CHAPTER

16 Environmental Chemistry

Pollutant

Substance which cause pollution is known as pollutant.

Atomospheric pollution → Tropospheric pollution
Atomospheric pollution → Stratospheric pollution

Troposheric pollution occurs due to presence of undesirable solid or gaseous particles in air.

Gaseous Pollutant

SO_2: Cause resipiratory diseases of asthma, bronchitis emphysema etc & irrataling to eyes.

NO_2: Form by fossil fuel burn, Damage lungs.

Higer concentration of NO_2 damage the leaves of plant and retard rate of photoshynthesis.

Hydrocarbon: Form by incomplete combustion of fuel of automobile, Carcinogenic.

Oxide of Carbon

CO: Blocks the delivery of oxygen to organs and tissues.

Carboxy hemoglobin is 300 times more stable then oxy hemoglobin about 3-4% of carboxy hemoglobin the oxygen carrying capacity is highly reduced.

CO_2: Main source is respiration, burning of fossil fuels, demposition of lime stone in cement industry.

Increase of CO_2 cause global warming.

Global Warming and Green House Effect

Some of the gases such as CO_2, CH_4,O_3 CFC(s) and water vapour tapped the heat and does not radiates back to the atmosphere. This cause global warming.

Acid Rain

- Normally the pH of rain water is 5.6 due to the reaction between rain water and CO_2.
- When pH less then 5.6 then it is called acid rain.
- **Source:** Burning of fuel (contain N & S) form SO_2 & NO_2.
- Harmful to agriculture, tree and plants.
- Taj Mahal is affected by acid rain.

Particulate Pollutant

Particulate pollutant (minute solid particle)
- Viable particulates (bacteria, fungi etc.)
- Non-viable (smoke, dust, mists, fumes)

Smoke: Solid/mixture of solid and liquid particles formed from burning of fossil fuel, oil smoke etc.

Dust: Find solid particle over 1μm diameter, produced by crushing, grinding etc.

Mist: Mist are produced by particle of spray liquid condensation of vapours, eg. herbicides, mist etc.

Note: Pb is major air pollutant.

Smog (Smoke + Fog)

Classical smog: (Smoke + fog + CO_2) also called reducing smog

Photochemical smog:

hydrocarbon : $NO \xrightarrow{hv}$

$NO_2 \xrightarrow{hv} NO + O$

$O + O_2 \xrightarrow{hv} O_3$

$NO + O_3 \rightarrow NO_2 + O_2$ → contribute of Haze

$(NO_2 + O_2)$ + hydrocarbon →
- CH_2O formaldelyde
- or
- $CH_2 = CHCHO$ Acrolein
- or
- CH_3COONO_2 peroxy acetyl nitrate (PAN)

Stratospheric Pollution

Formation & decomposition of ozone.

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

$$O_2(g) + O(g) \overset{UV}{\rightleftharpoons} O_3$$

Ozone is thermodynimcally unstable and thus dynamic equilibrium exist between production.

Ozone Hole

The main reason of ozone layer depletion the release of CFC(s) (also called as freons).

Reaction of Ozone Depletion

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

$$\dot{C}l(g) + O_3(g) \longrightarrow \dot{C}lO(g) + O_2(g)$$

$$\dot{C}lO(g) + NO_2(g) \longrightarrow \dot{C}lONO_2(g)$$

$$\dot{C}l(g) + CH_4(g) \longrightarrow \dot{C}H_3(g) + HCl(g)$$

$$ClONO_2(g) + H_2O(g) \longrightarrow HOCl(g) + HNO_3(g)$$

$$ClONO_2(g) + HCl(g) \longrightarrow Cl(g) + HNO_3(g)$$

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

$$Cl_2(g) \longrightarrow 2\dot{C}l(g)$$

Water pollution

Cause of Water Pollution

(i) Pathogen

(ii) Organic waste

(iii) Organic waster

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)**. Clean water would have BOD value of less than 5 ppm where as highly polluted water could have a BOD value of 17 ppm or more.

Fluoride: Soluble fluoride is often added to drinking water to bring its concentration upto 1 ppm or 1 mg dm^{-3}.

However, F^- ion concentration above 2 ppm causes brown mottling of teeth. At the same time, excess fluoride (over 10 ppm) causes harmful effect to bones and teeth.

Lead: The prescribed upper limit concentration of lead in drinking water is about 50 ppm. Lead can damage kidney, liver, reproductive system etc.

Sulphate: Excessive sulphate (>500 ppm) in drinking water causes laxative effect, otherwise at moderate levels it is harmless.

Nitrate: The maximum limit of nitrate in drinking water is 50 ppm. Excess nitrate in drinking water can cause disease such as methemoglobinemia ('blue baby' syndrome).

Table: Maximum Prescribed Concentration of Some Metals in Drinking Water

Metal	Maximum concentration (ppm or mg dm^{-3})
Fe	0.2
Mn	0.05
Al	0.2
Cu	3.0
Zn	5.0
Cd	0.005