SAVE OUR XAVIOUR

Dr. Jyothi P

Associate Professor, PG Department of Chemistry, KAHM Unity Women's College, Manjeri, Kerala-676122, India

E-mail: jyothipuramana@gmail.com

Now a days, we are very much concerned about the effects of ozone layer and its depletion because of its immense contribution towards sustaining life on our earth. It acts as a shelter for our earth from hazardous radiations from sun. Ozone, by virtue of its chemical properties becomes the Xaviour of all living organisms on our planet. Saving this xaviour is essential for the healthy existence of us and for the coming generations

The breakdown of ozone in the stratosphere results in reduced absorption of ultraviolet radiation. Consequently, unabsorbed and dangerous ultraviolet radiation is able to reach the Earth's surface at a higher intensity. Ozone levels have dropped by a worldwide average of about 4 percent since the late 1970s. For approximately 5 percent of the Earth's surface, around the north and south poles, much larger seasonal declines have been seen, and are described as "ozone holes". The discovery of the annual depletion of

The ozone layer was discovered in 1913 by the French physicists Charles Fabry and Henri Buisson. Measurements of the sun showed that the radiation sent out from its surface and reaching the ground on Earth is usually consistent with the spectrum of a black body with a temperature in the range of 5,500–6,000 K (5,227 to 5,727 °C), except that there was no radiation below a wavelength of about 310 nm at the ultraviolet end of the spectrum. It was deduced that the missing radiation was being absorbed by something in the atmosphere. Eventually the spectrum of the missing radiation was matched to only one known chemical, ozone. Its properties were explored in detail by the British meteorologist G. M. B. Dobson, who developed a simple spectrophotometer (the Dobsonmeter) that could be used to measure stratospheric ozone from the ground. Between 1928 and 1958, Dobson established a worldwide network of ozone monitoring stations, which continue to operate to this day. The "Dobson unit", a convenient measure of the amount of ozone overhead, is named in his honor.

WHAT IS OZONE?

Ozone is an inorganic molecule with the chemical formula O_3. It has a pale blue colour and has a distinctively pungent smell. It is an allotrope of oxygen that is much less stable than the diatomic allotrope O_2. It is also termed as Trioxygen by IUPAC. The Molar mass of ozone is 48 g/mol and has a density 2.14 kg/m³. its boiling point is -112 °C. Ozone is soluble in

WATER, SULFURIC ACID, CARBON TETRACHLORIDE

The ozone layer or ozone shield is a region of Earth's stratosphere that absorbs most of the Sun's ultraviolet radiation. It contains high concentration of ozone (O_3) in relation to other parts of the atmosphere, although still small in relation to other gases in the stratosphere. The ozone layer contains less than 10 parts per million of ozone, while the average ozone concentration in Earth's atmosphere as a whole is about 0.3 parts per million. The ozone layer is mainly found in the lower portion of the stratosphere, from approximately

ISBN 978-93-5396-526-6

15 to 35 kilometers (9.3 to 21.7 mi) above Earth, although its thickness varies seasonally and geographically.

When chlorine and bromine atoms come into contact with ozone in the stratosphere, they destroy ozone molecules. Ozone depleting substances, that release chlorine include chlorofluorocarbons (CFCs). Since they are not destroyed in the lower atmosphere, CFCs drift into the upper atmosphere.

ACTION OF OZONE

The ozone layer absorbs 97 to 99 percent of the Sun's medium-frequency ultraviolet light (from about 200 nm to 315 nm wavelength), which otherwise would potentially damage exposed life forms near the surface. In 1976, atmospheric research revealed that the ozone layer was being depleted by chemicals released by industry, mainly chlorofluorocarbons (CFCs). Concerns that increased UV radiation due to ozone depletion threatened life on Earth, including increased skin cancer in humans and other ecological problems, led to bans on the chemicals, and the latest evidence is that ozone depletion has slowed or stopped.

The United Nations General Assembly has designated September 16 as the International Day forthe Preservation of the Ozone Layer. The photochemical mechanisms that give rise to the ozone layer were discovered by the British physicist Sydney Chapman in 1930. Ozone in the Earth's stratosphere is created by ultraviolet light striking ordinary oxygen molecules containing two oxygen atoms (O_2), splitting them into individual oxygen atoms (atomic oxygen); the atomic oxygen then combines with unbroken O_2 to create ozone, O_3. The ozone molecule is unstable (although, in the stratosphere, long-lived) and when ultraviolet light hits ozone it splits into a molecule of O_2 and an individual atom of oxygen, a continuing process called theozone-oxygen cycle. Chemically, this can be described as:

$$O_2 + h\nu_{uv} \rightarrow 2\,O \qquad O + O_2 \leftrightarrow O_3$$

About 90 percent of the ozone in the atmosphere is contained in the stratosphere. Ozone concentrations are greatest between about 20 and 40 kilometres (66,000 and 131,000 ft), where they range from about 2 to 8 parts per million. If all of the ozone were compressed to the pressure of the air at sea level, it would be only 3 millimetres ($\frac{1}{8}$ inch) thick.

Although the concentration of the ozone in the ozone layer is very small, it is vitally important to life because it absorbs biologically harmful ultraviolet (UV) radiation coming from the sun. Extremely short or vacuum UV (10–100 nm) is screened out by nitrogen. UV radiation capable of penetrating nitrogen is divided into three categories, based on its wavelength; these are referred to as UV-A (400–315 nm), UV-B (315–280 nm), and UV-C (280–100 nm).

UV-C, which is very harmful to all living things, is entirely screened out by a combination of dioxygen (< 200 nm) and ozone (> about 200 nm) by around 35 kilometres (115,000 ft) altitude. UV-B radiation can be harmful to the skin and is the main cause of sunburn; excessive exposure can also cause cataracts, immune system suppression, and genetic damage, resulting in problems such as skin cancer. The ozone layer (which absorbs from about 200 nm to 310 nm with a maximal absorption at about 250 nm) is very effective at screening out UV-B; for radiation with a wavelength of 290 nm, the intensity at the top of the atmosphere is 350 million times stronger than at the Earth's surface. Nevertheless, some UV-B, particularly at its longest wavelengths, reaches the surface, and is important for the skin's production of vitamin D.

 ISBN 978-93-5396-526-6

Ozone is transparent to most UV-A, so most of this longer-wavelength UV radiation reaches the surface, and it constitutes most of the UV reaching the Earth. This type of UV radiation is significantly less harmful to DNA, although it may still potentially cause physical damage, premature aging of the skin, indirect genetic damage, and skin cancer.[8]

The thickness of the ozone layer varies worldwide and is generally thinner near the equator and thicker near the poles. Thickness refers to how much ozone is in a column over a given area and varies from season to season. The reasons for these variations are due to atmospheric circulation patterns and solar intensity.

The majority of ozone is produced over the tropics and is transported towards the poles by stratospheric wind patterns. In the northern hemisphere these patterns, known as the Brewer-Dobson circulation, make the ozone layer thickest in the spring and thinnest in the fall. When ozone in produced by solar UV radiation in the tropics, it is done so by circulation lifting ozone-poor air out of the troposphere and into the stratosphere where the sun photolyzes oxygen molecules and turns them into ozone. Then, the ozone-rich air is carried to higher latitudes and drops into lower layers of the atmosphere.

Research has found that the ozone levels in the United States are highest in the spring months of April and May and lowest in October. While the total amount of ozone increases moving from the tropics to higher latitudes, the concentrations are greater in high northern latitudes than in high southern latitudes, due to the ozone hole phenomenon. The highest amounts of ozone are found over the Arctic during the spring months of March and April, but the Antarctic has their lowest amounts of ozone during their summer months of September and October.

DEPLETION OF OZONE LAYER

The ozone layer can be depleted by free radical catalysts, including nitric oxide (NO), nitrous oxide (N_2O), hydroxyl (OH), atomic chlorine (Cl), and atomic bromine (Br). While there are natural sources for all of these species, the concentrations of chlorine and bromine increased markedly in recent decades because of the release of large quantities of man-made organohalogen compounds, especially chlorofluorocarbons (CFCs) and bromofluorocarbons. These highly stable compounds are capable of surviving the rise to the stratosphere, where Cl and Br radicals are liberated by the action of ultraviolet light. Each radical is then free to initiate and catalyze a chain reaction capable of breaking down over 100,000 ozone molecules. By 2009, nitrous oxide was the largest ozone-depleting substance (ODS) emitted through human activities. One above the Antarctic was first announced by Joe Farman, Brian Gardiner and Jonathan Shanklin, in a paper which appeared in *Nature* on May 16, 1985.

Ozone is an unstable compound and decomposes at about 573K to form oxygen. When UV radiation reaches ozone layer, ozone molecules present at the layer absorb its energy and decompose to form oxygen which is more stable than ozone. One ozone molecule decomposes to form one oxygen atom and a normal oxygen molecule. Hence the energy of UV radiation is absorbed in ozone layer even before reaching earth's surface. That's how ozone layer protects us from UV radiation.

Now, this does not deplete ozone layer since reverse reaction can also take place. That is, high energy UV radiation hits oxygen molecules and each decompose into two free oxygen atoms. Each oxygen atom combines with one oxygen molecule each and forms ozone molecules.

UV light creates ozone at wavelengths less than ~240 nm. While UV light from ~240 - 315 destroys ozone. In the process of creating and destroying ozone the UV light is absorbed in those wavelengths.The most severe case of ozone depletion was first documented in 1985

ISBN 978-93-5396-526-6

in a paper by British Antarctic Survey (BAS) scientists Joseph C. Farman, Brian G. Gardiner, and Jonathan D. Shanklin. Beginning in the late 1970s, a large and rapid decrease in total ozone, often by more than 60 percent relative to the global average, has been observed in the springtime (September to November) over Antarctica. Farman and his colleagues first documented this phenomenon over their BAS station at Halley Bay, Antarctica. Their analyses attracted the attention of the scientific community, which found that these decreases in the total ozone column were greater than 50 percent compared with historical values observed by both ground-based and satellite techniques. As a result of the Farman paper, a number of hypotheses arose that attempted to explain the Antarctic “ozone hole.” It was initially proposed that the ozone decrease might be explained by the chlorine catalytic cycle, in which single chlorine atoms and their compounds strip single oxygen atoms from ozone molecules. Since more ozone loss occurred than could be explained by the supply of reactive chlorine available in the polar regions by known processes at that time, other hypotheses arose. A special measurement campaign conducted by the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) in 1987, as well as later measurements, proved that chlorine and bromine chemistry were indeed responsible for the ozone hole, but for another reason: the hole appeared to be the product of chemical reactions occurring on particles that make up polar stratospheric clouds (PSCs) in the lower stratosphere.

MEASURES TO REDUCE OZONE DEPLETION

Avoid the consumption of gases dangerous to the ozone layer, due to their content or manufacturing process. Some of the most dangerous gases are CFCs (chlorofluorocarbons), halogenated hydrocarbon, methyl bromide and nitrous oxide.

Minimize the use of cars. The best transport option is urban, bicycle, or walking. If you use a car to a destination, try to carpool with others to decrease the use of cars in order to pollute less and save.

Do not use cleaning products that are harmful to the environment and to us. Many cleaning products contain solvents and substances corrosive, but you can replace these dangerous substances with non-toxic products such as vinegar or bicarbonate.

Buy local products. In this way, you not only get fresh products but you avoid consuming food that has traveled long distances. As the more distance traveled, the more nitrous oxide is produced due to the medium used to transport that product.

Maintain air conditioners, as their malfunctions cause CFC to escape into the atmosphere.

REFERENCES

1. J. W. Chamberlain and D. M. Hunten,Theory of Planetary Atmospheres, 2nd Edition, Academic Press, 1987.
2. F. R. de Gruijl, "Impacts of a Projected Depletionof the Ozone Layer", Consequences 1, #2, 1995, on the web atURL. http://www.gcrio.org/CONSEQUENCES/summer95/impacts.html.
3. G.M.B. Dobson, Exploring the Atmosphere, 2nd Edition,Oxford, 1968.
4. H. Mukhtar, editor: Skin Cancer: Mechanisms and HumanRelevance, CRC series in dermatology, CRC, 1995.
5. F. S. Rowland, "Stratospheric Ozone Depletion",Ann. Rev. Phys. Chem.42, 731, 1991.
6. M. Tevini, editor: UV-B Radiation and Ozone Depletion:Effects on humans, animals, plants, microorganisms, and materialsLewis Publishers, Boca Raton, 1993.

ISBN 978-93-5396-526-6