

Ozone depleting substances and mechanism of ozone layer depletion

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Abstract: In this article the importance of ozone layer, its depletion and mitigation measures are discussed in detail. Ozone acts as a protective umbrella for life and the earth from hazardous effect of UV rays. Ozone forms a layer in the middle of stratosphere. Ozone layer depletion is the thinning of the ozone layer present in the upper (15-35 km) atmosphere. When the gases like chlorine and bromine atoms come in contact with ozone in the upper atmosphere and destroy the ozone molecules. One chlorine molecule can destroy 100,000 molecules of ozone. Its destruction is more rapid than its formation. Such compounds are known as Ozone Depleting Substances (ODS). Strong ultraviolet radiations lead to retardation of growth and development of flowering plants. In animals direct exposure to ultraviolet radiations results into skin and eye cancer.

Introduction:

The discovery of ozone Layer was made by the French physicists **Charles Fabry and Henri Buisson in 1913.**

The planet Earth and life is protected by a protective umbrella known as ozone layer from hazardous Ultraviolet (UV) light of the sun. It is a highly reactive gas and is chemically represented by O_3 . It is naturally occurred in lower atmosphere as well as released by various man-made product such as chlorofluorocarbons (CFCs), hydrofluorocarbons (HCFCs) and halons in the Earth's upper atmosphere i.e. stratosphere.

Most of the chlorine entering the stratosphere is from man-made sources (84%), such as CFCs and HCFCs with the remaining 16% from natural

Importance of ozone layer in human life

Ozone protects the Earth from harmful ultraviolet (UV) light from the Sun. The life on the Earth would be difficult in absence of ozone layer in the stratosphere. Plants cannot survive and grow in abundance of ultraviolet radiation, nor the planktons that serve as food for most of the ocean life. With the thinning and weakening of the Ozone Layer, humans would be more prone to diseases like skin cancer, cataracts and impaired immune systems.

Mechanism of ozone depletion

Ozone layer depletion is the thinning of the ozone layer present in the upper atmosphere. Depletion occurs when the atoms of chlorine and bromine Such reactions cause the depletion of the ozone layer, especially since the chlorine radical is free to engage in another reaction chain.

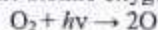
Causes of Ozone Layer Depletion

1. Although natural phenomena can cause temporary ozone loss, chlorine and bromine released from man-made appliances are now accepted as the main cause of ozone depletion.

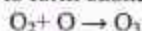
sources, such as the ocean and volcanoes. About half of bromine entering the stratosphere is from man-made sources, mostly Halons.

Formation of ozone

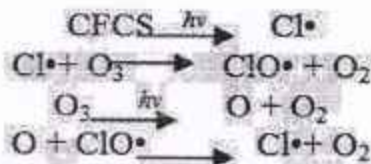
Naturally, ozone is formed through the interactions of solar radiation (UV) with molecular oxygen O_2 . It absorbs the harmful UV radiation reaching the Earth's surface. When the sun's rays split oxygen molecules into single atoms (nascent oxygen), Ozone is formed in the atmosphere. These single atoms combine with nearby oxygen molecule to form a tri-atomic oxygen molecule i.e. Ozone.



Then atomic oxygen then combines with molecular oxygen to form ozone.



reacts with ozone and dissociate to form another product and the process continues. One Chlorine molecule can destroy 100,000 ozone molecules through various chain reactions in presence of sunlight. Its destruction is quicker than its Formation



2. The ozone layer depletion is a major concern and is associated with a number of factors. The main reasons responsible for ozone layer depletion are as follows:

Emission of CFC's gases:

The major sources of emissions of CFC's are refrigerators, Air conditioners, sprays, fire extinguishers and various types of paints etc. CFCs, composed by chlorine, fluorine, and carbon, have a



long lifecycle that do not easily react with other substances. CFC's broken up only through sunlight, and releases chlorine (Cl).

• **Unregulated Rocket Launches:**

1. According to some researchers the unregulated launching of rockets might result in a massive loss of the ozone layer by the year 2050. It causes more impact than the CFCs.

• **Nitrogenous Compounds:**

1. N_2O is unregulated compound by Montreal protocol and highly potential for the ozone depletion.

• **Natural Causes:**

1. It is found that ozone layer is depleted by certain natural phenomenon such as Sun-spots and stratospheric winds. But it does not cause more than 1-2% ozone depletion.
2. The natural phenomenon of volcanic outburst is the cause of ozone layer depletion.

Mitigation measures

1. The depletion of ozone layer is a serious issue and various programmes have been launched by the Government of various countries to prevent it.
2. Globally we can avoid use of Pesticides in agriculture sector.
3. Biopesticides should be preferred to get rid of pests and weeds instead of using chemicals.
4. Prefer the use of public transport, bicycle, walking than individual vehicles.
5. The vehicle emission contributes very much to greenhouse gases that lead to global warming as well as ozone depletion.
6. Use Eco-friendly Cleaning Products such as vinegar and bicarbonate that do not emits hazardous fumes.
7. Most of the cleaning products have chlorine and bromine releasing chemicals that find a way into the atmosphere and affect the ozone layer in upper atmosphere.
8. Use of Nitrous Oxide (N_2O) should be prohibited.
9. The government should take stringent actions and prohibit the use of harmful nitrous oxide that adversely affects the ozone layer.

10. People should be made aware of the harmful effects of nitrous oxide and the products emitting the gas so that its use is minimized at the individual level as well.
11. Improvement in technology and adoption of green source of energy can reduces the emission of ozone depleting gases.
12. Buying local products can help in reducing the level of nitrous oxide in atmosphere.

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