

14. ENVIRONMENTAL CHEMISTRY

Environmental chemistry deals with the study of the origin, transport, reactions, effects and fates of chemical species in the environment.

❖ **What is mean by environmental pollution?**

It is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings.

❖ **What is a pollutant?**

A substance which causes pollution is known as pollutant. It may be a solid, liquid or gaseous substance present in greater concentration than the normal level.

❖ **Which are the different types of pollutants?**

Pollutants are of two types – degradable and non-degradable. Degradable pollutants are rapidly broken down by natural processes. E.g. vegetable wastes.

Non-degradable pollutants are not dissociated by natural processes or by micro-organisms and remain in the environment for a long time. E.g. DDT, plastic materials, heavy metals, many chemicals, nuclear wastes etc.

❖ **What is mean by Tropospheric pollution?**

The presence of undesirable solid or gaseous particles in the lower layer of atmosphere (Troposphere) is called tropospheric pollution.

❖ **“Sulphur dioxide is poisonous to both animals and plants”. Justify the statement.**

Low concentration of sulphur dioxide causes respiratory diseases like asthma, bronchitis etc and irritation to the eyes. High concentration of SO_2 leads to stiffness of flower buds. Also it produces acid rain.

❖ **How does Nitrogen dioxide form in the atmosphere?**

During lightning, atmospheric nitrogen combines with oxygen to form nitric oxide (NO), which further combines with oxygen to form nitrogen dioxide (NO_2). Also due to the combustion of fossil fuels in automobile engine, NO_2 is released to the atmosphere.

❖ **What are the harmful effects of NO_2 ?**

The adverse effects (bad effects) of NO_2 are:

- a) Its higher concentration damages the leaves of plants and retards the rate of photosynthesis.
- b) It is a lung irritant and cause severe respiratory disease in children. It is toxic to living tissues also.
- c) It is also harmful to various textile fibres and metals.
- d) Excess NO_2 in atmosphere results in acid rain and photochemical smog.

❖ **Carbon monoxide is one of the most serious air pollutants. How does it affect human being?**

Carbon monoxide binds to haemoglobin of our blood to form carboxyhaemoglobin, which is more stable than the oxygen-haemoglobin complex. So it reduces the oxygen carrying capacity of blood. This oxygen deficiency results into headache, weak eyesight, nervousness and cardiovascular disorder.

❖ **What is mean by the green house effect?**

When the concentration of carbon dioxide in the atmosphere is above the normal level (0.03%), it absorbs more infra-red radiation from the solar energy and hence the temperature of the earth's atmosphere increases. This is known as Green house effect. It results in global warming.

❖ **What is mean by green house gases? OR,**

❖ **What are the major gases which contribute towards global warming?**

The gases responsible for green house effect are called green house gases. They are CO_2 , methane, water - vapour, chlorofluorocarbons (CFC's), nitrous oxide and ozone.

❖ **What are the adverse effects of global warming and green house effect?**

Due to global warming, the average global temperature will increase. This will lead to the melting of polar ice caps and flooding of low lying areas all over the earth. Increase in the global temperature results in the infectious diseases like dengue, malaria, yellow fever, sleeping sickness etc.

❖ **What can we do to reduce global warming?**

Global warming can be reduced by the following methods:

- a) Reduce the burning of fossil fuels by minimizing the use of automobiles.
- b) Plant trees and encourage afforestation.
- c) Avoid burning of dry leaves, wood etc.

d) Aware the public about the bad effects of global warming.

❖ **What is mean by acid rain? What are the major compounds responsible for acid rain?**

When the pH of the rain water drops below 5.6, it is called acid rain. Oxides of nitrogen and sulphur (e.g. SO_2 and NO_2) are mainly responsible for acid rain.

❖ **What are the harmful effects of acid rain?**

- Acid rain is harmful for agriculture, trees and plants.
- It causes respiratory ailments and skin cancer in human beings and animals.
- It affects plants and animal life in aquatic ecosystem.
- It corrodes water pipes resulting in the dissolution of heavy metals into the drinking water.
- Acid rain damages buildings and other structures made of stone or metal (e.g. The Taj Mahal).

❖ **What are the different measures to reduce acid rain?**

Acid rain can be reduced by the following methods:

- Reduce the use of automobiles.
- Encourage the use of natural gas instead of coal.
- Catalytic converters must be used in motor vehicles to reduce the emission of CO and oxides of Nitrogen to the atmosphere.
- Acidity of the soil can be reduced by adding powdered limestone.
- Aware the public about acid rain.

❖ **Define particulate pollutants?**

Particulates pollutants are the minute solid particles or liquid droplets in air. These are present in vehicle emissions, smoke particles from fires, dust particles and ash from industries.

❖ **What is mean by viable and non-viable particulate pollutants? Give examples.**

The viable particulates are minute living organisms that are dispersed in the atmosphere. E.g., bacteria, fungi, moulds, algae etc. The non-viable particulates are non-living like smoke, fumes, mist, dust etc.

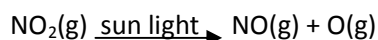
❖ **What is mean by 'smog'? Which are the different types of smog? Explain.**

Smog means smoke and fog. There are two types of smog – classical smog and photochemical smog. Classical smog occurs in cool humid climate. It is a mixture of smoke, fog and sulphur dioxide. Chemically it is a reducing mixture and so it is also called as reducing smog.

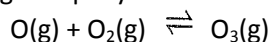
Photochemical smog occurs in warm, dry and sunny climate. The main components of the photochemical smog are nitrogen oxides, unburnt hydrocarbons, formaldehyde etc. Photochemical smog has high concentration of oxidising agents and so it is also called oxidising smog.

❖ **How is photochemical smog formed?**

When fossil fuels burnt, hydrocarbons and nitric oxide are released into the atmosphere. The nitric oxide (NO) so formed is first converted to NO_2 , which further breaks up to form nitric oxide and free nitrogen atom in presence of sunlight.



The atomic oxygen rapidly combines with atmospheric oxygen to form ozone.



Both NO_2 and O_3 are strong oxidising agents and reacts with unburnt hydrocarbons to produce compounds like formaldehyde, acrolein and peroxyacetyl nitrate (PAN). These are the main components of photochemical smog.

❖ **What are the adverse effects of photochemical smog?**

- Photochemical smog causes serious health problems like headache, chest pain, dryness of the throat, cough and difficulty in breathing.
- It leads to cracking of rubber and extensive damage to plant life.
- It also causes corrosion of metals, stones, building materials, rubber and painted surfaces.

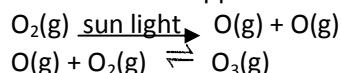
❖ **How can we control photochemical smog?**

We can control photochemical smog by the following methods:

- Use catalytic converters in automobiles, which prevent the release of nitrogen oxide and hydrocarbons to the atmosphere.
- Certain plants like Pinus, can metabolise nitrogen oxide. So their plantation helps to reduce these oxides.

❖ **Explain the formation of ozone in stratosphere. Write necessary equations.**

Ozone is formed in the upper stratosphere by the interaction of uv radiation on dioxygen.

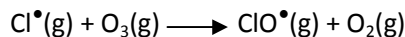


❖ **Explain with chemical equation, the destruction of ozone by chlorofluorocarbons causing ozone hole.**

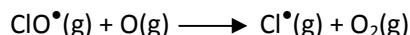
The main reason for ozone layer depletion is the release of chlorofluorocarbons (CFC's) to the atmosphere. In stratosphere, CFC's get broken down by UV radiations, releasing chlorine free radical.



The chlorine radical then react with ozone to form chlorine monoxide radicals and molecular oxygen.



Reaction of chlorine monoxide radical with atomic oxygen produces more chlorine radicals.



The chlorine radicals are continuously regenerated and cause the breakdown of ozone.

❖ **What are the harmful effects of ozone depletion?**

Due to the depletion of ozone layer, more UV radiation reaches into troposphere and leads to the following harmful effects:

- It leads to ageing of skin, cataract, sunburn, skin cancer, killing of many phytoplanktons, damage to fish productivity etc.
- It leads to the harmful mutation of cells.
- It also increases evaporation of surface water through the stomata of the leaves and decreases the moisture content of the soil.
- Increase in UV radiations damage paints and fibres, causing them to fade faster.

❖ **What is Biological Oxygen Demand (BOD)?**

The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water, is called Biochemical Oxygen Demand (BOD). The amount of BOD in the water is a measure of the amount of organic material in the water. Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

❖ **How do organic pollutants affect aquatic life?**

As the amount of organic matter in water increases, more oxygen is required to decompose them by bacteria. So the amount of dissolved oxygen in water decreases. This causes oxygen dependent aquatic life to die.

❖ **What is mean by eutrophication?**

Nutrient enriched water bodies support a dense plant population, but kills animal life by reducing the amount of free oxygen. This results in the loss of biodiversity and is known as Eutrophication.

❖ **There are international standards regarding drinking water. Write any four among them.**

The International Standards for drinking water are given below:

- Fluoride: For drinking purposes, water should contain fluoride upto 1 ppm (parts per million).
- Lead: The upper limit concentration of lead in drinking water is about 50 ppb (parts per billion).
- Sulphate: Less than 500 ppm
- Nitrate: The maximum limit of nitrate in drinking water is 50 ppm.

❖ **What are the following abbreviations stands for? PCB, PAN, BOD, CFC, DDT.**

PCB – Polychlorinated biphenyls (Pollution control Board)

PAN – peroxyacetyl nitrate

BOD – Biological Oxygen Demand

CFC – Chlorofluorocarbon

DDT – Dichlorodiphenyltrichloroethane

❖ **Give some examples for pesticides and herbicides?**

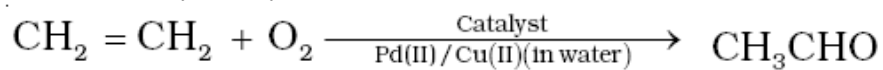
Pesticides – DDT, aldrin, Dieldrin etc.

Herbicides – sodium chlorate (NaClO_3), sodium arsenite (Na_3AsO_3) etc.

❖ **What is Green Chemistry?**

Green chemistry (also called sustainable chemistry) is an area of chemistry focused on the design of products and processes that minimize the use and generation of dangerous substances.

- (i) **Dry Cleaning of Clothes:** Liquefied carbon dioxide, with a suitable detergent is used for dry cleaning clothes.
- (ii) **Bleaching of Paper:** Hydrogen peroxide (H_2O_2) with suitable catalyst is used for bleaching paper.
- (iii) **Synthesis of Chemicals:** Ethanal (CH_3CHO) is now commercially prepared by one step oxidation of ethene in the presence of ionic catalyst in aqueous medium.

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