** According to the UN, diarrhoeal diseases linked to lack of hygiene cause the death of about 1,000 children a day worldwide.

Water quality parameters

a) Dissolved oxygen (DO)

It is the amount of oxygen dissolved in water. Most aquatic organisms need oxygen to survive and grow. Some species require high DO such as trout and stoneflies. Other species, like catfish, worms and dragonflies, do not require high DO.

If there is not enough oxygen in the water, the following may happen:

- Death of adults and juveniles
- Reduction in growth
- Failure of eggs/larvae to survive
- Change of species present in a given waterbody.

b) p^H

The optimum p^H range for drinking water is 6.5 -8.5.

Many chemical reactions inside aquatic organisms (cellular metabolism) that are necessary for survival and growth of organisms require a narrow pH range. At the extreme ends of the pH scale, (2 or 13) physical damage to gills, exoskeleton, fins, occurs. Changes in pH may alter the concentrations of other substances in water to a more toxic form. Examples: a decrease in pH (below 6) may increase the amount of mercury soluble in water. An increase in pH (above 8.5) enhances the conversion of nontoxic ammonia (ammonium ion) to a toxic form of ammonia (un-ionized ammonia).

c) Biological oxygen demand (BOD)

BOD is a measure of the amount of oxygen required to remove waste organic matter from water in the process of decomposition by aerobic bacteria (those bacteria that live only in an environment containing oxygen).

The waste organic matter is stabilized or made unobjectionable through its decomposition by living bacterial organisms which need oxygen to do their work. BOD is used, often in wastewater-treatment plants, as an index of the degree of organic pollution in water.

Drinking water has a BOD level of 1 - 2 ppm. When the BOD value of water is in the range 3 - 5 ppm, the water is moderately clean. Polluted water has a BOD value in the range of 6 - 9 ppm. A BOD value of more than 100 ppm suggests that water is highly polluted. The clean water should have BOD value less than 5 ppm.

d) Chemical oxygen demand (COD)

COD is a measure of the amount of oxygen required to chemically decompose **the** organic **matter** and to oxidise the inorganic chemicals such as ammonia and nitrite present in water. Chemical oxygen demand is measured as a standardized laboratory analysis in which a closed water **sample** is incubated with a strong chemical oxidant under specific conditions of **temperature** and for a particular period of **time**. A commonly used oxidant in COD analysis is potassium dichromate ($K_2Cr_2O_7$) which is used in combination with boiling **sulfuric acid** (H_2SO_4).

Compared to BOD, the COD analysis is faster and more accurate.

6. Noise pollution

Not all sound is considered noise pollution. **The World Health Organization (WHO) defines noise above 65 decibels (dB) as noise pollution.** To be precise, noise becomes harmful when it exceeds 75 decibels (dB) and is painful above 120 dB. As a consequence, it is recommended noise levels be kept below 65 dB during the day and indicates that restful sleep is impossible with night time ambient noise levels in excess of 30 dB.

According to the World Health Organization (WHO), it is one of the most dangerous environmental threats to health. And according to the European Environment Agency (EEA), noise is responsible for 16,600 premature deaths and more than 72,000 hospitalisations every year in Europe alone.

a) Sources of noise pollution

-Traffic Noise

Traffic noise accounts for most polluting noise in cities. For example, a car horn produces 90 dB and a bus produces 100 dB. A single aircraft produces 130dB.

-Construction sites

Building and car park construction and road and pavement resurfacing works are very noisy. For example, a pneumatic drill produces 110 dB.

-Animals

Noise made by animals can go unnoticed, but a howling or barking dog, for example, can produce around 60-80 dB.

-Noise from industries

Fans, motors, compressors etc can cause noise pollution to workers and also to the public.

-Noise from consumer products

House hold equipment's such as vacuum cleaners and some kitchen appliances are noise makers.

b) Effects of noise pollution

Physical

Respiratory agitation, racing pulse, high blood pressure, headaches and, in case of extremely loud or constant noise, gastritis, colitis and even heart attacks.

Psychological

Noise can cause attacks of stress, fatigue, depression, anxiety and hysteria in both humans and animals.

Sleep and behavioural disorders

Noise above 45 dB stops you from falling asleep or sleeping properly. Remember that according to the World Health Organization it should be no more than 30 dB. Loud noise can have latent effects on our behaviour, causing aggressive behaviour and irritability.

Memory and concentration

Noise may affect people's ability to focus, which can lead to low performance over time. It is also bad for the memory, making it hard to study.

Interestingly, our ears need more than 16 hours' rest to make up for two hours of exposure to 100 dB.

c) Noise Pollution (Regulation and Control) Rules 2000

The reasoning behind the enactment of these rules was that the noise emitted by loudspeakers, vehicular horns, construction activities, music systems, industries, and other mechanical equipment have an adverse impact on the physical and physiological growth of human beings. These rules were formulated in order to curb the menace of excessive noise pollution from these sources to create an ambient atmosphere for healthy living. The noise pollution rules prohibit the use of loudspeakers at night and provide provisions for penalties in case permission for the use of such devices is not sought from a competent authority.