PRODUCTION OF OZONE

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by

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APPROVAL SHEET

This research paper entitled, " Production Of Ozone " submitted by Leonila Teresa Jaca Rojas in partial fulfillment of the requirements in Science Research II, has been examined and is recommended for acceptance and approval.

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SALAMAT GUD HIN MADAMO !!!!!!!

CHAPTER I

INTRODUCTION

A. BACKGROUND OF THE STUDY

Changes such as less land for agricultural activities, constant expansion in population, rapid increase in pollution in land, water, and air. These, and many more, environmental changes have affected our daily lives. But their effects could be made useful if we would be able to understand their every behaviour and characteristic.

Since we were never contented with what we usually have at present for we continue to hunger for more information, many researches have been conducted. But as more and more knowledge we gain from interpreted results, the more we ask for more.

Yes, we know a lot of data regarding the changes in the environment but little do we know about the details because we often loose interest immediately. Well, this study is an answer to that. Ozone is a very controversial topic nowadays, but we think we already have enough about this gas. This study summarises the facts presented by encyclopaedia, scientific articles and journals about this topic, and other sources and would add more details especially on its physical attributes and behaviour.

B. PROBLEM STATEMENT

Designed to produce and gather ozone and discuss information about the characteristics and qualities of ozone, this study was conducted with the aim at answering the following questions :

1) Is it possible to produce ozone in a laboratory at Philippine Science High School using only the basic apparatuses offered and available at the said laboratory ? and

2) Is it safe to produce ozone, even at small scales, in the mentioned laboratory?

C. HYPOTHESES OF THE STUDY

Since the production of ozone is an experiment, this study had the following hypotheses :

1) Production of ozone, even at small scale only, was not possible though proper experimentation and observation of procedures and techniques were followed.

2) It is not safe to produce ozone despite the precautionary measures observed.

D. OBJECTIVES OF THE STUDY

Factors concerning the changes in our environment have affected many of our lives. There is no other better way of resolving these problems but to be able to explain and understand them fully for our own benefit. Conducting experiments and studies regarding these topics are just two of the many ways of doing this.

Environmental changes will continue to come and so as changes in ozone. So to help us learn about ozone, this study was aimed at ;

1) knowing whether it is possible to produce ozone in small scales to avoid certain harmful reactions in the surrounding that could disturb the environment ; and

2) producing enough ozone for the researcher to be able to gather distinctive qualities and record them as well.

E. SIGNIFICANCE OF THE STUDY

Studies regarding typhoons, tornadoes and twisters, earthquakes, and tidal wave which have caused many changes in the present environment have been explored by many unlike ozone, which is the "topic of the day."

Since many experiments and researches can yet be conducted to know more of ozone's existence, this study was formulated.

Ozone is a very important gas because it plays a very important role vital for the survival of the living creatures in this planet.

Furthermore, awareness of its physical appearance and behaviour could, one or another, trigger an idea that might improve the present day society.

F. STUDY SCOPE AND LIMITATION

Technology is very helpful especially in the fields of sciences specifically research. However, it is best that we know, or at least familiarise ourselves, the basic principles, concepts, and theories and the application of which.

Basic apparatuses have been used in the set-up namely test tube, iron stand and clamp, glass and rubber tubings, flask, corks, alcohol lamp, and a container (ice-cream gallon). An UV radiating lamp was used for the conversion of oxygen to ozone.

The experiments were conducted at the Chemistry laboratory of the Philippine Science High School - Western Visayas Campus.

Therefore, production was limited to the volume that could be contained by the apparatuses.

CHAPTER II

RELATED LITERATURE :

The word ozone, nowadays, seem to be a household term but the true meaning and use of this gas is, unfortunately, unknown to many.

Ozone, a triatomic allotropic (a form in which the molecule contains three instead of two as in the common form) is a pale bluish-coloured gas with a distinctive smell rather like a scent of odour similar to that of weak chlorine. It is found in very small quantities in the lower atmosphere but in considerable quantities at the height of 50 kilometres above sea level.

In comparison with oxygen, it is 1.5 times denser; at -112°C (-170°F) it condenses to a dark blue liquid, which Freezes at -251.4°C (-420°F). The gas decomposes rapidly at temperatures about 100°C (212°F)or, in the presence of certain catalysts, at room temperature.

Just like all the rest of matters - solids, liquids, and gases - ozone has its own properties and uses, aside from what has already been mentioned.

Ozone is both beneficial and harmful to mankind. It is beneficial because it serves a s a protection to all life on earth from overdose of ultraviolet light given off by the sun. The blanket of ozone in the upper atmosphere (10 to 30 miles up From the stratosphere) of the earth absorbs much of this ultraviolet light. This protective blanket is called the ozone layer, to many.

In nature, a region of the atmosphere (q.v.) from 19 to 48 km (12 to 30 miles) above the earth's surface, where ozone concentrations of as much as 10 parts per million occur. The ozone forms there by the action of sunlight on oxygen. There it is formed primarily by a short-wave solar ultraviolet radiation (wavelengths shorter than 242 nanometers) , which dissociates normal molecular oxygen (O2) into two oxygen atoms. These oxygen atoms then combine with nondissociated molecular oxygen to yield ozone. Ozone, once it has been formed, can also be easily destroyed by solar ultraviolet radiation of wavelengths less than 300 nanometers. This action has been taking place for many millions of years, but naturally, occurring nitrogen compounds in the atmosphere apparently have kept the ozone concentration at a fairly stable level. Because the ozone layer protects life on earth from the full force of the sun's cancer-causing ultraviolet radiation, it is critically important. Therefore, scientists were concerned when they discovered, in the 1970s, that certain chemicals called chlorofluorocarbons, or CFC's – long used as refrigerants and in aerosol spray cans -- posed a possible threat to the ozone layer. Released into the atmosphere, the chlorine-containing chemicals rise and are broken down by sunlight, whereupon the chlorine reacts with and destroys ozone molecules. For this reason, the use of CFC's in aerosol has been banned in the U.S. and elsewhere. Other chemicals, such as bromine halocarbons and nitrous oxides from fertilisers, may also attack the ozone layer.

For several years, beginning in the late 1970s, research scientists have

working in Antarctica detected a periodic loss of ozone in the atmosphere high above that continent. The so-called ozone " hole " develops in the Antarctic spring and continues for several months before closing up again. Other studies indicated that the overall percentage of ozone in the ozone layer above the Antarctica is actually declining. Studies made world-wide during the 1980s concluded that global levels of ozone had dropped during the previous several years, most notably over the Northern Arctic region, but also over major cities as well as across the heavily populated regions of the northern hemisphere. Some of this loss might be attributable to natural and periodic phenomena not yet understood, but human activities seem largely to blame. In 1987, a treaty for protection of the ozone layer was signed and later ratified by 36 industrial and developing nations, including the U.S. A total ban of CFC's during the 1990s was proposed by the European Community in 1989, a move endorsed by U.S. President George Bush.

But it should be noted that the ozone layer is not truly a layer, that is, with ozone stratified into a separate band. Ozone molecules are present throughout the atmosphere and, at the ratio of 1 ozone molecule to 100,000 other molecules, are simply more abundant in the region 6 to 25 miles (10 - 40 km) above the earth than in the atmosphere below. Similarly, " ozone hole " is a somewhat imprecise but catchy term referring to a relative depletion of stratospheric ozone in a local region. It is most often applied to the springtime reduction of ozone that takes place over Antarctica, but stratospheric ozone depletion has recently been observed in the Northern Hemisphere as well.

Significant increases in the amounts of ultraviolet radiation reaching the earth from the sun, such as might occur as a result of ozone depletion in the stratosphere, could cause skin cancer and cataracts in humans and damage agriculture crops and natural ecosystems.

Because atmospheric scientists have linked increasing quantities of CFC's in the stratosphere with a general increase in seasonal stratospheric ozone depletion in recent years, national and international efforts have been made to reduce the use of CFC's. The United States, for example banned CFC's after 1995. Internationally, an agreement called the Montreal Protocol, mandating a reduction in the use of CFC's, was reached in 1987; the agreement was strengthened in 1990 to require an end to the production of CFC's by the year 2000.

Some scientists have disputed the connection between CFC's and stratospheric ozone depletion on the grounds that 1) the relatively high molecular weights of CFC's would prevent them from reaching the stratosphere in sizeable amounts, and 2) that chlorine compounds from natural sources, such as sea water and volcanoes would outweigh any possible effects of CFC's in the upper atmosphere. Atmospheric scientists point out, however, that the motions of large masses in the atmosphere mix heavy and light gaseous molecules at equal rates without being separated by gravity, and that chlorine compounds from natural sources are washed out of the air by rainfall, with only relatively small amounts reaching the stratosphere. The special properties of CFC's are that they are not

water-soluble and that they are very chemically inert, so that remain chemically intact until they reach the stratosphere.

There are still many scientific uncertainties surrounding the problem of ozone depletion. For example, no study has determined that the amount of ultraviolet light reaching the earth's surface is actually increasing. For this reason, there can be disagreement as to present seriousness of the problem. Moreover, the fact that the extent of ozone losses are not readily predictable from year to year indicates that various influences other that CFC concentrations, such as natural changes in atmospheric circulation or sulfuric acid from volcano eruptions, may be contributing factors. Such uncertainties can only be clarified by additional research.

This severe regional ozone depletion was explained as a natural phenomenon.

Despite all these alarming data, it is known that ozone has been used with ultrasonic (noiseless) sound to purify sewage. The sound breaks the large particles into smaller particles and ozone destroys the bacteria and viruses. Ozone by itself has also been used as a replacement for chlorine in water purification. Water is treated in this manner lack disagreeable taste of water treated with chlorine.

Ozone is produced commercially for special uses. It is a good disinfectant and as such is used to purify water, as mentioned already, " sweeten " the atmosphere in closed systems, and disinfect or sanitise objects and foods. It is used as a ripener for grains and fruits and as a bleaching agent. The chemical

laboratory is frequently equipped with an " ozonizer " to produce ozone for use in chemical analysis and synthesis processes.

Ozone presents a major threat to leafy vegetables, field and forage crops, shrubs, and trees, particularly conifers. Damage from minute quantities of ozone can be significant; the yield of radishes can be reduced 50 percent be extended exposure to 0.05 parts per million.

Ozone damages textiles, discolours dyes, and greatly accelerates the cracking of rubber products.

Rubber is rapidly attacked by ozone, even in very low concentrations. In certain areas (such as Los Angeles) the significant concentration of ozone in the air results in rapid deterioration of rubber products unless these are protected with antioxidants. The same is true of many other major cities.

Ozone is quite toxic. Continued breathing of air with more than very low concentrations of ozone will cause headaches, nausea, and various other unpleasant effects.

Under certain conditions, photochemical reactions in the lower atmosphere can produce ozone in concentrations high enough to cause irritation of the eyes and mucous membranes.

Ozone usually is manufactured by passing an electric discharge through a current of oxygen or dry air. The resulting mixture of ozone and original gases are suitable for most industrial purposes, although purer ozone may be obtained from them by various methods; for example, upon liquefaction, an oxygen-ozone mixture separates into two layers, of which the denser one contains about 75

percent ozone. The extreme instability and reactivity of concentrated ozone makes its preparation both difficult and hazardous.

Furthermore, because of the strong absorption of solar ultraviolet radiation by molecular oxygen and ozone, solar radiation capable of producing ozone cannot reach the lower levels of the atmosphere, and the photochemical production of ozone is not significant below about 20 km (12 miles). This absorption of solar energy is very important in producing a temperature maximum at about 50 km (30 miles), called the stratopause, or the mesopeak. Also, the presence of the ozone layer in the upper atmosphere, with its accompanying absorption, effectively blocks almost all solar radiation of wavelengths less than 290 nanometers from reaching the earth's surface, where it would injure or kill most living things.

Certain air pollutants, particularly chlorofluorocarbons (as thoroughly discussed above), halons (chlorofluorobromine compounds), and nitrogen oxides can diffuse into the ozonosphere, another name for ozone layer, and destroy ozone.

When all the water in the flask was displaced, the flask was covered by a cork to stop the gas in the flask from escaping.

To know if the gas collected was truly oxygen, the splintered test was applied. Since the splinter glowed brightly after it was exposed at the opening of the flask containing the collected gas, it was then concluded that the gas was indeed oxygen.

Due to an accident, the UV lamp was not available for use during the experiment and so it was not possible to continue the said experiment.

CHAPTER IV

RESULTS AND DISCUSSION

The primary goal of this study which to produce ozone was not made possible so, to this moment, no results could be given and the same with the discussion.

At the beginning of the school year, I begun my thesis with the title "Drinking Water Purification by UV Sterilisation and Ozone Purification, " which was given to me (the problem) by Mr. Aaron Japitana, with the promise that he would send me journals, articles, clippings, and the procedure needed. Most of the quarter I waited for a mail, a call, or a package containing his promised goods, which I now realise as my biggest mistake of all the mistakes I had within the span of time I used for this thesis.

I thought maybe he's still looking for the mentioned stuff so I researched about the most important and probable terms that would be necessary for my research, terms such as ozone, water, water quality, water treatment, wastewater, and etc.

The first quarter passed without a word from Mr. Japitana but since we were required only the log or record books, I passed my record book.

On the second quarter, I do not know what kept me waiting – maybe it was because I trusted Mr. Japitana and that I know he would know how I would feel if he would not send me the materials because he was once a student and now a scientist – and until this very moment I still do not understand.

I was so attached to the paper because it seems so different from the others' research and yet it seemed so simple and easy . . . WITH the procedure, and the equipment and the right supervision. I wanted to prove to myself that I could do something . . . I can accomplish something with the aid of the teachers and maybe my classmates but basically alone. I thought, since this was my last year with PISAY as a student, I ought to prove something . . . even to myself only, even to myself only !

I conducted an interview at Agua Vida since their technology was in a way similar to my thesis. There I knew that their water passes through seven filtering processes namely, ion exchange (removes hardness), activated carbon (eliminates organic chemicals, bad taste and odour), 30 micron filter (filters dirt, rust, sand), 5 micron filter (removes fine particles), ultraviolet and ozone disinfectant (kills bacteria and virus), and last, polishing filter (enhances taste). I was to go back to take some pictures but never had the chance due to unavailability of funds and time(but actually I guess it was only management !!!).

It was also in the this quarter where Sir Ongcol and I found the procedure for the preparation of ozone from oxygen. Here we had Saturdays together looking for the fastest and easiest way of producing oxygen. Therefore, now the problem was the production of oxygen, which seemed to be a difficult task with

limited chemicals available at the laboratories. Sir Ongcol the requested through the school chemicals, those I will be using and also those necessary as supply for other classes' use. We waited for the chemicals to arrive but it was later decided to be disapproved due to the crisis the country is experiencing – inflation of prices.

At the end of the grading period, we were to submit Chapters I, II, III, and partial results of the experiments conducted. I was able to pass everything but the partial results because, as mentioned above, unavailability of supplies.

It was also in this quarter that we were to defend our work. As scheduled, I defended my thesis with the rest. I was told to rewrite my whole paper. I was confused for I did not know what to change and what not to change, but for unknown reasons, I did not ask questions. I was to concentrate on the production of ozone because that itself was an experiment already, according to Mrs. Biyo and Ms. Guiloreza.

And so I cancelled all the experiment results I had in the determination of water quality of the water supplied for the PSHS community.

I felt betrayed that after all this time Mr. Japitana did not contact me even just to tell not to expect any help him because he won't be sending anything, at least he won't keep me hanging on empty hopes! But instead of discarding this thesis, I was even challenged to let myself know that I can do this even without his help. So, even if my teachers suggested that I change my topic, I did not let go of my thesis.

CHAPTER V

SUMMARY OF SIGNIFICANT FINDINGS, CONCLUSION AND RECOMMENDATIONS

Since no results were made available, it was conclude that this study was not able to reach its objectives.

Therefore recommended that other procedures be used in the production of ozone if indeed this study were continued.

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