

## OZONE HOLES

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### **Abstract:**

*Ozone lies in the upper atmosphere (or stratosphere) which prevents the ultraviolet rays of sunlight coming to earth by absorbing them. UV ray may cause skin cancer , eye damage such as cataracts in human beings and can disrupt the marine eco-systems adversely. But Ozone layer has been depleted very fast in the past four decades, particularly over Antarctica due to several Ozone depleting substances viz. Chlorofluorocarbons (CFCs) which found wide application as coolant, refrigerant and aerosols in different home appliances and industries. The fast depletion of this layer over the Antarctica is due to some complex environmental chemistry in the upper atmosphere. Also Ozone loss has been detected over North America, Europe and even over the Gangetic planes in North India. In 1987, Montreal protocol was signed by over 170 countries whereby they are agreed to reduce the emissions of CFCs by half by 2000 and controlling the industrial production of various halocarbons by 2030. The scientists predict that Ozone layer will be restored to its normal level by 2050.*

### **Introduction:**

On the earth, the atmosphere from sea level to 8 km is known as Troposphere and the layer of atmosphere which extends from 8 km to 50 km is known as stratosphere. The stratosphere has virtually no clouds or other form of weather, it is thinnest at the equator and thickness at the poles. Mainly lighter gases remain in the layer and Ozone is most important constituents of this layer. Ozone (O<sub>3</sub>) made by three oxygen atoms and it has a useful characteristic that it can absorb UV radiations. If it is allowed to reach on the earth surface, the UV radiation can affect human health, development of plant and marine ecosystem etc. In 1970s few research groups have noticed that thickness of Ozone layer decreases over Antarctica. In fact in 1994 , Ozone level fell less than half its value in 1970. The actions that have been taken so far to minimize the Ozone depletion will be briefly discussed.

### **Aims and Objectives:**

Ozone layer depletion popularly known as Ozone hole is caused by human activities only due to production, use and inefficient handling of different Ozone depleting substances such as CFCs, halons etc. Original Ozone level can be restored by awarding the common people. This report will briefly emphasize the problem as a whole, its importance on life on earth, the complex nature of Ozone loss and highlight the international strategies to restore the lost layer.

### **Observation:**

Ozone loss in the atmosphere over the Antarctica was first noticed by British Antarctic Survey (BAS) in 1970. In 1985 a group of researchers reported from their experimental result that loss over Antarctica changes abruptly.

They said that the abrupt change in Ozone loss due to complex atmospheric chemistry of the Ozone is a naturally occurring molecule, mainly formed in the atmosphere in the presence of sunlight through the reaction :  $3O_2 \rightarrow 2O_3$ , but it is destroyed mainly by the halogen atom like chlorine and bromine and by nitrogen oxides:  $Cl \text{ (or Br)} + O_3 \rightarrow ClO \text{ (BrO)} + O_2$ , (In fact bromine atom is 40 times more destructive to  $O_3$  than the chlorine atom). Chlorine or Bromine atom is formed mainly by the photo dissociation of chlorine (or Bromine) molecule:  $Cl_2 \xrightarrow{\text{energy}} 2Cl$ . Volcanic activities and oceans liberate large amount of free chlorine molecule. Nitrogen oxides are formed during combustion e.g. aircraft emissions.

Recent scientific measurements have revealed that the loss of the Ozone layer over Antarctica is high than over the rest of the world. The whole process of Ozone depletion over Antarctica can be simplified as follows: first during long winter nights a kind of strong wind is originated from middle to lower atmosphere, which is known as polar vortex. In the absence of sun light the wind gets chilled to about  $-80^\circ C$  and a special kind of cloud is formed which is named as polar stratospheric clouds (PSC). PSCs are different from normal clouds. On the surface of this cloud chlorine molecules are formed from chlorine containing substances. Then long polar winter comes to an end and sunlight returns to the Antarctica. In presence of sunlight chlorine molecules breaks down to chlorine atoms which in turn destroy the Ozone molecule. From experimental result it is revealed that one chlorine atom destroys 100000 Ozone molecules through a complex chain reaction.

Initially it was thought that Ozone loss is faster over Antarctica and slower in the mid latitude countries. But recent satellite images have indicated severe loss of Ozone layer over middle latitude countries in the North America and Europe. In USA, it is dropped from 391 Dobson unit (DU) in 1979 to 360 Du in 1994. In Los Angeles it is dropped from 368 Du to 330 Du. Very recently, a joint research group from IIT, Kanpur and George Mason University, USA has reported significant Ozone loss over northern parts of India covering Indo - Gangetic basin.

### **Discussion:**

UV radiation can result in skin cancer and Eye damage such as Cataracts. Physiological and development processes of plants are affected by UV radiation. Marine ecosystem also is affected by UV radiation. UV radiation can result in deduction in phytoplankton in the oceans that forms the basis of all marine food chains. UV radiation has been found to cause damage to early development stages of fish, shrimp, crab, amphibians and other animals. UV radiation could also affect terrestrial and aquatic biochemical cycles, thus altering both sources and sinks of green house and chemically important trace gases e.g.  $\text{CO}_2$ , CO, Cos ( Carbonyl Sulfide) and other gases including Ozone.

If Ozone layer is allowed to degrade then increased UV radiation may ultimately challenge our very survival on earth. For this to restore the Ozone concentration to its pre 1970 value, about 180 countries unanimously agreed to reduce the production of CFCs and other depleting agents. Developed country USA was banned the production of CFCs after the year 1995 ( Other developing nations were given an additional period of 10 years to phase out their existing CFCs stocks). The US Environmental protection Agency (EPA) under the authority of the U.S. clean Act Amendments of 1990, issued regulations for the phase out production and importation of Ozone- depleting chemicals controlled under protocol through a marketable permit program. In addition EPA established controls on refrigerant recycling to prevent emissions in both motor vehicle and stationary system.

Researchers have been trying to develop effective CFC substituent having much shorter life times in Ozone layer thereby reducing their impact on Ozone layer as compared to CFCs, halons etc. So useful steps have been taken in this regard. Two international organizations, the British Antarctic survey and the world Meteorological organization, issue regular bulletins about the Ozone hole as it develops each year.

The general awareness about this problem among the common mass is most important. One should not buy any refrigerator or AC machines using CFCs or halons. Unauthorized production of CFCs must be immediately reported to law enforcing authority.

### **Conclusion:**

Governments, common people, industrialists and scientists are working hard in hand to restore the Ozone layer to its pre - 1970 level.

### **References:**

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