

Environment & Pollution

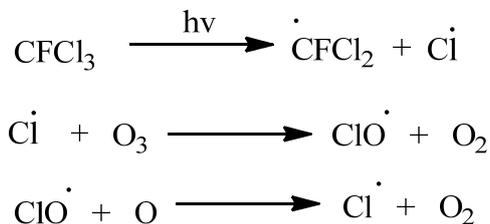
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Questions for one mark

1. **Define Smog:** Smog is a type of air pollutant. Smog is mixture of natural fog and manmade smoke. A form of air pollution produced by the photochemical reaction of sunlight with hydrocarbons and nitrogen oxides that have been released into the atmosphere, especially by industrial sources.
2. **Define COD:** Chemical oxygen demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as ammonia and nitrite. Chemical oxygen demand is measured as a standardized laboratory assay in which a closed water sample is incubated with a strong chemical oxidant ($K_2Cr_2O_7$ and H_2SO_4) under specific conditions of temperature and for a particular period of time.
3. **Name some major water pollutants:** Waste from houses, waste from industries, fertilizer industrial waste, waste from soap and detergent, metallic waste, soil and sand deposition in river, thermal pollution and nuclear pollution.
4. **Define Green house:** Carbon dioxide plays vital role in life of living. It is also referred as greenhouse gas. With increase in pollution via many means like air, water and thermal (industries, vehicle, and other activities) and decrease in forests and number of plants, the amount of carbon dioxide is increasing and causing subsequent hazardous effects, the phenomenon is known as greenhouse effect.
5. **Define Dissolved oxygen:** Dissolved oxygen (DO) is the amount of oxygen that is present in the water. It is measured in milligrams per litre (mg/L), or the number of milligrams of oxygen dissolved in a litre of water. It can be determined by electrode or oxygen meter method and iodometric method.

6. **Define Pollution:** solid liquid or gaseous material which are harmful to the ecosystem and are not biologically degradable are referred as pollutants and increase in the amount of such pollutants beyond a specific limit is called pollution.

7. **How CFC reacts with O₃?**



8. **What is thermal pollution?**

It is irradiation of heat in air or water causing change in the temperature, humidity of air and water. It is defined as warming of hydrosphere due to which aquatic life are affected. It also affects the concentration of dissolved oxygen.

9. **What is environment pollution?**

Environmental pollution is the build-up and concentration of toxic levels of chemicals in the air, water, and land, which reduces the ability of the affected area to support life. Pollutants may be gaseous- ozone and carbon monoxide, for example; liquid discharge from industrial plants and sewage systems; or solid-landfills and junkyards.

10. **Give the names of greenhouse gases:** Carbon dioxide, water vapour, nitrous oxide, CFC-12, methane, sulphur hexafluoride, SO_x and carbon monoxide.

11. **Water pollution:** Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities.

12. **Air pollution:** Air pollution is the introduction of chemicals, particulates, biological materials, or other harmful materials into the Earth's atmosphere, possibly causing disease, death to humans, damage to other living organisms such as food crops, or the

natural or built environment. The atmosphere is a complex natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems. Indoor air pollution and urban air quality are listed as two of the world's worst toxic pollution problems.

Questions for five marks

1. Explain BOD. Write the method for BOD.

Biochemical oxygen demand or B.O.D is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. Microbes are present in large quantity in domestic sewage that increases the demand of oxygen for carrying out oxidation process. The BOD can be measured by measuring oxygen concentration iodometrically before and after incubation in dark at 20 °C for five days. During incubation excess of dissolved oxygen must be present.

The samples that absorb more than 6 mg/litre oxygen are diluted synthetically using BOD free distilled water. To this sample major constituents like culture of bacteria are added in same concentration as in the sample in order to increase organic matter. Sewage is used as standard seed material.

Materials and reagents

- BOD incubator, BOD bottles
- All reagents used for dissolved oxygen determination
- BOD free water (Passing of unionized distilled water through column of activated carbon and redistill it)
- Phosphate buffer solution: 42.5 gm of KH_2PO_4 + 8.8 gm of NaOH + 700 mL BOD free water and adjust pH to 7.2. Further add 2 gm of $(\text{NH}_4)_2\text{SO}_4$ and dilute to 1 litre with BOD free water.
- MgSO_4 solution: 82.5 gm of MgSO_4 and dilute to 1 litre with BOD free water

- CaCl₂ solution: 27.5 gm anhydrous CaCl₂ and make it 1 litre with BOD free water.
- FeCl₃ solution: 0.25 gm FeCl₃ in 1 litre BOD free water.
- H₂SO₄: 2.8 mL and make it 100 mL by BOD free water.
- NaOH: 4 gm NaOH and make it to 100 mL by BOD free water.
- Alkyl thiourea solution: dissolve 500 mg alkyl thiourea in BOD free water and make it 1 litre.

Method

- Prepare synthetic dilution water. Aerate the required volume of BOD free distilled water in glass container by bubbling compressed air for 1 to 2 days to attain oxygen saturation.
- After saturation it is kept at 20 °C for at least 1 day. add 1 mL of phosphate buffer, MgSO₄ solution, CaCl₂ solution, and FeCl₃ solution per 1 litre of above prepared aerated water.
- Adjust the pH of sample to neutral using ammonium sulphate or NaOH. It is to be ensured that not all the oxygen of the sample is exhausted during incubation.
- Prepare two sets of BOD bottles of 125, 250 or 300 mL capacity. Add 1 mL of alkyl thiourea solution to each bottle. Avoid trapping of air in BOD bottles.
- Stopper the bottle.
- Determine DO (D₀) in one set immediately following Winkler's method of oxygen determination. Incubate the other set for 5 days and then determine the oxygen.

$$\text{BOD}_5 = D_0 - D_5 \times \text{dilution factor}$$

2. What is water pollution? What are the main sources of it? How it can be prevented?

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds.

It can be divided into four types.

- Physical pollution of water: it refers to change in colour, odour, taste, density and turbidity.
- Chemical pollution of water: it refers to change in pH, dissolved oxygen, addition of pesticides, insecticides or herbicides from industrial sources. Industrial water can be organic, inorganic, biodegradable or non-biodegradable.
- Biological pollution: It refers to addition of feces of livings that contain harmful bacteria, fungus or virus.
- Physiological pollution: it is addition of chlorine, sulphoxide, hydrogen sulphide, ketones beyond 0.02 ppm.

Sources of water pollution

Air water and land are prime necessities for living ones to live. But due to various living activities they are no more in pure states and being contaminated continuously.

The followings are the main sources of water pollution however it is being polluted right from our houses to industries.

- Waste from houses (sewage)
- Waste from pharmaceutical industries
- Waste from fertilizer industries
- Waste from soap and detergents
- Metallic waste
- Soil and sand deposition
- Thermal pollution
- Nuclear pollution

Sewage and domestic waste contains organic and inorganic waste related to food, beverages, detergent slums, scums, urine, metal particulates, and stool that need higher amount of oxygen for decomposition so increase the biological oxygen demand.

In flowing or steady water several layers of waste are formed.

- Degradation zone

- Active decomposition
- Recovery zone
- Unaffected zone

The waste water should be treated at sewage treatment plant where suspended particles are coagulated and then get precipitated. Remaining water contains all different soluble ions both cations and anions.

Toxic effects of sewage and domestic waste

- All different types of pathogens which get concentrated in river ponds or ditches.
- Sewage water requires higher BOD hence decreasing amount of dissolved oxygen. That results into imbalance of aquatic life.
- Lack of oxygen results into foul smell of waste water and starts decomposing.
- The suspended particles also affect the aquatic ecosystem.
- Due to lack of oxygen living organisms within aquatic ecosystem die and hence water is no more useful for household purposes.
- According to Wilber industrial effluent is hazardous for the living organism.
- Methylmercaptane: pentachlorophenol prevents sunlight to penetrate the water hence disrupts the photosynthesis.
- Several types of fishes, algae and diatoms are now extinct.
- Due to decrease in rainfall the river water is blocked hence the concentration of level of various elements has reached beyond toxic level.
- In nutshell, modernization the industrial wastes are thrown to the various water resources and made them extensively polluted that has disturbed ecosystem to a significant extent.

3. Photochemical smog & ozone depletion

Smog is a type of air pollutant. Smog is a mixture of natural fog and manmade smoke. A form of air pollution produced by the photochemical reaction of sunlight with hydrocarbons and nitrogen oxides that have been released into the atmosphere, especially by industrial sources.

The moisture content in atmosphere is called humidity of a particular area. Sometimes the industries also give a large amount of moisture content and subsequent depletion in temperature during night forms the fog but due to particles and gases it acquires colloidal state that does not settle and causes much harm to living, non-living and ecosystem.

Ozone depletion

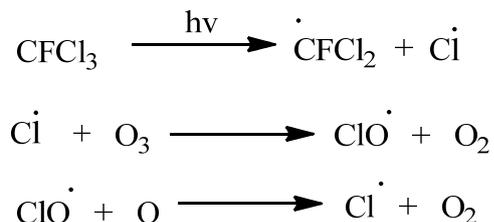
The earth's stratospheric ozone layer plays a critical role in absorbing ultra violet radiation emitted by our sun. In the last thirty years, it has been discovered that stratospheric ozone is depleting as a result of anthropogenic pollutants. There are a number of chemical reactions that can deplete stratospheric ozone; however, some of the most significant depletion comes from the catalytic destruction of ozone by freed halogen radicals like chlorine and bromine.

CFC molecules are made up of chlorine, fluorine and carbon atoms and are extremely stable. This extreme stability allows CFC's to slowly make their way into the stratosphere (most molecules are not around long enough to cross into the stratosphere from the troposphere). This prolonged life in the atmosphere allows them to reach great altitudes when photons are more energetic. When the CFCs come into contact with these high energy photons their individual components are freed from the whole. The following reaction displays how Cl atoms have an ozone destroying cycle:



Chlorine is able to destroy so much of the ozone because it is a catalyst. Chlorine initiates the breakdown of ozone and combines with free oxygen to create two oxygen molecules. After each reaction, chlorine is able to begin the destructive cycle again with another ozone molecule. One chlorine atom can thereby destroy thousands of ozone molecules. Because ozone molecules are being broken down they are unable to absorb any ultraviolet light so we experience more intense UV radiation at the earth's surface.

CFC also contributes a lot to the ozone depletion. They are used in aerosol, propellant and refrigerants. The reaction of CFC with ozone can be described as below.



4. Explain sources and prevention of thermal pollution?

“The pollution in which the irradiating out of heat in air or water and causing change in the temperature & humidity of air & water is called THERMAL POLLUTION”

(A) Sources

There are various types of the thermal pollution.

- (1) Nuclear power plants
- (2) Coal fired power plants
- (3) Industrial effluents
- (4) Domestic sewage
- (5) Hydroelectric power.

(1) Nuclear Power Plants :

The discharge of unutilized heat and traces of toxic radioactive waste into nearby stream of water causes significant pollution. The Radiology department is equally responsible for that. The emission of nuclear reactor and other waste increase the temperature of water. The liquid radioactive water consists H-3 , C-14 , Fe-59, Co-60(isotopic) severely affect the flora and fauna of Aquatic animals.

(2) Coal Fired Power Plants :

This is the major cause of the thermal pollution Many power plants utilize coal as a fuel. In which the coal is burnt in the boiler which contains the boiling tubes, now water is passed at higher presser which produces the steam. The steam then passed out

to the atmosphere and then cooled into water but the temperature of water is also affected and increased to 10°-15° C higher than the normal water. This affects the ecosystem by decreasing the D.O concentration and kill marine animals.

(3) Industrial Effluents

The industries which require high compressors like textiles, paper ceramic always require higher amount of energy which directly bought from the thermal power stations. Both oil and coal burning liberates large amount of CO₂,CO,SO gas in the air and other harmful gases which increases the environment temperature. It also generates solid waste and other dust particles. In modern stations producing 100MW energy produces 1 million gallon dust particles per hour. which increases the temperature to 8°-10° C

(4) Domestic Sewage

It is commonly discharge into rivers, lakes and canals or streams. The municipal sewage also have higher temperature than the natural water. This creates numerous problems to the aquatic habitat. The organic matter present in the sewage and the other oxidizable matter utilize the dissolve oxygen present in the surface. With increase in the temperature the D.O (Dissolved Oxygen) decreases. And hence without oxygen anaerobic condition will be set and the smell of water will be changed and rotting of organic matter will take place.

(5) Hydro Electric Power

Generation of hydroelectric power plant sometimes results in negative thermal loading in water. It has been reported that about 18% more heat is given to cooling water in nuclear power plants than any other power plants in equivalent size. Hence the cooling requirement will contribute to thermal loading

(B) Prevention

There are many ways by which we can prevent the thermal pollution.

- The thermal power plant site should be appropriate coupled with effective use of regulated river system. The site should be Away from agricultural land and should not fall within the area of the airport.
- The thermal effluents must be channeled.
- Proper mechanics should be applied for water mixed with the sea
- Temperature prediction and setup models can be design.
- By improving efficiency of electric power plants
- We must introduce safe methods for cooling of water which may not harm the ecosystem

5. MAJOR SOURCES OF AIR POLLUTION :

Gaseous and particulate emissions are released to the atmosphere ferrous and non-ferrous metallurgical process industries, fertilizers, cement, and thermal power plants. The contribution of storms and winds to the particulate aggregation in the air because of the soil properties of the indian fields.

Deforestation and unfavorable climatic condition may worst the situation

This problem of pollution is accelerated by poor town planning and random urbanization. A healthy man inhales 16 kg air/day.

Apart from specific emissions of toxic substances in to the air from industrial processes, There are many broad scale influence which must considered including

- Acid rain from SO emission from thermal power plants.
- Global warming due to increasing CO₂ levels
- Effect of emissions of fluorocarbon spray propellants and refrigerants in to the atmosphere with consequent U.V RAY damage to human beings.
- Pollutions of air is broadly due to particulate matter dispersed in it for gaseous pollutants completely miscible with it in all proportions. As the rate of flow of the air associated with applications involving particulate matter is normally high even bigger particles carried out by it.

- Particles obtain by the grinding, atomization, blasting or operation involving sudden disintegration of solid or liquid phases are non-uniform and they covered wide range of sizes.
- Aerosols are the particles of the sizes 1 micron. They were remained suspended even in low air velocities.
- Smoke is also a major source it produces by the incomplete combustions of the wood and coal.
- Mists are obtained by the direct contact of vapor and gas accompanied by the temperature inversion it occur by humidation and dehumidation processes.
- Fog is a mist formed by temperature inversion.
- Smog is the combination natural fog and man-made smoke.
- The other gaseous solutes are SO_2 , Cl_2 , NO , CO_2 , CO , SO . They are miscible in all proportions and all velocities. Their separation from atmospheric mist is quite difficult if present in the small proportions.
- Another source of the ambient air pollution is emission of auto mobiles where pollutants are CO , NO , hydrocarbons, particulate matter and trace amount of SO_2 , formaldehyde and lead.
- A new vehicle exhaust emits 3.5% CO .

I have work hard preparing this material.....

You also work hard preparing from this material!!!!

Best Luck....