

The Ozone Cycle in the Course of Study Related to the Biological Science at Various Levels

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Abstract - Ozone is constantly produced and destroyed in a natural cycle. Ozone production and destruction are balanced, ozone levels remain stable. Large increases in stratospheric chlorine and bromine have upset the balance of the ozone. In effect they have added siphon downstream, removing ozone faster than natural ozone creations can keep up. Therefore ozone level falls. It is essential to know about ozone and its circulation in environment to maintain a proper environmental balance. This is also essential knowledge for everybody studying the biology at various levels.

Keywords: Ozone, Ozone Layer, Ozone Hole, Depletion, Ozone Formation, Regulation.

I. INTRODUCTION

In the stratosphere, ozone is created primarily by ultraviolet radiation when high-energy ultraviolet rays strike ordinary oxygen molecules (O_2), they split the molecule into two single oxygen atoms, known as atomic oxygen. A freed oxygen atom then combines with another oxygen molecule to form a molecule of ozone. There is so much oxygen in our atmosphere, that these high-energy ultraviolet rays are completely absorbed in the stratosphere ozone is extremely valuable since it absorbs a range of ultraviolet energy. When an ozone molecule absorbs even low energy ultraviolet radiation, it splits into an ordinary oxygen molecule and a free oxygen atom. Usual this free oxygen atom quickly re-join with an Oxygen molecule. Because of this cycle, harmful ultraviolet radiation is continuously converted into heat.

Ozone layer in the atmosphere protects us from the harmful UV radiations of the sun. The depletion of this ozone (O_3) layer by human activities may have serious implications and this has become a subject of much concern over the last few years. On the other hand, ozone is also formed in the atmosphere through chemical reactions involving certain pollutants (SO_2 , NO_2 , aldehydes) on absorption of UV radiations. The atmospheric ozone it's now being regarded as potential danger to human health and crop growth.

Ozone is highly reactive gas which causes oxidation of a number of macromolecules within a biological system and produces free radicals which have been implicated in a

number of ozone induced pulmonary or extra pulmonary damages. DNA molecules and cause carcinogenesis. Ozone can crack and deteriorate rubber, damage textiles and other materials due to its strong oxidizing action. This gas is a deep lung irritant and when inhaled in large concentrations may cause pulmonary oedema leading to death of individuals.

II. THE GOOD AND BAD OF OZONE

Essentially, ozone (O_3) is an unstable and highly reactive form of oxygen. The ozone molecule is made up of three oxygen atoms that are bound together, whereas the oxygen we breathe (O_2) contains only two oxygen atoms from a human perspective, ozone is both helpful and harmful, both good and bad.

The temperature decreases with increasing altitude in the troposphere, while it increases with increasing altitude in the stratosphere. This rise in temperature in stratosphere is caused by the ozone layer. Ozone layer absorbs UV (ultra violet) light and thus protects all life, on earth from harmful effect of radiation. By absorbing the UV radiation the ozone layer, heats the stratosphere causing temperature inversion. It limits the vertical mixing of pollutants over larger areas and near the earth's surface. That is why a dense cloud of pollutants usually hangs over the atmosphere in highly industrialised areas causing several unpleasant effects,

The ozone problem is thus of global concern. In spite of slow vertical mixing, some of the pollutants (CFCs) enter the Stratosphere. The stratosphere could be regarded as a sink, but unfortunately these pollutants (CFCs) react with ozone and deplete it.

The ozone near the earth's surface in the troposphere creates pollution problems. Ozone and other oxidants such as peroxyacetyl nitrate (PAN) and hydrogen peroxide are formed by light dependent reactions between NO_2 (Nitrogen dioxide) and hydrocarbons. Ozone may also be formed by NO_2 under UV-radiations effect. These pollutants cause photo chemical smog. Ozone protects us from the harmful UV-radiations of the sun. In spite of being in such a small proportion (0.02 -0.07 ppm), it plays a major role in climatology and biology of the earth. It filters out all radiations, below 30000 Å. This ozone (O_3) is intimately connected with the life sustaining

process. Any depletion of ozone would, therefore, have catastrophic effects on life systems of the earth. Over the last few years it could be realised that the ozone concentration of earth's atmosphere is thinning out.

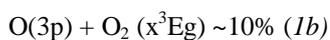
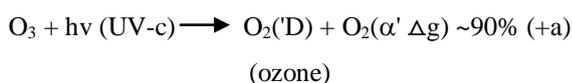
Depletion of ozone - In stratosphere, the depletion of ozone causes direct as well as indirect effect, since the temperature rise in stratosphere is due to heat absorption by Ozone, the radiation in ozone would lead to temperature changes and rainfall failures on earth. Moreover one percent reduction in ozone (O₃) increases ultraviolet (UV) radiation on earth by 2%. A series of harmful effects are caused by an increase in UV radiation. When the ozone (O₃) layer becomes thinning or has holes, it causes concerns, especially relating to skin like melanoma. A 10% decrease in stratospheric ozone appears likely to lead a 20-30% increase in skin cancer. The other disorders are cataracts, destruction of aquatic life and vegetation and loss of immunity.

Ozone Formation - Ozone is formed primarily from nitrogen dioxide (NO₂). Ozone can also react with nitrogen monoxide (NO), where by the ozone is used up and nitrogen dioxide forms anew. It only there hydrocarbons enter into the picture that really high levels of ozone are reached.

That is because the hydrocarbons can transform nitrogen monoxide to nitrogen dioxide without using up the ozone. In this way the nitrogen dioxide can again become the starting material for ozone.

The standard view is that solar radiation at wavelengths shorter than 242 nm photo dissociates oxygen, and the resultant atoms form ozone by O+O₂ reaction. But the atmosphere is a stew, albeit dilute, of high-energy particles. This is particularly true for oxygen. The products of direct drone photo dissociation are not necessarily distinguishable from those originating with oxygen (O₂). Thus, ozone photo-dissociation, usually viewed as a do nothing process in terms of changing the ozone balance, can have a significant effect in this regard, particularly because ozone photo-absorption rates are much greater than those for oxygen.

Life on earth is protected from UV-c radiation by stratospheric ozone photo absorption and dissociation



O(¹D) is quenched rapidly by all collision partners and is the single most important intermediate in the atmosphere as it generates several reactive molecules (OH, NO, and CH₃) important in stratospheric chemistry. Till, recently, the reaction shown in +b, giving ground state products, have been largely

ignored. But the active O₂ molecules appear to have much impact on atmospheric chemistry in that they are copiously produced and unlike O(¹D), are not rapidly quenched by O₂ and N₂.

III. OZONE CYCLE

Oxygen atoms cycle between oxygen molecules and ozone. The sun's rays split oxygen molecules apart into individual O atoms. These O atoms then join with an oxygen molecule (O₂) to make ozone (O₃). As the ozone absorbs UV rays, it splits into O and O₂. Then the atomic oxygen (single O atoms) will either join back up with an oxygen molecule, O₂, to make an ozone molecule again or "recombine" with an ozone molecule, O₃ to make two oxygen molecules.

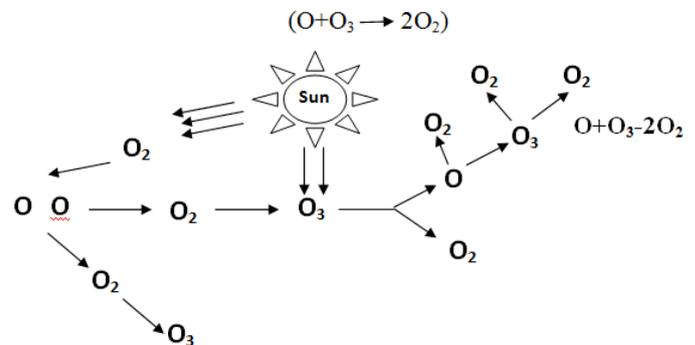


Figure 1: Ozone cycle

IV. CONCLUSION AND RECOMMENDATIONS

Ozone is generated in the lower atmosphere during the formation of photo chemical smog when nitrogen dioxide splits up to produce reactive oxygen atoms which combine with molecular oxygen - High up on the stratosphere oxygen molecules split up under ultraviolet radiations to produce oxygen atoms which combine with molecular oxygen to form ozone. It is this goes which forms the protective ozone umbrella in the stratosphere and shields life from biocide high energy radiations. But this gas is a serious pollutant lower down in the troposphere.

Ozone is highly reactive gas which causes oxidation of a number of macromolecules within a biological system and produces free radicals which have been complicated in a number of ozone induced pulmonary or extra-pulmonary damages. It has been suspected that these free radicals can damage DNA molecules and cause carcinogenesis. Ozone can crack and deteriorate rubber, damage textile and other materials due to its strong action. This gas is a deep long irritant and when inhaled in large concentrations may cause pulmonary leading to death of individuals.

Since the life sciences along with physical sciences have received much more attention to revise and refresh course there is an urgent need now to lay emphasis on the protection of environment all over the world and thence to provide a better life to the living beings of this planet. In order to maintain a proper balance between the environment and the human survival it becomes imperative to incorporate concepts of immediate concern that have direct implications not only to theory but practical work and their subsequent application for environmental protection and human survival. This is also significant with the view point to bring out social awareness towards the protection of environment, human survival and then to maintain the ecological balance.

Awareness for maintaining a proper balance between man, plants, animals, water, oxygen, carbon dioxide, nitrogen and ozone layer so that the proper balance between the Some may not be disturbed.

The study of such concept as ozone cycle should be specifically introduced in the course of study related to the biological Sciences at various levels.

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