Ozone Generation

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Abstract- *The current report relates to the project, ozone generator. Since last few decades a steady decline in the total percentage in the ozone concentration in the atmosphere has been observed. Reduced ozone cover in the earth's atmosphere makes the life-form on earth prone to destruction by the harmful ultraviolet light coming from the sun. Due to a constant increase in the industrial as well as the automobile sector the air pollution is on rise. We cannot eliminate the pollution directly, but we can surely counteract the effects of pollution. Hence, the need of an ozone generator is felt. The current project focuses on the generation of Ozone (O) gas using the corona discharge principle. It is a portable Ozone generator for producing ozone in high concentrations. It consists of an enclosed casing which houses a high alternating voltage supply circuit, a tube-in-tube structure for producing ozone and a blower for dispersing ozone. An ON/OFF switch is also used for activating and de-activating the module Also, an ON/OFF switch is provided for controlling the blower.*

I. INTRODUCTION

The present report is related to the production of ozone using corona discharge principle, Ozone is a tri-atomic, inorganic molecule with the chemical formula O_3. It is a pale blue gas with a distinctively pungent smell. It is formed from di-oxygen by the action of ultraviolet light and also atmospheric electrical discharges, and is present in low concentrations throughout the earth's atmosphere. The highest levels of ozone in the atmosphere are in the stratosphere in a region also known as the ozone layer between about 10km and 50km above the surface.

Ozone layer filters out sunlight wavelengths from about 200nm UV rays to 3150m, with ozone peak absorption at about 250nm. This UV absorption is important to life, since it extends the absorption of UV by ordinary oxygen and nitrogen in air. The ozone layer absorbs 97-99% of the Sun's medium-frequency ultraviolet light (from about 200 nm to 315 am wavelength), which otherwise would potentially damage exposed life forms near the surface. Ozone in the Earth's stratosphere is created by ultraviolet light striking oxygen molecules containing two oxygen atoms (02), splitting them into individual oxygen atoms (atomic oxygen)(*fig.1.1)*; the atomic oxygen then combines with unbroken $O_2$to create ozone O_3

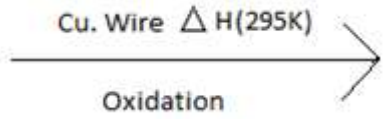
$$3O_2 + \text{UV-B} \rightarrow 2O_3$$
$$O+O2 \rightarrow O3$$

The ozone layer can be depleted by free radical catalysts, including nitric oxide (NO), nitrous oxide (NO), Hydroxyl(OH), atomic chlorine(Cl), and atomic bromine(Br). While there are natural sources for all of these species, the concentrations of chlorine and bromine have increased markedly in recent years due to the release of large quantities of man-made organ halogen compounds, especially chloral-fluoro-carbons (CFCs) and bromo-fluoro-carbons. These highly stable compounds are capable of surviving the rise to the stratosphere, where Cl and Br radicals are liberated by the action of ultraviolet light. Each radical is then free to initiate and catalyse a chain reaction capable of breaking down over 100,000 ozone molecules. The breakdown of ozone in the stratosphere results in a reduction of the absorption of ultraviolet radiation. Consequently, unabsorbed and dangerous ultraviolet radiation is able to reach the Earth's surface. Ozone levels over the northern hemisphere have been dropping by 4% per decade.

Over approximately 5% of the Earth's surface, around the north and south poles, much larger seasonal declines have been seen, and are described as ozone holes. In 2009, nitrous oxide (NO) was the largest ozone-depleting substance (ODS) emitted through human activities the emission of these ozone depleting substances cannot be eliminated directly but their effect can be minimised to some extent and the holes thus generated in the ozone layer due to these radicals can be covered. Ozone generation by corona discharge method is an effective way of doing so. Ozone generating devices are available commercially. These devices make use of UV lamps for the production of ozone. But the ozone so generated is very little in concentration. Also, the amount of electricity required for generating ozone is much higher Emphasis is laid in this project for creation ofsuch an ozone generating device which generates high amount of ozone but consumes a little amount of energy the ozone generator is a simple device held in a casing. The corona discharge so generated in the structure is responsible for the production of ozone gas. Upon generation, ozone can be used efficiently for the covering of ozone holes. Ozone, being a lightweight molecule has a lower density as compared to the other atmospheric gases. Hence, even upon being generated at the ground level it automatically

rises in the stratosphere, the ozone layer and gets settled over there.

The given chemical reaction states that 4 oxygen atoms when added with nitrogen, heat is added in the copper wire with ΔH of 295K and the oxidation reaction occurs in between. Oxidation reaction is a reaction in which the oxidation states of atoms are changed. Then the ozone is formed, taking one atom from oxygen which is charged and remaining will split to nitrogen dioxide.



$4O_2+N_22O_3+NO_2$

1.1 PROBLEM STATEMENT

Mostly ozone generation are done with higher cost and more amount of electricity

1.2 OBJECTIVES

- To increase production of ozone
- To minimize cost
- To get negligible amount of No_2
- Control of pollution and kill bacteria
- To apply our new concept

1.3 SCOPE

The scope of the market analysed in this report includes OGT categories for water applications, air and gas treatment, and medicine on a global basis.

1.4 METHODOLOGY

Ozone or trioxide, is an inorganic molecule with the chemical formula O It is a pale blue gas with a distinctively pungent smell. It is an allotrope of oxygen that is much less stable than the diatomic allotrope O breaking down in the lower atmosphere to O or dioxygen. Ozone is formed from dioxygen by the action of ultraviolet light (UV) and electrical discharges within the Earth's atmosphere.

Ozone's odour is reminiscent of chlorine, and detectable by many people at concentrations of as little as 0.1 ppm in air. Ozone's O3 structure was determined in 1865. The molecule was later proven to have a bent structure and to be diamagnetic. In standard conditions, ozone is a pale blue gas that condenses at progressively cryogenic temperatures to a dark blue liquid and finally a violet-black solid. Ozone's instability with regard to more common dioxygen is such that both concentrated gas and liquid ozone may decompose explosively at elevated temperatures or fast warming to the boiling point.

Ozone is a powerful oxidant (far more so than dioxygen) and has many industrial and consumer applications related to oxidation. This same high oxidising potential, however, causes ozone to damage mucous and respiratory tissues in animals, and also tissues in plants, above concentrations of about 0.1 ppm. While this makes ozone a potent respiratory hazard and pollutant near ground level, a higher concentration in the ozone layer (from two to eight ppm) is beneficial, preventing damaging UV light from reaching the Earth's surface.

II. LITERATURE REVIEW

- **Boudiaf.M et,Al [2016] [school of engineering Taylor's university],**Development of high voltage power supply for ozone -This type of ozone generator required high Maintenance.
- **Cleland M [2015][IBA industrieal,inc,NY USA],**Ozone Generation in Air during Electron Beam Processing,-This type of ozone generator Has low Accuracy.
- **Laercio Ferro Camboim et, All [2017][ISOR journal of electrical engineering],**Construction of Low budget ozone generation prototype-By Using die electric material as aluminium foil.
- **Rajendra Shrestha [2016][department of natural science Kathmandu university, Nepal]**, Study of Ozone Generation by Atmospheric Pressure Dielectric Barrier Discharge- By using dielectric material Aluminium Foil corona discharge is occurs.
- **Nacera Hammad**By using dielectric material Aluminium Foil corona discharge is occurs-By using this paper Reaction temperature is obtain for better oxidation.
- **k.hadgi [2014] [Infoma LTD. London, UK],**Ozone generation by negative corona discharge by mixture on N_2 and O_2-From this paper the Diameter of tube is determined.

2.1 DEVLOPMENT OF HIGH VOLTAGE HIGH FREQUNCY POWER SUPPLY FOR OZONE GENARATION

2.1.2 ELECTRICAL CHARACTERIZATION

The DBD ozone generator has been implemented and tested using the experimental bench .the ferrite-core HV transformer energized by the inverter, supplies the ozone

generator. A high voltage probe (Tektronix 6515A) and a digital scope (GW INSTEK GDS-8400) were used to visualize the output high voltage.

2.1.3 Ozone generation

The power supply and ozone generator were thereafter tested for water treatment, using an experimental laboratory bench described. A first set of experiments was carried out with tap water to measure the ozone concentration dissolved in water. The contaminated water to be treated of volume 10 L is set in moon by means of a water pump with a water flow rate of 10 L/min. A Venturi system enables injection of ozone within the water loop and the ozonised water is traduced in the tank in a closed-loop system for a total duration of 10 un

2.2. OZONE GENARATION IN AIR DURING ELECROBEAM PROCESSING

2.2.1 Ozone production rate

A more accurate way is to use a Monte Carlo computer program to calculate the energy deposition per electron in units of MeV cm/g or MeV/ (g/em) in many thin air spaces between the beam window and the irradiated material. When these energy deposition values are multiplied by the associated area or areal density values Zin g/cm, the result is the energy deposition per electron in MeV units in each of the thin air spaces.

The ozone production rate can be obtain by using equation above and the beam power deposited in the air space 4.883 KW

Ozone production rate = 8.95*10^-2 p (air) kg/h
Ozone production rate = 8.95*10^-2*4.883
Ozone production rate = 4.37*10^-1 kg/h

III. CONSTRUCTION OF LOW BUDGET OZONE GENERATION PROTOTYPE. (CORONA DISCHARGE)

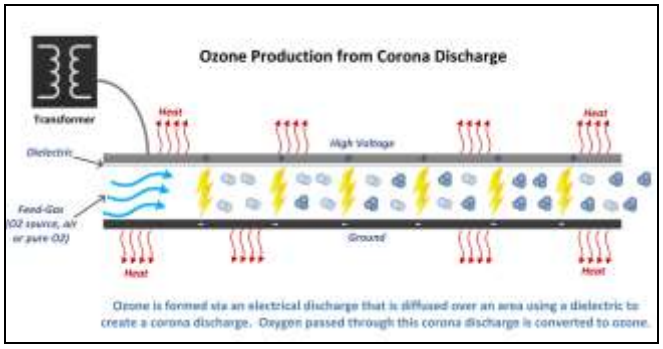


Fig.3.1corona discharge principle

3.1 Working principle and construction

One of the most common phenomena found in electrical engineering is the corona effect, which electrostatic discharge choir due to it's of an acting music rally sea to am clime field with sufficient it to break its dielectric strength la dioptric power, the effect abo known c discharge is not only disadvantageous it has some industrial applications, such as the delta l on aircraft surfaces, and especially in one production One of one application is the cell cuts treatment,. action gas absorption process where the limiting step of the process is the mass transfer due to too low of anime in the water Corona effect generates ozone through a high voltage process that produce to math electric field to break the dielectric strength of the air between the electrodes, we reach high speeds, breaking the oxygen molecules and forming zone when regrouping O compound The electric discharge process, which consists in the application of an electrical potential difference at the reactor electrodes, can be obtained from the use of a fly back converter, exceed by frequency oscillator acting as a high voltage transformer

*At 27 to 30 *c the ozone deformation occurs*

3.2.1Methodology for preparing inner glass tube:

The inner glass tube is a simple glass test tube it is made up of hardened glass it is cylindrical shape with outer diameter 28mm, length 150mm and thickness inthe glass cube which is bought for the supplier is closed at one of the ends.

Fig.3.2 INNER GLASS TUBE

3.2.2Methodology for preparing outer glass tube:

The outer glass tube is a simple glass test tube). It is made up of hardened glass. It is cylindrical in shape diameter 32mm, length 210mm and thickness 1.5mm.

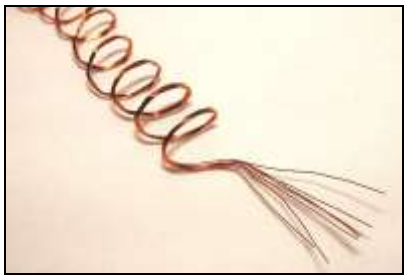


Fig 3.3 OUTTER GLASS TUBE&COPPER WIRE

3.2.3Capacitor:

The capacitor used in this project is of 440V 3.5uF. One of its terminals is connected to the positive of primary of ignition coil.

Fig 3.4440v Capacitor

3.2.4Light Dimmer:

The light dimmer used in this project is a simple TRIAC device. It is a 1000W light dimmer

Fig 3.5Light dimmer

3.3.5Ignition coil:

The ignition coil is a simple step up transformer with three terminals namely, positive form primary, positive for secondary and neutral.

Fig 3.6 Ignition coil

IV. DESIGN& CALCULATION

V=IR
Current at minimum = 0.05Amp.
Now at maximum = 0.27 Amp.
For best oxidation reaction V_{min}= 2 v

At minimum,
V=IR
2= 0.05R
R= 40 ohm.
At maximum,
V=IR
2=0.27R
R= 7.4 ohm.

For temperature we have,
$T=V-V_{ref}/10mV$
T = 230-2/10
T=22.8 C 295.8 K

Mass flow rate,

CPU fan specification,
N=2000 rpm
D=0.12 m

V= ((3.14*D*N)/3600)
V=753.98/3600
V=0.2094 m/s

Q=AV
$Q=0.785(D^2-d^2)*V$
$Q=0.785(0.030^2-0.028^2)*0.2094$
$Q=1.907\ m^3/sec$

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