STRATOSPHERIC OZONE DEPLETION: A BANE TO ACHIEVING GLOBAL ENVIRONMENTAL COMFORT

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Abstract

Ozone, a component of the earth's atmosphere is having 0.00006 percent of the dry atmosphere and it is mostly located in the stratosphere. Its location in the second layer of the atmosphere is meant to screen out one of the electromagnetic waves known as ultraviolet ray which is a short wave radiation heating up the earth's surface. The data were collected through literature search, hence, it is theoretical in nature. It is meant to conceptualize ozone, ozone depletion; identify causes of ozone depletion and to proffer what could be the proper control measures. The ineffectiveness of ozone shield to perform the primary function of protecting both biotic and abiotic components of the natural ecosystem from the scorching effects of the ultraviolet ray due to human activities such as urbanization, industrialization that cause pollution implies the destruction of valuable components of the earth's total ecological systems and the manifestation of its consequential outcomes. It is revealed that ozone depletion could trigger rising earth's temperature, reduction in crops' yields, disruption of marine food chain, inhibition of photosynthesis, skin cancer, blindness, genetic changes, and human immune systems' impairment among others. To curb this bane from its multiplier effects, it is suggested that the use of ozone friendly materials should be embraced in the production of products by industries. People should be educated on how best to interact with their biophysical environment to curb excessive pollution of man's environment.

Keywords: ***Atmosphere, Biophysical environment, Ecosystem, Ozone, Ozone depletion, Pollution, Ultravioletray.***

INTRODUCTION

Ozone is from Greek word meaning smell. New ozone molecules are constantly created in chemical reactions fuelled by power from the sun in the stratosphere.It is formedwhen oxides of nitrogen and unburned volatile organic hydrocarbons, mostly from vehicle exhausts, mix together with oxygen with the influence of sunlight. Smog has ozone as its main component. It is found in the second layer of the atmospherethat is,15 to50 kilometers skywards (Miller and Mintzer 1986). It blocks the scorching effects of thesolar ultraviolet radiation having 0.2 to 0.4 micron as its electromagnetic wavelength and the energy percentage of 9 in the upper atmosphere but, it is hazardous (harmful) at ground level. It also plays some role in the energy balance ofthe atmosphere and it can influence climate. Ozone is only 0.00006% of the dry atmosphere. In the upper atmosphere, oxygen molecule (02) breaks-up into its constituent atoms by ultraviolet radiation. The separated atoms may individually mix up with other oxygen molecules to create ozone (03) which is a triatomic form of oxygen.

$$0_2 + 0 \longrightarrow 0_3$$

Maximum production of ozone occurs between 30 and 40km above the earth's surface. Ozone is a very unstable gas and may be destroyed when combined with further atomic oxygen or by the action of radiation on it. Despite the constant change of ozone to oxygen and back to ozone by photochemical processes, equilibrium rates are maintained such that an accumulation of the gas occurs, especially at levels where its destruction is less likely. The greatest concentration of ozone occurs mainly between 15 and 30km.

Although ozone occurs in very small quantities, it is important in influencing global heat balance. The effect is extremely high in the mesosphere.The ultraviolet rays are capable of destroying and burning animal tissues severely.

It has a pale blue colour and hazardous to health. It boils at - 111.90C. (-169.520F), melts at - 192.520C (-314.50F), and ithas a relative density of 2.144 and molecular weight of 48.00. Ozone is an important atmosphere constituent whose concentration in the atmosphere is influenced by human activities (Ayoade, 1988; Nunez, 2019). Ozone layer is concentrated between the heights of 15and 35km within the atmosphere. The ozone content of the atmosphere is low over the equator and increases pole wards of the 500 latitudes (World Meteorological Organization, 1998).

The stratosphere (second layer of the atmosphere) characterized by a steady increase in temperature (temperature inversion) caused by a concentration of ozone (03). Ozone is formed when under the influence of ultraviolet radiation, oxygen molecules break up and the separated atoms individually combines with other

oxygen molecules usually takes place in the layer between 80 and 100km. This is because of the very low density of the atmosphere at 80 and 100km which do not encourage collision between 0 and 02: a process necessary for the formation of ozone.The ozone layer is greatly being depleted by greenhouse gases and chemicals that threaten to transform the climate that reduce the ozone layer. The negative effect is caused by differentactivities of man such as burning coal and oil, clearing forests and grasslands, and using motor vehicles from which unburned volatile organic hydrocarbons are emitted, refrigerators and air conditioners; all these release a growing amount of polluting gases into the atmosphere initiating health hazards and environmental disturbances. Some ecologists with particular reference to Epstein of Harvard Medical School identify deteriorating environmental conditions and result threats to health through a term coined "Environmental Distress Syndrome and this is even supported by Tony McMichael of the London School of Hygiene and Tropical Medicine which they say can cause the depletion or disruption of natural biophysical processes that are the basic source of sustained good health.

Causes of Stratospheric Ozone Depletion.

The most common cause of ozone layer depletion in the developing nations (Nigeria inclusive) include burning of bush/refuse, smokes form generators/engines, the use of old and worn-out vehicles, dusts from mining regions and saw milling.

Scientists in the 1980s attributed the destruction of the global ozone layer to human activities and without this gaseous layer, organisms cannot adequately survive.Waught (2000) said that it is being damaged by heat trapping gases that are emitted into the atmosphere such as chlorofluorocarbons (CFCs), compounds of fluorine that are used in refrigeration, air-conditioning, cleaning solvents, packing materials, and aerosol sprays and other industrial chemicals.

Nuclear radiation remains an environmental problem despite the banning of atmospheric testing of nuclear weapons, eliminating a large source of radioactive fallout by most countries. Power plants always release some amount of radioactive waste into the air and water, but the main danger is the possibility of nuclear accidents, in which massive amounts of radiation are released into the environment as happened at Chernobyl, Ukraine, in 1986 (WMO, 1998).

Stratospheric ozone is geometrically depleted due to the following:

i. ChloroFluoro Carbons (CFCs)
ii. Chemicals used as solvents
iii. Halon that is used in the production of fire extinguishers (United Nations Environment Programme, 1989)
iv. Methylbromide (a crop fumigant)(Begley and Hager, 1991)

All the above mentioned gases are important in industrial and agricultural productions and they do a lot of damage to the atmosphere. According toBegley,1991 and Frankel 1990, the industrialized nations have taken measures to phase out harmful substances and thustaking up healthful measures which are funded to support the introduction of new technology by developing countries. New research has found, however, that these measures will not completely prevent further ozone depletion. This is because CFCs remain in the atmosphere for a century, continuing to do damage. Also levels of chlorine in the atmosphere from CFCs could triple in the next century (UNEP, 1989).

Rate of Decrease(Decline) of Ozone

It is opined by Corson, 1990 and Shea, 1988 that the amount of ozone droppedworldwide between 1969 and 1986, was about 2percent with larger declines over parts of North and South America, Europe, Australia, and New Zealand. A 1992 Study reports that the ozone layer is thinning even more rapidly than previously thought (United National Aeronautics and Space Administration, 1992).

Effects of Ozone Layer Depletion on the Living Organisms

Apart from the formation of ozone in the stratosphere, ozone may also form along the ground level of the troposphere. Concentration of ozone greater than 50 parts per hundred million (0.00005%) by volume near the ground surface is dangerous.

A thinning of the ozone layer is the key factor in the global warming and it highly exposes life on earth to excessive ultraviolet radiation, which can increase skin cancer and eye cataracts, reduce immune-system responses, interfere with the photosynthetic process of plants, and it affects the growth of oceanic phytoplankton. As a result of the growing threat of these dangerous environmental effects, many nations are working towards eliminating the manufacture and the use of CFCs.

However, CFCs can remain in the atmosphere for more than 1000years, so ozone destruction will continue to pose a threat for decades to come. Extensive use of synthetic pesticides derives from chlorinated hydrocarbons in pest control has had disastrous environmental side effects. Although these synthetic chemicals are not found in nature, they nevertheless enter the food chain. The pesticides are either taken in by plant eaters or absorbed directly through the skin by such aquatic organisms as fish and various invertebrates. The pesticides is further concentrated as it passes from herbivores (plant eaters) to carnivores (meat eaters). It becomes highly concentrated in the tissues of animals at the end of the food chain, such as the peregrine falcon, bald eagle, and osprey. Chlorinated hydrocarbons inhibit in the calcium metabolism of birds, causing thinning of egg shells and subsequent

reproductive failure. As a result, some large predatory and fish eating birds have been brought close to extinction (Gunderton, 2000).

Ozone damages lung tissues and causes irritation of the eyes, nose, and throat. Ozone is also harmful to plants. It takes them susceptible to fungal disease and insect attack (Ayoade, 1988). According to the 1998 report on ozone depletion of the World Meteorological Organization (WMO, 1998), ozone had been particularly low over the Arctic during later winter and spring in six out of the previous nine years. The real danger is to local biological life of the phytoplankton living in the surface water around Antarctica. These small organisms form a part of the important food chain.

Other issues concerning the loss of ozone include induced changes in climate. According to Strahler and Strahler 2002; United States Environmental Protection Agency 2014, ozone is believed to be harmful to human lung tissue, and it aggravates bronchitis, emphysema, and asthma.

The result of incessant depletion of the ozone shield would have serious effects on human health (US EPA,2014). Additionally, growth of the world's oceanic plankton, the base of most marine food chains, would decline. Planktons contain photosynthesized organisms that break down carbon dioxide. If planktons' population declines, it may lead to increased carbon dioxide. If planktons' population declines, it may lead to increased carbon dioxide levels in the atmosphere and thus to global warming. Recent studies suggested that global warming, in turns, may increase the amount of ozone destroyed. Even if the manufacture of CFCs is immediately banned, the chlorine already released into the atmosphere will continue to destroy the ozone layer for many decades.

Impacts of Ozone Depletion

a. Changes in climate by raising the earth's temperature through which global warming is heralded.
b. reduction in crop yields. Plants are exposed to ultraviolet radiation due to changes in climate and stratospheric ozone and this is occurring in concert with rising atmospheric carbon dioxide concentrations, extreme air temperatures and more variable precipitation patterns (IPCC,2020).
c. disruption of marine food chain, and
d. inhibition of photosynthesis throughout which green plants manufacture their foods.(UNEP, 1989; WRI, UNEP and UNDP,1990/ 1991).
e reduction insoybean yields by 25%, plankton- the major food for ocean fish by 35% (Shea, 1988)
f increase the rate of skin cancer and blindness from cataracts, cause genetic changes ,impair human immune systems (UNEP, 1989; WRI, UNEP, UNDP 1990/91; Ehrlich and Ehrlich 1990 and Pan American Health Organization,

1990).It is ascertained by Begley, 1991 that for every 1% drop in ozone,the rate of skin cancer is projected to increase by 5% to 7

At what point then might the depletion of the world's ecological and biophysical capital undermine global public health? This question is asked because the greenhouse gases (heat trapping gases) most of which are secondary pollutants are continuously destroying the stratospheric ozone layer that could protect human body cells from the scorching effect of ultraviolet ray of the sun.

The ozone layer can be damaged by man in two ways. One is through production of fluorocarbons used in refrigerants, and aerosol propellants. The other is through nitrogen oxides produced from exhausts of high flying aircraft (SST) and perhaps from fertilizers. When fluorocarbons (also known as chlorofluoromethanes e.g. CCl3F and CC2F2) reach the stratosphere, the absorption of ultraviolet radiation causes the molecules to emit chlorine atoms (cl) which then react with ozone (O3) to produce chlorine oxide and oxygen.The chlorine oxide in turn reacts with atomic oxygen (O) to regenerate chlorine atom (cl) and oxygen. It is believed that such global warming will cause more violent storms in the tropics, a shift in climatic belts as we know them now.

Measures to Curb Stratospheric Ozone Depletion

Federal Ministry of Environment has started a sensitization programme for secondary schools in Abuja (Nigeria) on the danger posed by Ozone Depleting Substances (ODS). News Agency of Nigeria (NAN) reports that 20 secondary schools in Abuja took part in the programme. Speakingwith NAN in Abuja on the programme, AbdulkazimBayero, an Assistance Director in the Ministry, said students were among the groups targeted for information on the harmful effects of the substances.Bayero said the programme would involve all the 36 states in the federation and will start with FCT Secondary Schools. The Ministries of Environment in all the 36 states would help to educate secondary school students at the state level. The Assistant Director said the UNDP and United UNEP were supporting the programmes through the provision of information materials for distribution to students.

Bayero (2009) and others have pointed to the need for the global community to imbibe the use of Ozone friendly substances in the manufacturing of household equipment. Bayero said aircraft emissions of nitrogen oxides also play a part. Its part in reducing ultraviolet radiation from the solar spectrum is well documented and it has been feared that any reduction in this ability could increase the amount of ultraviolet radiation coming to the earth's surface resulting to health problems (e.g. Skin cancer).

Montreal Protocol was agreed upon and ratified in 1987, which came into effect in January 1989. It aimed at phasing out the use of harmful gases and chemicals globally as the first of several comprehensive international agreements (Wuebbles, 2022). The main CFCs ceased to be produced by the signatories in 1995, and the European Union ceased using them in1998. The benefits of Montreal Protocol were supported by Polvani et al., 2020; Goyal et al, 2019.

Nations close to Antarctic e.g. Australia are undergoing education programmes to ensure that people use sun block creams before they go out. Other measures include reduction of the gases right from domestic fuel consumption; control agriculture and waste management that emits methane and carbons, stop gas flowing and limit industrial air pollution etc.

Conclusion

The depletion of the stratospheric ozone shield has negative effects on the ecosystem within which both biotic and abiotic components are located. The actual destruction (depletion) is caused by anthropogenic activities, that is, human activities which could be summed up under the quest for livelihood. If human quest for survival is not reasonably and conservatively looked for, there is high tendency for human health to be absolutely affected which could lead to outbreak of diseases such as skin cancer, blindness, genetic changes among others.

Recommendations

Based on the above mentioned effects of ozone depletion, the following recommendations have been put up.

a. Government should continually organize environmental education for people to know how best to relate with their biophysical environment in order to achieve adequate conservation of their environment.
b. The Montreal Protocol that emphasized total ban on the use of chlorofluorocarbons should be embraced and acknowledged by different levels of governments (Local, State, National and at the International levels.)
c. .Punishments such as penalty and fines should be metted out to people who have violated the standing protocol.
d. The global community should adopt the use of ozone non-depleting methods in the production of household equipment.
e. The generation of waste and the actual disposal should be adequately managed to curb emission of toxic substances for man's environment to be adequately protected to achieve its sustainability.

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