## Impact of Ozone Layer Depletion on Enviroment

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#### Abstract

The presence of ozone in stratosphere has play very important role in existence and survival of human beings and all other kind of life. It is very important factor for all kind of biological and global phenomenon. It is very important because it act as a barrier against the harmful ultraviolet radiations and balance the life in biosphere. But unfortunately, different anthropogenic activities such as emissions of CFCs, HCFCs, methyl chloride, methyl bromide and other halogens lead to the depletion of ozone. The ozone depletion resulted in production of an ozone layer in troposphere near the ground which act as a pollutant and it is responsible for adverse effects on plants, humans and aquatic environment and it has increased different kinds of diseases in humans. The mutations caused by UV rays result in variation in different traits of plants which ultimately decrease in production of crops. However, UV radiation is required in optimum intensity for both plants and animals. The wide-ranging effects of ozone depletion with most of them being detrimental for all kinds of system are being assessed. The adverse effects of ozone depletion can be minimized by adopting some measures including preferring public transport, minimizing the use of harmful nitrogenous compounds, planting trees and most important is the use of less harmful alternatives of ozone depletion substances.

Keywords: UV rays • Ozone depletion • Human beings

## Introduction

Ozone layer contain high concentration of ozone which is more than 91% and absorb 93%-99% of UV radiations and its depletion is dangerous for life. It is mainly located on the lower portion of stratosphere, which is approximately 10 to 50 km above the earth and its thickness varies seasonally and geographically. It was discovered by French Physicists Charles Fabry and Henri Buisson in 1913 and further studied by British Meteorologists G.M.B Dobson. A simple spectrometer was designed to measure it. Dobson established a worldwide network of ozone monitoring stations between 1928 and 1958 that is continuing to operate these days. Dobson unit is measure of total amount of ozone in a column overhead, this name was given in the honor of those who discover it [1].

### Ozone

It is formed through action of oxygen and trace component of atmosphere that act as a barrier. But now it is depleting due to different reasons. Its formation occurred about 3000 million years ago when primitive type of plant began to evolve and emission of oxygen was started. Ozone is a form of oxygen and it consist of three atoms of it. Normal oxygen is colorless and odorless, but ozone is colorless and have harsh odor. Ozone rich band is present between 19 and 30 km above the earth. Chemical reaction between sunlight, volatile organic compounds and nitrogen oxide produces ozone in troposphere and this ground level ozone act as a pollutant and it is dangerous.

## Ozone Layer Depletion, Ozone Hole and its Recovery

At Antarctica ozone is depleting at alarming rate and this depletion mostly occur in winter and early spring. The main cause of this destruction is release of chlorine atoms and one chlorine atom can destroy 100,000 ozone molecules. A single chlorine atom keeps on destroying the ozone for up to 2 years. Ozone Hole refer the region where concentration of ozone is below 200 D.U while its normal concentration is about 300-350 D.U (AFEAS, 1995). Ozone layer has been shrinking about 0.5% since 1974 due to chlorine atoms that are released from CFC (Farman et al., 1985) and UV-B radiations has increased about 5%. In ozone hole region the thickness of this layer is only 1mm. Dobson units are measured how much the layer would be thick if it is compressed into one layer at a 0 degree Celsius if the pressure that is 1 atm above it. During 1956-1970, the thickness of ozone layer over Antarctica was 280-325DU, it was 225DU in1985 and 94DU in1994. The Hole in Antarctica has produced due to polar vortex, which are westerly circulation at poles due to drop of temperature in stratosphere [2].

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Ozone depletion has also occurred over arctic region during 1995-1996. Climatically, arctic region is different and less cold than southern polar region. There are no signs of recovery of ozone hole that was occurred in 2003 and the largest hole that has been seen ever. There might be chances of recovery during 2050-2060. In 2006, ozone hole was detected over Tibet which is about 2.5 million square kilometers. Again, the ozone hole appeared in mountains regions of Tibet, Xinjiang, Qinghai and Hindukush in 2011 which is less intense and dangerous than Holes over Arctic and Antarctic region. Human activities would increase the amount of chlorine and bromine in stratosphere 10 folds by mid of 2050s compared with 1980s amount (Stedman, 1981). Most of chlorofluorocarbons and halons have residence time in atmosphere about 50 to several hundred years. If there are full implications Montreal Protocol, then it might be possible to obtain the original state of ozone [3].

# Situation in Pakistan and Other Countries

Ozone depletion and its effects are main concern of scientists all over the world including Pakistan where annual, monthly and seasonal analysis were performed to check its status. Seasonal analysis was made from December to April, when the intensity of UV radiation is less, there is more thickness of ozone layer, but in October and November it decreases due to increases in intensity of UV rays over Pakistan. There is increase in flux of UV radiations that reaches the Arabian Sea especially in Pakistan Atmospheric Region that is present in west and northwest of Asia. This study was done on Sindh and Baluchistan cost and its effects were observed on marine life. This has proved that there is inverse relation between yield of fish and UV radiation. As these radiations increase the, the yield of fish decrease. If all these activities that are contributing to ozone depletion would not control, there is likely to increase the level of ozone depletion in future by the end of 2030, where its concentration is 60 ppb would expand especially in Europe and North America. By 2060, most populated areas would experience its concentration at least 60 ppb. By the end of this century, there would be a largest increase in ozone depletion over south Asia nearly 15ppb and large increase in middle east, southeast Asia, Latin America and east Asia. This could be avoided by using maximum number of reasonable reduction technologies.

## **Causes of Ozone Depletion**

Its depletion occurs when balance is disturbed between its production and destruction. Human activities are main cause of by producing chemicals like carbon tetrachloride, 1,1,1-Tetrachloro-ethane and methyl bromide. Natural phenomenon causes the temporary loss of ozone, but chlorine and bromine released from human activities especially from CFCs are main causes of this depletion.

## Main ODS (Ozone Depleting Substances)

The main ODS are CFC, Carbon tetrachloride, halons, Rocket launches, nitrogenous compound, chlorine molecules, methyl

chloride, methyl Bromide and Methane. Chlorofluorocarbons are manmade group of compounds which are main cause and known as Freon's and they are non-toxic, non-flammable and non-carcinogenic. They contain 3 types of atoms including carbon, chlorine, fluorine. All different types of CFC are used as a blowing agent, as a propellent and in electronic circuit board. They adversely affect the human health because of their high volatile nature. However, CFC are not only the main cause of its deletion. They are not only the source of emission of chlorine, but release also take place doe to industrial activities, biomass burning solid rocket booster, volcanoes, sewage and from household chlorine bleach. Other sources include Halons are used in fire extinguisher and military vehicles like ships and airplanes. There increasing concentration has destroyed ozone layer. Methyl chloroform are used in industry, cold cleaning, in aerosols and in chemical processing. Carbon tetrachloride are used in solvents and fire extinguisher [4].

Hydrofluorocarbons are less harmful than CFC but still cause some destruction. Methyl chloride released from industrial activities, oceans and biomass burning. Methane from habitat destruction and deforestation release it into atmosphere. It releases from natural source, present in swaps and sediments, rice paddies and clathrate. Oxidation of methane and hydrocarbons also cause ozone depletion. Nitrous oxide release from natural and agricultural nitrogen cycling. It also releases from internal combustion engines as a byproduct, lightening in thunderstorm and from human activities release NO and NO2. Rocket launches causes more ozone depletion than do the CFC and stimulated the 1987 Montreal protocol. Growth of space industry and rocket launches will cause future ozone depletion. If it was not controlled till 2050, it will be more dangerous than CFC. Global warming and greenhouse effect also have a main contribution to ozone depletion.

## **Effects of Ozone Layer Depletion**

#### Effects on human

UV radiation radiations has profound effect on human health. It causes skin cancer, infectious diseases and premature aging of skin. Photokeratitis is also caused due to UV rays. The major effects chronic UV radiations are pterygium and cataracts, effects on cornea and conjunctiva and muscular degeneration. Maculopathy is also a cause of loss of vision in developed countries. It occurs due to destruction of retinal epithelium pigment that effect the neural retina and causes AMD (Age related Macular Degeneration). Cataract occurs when damage to eye lens and cornea occur and its prevalence vary according to races. 10% ozone layer thinning causes 2 million cases per year. To check the effects of UV radiations on eye variety of animals were used including mice, rat, rabbit and guinea pigs. Eclipse retinopathy is basically a sun burn occur due direct looking at sun after solar eclipse due to UV rays. Pterygium is an inflammatory, proliferative and in invasive growth on conjunctiva and cornea of human eye and it impair the vision. Increases exposure causes primary and recurrent pterygium. Its formation occurs due to proinflammatory cytokines. UV rays are main risk factor. Ocular melanoma is type of tumor in eyelids, conjunctiva, iris and choroid. It is common eye cancer in adults. Exposure in early age is main risk

factor. The risk increases with increase in exposure and its chances increases in people of Punta Arena about 56% [5].

Immunosuppression is a weakening of immune system due to UV radiations (UNEP, 2006) and body become exposed to cancer, antigens and infectious diseases. Melanoma and non-melanoma skin cancer occur due exposure of skin to UV rays and melanoma is more fatal than non-melanoma. UV rays because skin burn and skin cancer and responsible for breast cancer and leukemia. There is positive association between NHL and UV rays. NHL is a risk factor for non-melanoma skin cancer. The chances of melanoma are more in girls than boys due to thin skin and more likely to develop in trunk region than lower limb. Wrinkled face and more sun exposure are its risk factor. DNA damage and lung disease occur due to UV radiation and disturb the macromolecules. Mutation in DNA due to UV causes error during its replication and causes basal and squamous carcinoma and 2% risk increase with 1% ozone depletion. Lungs obstruction, emphysema and asthma also caused by UV rays. Reduction of oxygen causes hydrogen peroxide formation, which effect human health by having long stability and pollute the drinking water and changes the chemical nature of metals like copper. If ozone depletion continues at the same rate it will lead to food shortage for humans because its effects plant productivity and causes the shortage of food for man.

#### Effects on materials

CFC has not even distribution in atmosphere they produce free radicals which destroy ozone molecules. UV radiation destroy the synthetics polymers and decrease the integrity of materials like plastic, wood and natural fibers. The annual demand of industrial annual wood is about 17000 million cubic meters while that of plastic about 245 million tones. But they are exposed to solar radiations which causes their degradation. Common polymers are easily affected by UV-B radiations in sunlight, high temperature and high humidity level. As a result, there is a loss in physical, aesthetical and, mechanical properties. Moisture is also a powerful agent that causes wood weathering. In case of wood, surface coating like polyurethane coating block the UV radiations and provide a protection from reaching the solar UV radiations to materials.

#### Effects on climate change

Ozone depletion and climate change are linked together. Ozone not only absorb the solar radiations but also IR radiations and its loss produces changes in temperature. Increasing concentration of ozone in troposphere due to surface pollution gases has produced warming effect on surface of earth.

#### Effects on animals

Sunlight particularly effect the farm animals and in Hereford cattles that deficient in pigments in body increase the risk of eye cancer. Its risks increase with age of animals. If pigmented skin is selected, there are chances of occurring it. These rays cause eye and skin cancer and effect the developmental stages of fish, crab and shrimp larvae. Skin that is lack in pigmentation, increase the risk papillomatosis in goats. The symptoms include warts on udder and eye and more in those areas where is high intensity of sunlight like Australia. Pigmented skin is a barrier in its development. The risk of sunburn in those sheeps that are chemically treated to increase the wool growth than without it. it is more in dairy cows of New Zealand. So, the strategy that is needed to adopt is providence of shade to animals to overcome this situation. Increase UV level also effects immune system of animals.

#### Effects on aquatic ecosystem

Aquatic bacteria are important decomposers of aquatic ecosystem and breakdown organic matter and their population effect the water transparency. Their productivity inhibited at noon. UV radiations affect them at molecular, cellular and population level and effect their assemblage. Photosynthetic cyanobacteria are ubiquitous in both fresh and marine habitats from polar to equator region. They are first organisms that begin to produce the oxyge. But UV rays effect their photosynthetic ability and stop formation of heterocyst. Phytoplankton's are main producers of marine ecosystem and synthesis organic matter. But UV radiations effects their DNA, carbonic anhydrase fatty acid composition metabolic process like photosynthesis and calcification. Different phytoplankton's show different to response to UV light and carbon, nitrogen and phosphorous ratio in their body. Solar radiations affect the respiration and photosynthesis in aquatic plants and decrease the photosynthesis yield. Zooplanktons play important role in aquatic food web. Direct effect of UV is that it kills the larvae and copepods and indirect effect include deformed larvae and few eggs production. It damages their reproductive state of female copepod and DNA.

## **International Action**

The first International Action was focused in 1977, in order to bring the attention of world on the destructive effects of ozone in stratosphere, where the meeting of 32 countries were held in Washington D.C. Different persons gave their point of view on this problem and finally it urged the scientific community to take remedial actions to solve this problem. As a result, international treaty was signed known as Montreal Protocol came into force on 1 January 1989. It was designed to reduce the production and consumption of ODS like CFC, carbon tetrachloride, methyl chloroform etc. All those countries who have signed on it were responsible to reduce their contribution to depletion.

## Conclusion

Although much of work has been done regarding the ozone depletion, its causes, consequences and to overcome this problem. But still there are some areas in which there is need to do more work. These areas include deficiency of reliable technologies regarding the measurements of atmospheric ozone which are needed to estimate global patterns and variability in UV radiations. Satellite sensor that are using currently do not accurately measure concentration of ozone in troposphere. So, there is need of more advance and accurate measuring technologies for the measurement of ozone concentration. There is little work about the substances that could be used as a best alternative of ODS. Many of the substances that were suggested as alternatives after Montreal Protocol are proving harmful. So, there is need to work on introduction of those substances that must be less harmful, and they must in a framework of acceptable risk. It is suggested to limit private vehicle driving, because it causes the emission of different harmful agents that result in smog and it further

accelerate the destruction of ozone layer. Preference should give to the public transport, walking, using bicycles. Use eco-friendly household cleaning product for household because they are toxin free and can prove beneficial. Avoid using pesticides as they are harmful for ozone layer and use the natural remedies to get rid of weeds. There is need to regulate the rocket launches because the byproduct that are produced during rocket launching in a process of combustion are directly released in middle stratosphere. The steps must be taken towards banning the use of dangerous nitrous oxide.

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