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3. Stratospheric Ozone- Reasons for Depletion and Remedies

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Ozone is an inorganic molecule having one more oxygen than O_2 (dioxygen) and having chemical formula O_3. The name ozone is given to this by scientist as its smell, in Greek 'ozein' means smell. We know our breathing oxygen (O_2 Dioxygen) is without smell, but as it converted to trioxygen (O_3) the nature changes and it acquire a pungent smell. In such a way nomenclature for this gas was reported. Ozone is a pale blue coloured gas and has a typical pungent smell. Our nostril easily captures when concentration of ozone increases above 0.1 ppm in surrounding. Ozone a word now a day very commonly linked with our nature. As tracing back in history no one exactly knowing how it was first coming in existence on earth, because as we know ozone formed when heat and solar radiations induce chemical reaction in between oxides of nitrogen and volatile organic compounds i.e., hydrocarbons. These activities are seeming to be human impact. But in past there may be natural factors which are responsible for ozone layer existence.

3.1 Discovery of Ozone:

In 1776, the elementary nature and nomenclature of oxygen was done by Lavoisier, in 1785 Van Marum when in his experiment passed electric current through oxygen gas noted a peculiar smell and they assumed it, may be due to electrode and named as "electrical odour". The German scientist Cristian Friedrich Schonbein made this gas in his laboratory in 1839.[1] the molecular formula was determined by Soret in 1865.[2]

The UV radiation absorption property of ozone was suggested by W.N. Hartley[3] in 1880.It is natural substance and present in our atmosphere as the earth atmosphere developed.

3.1.1 Location of Ozone:

Ozone gas found in atmosphere, but stratospheric ozone is beneficial to earth and its ecosystem. This stratosphere is the second layer of earth's atmosphere and located above the troposphere. Troposphere is located up to 10 km (6.2 miles or 33,000 ft.) above the earth crust. Stratospheres locate in between 10 km to 50 km (around 35 miles or 185000 ft.). The height of stratosphere is minimum i.e., 7 km at the polar region of earth and maximum at 20km at equator.[10] In 1930 British scientist, Chapman proposed a theory and predict that ozone layer is maximum at equator and decreases toward the poles[4].

3.1.2 How Ozone Form in Stratosphere:

The interesting thing about stratosphere is that when we go upward (altitude) then the temperature rises this is exactly opposite to the troposphere where temperature declines when we move to upward. The stratospheric ozone band is a natural chemical process. The two things are most important for this conversion, O_2 and Ultraviolet radiations. In the presence of solar UV radiation, the O_2 molecule get converted to two O atoms (2O), this single oxygen reacts with normal dioxygen(O_2) and #form trioxygen molecule i.e., Ozone(O_3) Figure 3.1.

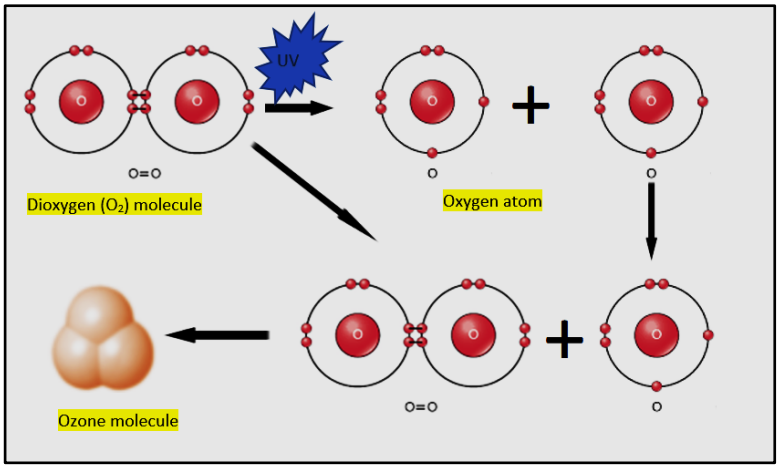

Figure 3.1: In stratosphere Dihydrogen in presence of UV radiation converted to atomic Oxygen (Highly reactive), combine with normal Dioxygen molecule form Ozone (Trioxygen).

3.1.3 How Ozone Destroyed in Stratosphere:

There are two main ways of destruction of ozone

1. Natural process of ozone destruction and
2. Pollution (Human activities)

Ozone is unstable molecule; solar UV radiations not only support the formation of ozone but it also destroys ozone and convert it back to Dioxygen (O_2).

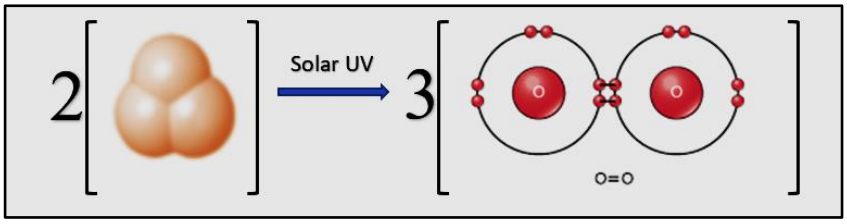

Figure 3.2: Effect of solar UV radiation in destruction of Ozone

3.1.4 Ozone Depletion:

Ozone depletion means decrease the layer of ozone surrounding earth atmosphere specifically in the stratosphere. Before 1979 scientist did not aware about depletion of atmospheric ozone concentration, but later. According to NASA.gov ozone depletion means decrease in concentration of ozone below 220 Dobson unit, this is also known as ozone hole[11].

The reason behind depletion is, the rate of formation of ozone is less than ozone destruction. Human knowingly or unknowingly uses chemicals in which halogens are single or in combine state, these halogens when move upward to the stratosphere where they react with ozone and destruct it. Two main gases chlorine and bromine are more reactive to ozone than other. These two gases are present in Chlorofluorocarbons (CFC), a gas present in refrigerator and air conditioner. Bromine is rank second and found in fire extinguishers. Other human sources from where bromine released in atmosphere are water disinfectant in swimming pool, wastewater treatment plant, industrial processes and burning of fossil fuel. According to many researchers the life span of CFC's and other Chlorine and bromine containing compounds are very short and when they release mostly destroyed in troposphere and hence play negligible role in ozone depletion.

Fluorine and iodine are again two halogens which are heavier than chlorine and bromine and very short life span hence not involved in ozone depletion in stratosphere. Other substances like methane, nitrous oxide, and water vapours together involved in ozone in stratosphere.

3.1.5 Ozone Rising is Always Useful???

No! As per definition of pollution any substance when decrease or rise from normal level then they cause adverse effect on human and its environment. Likewise, when ozone level rise above 5 ppm or higher, condition is most dangerous for survival of living organisms.

Direct contact with ozone shows a variety of health issue in human being and responsible for breathing related problems like asthma. But stratospheric ozone is good for human because it protects carcinogenic UV radiations from direct contact.

3.1.6 How to Protect Stratospheric Ozone??

By changing our lifestyle and following some strict laws helps to protect ozone layer in stratosphere.

- Avoid using HCFCs dependent cooling instruments.
- Avoid HCFCs as insulating agents
- Use aerosol propellant which do not contain HCFCs.
- Use other alternatives in ACs and Refrigerators gas.
- Follow proper maintenance and services for instruments.
- If possible, replace Bromine or chlorine with iodine or fluorine

3.1.7 CFC Alternative:

CFCs were first synthesized in 1928 by Thomas Midgley[7], Jr. of General Motors, as safer chemicals for refrigerators used in large commercial applications. Of the chemical classes for replacement of CFCs are two, Hydro chlorofluorocarbon (HCFC) and Hydro fluorocarbons (HFC). HCFC contributes to the destruction of stratospheric ozone, but much less than CFC. The use of HCFC as an infectious refrigerator will allow industries to stop the production of CFC and the continuous use of CFC will provide environmental benefits. Because of its hydrogen, HCFCS is more easily decomposed than CFC in the environment. Therefore, in addition to low global warming capacity in HCFC, ozone has a low capacity to decrease.

3.1.8 Laws to Reduce Ozone Depletion:

The United Nations Environment Protection Committee signed an international agreement in September 1979 to protect ozone depletion, September 16, 'International Ozone Day' [5, 9].

The Montreal Agreement[6] of 1959 have noticed the seriousness of the ozone depletion. As a result, the creation of CFC has decreased by 5 percent. United States “Clean air act” was enforced in 1963, 1965, 1970, 1977, 1990 rspectively.[8]

India is a responsible and conscious nation regarding the Ozone problem. India has signed a Montreal Agreement in 1992, knowing that ozone exploitation is a global problem. India has banned the production and trade of liquids that destroy ozone.

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