Ozone layer formation through Corona Discharge utilizing natural phenomena

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***Abstract*—** Here it has been tried to explain the mechanism of ozone formation, which would travel into the stratosphere where the odd numbered oxygen particles(O3) has a longer lifetime, thus basically serving to the formation, even though gradually, of the ozone layer in the upper atmosphere. An indepth analysis has been provided on the basis of the current state of perception of various atmospheric characteristics and phenomena that can result or that can obstruct the formation of ozone particles. A theory has been developed and discussed for generation of climatic conditions to induce various phenomena like thunderstorms, lightning, etc.. The results of this phenomena is been tried to explain with greater detail. Static atmospheric conditions are discussed to try to analyse the effects on the resultant theory of ozone generation thus reducing or even curbing the global warming by compensation of the depletion of ozone.

***Keywords*—** corona discharge, global warming, lightning, ozone layer.

I. Introduction

OZONE layer protects the planet Earth from harmful solar and cosmic radiations. The intensity of its influence on living being and their sheer existence dominates when it comes to the critical issue of "Global Warming". The compromise with ozone layers declining ozone can pave a way for a disastrous and apocalyptic consequences. So it becomes a necessity for us to gain sufficient knowledge about the matter and provide some appropriate analysis to the subject, thus enlightening it.

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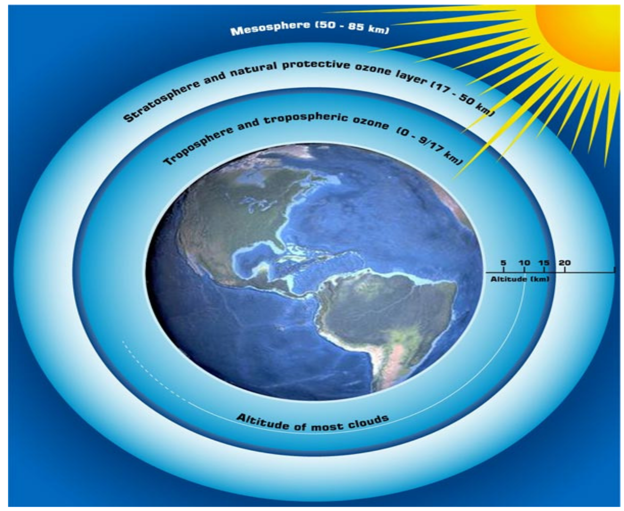

Fig. 1(a) Span of ozone layer

Planet Earth is surrounded by innumerable atmospheric layers surrounding it. It consists of, chronologically viewing from earths surface, the troposphere, stratosphere, mesosphere, thermosphere (ionosphere and exosphere), etc.. The ozone layer serves its existence in the troposphere and stratosphere at about vertically considering the perpendicular height of 15000m to 35000m above Earths surface.

Ozone layer is formed due to the appropriate blend of oxygen(O2), volatile organic compounds (VOC) and nitrogen oxides (NOx).

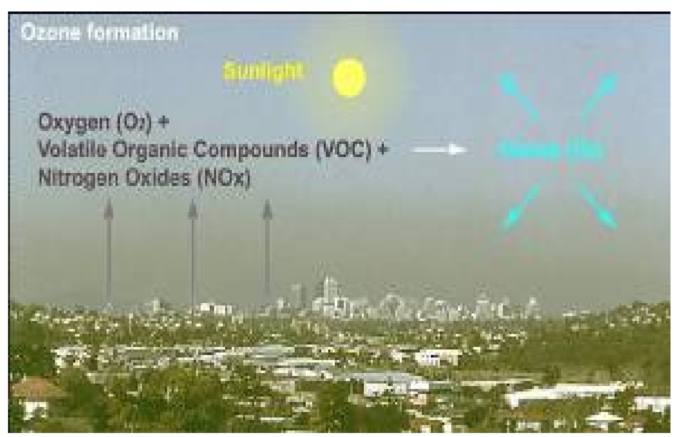

Fig. 1(b) Ozone formation

Volatile organic compounds helps as the catalyst for increasing the rapidness of ozone formation. This is also accompanied by sunlight which tries to ionize molecules in the ozone layer. Here the presence of nitrogen oxides is the most vital compound required for the formation of ozone. Without its presence in the upper atmosphere, the formation of ozone is practically not feasible in the natural environment.

II. Ozone Formation In Troposphere And Stratosphere

Ozone is a gas made up of three oxygen atoms (O3). It occurs naturally in small (trace) amounts in the upper atmosphere (the stratosphere). Ozone protects life on Earth from the Sun's ultraviolet (UV) radiation. In the lower atmosphere (the troposphere) near the Earth's surface, ozone is created by chemical reactions between air pollutants from vehicle exhaust, motor gasoline vapors, and other emissions. At ground level, high concentrations of ozone are toxic to people and plants. Ozone comes from the Greek "ozein" meaning "to smell", and ozone has a characteristic odor that you can detect around high-voltage discharges. A few examples are a photocopy machine, a television, or during a thunderstorm.

Formation of ozone (O3) is very different in the troposphere and stratosphere. The formation in the troposphere of ozone and related compounds, such as Peroxy-Acetyl Nitrate (PAN) is the result of reactions between nitrogen oxides and hydrocarbons.

Volatile organic compounds, such as hydrocarbons, together with nitrogen oxide and solar light, react to ozone and other pollutants. The light is needed because OH-radicals are, to a large extent, formed out of ozone and the initial step in ozone formation is the reaction of an OH-radical with a hydrocarbon.

Formation of OH-radicals

O_3 + hv ⇒ O_2 + $O(^1D)$ ($\lambda < 320$ nm)

$O(^1D)$ + H_2O ⇒ $2OH^\bullet$

Radicals are chemical species with an unpaired electron. And this single electron makes them reactive. Radicals are indicated with a dot behind their chemical formula. $OH^\bullet$ is the central species in atmospheric reactions.

In general light with a wavelength shorter than 400 nm is considered short wave. Visible light ranges from 400 to 750 nm and light over 750 nm is considered to be long wave.

Fig.2.3.1 Reaction scheme for OH radical formation.

Through this process, organic compounds are oxidized and eventually form carbon dioxide and water. Not only ozone and peroxides, but also extra OH radicals, are formed.

The compound chosen here to describe this process is methane, because it is simplest, but in principle all hydrocarbons follow this chain of reaction. Methane is converted first to formaldehyde, then oxidized to carbon monoxide and finally to carbon dioxide.

Fig. 2.3.2 shows the oxidation of methane to formaldehyde.

Oxidation of methane and ozone formation:

CH_4 + $OH^\bullet$ ⇒ $CH_3^\bullet$ + H2O

$CH_3^\bullet$ + O_2 ⇒ $CH_3O_2^\bullet$ (formula H_3C-O-O, peroxide)

$CH_3CH_3O_2^\bullet$ is formed the same way and can react with NO_2 according to:

$CH_3CH_3O_2^\bullet$ + NO_2 ⇒ $CH_3CH_3O_2\ NO_2$ (PAN)

PAN is quite toxic to human beings and damaging for ecosystems and used to be a major problem during episodes with very high concentrations of ozone which formerly occurred in the US and Europe, and currently in e.g. Mexico city. PAN is not very stable and can easily decompose at elevated temoratures. Peroxides are very reactive and interact with NO:

$CH_3O_2^\bullet$ + NO ⇒ $CH_3O^\bullet$ + NO_2

$CH_3O^\bullet$ + O_2 ⇒ H_2CO + $HO_2^\bullet$

Fig. 2.3.2 Oxidation of methane to formaldehyde.

In the process, four HO2 radicals are formed. The role of nitrogen oxides is to form back the OH• species. Nitric oxide (NO), nitrogen dioxide (NO2) and ozone (O3) are depending on the amount of light, in equilibrium. The result is a net production of four ozone molecules. Two extra OH• molecules are generated and importantly, the original NO molecules have reformed. In this process, nitrogen oxides act as a catalyst, not as a reagent, and one nitrogen oxide can form many ozone molecules until it disappears, mainly by conversion to nitric acid.

The role of nitrogen oxides is to form back the $OH^\bullet$ species from $HO_2^\bullet$ radicals.

$HO_2^\bullet$ + NO ⇒ $OH^\bullet$ + NO_2

NO_2 + hv ⇒ NO + $O^\bullet$ (< 380 nm)

$O^\bullet$ + O_2 ⇒ O_3

hv means light quant, in this case with a wave length of shorter than 380 nm.

Fig. 2.3.3 Conversion of HO2 to OH radicals.

Oxygen molecules, O2, are split by shortwave UV and the resulting oxygen atoms react with oxygen molecules to form ozone. The final result of formation of ozone in the stratosphere is shown in fig. 2.3.4.

Hence ultimately, the complete process of ozone formation in the stratosphere is understood. The resultant information will help us derive the reasoning for the chemical reactions that takes place when corona discharge technique is understood and applied.

Formation of ozone in the stratosphere, 20 to 40 km height:

$$O_2 + h\nu \Rightarrow 2O^\bullet$$

(wavelength shorter than 240 nm)

$$O^\bullet + O_2 \Rightarrow O_3$$

net: $3O_2 + h\nu \Rightarrow 2O_3$ **(fast reaction)**

And destruction:

$$O_3 + h\nu \Rightarrow O^\bullet + O_2$$

(wave length shorter than 1140 nm)

$$O^\bullet + O_3 \Rightarrow 2O_2$$

net: $2O_3 + h\nu \Rightarrow 3O_2$ **(slow reaction)**

The resultant ozone concentration is in the order of 5000 parts per billion (mixing ration in ppb, one ozone molecule on 10^9 air molecules

Figure 2.3.4 Formation of ozone in the stratosphere.

III. Ozone Generation Through Corona Discharge

Here the "Lightning" is employed as the catalyst for ozone generation. This section deals with the generation of ozone particles resulting due to the lightning in the upper atmosphere.

A. *Experiment Conducted*

Reference [3] shows the demonstration of a simple experiment. Experiment employed allows us to perceive the conditions and the amount of discharge required to generate ozone under static and dynamic atmospheric conditions. The experiment conducted requires a discharge tube to simulate the environmental conditions and few other apparatus.

B. *Construction of Discharge Tube*

A simple method for constructing the discharge tube, as shown in fig. 3.1.1, is presented here. An aluminium tube of 20 cm length and about 1 cm diameter is taken. This tube is blocked on the inside with small amount of m - seal compound, so that no air can directly pass through the middle hole.

To provide the discharge gap, a thin walled glass tube, commonly used as a chemistry test tube, is required. It should have inner diameter about 1.2 - 1.5 mm greater than that of aluminium tube, i.e., if a 10 mm outer diameter Aluminium tube is taken, a glass tube of 11.5mm inner diameter should be used. This will ensure the best performance with an air gap of 0.75mm all around. If the gap is 0.6mm, it is still better; but then the metal tube should be perfect.

The glass tube is cut such that it covers the length of the aluminium tube, except for about 1.5cm at each end. Now, the glass tube fits the metal tube with no gap. Still the glass tube should be able to slide over the aluminium tube.

After the glass tube is positioned over the metal tube, the ends of the tube are taped using Teflon tape. The tube assembly, with the glass envelope tape, is held at its edge leaving about 1.5cm free at either end, or clamp to the wall of a plastic box.

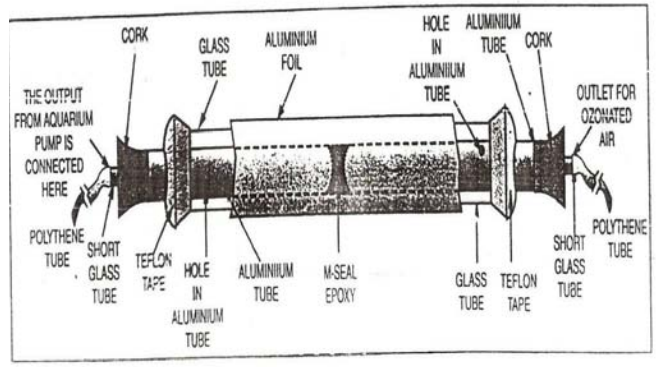

Fig. 3.1.1

C. *Preparation of Hot Electrode*

The hot electrode, to which a voltage greater than 6,OOO volts is applied at a high frequency, is made by closely wrapping plane aluminium around an outer side of the glass tube. The foil is wrapped leaving 1 cm uncovered area on either ends of tube. The foil is to be taped for tightness on the outer glass, using cellulose tape and the piece of Teflon insulated wire connected to aluminium foil should be brought out. This wire is connected to the EHT lead from the LOT on the circuit board.

D. *Experimental Setup and Working*

The following fig. 3.1.2 shows the block diagram of the setup of the experiment performed.

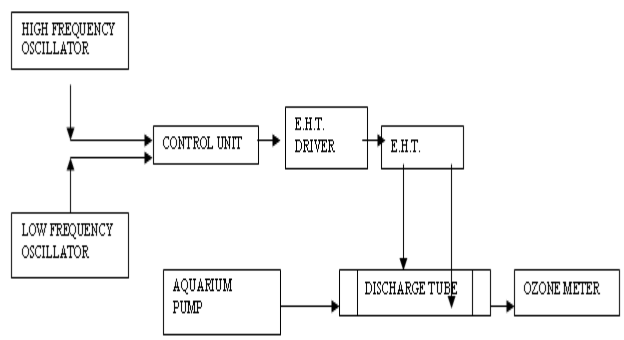

Fig. 3.1.2

The two oscillators will generate two frequencies such that the high frequency is 15-20 KHz and the low frequency is about 2 KHz. The output of these two oscillators is combined using a NAND gate in the Control Unit. The combined output is then inverted by using another NAND gate. The inverted output is then given to the next unit through a complementary push – pull amplifier circuit which is used to boost the signal. The next unit is basically an EHT Driver_which consists of a MOSFET, a boon to switch – mode circuit operation. The drain of this MOSFET is connected to the primary winding of the EHT transformer from where a Teflon insulated wire is taken out. The air flow (or any compound chemicals, stored in a pressurized cylinder, that are the dominant reactants in troposphere and stratosphere) passes through an aquarium pump. The quantity of ozone gas generated is depending upon the air (or any compound chemicals that are the dominant reactants in troposphere and stratosphere) supplied through the aquarium pump to the inlet of the discharge tube. The inner construction of discharge tube comprises of a separation created by a hollow cylindrical gap wherein actual electrical discharge takes place between two distinct electrodes due to the potential difference produced in accordance with the charge separation. High frequency causes hot electrode to generate 6 kV. Due to this voltage, an extremely high electric field is generated.

Ozone generator invariably makes use of a discharge tube to which a high electric field is applied, so as to breakdown oxygen present in the air. This phenomenon occurs at or near an electric field strength of 6kV/cm & the resulting discharge that takes place is known as CORONA. In this corona field, the oxygen becomes ozone (O_3).

Aluminium tube is placed inside the glass tube where high voltage as well as air (or any compound chemicals that are the dominant reactants in troposphere and stratosphere) is applied and sparking is occurring. In this way, the oxygen gas supplied by the pump is discharged to ozone.

E. *Experimental Results and Analysis*

I observed that the ozone meter detects the presence of ozone in the gaseous state at the output of the Discharge tube. The technologies involved in corona discharge ozone generation are varied, but all operate fundamentally by passing dried, oxygen-containing gas through an electrical field. The electrical current causes the “split” in the oxygen molecules as described in the section on ultraviolet ozone generation.

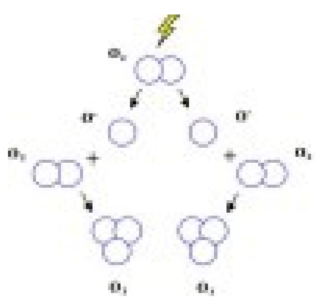

Fig. 3.2 Ozone being created via corona discharge

Past this common feature the variations are many, but the generally accepted technologies can be divided into three types - low frequency (50 to 100 Hz), medium frequency (100 to 1,000 Hz), and high frequency (1,000 + Hz).

Safety Note: Since 85% to 95% of the electrical energy supplied to a corona discharge ozone generator produces heat, some method for heat removal is required. Also, proper cooling significantly affects the energy efficiency of the ozone generator, so most corona discharge systems utilize one or more of the following cooling methods: Air or water.

F. *Corona Discharge*

The biggest natural phenomena that supports the theory of generating ozone is the Corona Discharge (Lightning). We all are aware of the fact that ionization is the result of very high temperature fluxes in the form of voltages or currents. Hence it is evident that, when lightning occurs, about 10% of the atmosphere surrounding it is converted into ozone. But ozone, in this atmosphere, is very negligible in amount and due to the decomposition property of ozone, it very easily converts back into oxygen compounds and hence is not a threat to human beings over the surface.

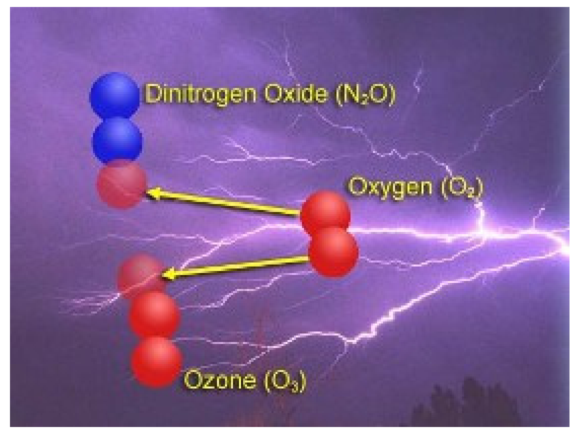

Fig. 3.4

Lightning is the direct result of the thunderstorms which is about 12000m above earth’s surface. Fortunately there the presence of nitrogen oxides (NOx) is abundant. Hence the generation of ozone can be achieved in appropriate amounts since the presence of ozone gas in the ozone layer is sparsely 10 parts per million amounts of air. So now the only requirement that holds the key to the threat of global warming is to create lightning within the specified atmospheric conditions.

Lightning produces nitrogen oxides within thunderstorms. These chemicals can react with others in the presence of sunlight to produce ozone (Fig. 3.4). Since most lightning occurs inside a storm, the added ozone tends to show up several miles high rather than near the earth's surface, so it doesn't add significantly to ozone pollution at ground level.

G. *Reactions*

Lightning produces Nitric oxides. If “hv” stands for “high voltage”, “R” stands for whatever the 3rd reactant is to carry out the energy from the reaction. Without the “R”, the reaction proceeds very slowly.

$$NO2 + hv \rightarrow O + NO \quad (1)$$
$$O + O2 + R \rightarrow O3 + R \quad (2)$$
$$OH + CO \rightarrow H + CO2 \quad (3)$$
$$H + O2 + R \rightarrow HO2 + R \quad (4)$$
$$HO2 + NO \rightarrow OH + NO2 \quad (5)$$

$$CO + 2O2 + hv \rightarrow CO2 + O3 \quad (6)$$

This is the net result, subtracting all the above equations and this is called tropospheric ozone production, that is, the net result of all these reactions is that O3 and CO2 are produced.

Hence, lightning produces NOx (NO+NO2) that can participate in ozone production in this way in troposphere. It is important to note that in all cases NOx is absolutely necessary for these reactions to happen. These reactions are negligible above troposphere.

H. Research Analysis

In 1996, NCAR and several other institutions studied the chemical environment of thunderstorms across the northeast plains of Colorado in the STERAO experiment noted above. This study confirmed that nitrogen oxides are more prevalent in the storm anvils rather than at the cloud bases. This lends support to the idea that thunderstorms have only a minor influence on ozone levels close to the ground.

Until recently, most studies of ozone and lightning have focused on measuring the production of nitrogen oxides in the immediate vicinity of storms. However, the resulting ozone has a long lifetime in the upper troposphere (a few miles above the ground), so it could be carried over long distances. According to an NCAR analysis, ozone from storms across southern Africa is being transported by the subtropical jet stream eastward to Australia, where it causes significant rises in ozone levels in the upper troposphere.

I. Directions of Research

Since the method described is yet not well posed and well developed till date, it becomes essential to provide certain directions of research. It is observed that employing the experiment, ozone is generated in the gaseous state. Hence, the theory justifies itself as a self developed prototype regarding the generation of ozone under the environmental conditions prevailing in the upper atmosphere i.e. from troposphere to stratosphere in general.

The ozone generated will be in the upper atmosphere itself. So, no effort shall be driven in the direction of transporting ozone particles above, towards troposphere. Hence the only problem would be of the generation of artificial lightning. Lightning can be generated artificially, methods of which are discussed under section V in detail. However, it is still a well known fact that generation of lightning is not a well perceived phenomena. Hence, all the researches are still at its preliminary stage.

The theory might well be a matter of subject regarding the amount of ozone particles generated. The graph in the fig. 3.4.3 shows the maximum amount of ozone particles required between troposphere and stratosphere, where resides the ozone layer. It is clearly seen that the amount of ozone particles required in the ozone layer, which is 2.5 ppm at its apex, is well below the amount of ozone particles generated due to manifested lightning which is well above 3 to 4 ppm.

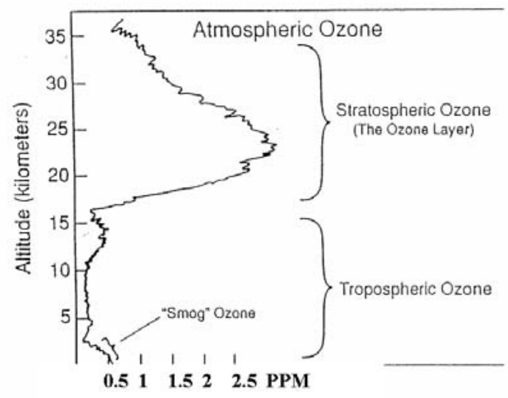

Figure 3.4.3. Ozone concentration in ppm (1 ozone molecule per 1 million air molecules) as function of height.

IV. GENERATION OF LIGHTNING

Lightning is the result of the thunderstorms formed in the upper atmosphere.

As per reference [1], in many storms worldwide, the negative region is found to occur between temperatures of -10 degree celcius to -25 degree celcius, centered on -15 degree celcius level, suggesting interactions involving ice phase. The process of cloud formation is shown by fig. 4.

The view currently favoured by the Royal Meteorological Society, in its 'Scientific statement on lightning'(RMS 1994), is that, during collisions between ice crystals and small hail pellets, in the presence of supercooled water droplets, the pellets becomes negatively charged while the ice crystals bounce off with a positive charge. The updraught then carries the crystals aloft, where they produce the upper positive charge, while the pellets are heavy enough to fall against the updraught, forming a negative charge lower down.

Atmospheric dynamics causing warmer temperatures results in a reverse charging process, giving the lower region a positive

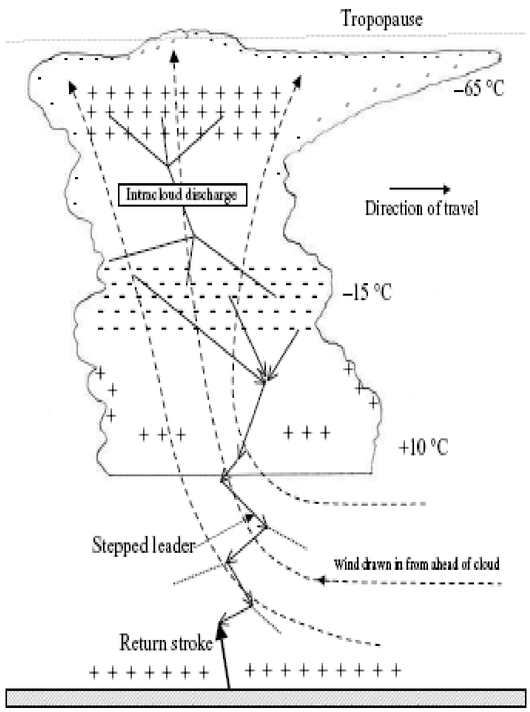

Fig.4

charge. The negative charged thin layer around the top edge of the cloud is produced by negative ions (due to cosmic ray activity) being attracted to the upper positive charge.

Discharging can be intracloud known as sheet lightning or from cloud to ground known as fork lightning. Over 70% to 90% of flashes are of sheet lightning type. A typical sheet type lightning discharge is shown in fig. 4.1.

Fig 4.1 Sheet Lightning over Kalgoorlie, Western Australia

V. Artificial Lightning Theories

Here Lightning is employed as the catalyst for the ozone generation. Artificial theories of generation of lightning suggests three of the following approaches under static consideration of the environment and atmospheric conditions. They are :

1. Insertion of plumes of highly active ionized aerosols or insertion of sprites.
2. Causing high frequency vibrations in the electron clouds in the upper atmosphere.
3. Creating a potential difference between Ground and cloud level.

A. Plumes and Sprites

The basic foundation supporting the theory of ozone generation is based on the fact that we can "seed" the upper atmosphere to produce sprites like we do in the lower atmosphere to make it rain. There are evidences, albeit limited, that clouds completely above the freezing level can become charged and plumes from volcanoes or forest fires can also produce lightning, as can sandstorms (Dudhia 1996,1997). An example of such naturally originating plumes is as shown in fig. 5.1(a). Even sprites, which are still less understood, in the mesosphere, occurs high above thunderclouds.

Fig. 5.1(a)

Hence, in accord with the given facts it can be deduced that if plumes of some highly active ionized infinitescimle particles are injected into the upper layer near or at the troposhere can produce lightning in the required regions which paves a way for ozone generation. An abstract view of seeding plumes is shown in fig.5.1(b). Injection of sprites as high electron density clouds, can also create discharges in the form of sheet lightning and hence generate ozone. Here it follows that major type of lightning would be of the sheet type which can generate good quantity of ozone molecules.

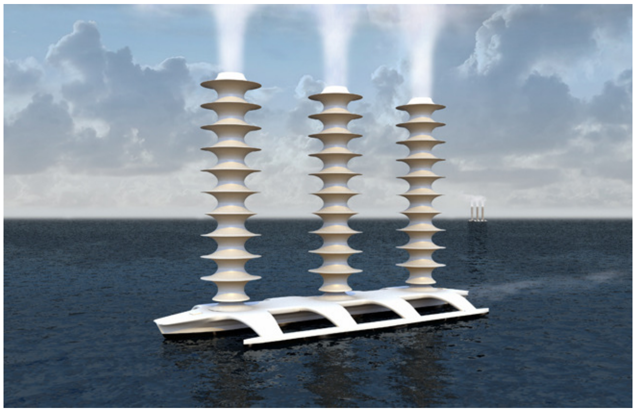

Fig5.1(b)

B. High Frequency Shock Waves

A turbulence within the ionic crystal structures in the upper atmosphere can create charge distribution which forms the basis of lightning.

Our troposphere (0-10km altitude) is composed of layers of air having different temperatures and moisture contents. When a sharp transition, called an inversion, appears between a cold dry layer and a warm moist layer of air, this transition causes refraction of radio waves. This is analogous to the refraction caused by the transition between water and air. For instance, when you put a stick into the water, it looks like it is bent. This same type of refraction occurs when a radio wave travels through a climate inversion.

Inversions usually develop under the influence of high pressure weather systems when there is very little air movement. Also, low pressure systems may produce an inversion when a cold air mass collides with a warmer air mass (called a frontal system in meteorology). Inversions that occur along frontal systems support propagation along a line parallel to the weather front, and radio amateurs using frontal inversion often point their antennas parallel to the frontal system to take advantage of this form of propagation.

Certain radio waves can be transported between these two inversions. Therefore, this type of propagation is called "ducting" (or "tunnelling"). Records of over 2500km have been set due to such ducting on VHF and UHF. It can occur as high as 1.2 GHz (usually along frontal systems).

Frequencies ranging from Extremely low frequencies to the Very High frequencies are trapped or reflected back on earth from the troposphere to the ionosphere (fig. 5.2(b)), depending on the atmospheric conditions prevailing during that time of the day.

Reference [12] shows that a Fourier spectral analysis is used to analyze the frequency power spectra of the wave packet, which propagates through and dwells within several thermal ducting regions (fig. 5.2(a)). The frequency power spectra of the wave packet are derived at several discrete altitudes, which allow us to determine the evolution of the packet. This spectral analysis also clearly reveals the existence of a stratospheric duct, a mesospheric and lower thermospheric duct, and a duct lying between the tropopause and the lower thermosphere. In addition, we determine the spatially localized wave kinetic energy density and the horizontally averaged, time-resolved, normalized vertical velocity. Examination of these diagnostic variables allows us to better understand the process of wave ducting and the vertical transport of wave energy among multiple thermal ducts. The spectral analysis allows us to unambiguously identify the ducted wave modes.Hence, a particular resonant frequency selection within a particular vector mode, is possible, that can get trapped between troposphere and stratosphere or mesosphere and causes huge amount of vibrations and oscillations of atoms in the upper layer on a continuous basis thus causing the formation of plumes of highly active ions ultimately resulting in the form of lightning due to charge separation.

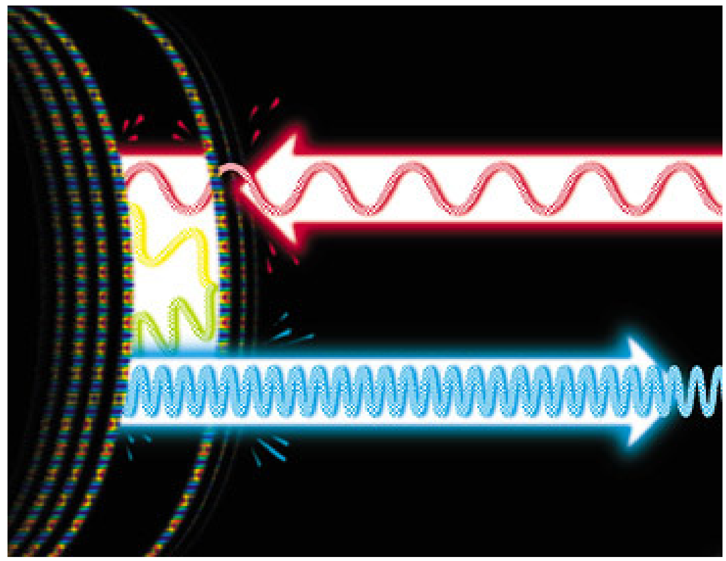

Fig. 5.2(a) Replication of resonant ducting wave with Doppler shift due to strong frequency generated vibrations.

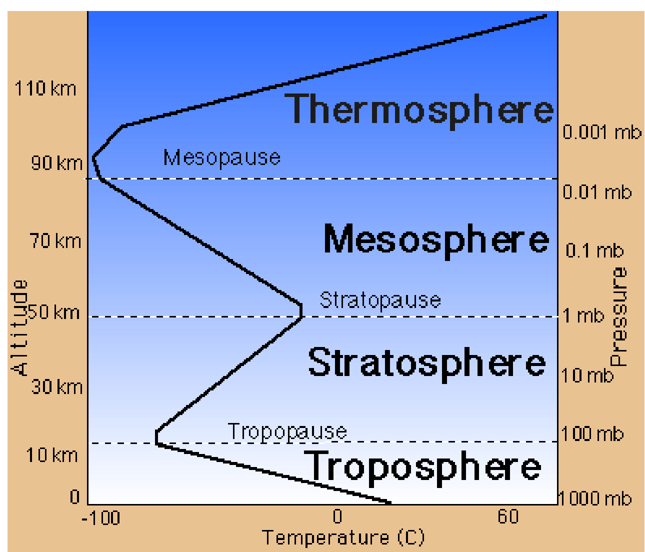

Fig. 5.2(b) Varying temperature and pressure as a function of height.

C. Potential Difference between Cloud and Ground

Cloud-to-ground lightning is the most damaging and dangerous form of lightning. Although not the most common type, it is the one which is best understood (fig. 5.3(a)). Most flashes originate near the lower-negative charge center and deliver negative charge to Earth. However, an appreciable minority of flashes carry positive charge to Earth. These positive flashes often occur during the dissipating stage of a thunderstorm's life. Positive flashes are also more common as a percentage of total ground strikes during the winter months.

Under static conditions a corona discharge can be obtained within an appropriate discharge tube, between two isolated terminals. Assume these terminals carrying ground and cloud potentials. A very high potential difference is required to be generated in order to achieve an electrical discharge through the insulating air between ground and clouds in the form of lightning (fig. 5.3(b)).

The brute force approach is to generate a multi million volt pulse of electricity, which will jump from the electrode to whatever is nearest. A million volts will reliably jump about 5-6 feet through the open air, with the distance proportional to voltage. Other objects would need to be a minimum of 20 feet away from the electrodes to prevent inadvertent side flashes which would damage equipment. The Deutsches Museum in Munich, Germany has a nice high voltage show which illustrates this technique nicely.

For testing purposes, some experiments could be employed alongwith the generation of very high voltages between electrodes. A better way, which we use to make the lightning safe and controllable, is to pre-rig a fine wire (invisible from more than 10 feet away) between the electrodes. A high energy electrical pulse vaporizes the wire (it actually explodes) and an electrical arc follows the path of the wire. Since there is a wire already there, we don't need as high a voltage to jump the gap. A single wire spanning 40 feet can be exploded with very high voltages near a megavolt (1,000,000 volts). With more reasonable voltages and powers, the wire segments are 6-10 feet long. To create longer lightning bolts, or for creating jagged forks, we arrange a series of wires, and fire them simultaneously or in quick succession. For multiple strokes, you can rig multiple wires, and switch between them during the show. Different types of wire can be used to produce colored arcs: red, yellow, green, blue, etc

In an abstract sense, a charge over surface can be created employing any good conductor rod array or thick plated metal (fig. 5.3(c)). Supplying Very high voltage can generate a particular charge separation between Earth and cloud. When the potential difference between earth and cloud exceeds the potential difference required for air insulation to break, a spark in the form of lightning flash is induced. As soon as the lightning is produced, the chemical reactions in the upper atmosphere causes the generation of ozone particles. Required proportions of ozone can be generated, which depends upon the potential difference created, thereby, causing High Voltage lightning to break more chemical compounds resulting in higher amount of ozone particles ultimately produced.

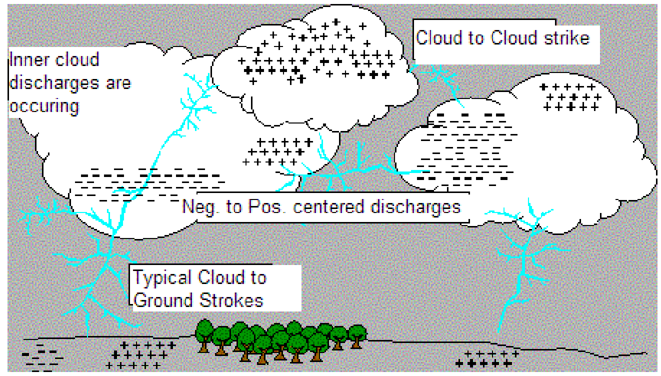

Fig.5.3(a) Charge distribution for Cloud to Ground Lightning.

Hence, through scientific methods, either ground potential or cloud potential or both are required to be varied in order to carry the corona discharge in the form of lightning thus resulting into the generation of quantum amounts of ozone.

Fig.5.3(b) An example of Cloud to Ground Lightning.

Fig.5.3(c) A replica of very high voltage plates affixed to generate charge separation.

VI. Conclusion

The following important conclusions can be drawn from the previously described data :

Lightning can be employed to replace the lost ozone within the ozone layer.

Over 70% to 90% of flashes are of sheet lightning type.

A turbulence within the ionic crystal structures in the upper atmosphere can create charge distribution which forms the basis of lightning.

Artificial lightning techniques utilizes natural phenomena of Lightning strikes. Hence nature is employed as a stealth and the ideal model for generation of lightning in adequate proportions.

Higher amount of ozone can be generated through sheet type lightning rather than cloud to ground lightning.

Since most lightning occurs inside a storm, the added ozone tends to show up several miles high rather than near the earth's surface, so it doesn't add significantly to ozone pollution at ground level.

The mere employment of science and technology cannot help the process of generating ozone and also without providing fatal side effects (viz. pollution). The only way to fulfill the requirement is by making the natural phenomena, the stealth, for creating a harmless ozone and thus achieve our objective by being in harmony with nature and employing natural laws, the biggest weapons in harnessing our need for generating ozone.

Here, the theories described, are illustrated on static atmospheric considerations but with a view to enhance these applications in the near future for the protection and well-being of all species from the worlds biggest threat "Global Warming".

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