RESEARCH HUB – International Multidisciplinary Research Journal (RHIMRJ)

A Study on Ozone Depletion in Environment

Ankit Upadhyay
Shri R.P. Arts, K.B. Commerce and Smt B.C.J. Science College,
Khambhat, Anand,Gujarat (India)

Abstract: This paper describes the protective action of stratospheric ozone together with different mechanics causing ozone depletion. Stratospheric ozone depletion has been much studied as a case history in the interaction between environmental science and environmental policy. The positive influence of science on policy is often underscored, but here I review the photochemistry of ozone in order to illustrate how scientific learning has the potential to mislead policy makers. The object of this paper is to review the origin, causes, mechanism and bio effects of ozone layer depletion as well as the protective measures of this vanishing layer. The chlorofluro carbon and some gases are pretent ozone depletors. One of the main reasons for the widespread concern about depletion of the ozone layer is the anticipated increase in the amounts of ultraviolet radiation received at the surface of the earth and the effect of this on human health and on the environment. The future behaviour of ozone will also be affected by the changing atmospheric abundances of methane, nitrous oxide, water vapour. Even for the well-studied case of ozone depletion .Further research is needed on the dynamics of scientific learning,particularly the scientific assessment process how assessment influence the development of public policy.

Key Words: Ozone depletion, Ozone environment, UV absorption, UV environment, UV effect

I. INTRODUCTION

In 1974, F.S.Rowland and M. Molina published in “Nature” their ideas on the influence of the chlorofluorocarbon (CFCS) on ozone depletion. These gases are used as propellants in the spray cans, as well as a cooling medium in air conditioning system and refrigerators. As might have been expected, this study was not at all welcomed by the industry.

The ozone layer is a larger in Earth,s atmosphere in which contains relatively high concentrations of ozone. This layer absorb 93-99% of the sun,s high frequency ultraviolet light, which is potentially damaging to life on earth. Over 91% of the ozone in Earth’s atmosphere is present here. It is mainly located in the lower portion of the stratosphere from approximately 10Km to 50Km above earth, though the thickness varies seasonally and geographically.

In this article, I review the history of learning about ozone depletion with the aim of understanding the limits of the scientific learning process as it applies in the global change arena: How new understanding may ultimately prove incorrect and how the consensus view embodied in assessment can sometimes overshadow important uncertainties.

In 1985 evidence of a large “Ozone hole” was discovered above the continent of Antarctica during the spring time. This has reappeared annually, generally growing larger and deeper each year. More recently, fears have emerged about significant ozone depletion over the Arctic, closer to the more populous regions of the Northern hemisphere.

Protecting the ozone layer is essential .Ultraviolet radiation from the sun can cause a variety of health problems in humans, including skin cancer, eye cataracts and a reduction in the body’s immunity to disease. Furthermore, ultraviolet radiation can be damaging to microscopic life in the surface oceans which forms the basis of the world. A loss of ozone in the ozone layer in the stratosphere may even affect the global climate.

Chlorine and bromine both are responsible for ozone depletion. Bromine is even more efficient than chlorine at destroying ozone, but there is much less bromine in the atmosphere at present. As results, both chlorine and bromine contribute significantly to overall ozone depletion. Laboratory studies have shown that fluorine and iodine atoms participate in analogues cycles.

On average, a single chlorine atom is able to react with 100000 ozone molecules before it is removed from the catalytic cycles. This fact plus the amount of chlorine released into the atmosphere yearly by chlorofluorocarbons (CFCs) and hydrofuorocarbons (HCFCs) demonstrates how dangerous CFCs and HCFCs are to the environment.

International agreement and other legislation have gone a long way to safeguarding this life supporting shield. Nevertheless, for there to be real and long lasting success, every one becomes part of the solution. Individual effort taken together can be powerful forces for environmental change. There are a number of things that we, as individuals can do to both protect the ozone layer. This include proper disposal of old refrigerators, the use of halogen-free fire extinguishers and the recycling of foam and other non-disposable packing.

Finally, we should all be aware that whilst emissions of ozone depletes are now being controlled the ozone layer is not likely to fully repair itself for several decades.

II. THE OZONE PROTECTIVE EFFECTS: UV RADIATION

Ozone is mainly found in two region of the Earth's atmosphere. Most ozone (about 90%) resides in a layer that begins between 6 and 10 miles (10 and 17 kilometers) above the Earth's surface and extend upto 30 miles (50 kilometers).This region of the atmosphere is called stratosphere.

It is beneficial because it protects Earth's surface from the UV radiation coming from the sun, which has a large energy and it is capable of causing damages to living beings and materials.

Ozone in the Earth's stratosphere is created by ultraviolet light striking ordinary oxygen molecules containing two oxygen atoms, splitting them into individual oxygen atoms (atomic oxygen), the atomic oxygen then combines with unbroken O_2 to create 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 the ozone-oxygen cycle. Chemically, this can be described as:

$O_2 + h\gamma_{UV} \rightarrow 20\ O + O_2 \leftrightarrow O_3$

About 90% of the ozone in our atmosphere is contained in the stratosphere.

As the ozone layer is reduced, the Earth's surface is exposed to more of the shorter UV wavelength of the suns radiation that damage living things. For each 10% depletion of the ozone layer we can expect 20% more radiation in this damaging wavelength.

Everyone is exposed to UV radiation from the sun and an increasing number of people are exposed to artificial sources used in industry, commerce and recreation. Emissions from the sun include visible light, heat and UV radiation. The UV region covers the

wavelength range 100-400 nm and is divided into three bands:

UVA (315-400 nm)
UVB (280-315 nm)
UVC (100-280 nm)

As sun light passes through the atmosphere, all UVC and approximately 90% of UVB radiation is absorbed by ozone, water vapour, oxygen and carbondioxide.UVA radiation is less affected by the atmosphere therefore the UV radiation reaching the Earth's surface is largely composed of UVA with a small UVB component.

A depletion of the ozone layer will increase the UV radiation at ground level. Increasing doses of UVB may causes skin cancer, eye cataracts, and damages to immune system in animal as well as human beings?

III. OZONE DEPLETION MECHANICS

Chemical equation of ozone depletion.

$CFCl_3 + \text{UV Light} \rightarrow CFCl_2 + Cl$

$Cl + O_3 \rightarrow ClO + O_2$

$ClO + O \rightarrow Cl + O_2$

The free chlorine atom is then free attack another ozone molecule.

$Cl + O_3 \rightarrow ClO + O_2$

$ClO + O \rightarrow Cl + O_2$

And again

$Cl + O_3 \rightarrow ClO + O_2$

$ClO + O \rightarrow Cl + O_2$

And again ...... for thousands of times.
Ozone is destroyed when it absorb UV light that otherwise would reach Earth's surface.

$O_3 + h\gamma \rightarrow O_2 + O$

There is no net ozone depletion, however because that produces atomic oxygen that reacts with molecular oxygen to form another ozone molecule. The concentration of ozone in the stratosphere naturally increases with things like altitude, temperature and weather. The considerable level of ozone reduction is not due to only natural factors. Synthetic chemicals and gases play a huge role in the ozone depletion. Aerosoles and chlorofluorocarbons or CFCs have been found to be largely responsible for the depletion of the ozone layer. The reduction of the ozone layer presents a large risk for many chemical and biological process on the Earth's surface.

There are a number of catalytic processes of ozone depletion that occur above the ozone layer of the stratosphere, where the ozone molecule is less abundant.

A catalytic process occurs when a molecule which will act as the catalyst, react with an ozone molecule to remove one of the oxygen atoms to generate oxygen gas and the oxygenated form of the molecular catalyst. The mechanism of ozone depletion shown that the basic features of these processes are the presence of a limiting stage, which determines the rate of chain propagation in this process and accordingly the rate of ozone depletion.

It is also shown that the practice, so far widespread in the stratospheric chemistry of defining the rate-limiting step of the chain process as a single reaction with the lowest rate throughout the stratosphere does not enable to correctly determine the rate of the chain process and leads to a significant overestimation of the latter.

Methods for correctly calculating the rate of the limiting step for an arbitrary number of chain propagation reactions and for determining the termination rate and the chain length are for the first time proposed.

References

1. Alternative fluorocarbon environmental acceptability study (AFEAS), Washimgton,DC,1975.
2. Chapman,S.1930 : A theory of upper atmospheric ozone .Mem,Royal meteorological society . 3:103-125.
3. Desssler, Andrew .The chemistry and physics of stratospheric ozone. San diego, Academic press,2000.
4. Hoffman, Matthew J. Ozone depletion and climate change. Albany NY: state university of New York press,2005.
5. Karol et al,1992. I.L. Karol, Y.E.Ozolin and E.V. Rozanov. "effect of space rocket launches on ozone" Annales geophysicae ,vol.10,No.10,pp.810- 814
6. McGrath,Matt."Mysterious new man made gases pose threat to ozone layer" BBC.Retrieved March 10,2014.
7. Molina, M., Rowland F.S.1974:Stratospheric sink for chlorofluorocarbon : Chlorine atom catalysed destruction of ozone.Nature, 249: 810-812.
8. " Ozone facts: what is the ozone hole" ozone hole watch.NASA.November 18,2009.Retrived April 16,2011.
9. Pason,Edward A. Protecting the ozone layer: science and strategy. New York: Oxford university press,2003.
10. Scientific assessment of ozone depletion 1998.-preface .Esrl.noaa.gov. Retrieved on December 21,2012.
11. Shea, 1988.C.P.Shea.Protecting life on earth :step to save the ozone layer, World watch paper 87.world watch institute,December 1988.
12. Stratosphere ozone depletion by chlorofluorocarbons Eo earth.org.archived from the original on September 9,2011.
13. Tevini, 1993.Manfred tevini, editor, UV-B radiation and ozone depletion, Effect on humans,animals,plants,microorganisms and materials,1993.

ISSN: 2349-7637 (Online)