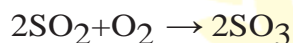


CLASS 11 Chemistry 14 Environmental Chemistry

- ▶ **Environmental pollution:** Environmental pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. A substance which causes pollution is known as pollutant. Pollutants can be degradable and non-degradable.
- ▶ **Atmospheric pollution:** Any undesirable changes in their atmosphere which adversely affect living beings is called air pollution. Air pollution is generally limited to troposphere and stratosphere.
Ozone is present in stratosphere and prevents UV radiations of sun from reaching the earth's surface.
- ▶ **Tropospheric pollution:** It is due to gaseous and particulate pollutants.

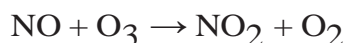
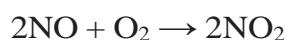
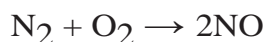
1. Gaseous air pollutants:

Oxides of Sulphur: Major sources of oxides of Sulphur (mainly SO₂) are burning of fossil fuels containing Sulphur. Sulphur dioxide is converted to Sulphur trioxide in presence of particulate matter.



Sulphur dioxide is a corrosive gas which produces acid rain that causes damage and destruction of vegetation and degradation of soils, building materials and watercourses. SO₂ in ambient air is also associated with asthma and chronic bronchitis. It also causes irritation to eyes.

- **Oxides of nitrogen:** Major sources of nitrogen oxides are high temperature combustion processes, oxidation of nitrogen in the air and fuel respectively, denitrifying bacteria, etc.



Finally, these gases are converted into nitric acid (HNO_3) which comes down to the surface of the earth in the form of acid rain.

— NO_2 is a respiratory irritant,

— The oxides produce eye irritation, injury to liver and kidneys.

- **Hydrocarbons:** They are majorly produced naturally (e.g. marsh gas) as well as due to incomplete combustion of automobile fuel.
— Hydrocarbons are carcinogenic, these harm plants.
- **Oxides of carbon:** two major pollutants are oxides of carbon i.e., carbon monoxide and carbon dioxide.
- **Carbon monoxide:** Carbon monoxide (CO) is a toxic gas which is emitted into atmosphere by incomplete combustion of coal and firewood and by oxidation of hydrocarbons and other organic compounds.
 CO may reduce the oxygen carrying capacity of the blood by combining with haemoglobin to produce carboxy haemoglobin, This oxygen deficiency results in headache weak eyesight, choking and cardiovascular disorders.
- **Carbon dioxide:** CO_2 is released into atmosphere by respiration burning of fossil fuels, forest fire decomposition of limestone in cement industry, etc.
— It is a greenhouse gas, the concentration of which is constantly raising.
— In excess it causes headache and nausea.

EFFECTS OF POLLUTION:

- a) Due to London Smog nearly 3000-4000 people died.
- b) Many people in Japan have suffered from a disease called "Minamata", a disease that spread after eating fish in Minamata Island, as the island waters were contaminated with mercury.
- c) In 1984, thousands of people were killed by the gas, methyl isocyanate (MIC), which leaked from union carbide factory at Bhopal.
- d) Many buildings in Italy and Rome are getting destroyed by the acid rain
- e) The Mediterranean Sea turned into "dead sea" is unable to support aquatic life.
- f) A special board has been established to purify the holy river Ganges in India.
- g) The dangerous radiations from the radioactive fallout of reactors and testing of nuclear weapons creating problems in the air.
- h) The beauty of Taj Mahal is decreasing due to air pollution.
- i) In the second world war lakhs of people died in Hiroshima and Nagasaki cities of Japan due to

atom bomb.

j) nuclear pollution gave more effect to the people at Chernobyl in Russia.

k) The accident in the oil refinery of HPCL near Visakhapatnam.

► **Greenhouse effect and global warming:** The greenhouse effect is the process in which the emission of infrared radiation by the atmosphere warms the Earth surface.

- Greenhouse gases include carbon dioxide, methane, ozone chlorofluorocarbons (CFCs) and water vapour.
- Earth absorbs energy from sunlight entering the atmosphere and emit energy out to space in form of infrared rays. The outgoing radiation emitted by the surface is in the absorption range of many atmospheric gases, including carbon dioxide, methane, and water vapour. These radiations are thus locked in the earth's atmosphere. This results in the steady increase in the temperature of the earth resulting in global warming.

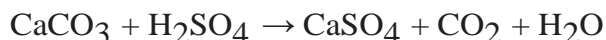
► **Acid rain:** Rainwater normally has a pH of 5.6 due to dissolution of CO₂ present in the atmosphere.



- When the pH Falls below 5.6, the rain water becomes acidic, it is caused due to presence of acidic gases into the atmosphere the common ones are Sulphur dioxide and nitrogen oxides which are changed into Sulphuric acid and nitric acid by combining with oxygen and water.



- Harmful effects of acid rain: It causes extensive damage to buildings and statues made by marble, limestone due to the reaction,



— It is toxic to vegetation and aquatic life.

— It corrodes water pipes resulting in the leaching of the heavy metals such as Fe, Pb, and Cu into the drinking water which have toxic effects.

2. **Particulate pollutants:** Particulate pollutants are small solid particles and liquid droplets suspended in air.

Smoke: it consists of solid or mixture of solid and liquid particles formed by combustion of organic matter. e.g., cigarette smoke, oil smoke, smoke from fossil fuel etc.

Dust: It consists of fine particles produced during crushing and grinding of solid materials. Common dust particulate emission include cement, fly ash, silica dust, from Industries, dust storm, ground limestone, etc.

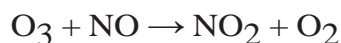
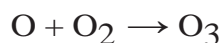
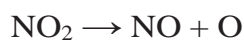
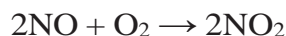
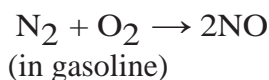
Mist: These are formed by particles of spray liquids and condensation of sepals in air. For example, sulphuric acid, mist herbicide or insecticide that Miss their targets and travel through air from mist.

Fumes: These are produced by condensation of vapors. For example, metal fumes, metallurgical fumes and alkali fumes.

Smog: The word smog has its origin from smoke and fog. It is a major airpollutant.

Classical smog	Photochemical smog
Also called as London smog.	Also called as Los Angeles smog.
Form due to oxides of sulphur.	Formed due to oxides of Nitrogen.
Contains primary pollutants.	Content secondary pollutants.
Causes bronchitis and problem in lungs.	Causes irritation in Eyes.
It is reducing in nature.	It is oxidising in nature.

Formation of photochemical smog: It is formed through sequence of following reactions:



Ozone reacts with hydrocarbons to form Peroxyacetyl nitrate (PAN), formaldehyde, acrolein etc. Effects of photochemical smog:

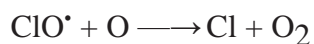
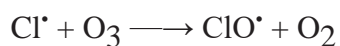
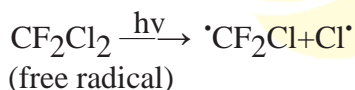
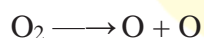
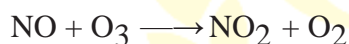
Ozone and PAN are eye irritants. Photochemical smog also corrodes metals stones buildings materials rubber and painted surfaces.

Measures to control photochemical smog:

Catalytic converters are used in automobiles, which prevent the release of Nitrogen oxide and hydrocarbon to the atmosphere. Certain plants e.g. Pinus, Juniparus, Quercus, Pyrus and Vitis can metabolize nitrogen oxide and therefore their plantation could help in this matter.

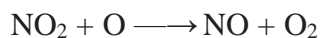
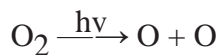
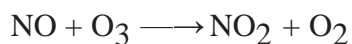
- ▶ **Stratospheric pollution:** The upper stratosphere consists of considerable amount of ozone (O₃) which protects us from the harmful ultraviolet (UV) radiations coming from the sun. These radiations causes skin cancer in humans.

Depletion of Ozone layer : Nitric Oxide and chlorofluorocarbons are found to be most responsible for depletion of Ozone layer.



- **Ozone depletion by oxides of Nitrogen:**

Nitrous oxide is quite inert, in the stratosphere it is photochemically converted into more reactive nitric oxide.



Thus, NO is regenerated in chain reaction.

- **Effects of ozone depletion:**

With the depletion of Ozone layer, more UV radiation filters into troposphere.

— UV radiations leads to ageing of skin, cataract, Sunburn, skin cancer, killing of many phytoplanktons, damage to fish productivity, etc.

Water pollution: Water pollution may be defined as any change in its physical, chemical, biological properties or contamination with foreign materials that can adversely affect human beings or reduce its utility for the intended use.

Major water pollutants and their sources:

Pollutants	Major sources
natural waste	Leaching of minerals slits from soil erosion falling of organic matter from bank, etc.
organic Chemicals	Pesticides, surfactants, detergents, Industrial waste
metals	Nuclear power plants, mining, metal plating industries.
man-made wastes	Sewage domestic waste, soaps and detergents, waste from animal sheds and slaughter houses, run off from agricultural fields, industrial wastes, oil pollution.

- **Eutrophication:** The process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of Oxygen and results in subsequent loss of biodiversity is known as eutrophication.
- **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).

International standards for drinking water:

Element	Permissible limit	Effect of excess amount
Fluoride	1 ppm or 1 mg dm^{-3}	Over 10 ppm causes harmful effect to bones and teeth.
Lead	50ppb	Excess amount can damage kidney, liver reproductive system, etc.
Nitrate	50ppm	Excess amount can cause blue baby syndrome.
Sulphate	500ppm	Excess can cause laxative effects.

- **Soil pollution:** Soil pollution is the addition of such chemical substances (in an indefinite proportion) which deteriorates the quality, texture and mineral content of the soil and disturbs the biological balance of the organisms in it and has little effect on the plant growth.

Some major soil pollutants and their sources:

Pollutants	Major sources
Industrial wastes	Waste products from paper, sugar, chemical Industries dumped into the soil.
Agricultural wastes	Chemical such as fertilizers pesticides extra used for killing insects fungi and weeds.
Soil conditioners	Used to protect soil fertility but contains several toxic metals like Pb, As, Hg, Cd, etc

Farm wastes	Wet slurry, faecal wastes are seeped into the soil.
Radioactive pollutants	Dumping of nuclear waste into the soil.

► **Remedial measures:**

- Forestation should be done to check the spread of desert.
 - Use of chemical fertilizers should be minimised.
 - Recycling, digestion and incineration of urban waste and organic waste should be done.
 - The industrial effluents should not be allowed to discharge into fields.
 - The fertility of the soil can be improved by soil rotation and mixedfarming.

► **Control of environmental pollution:**

- **Waste management:** Environmental pollution can be controlled to a certain extent by managing the waste disposal in a proper way.
- **Recycling:** A large amount of disposed waste materials can be reduced by recycling the waste. Thus, it reduces the landfill and converts waste into usable products.

► **Green chemistry:** Green Chemistry may be defined as a strategy to design chemical process and products that reduces or eliminate the use and generation of hazardous substances.

- It is an alternative tool for reducing pollution. Green Chemistry includes concepts such as waste minimization, solvent selection, atom utilisation, intensive processing and alternative synthetic routes from sustainable resources.
- **Green chemistry in day-to-day life:**
 1. Dry cleaning of clothes: Tetra chloroethene ($\text{Cl}_2\text{C} = \text{CCl}_2$) was earlier used as solvent for dry cleaning. The compound contaminates the ground water and is also a suspected carcinogen.
 2. The process using this compound is now being replaced by a process, where liquefied carbon dioxide, with suitable present is used.
 3. Bleaching of paper: Chlorine gas was used earlier for bleaching paper. These days, hydrogen peroxide (H_2O_2) with suitable catalyst, which promotes the bleaching action of hydrogen peroxide, is used.

