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Ozone Layer Depletion and its Consequences on Humans: A Review

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Abstract

Ozone (O3) is a stratospheric layer that assumes significant job in offering help to people for their endurance. It is a basic factor for some worldwide, natural and ecological wonders. The ultra-violet (UV) beams discharged from sun are caught by ozone and in this manner give a stable ontological structure in the biosphere. Different anthropogenic exercises, for example, emanations of CFCs, HCFCs and other organo-incandescent lamp lead to the exhaustion of ozone. Ozone exhaustion is enabling the UV radiation to earth surface. The introduction to these radiations is seriously influencing all living things on earth, particularly the people. Perpetual or transitory visual deficiency, skin malignancy and insusceptibility concealment are the principle impacts of these radiations revealed by different scientists on people. The possibilities of ozone recuperation are as yet unfamiliar. The present circumstance of ozone portrayal requests dire healing measures to secure lives on this planet. Chlorofluorocarbons, halons and methyl bromide are largely critical ozone exhausting substances controlled under the Montreal Protocol. Satellite perception frameworks help to foresee future changes to the ozone layer. In view of understandings under the Montreal Protocol, the ozone layer is relied upon to recoup toward the center of the twenty first century. Research should be done to evaluate that how different alternatives of cooling agents (chlorofluorocarbons) tend to decrease the emission of chlorine.

Keywords: Depletion • Chlorofluorocarbons • Stratospheric • Ultra-violet

Introduction

A number of human activities has a foul impact on atmosphere. Ozone depletion is one of them. Our atmosphere is split into different layers like troposphere and stratosphere. Troposphere is just above the stratosphere. Stratosphere where 90% of ozone is present exists in atmosphere is approximately at 25 to28 km from Earth surface and is called ozone layer. The remaining 10% of ozone forms the tropospheric ozone. It is close to ground. French physicist Charles Fabry and Henri Buisson discovered the ozone layer in 1913. Its properties were given by British meteorologist G.M.B Dobson. He also made a simple spectrophotometer (Dobson meter) that can measure the stratospheric ozone from ground. “Dobson units” (Du) are used for the measurement of ozone concentration in atmosphere.

Ozone

Without ozone life on Earth could not survive. As we know that the plants release oxygen in the atmosphere through photosynthesis reaction(which convert carbon dioxide into oxygen)(AFEAS, 1995).The accumulation of this oxygen led to the formation of ozone layer in stratosphere. The process of ozone formation is called photolysis. This layer absorbs 93 to 99% of UV light coming from Sun which are harmful for life on Earth. Ozone is colorless just like oxygen but has very pungent odour. Ozone consists of three oxygen atoms but the oxygen that the plants release consists of two oxygen atoms. So ozone is a form of oxygen but it is less common than oxygen. It is estimated that out of three million air molecules only 3 are of ozone and the remaining 2 million are of oxygen. Most ozone is present in the stratosphere. Small amount of ozone is also present in troposphere. It is produced through the reaction between sunlight , volatile organic compound and nitrogen oxide. Some of which are produced by anthropogenic activities like driving cars. It is called ground level ozone. It is harmful to human health and also causes smog. Stratospheric ozone prevent harmful solar radiations to reach on earth surface. Ground level ozone absorbs some incoming solar radiations. It is simply a pollutant but it cannot compensate ozone losses in stratosphere [1-5].

Ozone Layer

Ozone layer is really not a layer , it is a naturally gas in a region called stratosphere, where ozone particles are scattered between 19 and30 kilometers. Ozone layer is very beneficial because it

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prevents harmful ultraviolet radiations from reaching on Earth surface. But now a days chlorofluorocarbons (CFCs) is destroying ozone in stratosphere.

Ozone is formed in stratosphere when oxygen molecule is broken down by UV radiation from the Sun into oxygen atoms. Now if any of these oxygen atoms again combine with another oxygen molecule then it will form ozone. This process of formation of ozone is called photolysis. Ozone layer is naturally broken down but there is a balance between its formation and natural depletion. As a result total amount of ozone in stratosphere remains constant. But ozone layer thickness in stratosphere varies according to altitude. Maximum amount of ozone is found between 19 and23 kilometers (Morrisette and Peter,1995). Mostly ozone is produced at equator because of maximum sunshine but with wind it travels toward high latitude and get accumulated in stratosphere [6-10].

Ozone Hole

Due to depletion of ozone layer by CFCs ozone hole is formed in that region. The average concentration of ozone in atmosphere is 300 Dobson Units. When the concentration of ozone in a region becomes low than 200 Du then the term ozone hole is applied in that region. In 1970 ozone holes are first discovered in Antarctica. Ozone hole is also discovered in arctic region few years ago. Due to formation of ozone hole , more ozone is formed in troposphere due to penetration of UV light in troposphere. It is harmful for us because ozone is toxic for our body [11-15].

Ozone Hole Over Antarctica

In Antarctica there is a winter with extreme cold so there is no Sun in months of July to December. During these months strong wind blow around the continent which isolates the air over Antarctica from other World. This strong wind forms polar vortex which traps and chills the air to the temperature below -80 Celsius. The ice and polar stratospheric clouds give surface for chemical reaction that break down the ozone but due to lack of sunshine, chemical reaction cannot start.

In spring when sun shines it provides energy to start photochemical reaction. This energy melts the clouds and release the trapped compounds like chlorine and chlorine monoxide from CFCs This destroy the ozone layer and result in formation of ozone hole in large amounts.

Ozone Hole and Global Warming

Stratospheric ozone is greatly affected by global warming. Global warming increases the stratospheric ozone depletion. Ozone is depleted in stratosphere when it gets colder. As we know that the global warming prevents the heat to enter the stratosphere because it traps the whole heat in troposphere. Most commonly the CO2 which is also known as greenhouse gas form a canopy in atmosphere and traps the heat in troposphere making it warmer. No heat reaches the stratosphere then it becomes colder. In this way Global warming makes the ozone depletion more worse. In Antarctica ozone hole is formed due to low temperature in stratosphere.

Ozone Depletion

Now ozone depletion has become a general problem that effects the whole globe. The main cause of this depletion is manmade organohalogen compounds. When ultraviolet light falls on these anthropogenic compounds like Cl and Br radicals it destroys some of the ozone in ozone layer and cause ozone depletion. Due to this reason UV radiations reach the Earth surface and affect all ecosystems: terrestrial and aquatic. It even affects the microbes, plants, inert material and also pollute the air we breathe.

Ozone Depletion Mechanism

Ozone is formed in stratosphere and is also naturally broken down so its amount remains constant in stratosphere. Amount of ozone is maximum in poles and is minimum in tropics. It also has seasonal changes but locally it remains constant.

However anthropogenic compounds reach the stratosphere and go over the tropopause. When UV radiations strike on them , they cause ozone depletion. These anthropogenic compounds are commonly called chlorofluorocarbons(CFCs). They are produced in great volume. CFCs reach the stratosphere because they are highly stable. The common ozone depleting substances are CFC-11, CFC-12, CFC-13 and halons which contains chlorine and bromine.

CFCs itself does not destroy the ozone later in stratosphere. It Is stable in troposphere and slowly diffuses into stratosphere. In stratosphere when it is subjected to UV radiations free chlorine is produced. Due to CFCs direct catalysis free atoms of chlorine and ClO appear in stratosphere. This free chlorine atom react with ozone and produces ClO and oxygen molecule(O2).This ClO free radical again react with oxygen atom and produce chlorine free radical and oxygen molecule. Now this chloride free radical destroy ozone in stratosphere and cause ozone depletion. In this whole photolytic reaction chlorine acts as catalyst so at the end of reaction it is ready to reinitiate and does not disappear. Therefore it is said that single atom of chlorine can destroy millions of ozone atoms before disappearing.

If ClO reacts with OH then it results in formation of HCl. Because HCl is soluble in water so it can easily be eliminated from the atmosphere through rainfall. It is very important reaction because through it excess of Chlorine can be removed from the atmosphere.

Measuring Ozone Depletion

Dodson Unit (DU) is the most common stratospheric ozone measurement unit . G.M.B. Dobson carried out the earliest studies on ozone in the atmosphere from the 1920s to the 1970s so the Dobson Unit is named on the name of this pioneer. A Dobson Unit measures the total concentration of ozone in stratosphere. The average amount of ozone in stratosphere is 300DU.When this concentration falls below 200DU then it represents the formation of ozone hole. During springtime ozone whole form in Antarctica.

Ozone Protective Effect: UV radiation

It is important to understand that depending on the height of ozone it can be beneficial or harmful. There are two types of ozone. The tropospheric ozone is also called ground ozone because it is close to ground. Due to its particular origin it is dangerous for both living things and other materials. Tropospheric ozone is produced from the pollutants which are released into the atmosphere from different sources like road sources and thermal power plant. It forms 10% of the Earth total ozone.

Second type is stratospheric ozone It forms 90% of the Earth total ozone. It is beneficial for us because it prevents us from harmful UV coming from the Sun. It produces in creation – destruction process. Due to this the net amount of ozone in stratosphere remains constant.

Causes of Ozone Depletion

Population is increasing continuously. Now humans prefer to live in urban areas but the land is limited for living. Population is increasing but land is limited , so to solve this problem humans cut the forests for their own purposes and speed up deforestation and habitat destruction. In this advanced era industrial , agricultural and economic activities are rising and it increases the deforestation. As a result chemical composition of Earth atmosphere is changing due to releasing of chemicals like CFCs , halons etc. from industries, agriculture and due to combustion of fossil fuel. All these factors led to ozone depletion. Level of ozone depletion is measured by researchers in last two decades. It has varied from 3% to 20%.

Chlorofluorocarbons

Although ozone is depleted naturally but anthropogenic chemicals like CFCs and other anthropogenic activities are now the main cause of ozone depletion. Drs. M. Molina and S. Rowland in 1974 first suggested that anthropogenic compounds like CFCs are the main source of ozone depletion.

CFCs is also known as freon. It contains chlorine, fluorine and carbon atoms. It is highly volatile, non- combustible and non-carcinogenic. They are used as cooling agents in air conditioning and refrigeration, as dry cleaning fluids, as solvents in electronic industries and in the production of foam plastics. As a result a large amount of CFCs is released and is going to stratosphere. When it is released into the atmosphere it do not break down because it is highly stable in lower atmosphere. It gradually diffuses into stratosphere from the lower atmosphere and take 7 to 15 years to reach the stratosphere. Its life time in stratosphere is very long about 20 to 100 years. During their lifetime in stratosphere it is broken down when UV radiation strike on it and produce chlorine free radicals. Each CFCs produce two to four chlorine free radicals. These radicals then react with ozone and cause ozone depletion. But they do not damage themselves Chlorine acts as catalyst and continue to damage the ozone molecule. After the release of CFCs into atmosphere this reaction lasts for many years.

It is estimated that CFCs accounts for 80% of ozone depletion. Modern life style of 20th century has been made possible due to CFCs. Although in developed countries ejection of CFCs has ceased due to international control agreements, the damage to the stratospheric ozone layer will continue well into the 21st century.

Ozone Depleting Substances (ODS)

Chemicals that deplete ozone layer are called ozone depleting substances. Well known ozone depleting substances are: methyl chloride, methyl bromide, carbon tetrachloride and halons. These are also known as anthropogenic compounds.

Halons

Halons are specific bromine compounds. They deplete the ozone layer just like CFC but they have more capacity to deplete ozone layer. Because they release bromine which is 50 times more harmful than chlorine for ozone. But their lifetime in stratosphere is less than CFCs.

Methyl chloride

Methyl chloride is a less destructive ozone depleting substance than CFCs and halons. It is used as a solvent, pesticide and herbicide. During usage some amount of methyl chloride escapes and move to the stratosphere. The life time of methyl chloride in atmosphere is about 1.5 years. Methyl chloride releases chlorine during its lifetime which reacts with atmospheric ozone and deplete ozone layer. It is also important ozone depleting substance that destroy global ozone layer. The ODP of Methyl bromide is about 0.22 to 0.48. Its atmospheric residence time is more than 1.5 years.

Methyl Bromide

Both natural and anthropogenic origins release methyl bromide. 5% to 10% global ozone depletion is done by methyl bromide. Due to this reason it is said that bromine has largest contribution in ozone layer depletion.

Conclusion

The earth has just got a lot of bright radiation and optional infrared warming from the photochemical responses in the environment. Without a doubt, the entire world is presently in peril and to dispose of this danger we need to stop quickly the utilization of chlorine, CFCs, halons, methyl bromide and other ozone draining substances. Not just this, we need to locate the sheltered choices so as to recoup the characteristic ozone layer in the stratosphere.

We should reclassify our association with the sky and start to consider worldwide ozone consumption as risk to the earth. We sincerely need a unique Environmental Defense Force and an International Environmental Constitution so as to protect the world's ozone shield. Researchers and specialists are presently to a great extent ready to decide the impacts of stratospheric ozone consumption utilizing the trend setting innovations. This incredible

headway should now be used to recuperate and safeguard the ozone layer for who and what is to come and for the environmental soundness of the planet.

The projection of a multiplying in the occurrence of each of the three sorts of skin disease in the following ten years, in addition to an enormous increment in the quantity of waterfalls ,due halfway to a maturing populace, imply that wellbeing efforts that pressure the unsafe impacts of sun based UVR are required and justified. However, the researchers don't have the foggiest idea about that what are the pathogenic instruments engaged with the waterfall types? What are the wavelength conditions for waterfall advancement? In any case, in any exploration it isn't talked about that what amount sun powered UVR introduction is required, and in what capacity would it be a good idea for it to be appropriated throughout the year, to keep up sufficient nutrient D levels in individuals of various skin phototypes living at various scopes? People should plant trees on footpaths, in school courtyard and especially near the buildings that have a lot of air conditioning systems because plants absorb a lot of pollutants. Every country must have 25% trees but in Pakistan it is about 3%.

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