Effects of photochemical smog

Thus, the major constituents of photochemical smog are oxides of nitrogen, ozone, acrolein, formaldehyde, PAN etc. Each contributes to the harmful effects of smog.

(i) Both ozone and PAN act as powerful eye irritants

(ii) Ozone and NO irritate the nose and throat and in high concentration causes headache, chest pain etc.

(iii) Photochemical smog causes much damage to plants

(iv) It also causes corrosion of metals, building materials and painted surfaces.

Control of photchemical smog

Photochemical smog can be controlled by controlling the release of oxides of nitrogen and hydrocarbons to the atmosphere by the following ways

(i) Use of catalytic converters in automobiles to prevent the release of oxides of nitrogen and hydrocarbons

(ii) Planting certain plants such as Pinus, Juniparus etc which can metabolise nitrogen oxides

Stratospheric pollution:Ozone layer depletion

The upper stratosphere consists of considerable amount of ozone which protects us from the harmful ultraviolet radiations coming from the sun. These radiations can cause skin cancer in human beings. Therefore, it is important to maintain the ozone shield.

Ozone is formed in the stratosphere by the effect of uv radiation on dioxygen. Some O_2 molecules split into oxygen atoms which combine with other O_2 molecules to form ozone.

$$O_2(g) \xrightarrow{UV} O(g) + O(g)$$

$$O(g) + O_2(g) \longrightarrow O_3(g)$$

Ozone is thermodynamically unstable and decomposes to O_2. Thus a dynamic equilibrium exists between the production and decomposition of ozone.

In recent years, there have been reports of the depletion of ozone layer and formation of ozone hole. The major cause of ozone layer depletion is believed to be the release of chloroflurocarbon compounds (CFCs) known as freons into the atmosphere. One major freon used as refrigerant is Freon 12 (CF_2Cl_2). Freons mix with the atmospheric gases and finally reach the stratosphere. In stratosphere they release chlorine free radicals under the influence of UV radiations

$$CF_2Cl_2(g) \xrightarrow{UV} \dot{Cl}(g) + \dot{C}F_2Cl(g)$$

The chlorine radicals react with ozone to form chlorine monoxide radical and O_2

$$\dot{Cl}(g) + O_3(g) \longrightarrow \dot{ClO}(g) + O_2(g)$$

Chlorine monoxide radical reacts with atomic oxygen and regenerate chlorine radical.

$$\dot{ClO}(g) + O(g) \longrightarrow \dot{Cl}(g) + O_2(g)$$

These chlorine radicals react with O_3 and reaction continues resulting in breakdown of ozone layer.

Ozone depletion over Antartica : The Ozone Hole

It is reported that large ozone hole occurs in the stratosphere over Antartica during spring season.

In summer season, NO_2 combines with chlorine monoxide radical to form chlorine nitrate

$$\dot{ClO} + NO_2 \longrightarrow ClONO_2$$

During dark winter (May-July), Antartica is isolated from the surrounding temperate region by a special type of cloud known as Polar stratospheric clouds.

On the surface of these, clouds chlorine nitrate undergoes hydrolysis and it also reacts with hydrogen chloride.

$$ClONO_2 + H_2O \rightarrow HOCl + HNO_3$$

$$ClONO_2 + HCl \rightarrow Cl_2 + HNO_3$$

When sunlight returns to Antartica in the spring, the clouds break up and HOCl and Cl_2 are photolysed to atomic chlorine as follows

$$HOCl\ (g) \xrightarrow{h\nu} \dot{O}H\ (g) + \dot{C}l\ (g)$$

$$Cl_2(g) \xrightarrow{h\nu} 2\dot{C}l\ (g)$$

The chlorine radicals thus formed causes ozone depletion

Effects of Ozone layer depletion

(i) The depletion of ozone layer will allow UV radiation to enter the atmosphere. UV radiations lead to cataract, sunburn, skin cancer, etc.

(ii) UV radiation increases the evaporation of water from leaves of plants and decreases the moisture content of the solil

(iii) UV radiation damage paints and fibres.

WATER POLLUTION

Water pollution refers to the presence of any undesirable substance in water which produces harmful effect in animals and aquatic life . Pollution of water originates from human activities.

Causes of water pollution

The major pollutants of water are pathogens produced from domestic sewage, organic wastes and soluble chemical compounds.

(i) Pathogens

The most harmful water pollutants are the disease causing agents known as pathogens. They include bacteria and other micro organisms that enter water from domestic sewage and animal excreta.

(ii) Organic wastes

This group includes organic matter such as leaves, grass, plant nutrients, etc. They slowly undergo decay and pollute water.

(iii) Chemical Pollutants

Water soluble salts of heavy metals such as Cd, Hg , Ni etc are found in water sources near industries. All these metals are dangerous because our body cannot excrete them. These metals can damage kidneys, liver etc.

Petroleum products are found to pollute certain sources of water. Pesticides and fertilizers washed down by rain from agricultural farms also pollute water. Polychlorinated biphenyls (PCBs) which are used as cleansing solvents also pollute water in certain places. PCBs are considered as carcinogenic.

Dissolved oxygen (DO) and Biochemical Oxygen Demand (BOD)

The small amount of oxygen dissolved in water is known as dissolved oxygen (DO). In cold water, dissolved oxygen can reach a concentration up to 10 ppm (parts per million). The concentration of dissolved oxygen is very important for aquatic life. If the concentration of dissolved oxygen is less than 6 ppm, the growth of fish is affected.

Polluted water containing organic matter has less dissolved oxygen. This is because the dissolved oxygen is used by micro-organism to oxidise the organic matter. Thus decrease in dissolved oxygen of water is a measure of pollution by organic matter. It is expressed as Biochemical Oxygen Demand (BOD).

Biochemical oxygen demand (BOD)

It is the amount of oxygen required by micro-organisms to oxidise organic matter present in polluted water. It is generally expressed in ppm (parts per million). 'Clean water' would have a BOD value less than 5 ppm while highly contaminated water (say, river water) could have a BOD value of 17 ppm or more.