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Evaluation of the Concentration of CO_2, NO_2, SO_2, $PM_{2.5}$, PM_{10} and O_3 in Oghara Community.

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ABSTRACT

Thirty air samples were collected at six location that is, five from each location namely Oghareki, Ogharefe, Ijomi, Otefe and an Office in Delta State Polytechnic which served as control site. The air samples for sulphur dioxide, nitrogen dioxide and ozone were collected by using passive method while carbon monoxide and particulate matters were by active method within a period of fourteen days. The air samples upon collection were tested for the presence of sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide and particulate matters. The presence of sulphur dioxide, nitrogen dioxide and ozone were analyzed by the use of Uv / visible spectrophotometer after digestion / extraction while carbon dioxide and particulate matter were read from an automated sampler. Results of analyses showed sulphur dioxide in the range of 10.11 – 54.55 µg/m^3, nitrogen dioxide 13.70 – 41.80 µg/m^3, carbon monoxide 2.50 – 14.60µg/m^3, particulate matters 0.20 -1.20µg/m^3 and 1.00 – 10.00 µg/m^3 for $PM_{2.5}$ and PM_{10} while ozone was below detection. The results of analyses found the presence of the various contaminants to be within the permissible value of the WHO. Among the study locations, Oghareki and Ogharefe were found to be the most contaminated followed by Otefe while Ijomi was the least.

Keywords: Air, Pollution, pollutants, contaminants, environment

1. INTRODUCTION

The atmosphere is the gaseous envelope that surrounds the earth and constitutes the transition between its surface and the vacuum of space (Bhatia, 2009). Concerns about the air quality have probably been around as long as mankind; from the moment fire was invented, air pollution became a problem (Brimblecombe, 2017). Elevated levels of gaseous contaminants have been observed in the vicinity of certain industries like refineries, ports, and near busy roads and within urban areas in general (Onwukeme and Etienajirhevwe, 2014). The measured level of these contaminants serves as an index of air pollution (Khandekar et al., 2020). The presence of elemental concentration in the atmosphere of one or more contaminants of combination thereof in such quantities of such duration may cause injury to human health, plant or animal life or properties (materials) or may reasonably interfere with the comfortable enjoyment of life or properties or the conduct of business (Canter, 2016). Breathing is not optional, it is essential even for a short time and air has to be used as it is found and "the air we receive at our birth and resign only when we die is the first necessity of our existence" (Brimblecombe, 2017) Analysis of air shows the presence of numerous substances in trace amounts some of which could be explained to emanate from either natural or anthropogenic that is, man-made source activities; other substances could be formed indirectly from chemical process in the atmosphere. Hence, the combination of a source to the atmosphere varies according to its emission characteristics and the emitted substance. Despite the essentiality of air, its qualities has been historically variable and frequently to the detriments of human health. Nevertheless, our quality of life dramatically improved during the twentieth century. Now however, a growing body of research has found that certain substances may affect human health at lower concentration than had previously been thought. This concern has heightened public anxiety to the importance of improving and managing the quality of air is protected and managed for future generations (Department of the Environment, (DOE), 2013). Despite the growing rate of industrialization in our country, Nigeria, little attention and concern is paid to the environment as it affects the health of occupants around its vicinity (Ndego and Imonitie, 2012). There is also little or no availability of adequate regulatory and enforcement measures to ensure that the pollution of the environment is minimized when most of such industries that pollute the environment are spread around Delta State, Nigeria (Ekeayanwu et. al., 2011). This research is therefore initiated to evaluate the pollution of the atmosphere in order to create awareness and proffer how to manage the problems of air pollution. The aim of this work is to determine some pollutants in air at some selected locations in Oghara in Delta State, Nigeria. The objectives of this research work are to determine the concentrations of sulphur dioxide, nitrogen dioxide, carbon monoxide, particulate matter ($PM_{2.5}$ and PM_{10}) and ozone in the atmosphere.

2. METHODOLOGY

Sample collection

Nitrogen dioxide (NO_2) samplings

Nitrogen Dioxide component was collected by treating NO_2 sampler with a standard solution prepared by mixing 7.90g sodium iodide (NaI) with 0.88g sodium hydroxide (NaOH) into 100mL methanol which was stirred in an ultrasonic bath (Alaa et. al., 2009). The sampler was then mounted on an average height of 2.0 meters and was allowed to stay for a period of four days.

Sulphur dioxide (SO_2) samplings

Sulphur Dioxide component was collected by treating and impregnating the SO_2 samplers with a standard solution prepared by dissolving 5.60g Potassium hydroxide (KOH) into 50.0mL methanol and mixed with 10.0mL glycerol which was made to 100mL by methanol (Alaa et. al., 2009). The samplers were mounted at average height of 2.0meters from ground and were allowed to stay for a period of fourteen days.

Ozone (O_3) Samplings

Ozone components was collected by treating and impregnating the ozone samplers with a standard solution of ethene which was then mounted at an average height of 2.0 meters from ground for a period of fourteen (14) days (Onwukeme and Etienajirhevwe, 2014).

Carbon monoxide

An automated instrument was used to read the amount of atmospheric carbon monoxide in the air

Particulate matter $PM_{2.5}$ and PM_{10}

Concentrations of $PM_{2.5}$ and PM_{10} were measured by a monitoring device, environmental dust model Haz-Dust EPAM 5000.

Harvesting of samplers

All the samplers mounted were harvested after a period of fourteen (14) days. The samplers which were initially open for in-flow of air were then closed with special caps to avoid any form of contamination and desorption. The samplers were placed into tightly closed special bags and were kept in a refrigerator at a controlled temperature until they were processed.

Instrumental analysis

Sulphur dioxide (SO_2)

The harvested adsorbent sampler was cut into pieces and were digested and extracted by bubbling them in solution of 0.05% hydrogen peroxide (H_2O_2) in distilled water using magnetic stirrer for a period of thirty minutes and was filtered. 10mL of the extracts were measured into a clean cell and one content of a “sulfaver 4” (a sulphate test tablet) was added to the content (to ensure colour development of SO_2 in the samples) and was thoroughly swirled to ensure proper mixing. The resulting solution were subsequently analyzed for SO_2 concentration by using UV/visible spectrophotometer (Perkin Elmer Lambada E = 301) with their concentration recorded at a wavelength of 680nm. Blank determination was carried out in the same manner (Onwukeme and Etienajirhevwe, 2014).

Nitrogen dioxide (NO_2)

Harvested adsorbent sampler was cut into pieces and digested with a solution of N-(1-Napthl) ethylenediamine dihydrochloride for a period of thirty minutes using a magnetic stirrer (ASTM, 2015). This was then filtered into a volumetric flask. 25mL of the filtrate was measured into a measuring cylinder followed by the addition of “Nitraver 6” reagent powder pillow to ensure NO_2 development, stoppered and was homogenized and subsequently analyzed with a UV/visible spectrophotometer at a wavelength of 550nm. Blank determination was also carried out in the same manner (Onwukeme and Etienajirhevwe, 2014).

Ozone (O_3)

The harvested adsorbent samplers for Ozone were cut into pieces and were extracted using deionized water over low heated using magnetic stirrer, cooled and were filtered into conical flasks. 40mL of the extracts were measured into conical flasks followed by the addition of an indigo ozone reagent (“Accu vac Ampul”) and were subsequently analyzed for ozone concentration using UV/visible spectrophotometer at a wavelength of 450nm, Blank determination was carried out in the same manner. (Onwukeme and Etienajirhevwe, 2014).

Particulate matter and carbon monoxide

The amount of particulate matter and carbon monoxide were read from the automated instrument for that purpose

3. RESULTS AND DISCUSSIONS

Results

Location / Parameter	Oghareki	Ogharefe	Ijomi	Otefe	Control site
Sulphur dioxide (μg/m³)	**54.55**	**42.58**	**10.11**	**18.65**	**2.55**
Nitrogen dioxide (μg/m³)	**41.80**	**30.30**	**13.70**	**28.45**	**1.45**
Ozone (μg/m³)	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**
Carbon monoxide (μg/m³)	**12.00**	**12.60**	**2.50**	**14.60**	**1.60**
$PM_{2.5}$ (μg/m³)	**0.80**	**0.90**	**0.20**	**1.20**	**0.20**
PM_{10} (μg/m³)	**5.00**	**8.00**	**1.0**	**10.00**	**0.10**

Key: BDL- Below detection limit

Discussion

Ozone concentrations were below detection limit in all the study locations and the absence of ozone in these location justified the statement of Harrop (2020) that low or absence of ozone is always observed where there is high concentration of NO_2 as O_3 presence are used for the conversion of NO to NO_2. The study locations are therefore found to be free from ozone.

Nitrogen dioxide was found present at all the study location in the range of 13.70 – 41.80 μg/m³. Comparison of the nitrogen dioxide concentrations from the study locations with ambient air quality standards of 200 μg/m³ as provided by the World Health Organization (WHO) showed that the locations are in safe condition and not contaminated with nitrogen dioxide. Statistical analysis of the results suggested contamination at all the locations as values obtained were significantly higher than the control sight. This difference could be attributed to the high rate emission from automobile exhaust; gas flaring and other natural phenomenon are released into the atmosphere.

It is worth noting that since there are traces of nitrogen dioxide in all the study locations with values higher or lower than those set up by the monitoring bodies, over exposure to such concentrations over a long period pose danger to human health. The effect of over exposure to concentration below or above the critical value could bring about reversible effect on lungs function and airway responsiveness and increase reactivity to natural allergens. Nitrogen dioxide exposure can also put children at an increased risk of respiratory infection and may lead to poorer lung function in after life. At relatively high concentration, nitrogen dioxide could cause acute inflammation of the pathways (Onwukeme and Etienajirhevwe, 2014). Asthmatic patients are very sensitive to air with exposure to concentration of about 50μg/m³ for thirty minutes producing as small change in standard indices of lung function in asthmatics; exposure to about 1800 μg/m³ would be necessary to produce a similar response; the exposure response relationship for NO_2 could be erratic. Exposure to concentration of 560μg/m³ may produce a response whilst exposure to double that may not; the exposure may not reappear and remain as concentration approach and exceed 1800μg/m³ though the explanation for this is not clear (European Environment Agency, 2000).

Sulphur dioxide was present at all the location in the range of 10.11 – 54.55 μg/m³. Concentration of sulphur dioxide al all the locations were all higher than that of the control. The maximum permissible value by World Health Organization is 125μg/m³. Based on this permissible limit, the locations are considered to be in safe condition even though the values obtained are higher than that of the control site. The results obtained for sulphur dioxide in this study were found to be lower than those of Onwukeme and Etienajirhevwe (2014) for Warri refinery of 61μg/m³. The results of this present study could be attributed to the nature of the activities in the area such as supply of premium motor spirit, emission from motor vehicle and other natural phenomenon.

It is worth noting that exposure to sulphur dioxide above the permissible limits for ambient air can results in health effects such as respiratory irritation (Environment Agency, 2000), stimulation of nerves lining of the nose, throat and airways of the lungs (Onwukeme and Etienajirhevwe, 2014). It should be noted that exposure to sulphur dioxide of 20μg/m³ causes eye irritation and coughing in healthy adults, 15μg/m³ for 1hour decreases mucoduary activity, 5μg/m³ causes throat irritation in adult at rest, 0.19 μg/m³ for 24 hours leads to aggravation of chronic respiratory disease in adults while 0.07 μg/m³ for animal exposure leads to aggravation in children (Harrop, 2020).

Carbon monoxide was found present in the range of 2.50 – 14.60μg/m³. The concentration of carbon monoxide were all higher than that of the control and the permissible value of the World Health Organization value of 555 μg/m³ which showed that the locations are in safe condition.

Breathing air with a high concentration of carbon monoxide reduces the amount of oxygen that can be transported in the blood stream to critical organs like the heart and brain. At very high levels, which are possible indoors or in other enclosed environments, carbon monoxide can cause dizziness, confusion, unconsciousness and death (USEPA, 2015). Very high levels of carbon monoxide are not likely to occur outdoors. However, when carbon monoxide levels are elevated outdoors, they can be of particular concern for people with some types of heart disease. These people already have a reduced ability for getting oxygenated blood to their hearts in situations where the heart needs more oxygen than usual. They are especially vulnerable to the effects of carbon monoxide when exercising or under increased stress. In these situations, short-term exposure to elevated carbon monoxide may result in reduced oxygen to the heart accompanied by chest pain also known as angina (USEPA, 2015)

Particulate matters were found present in the atmosphere of Oghara community with concentration range of 0.20 -1.20$\mu g/m^3$ and 1.00 – 10.00 $\mu g/m^3$ for $PM_{2.5}$ and PM_{10} respectively. All the study locations were found to be lower than that of the control site which suggested little or no contamination of the area with particulate matter. Particle pollution from fine particulates is a concern when levels in air are unhealthy. Breathing in unhealthy level of PM can increase the risk of health problems like heart disease, asthma and low birth weight. Unhealthy levels can also reduce visibility and cause the air to appear hazy.

4. CONCLUSION AND RECOMMENDATION

Among the study locations, Oghareki and Ogharefe were found to be the most polluted with contaminants analysed followed by Otefe while Ijomi was the least. One of the major activities in these two locations are the sales of petrol and diesel which could have evapourated into the air making the air to be concentration with the various gases. The major activity in Otefe is the use of motor vehicle and tricycle for transportation and the emissions from their exhaust could have polluted the air. There is no major industrial activity in Ijomi hence the contamination there was lowest. The pollution of the locations followed the order: Oghareki>Ogharefe>Otefe>Ijomi. It is therefore worthy to note that long time exposure to polluted air above the critical values set by the monitoring bodies for ambient air would pose serious health problems.

Breathing of air is obligatory and without it there is no life. It is today's generations of people who have realized that the air they breathe is not an unlimited natural resources. It should be a concern to effectively manage air for a sustainable future. The management of these natural resources should enquire methods and techniques based on sound science and careful application towards finding solution to already polluted resources. There should be future development of air pollution management by bringing awareness to the general public of the scale of this pollution and how to manage it. There should be the development of philosophy and attitude towards monitoring air pollutions. As an individual, we must consider the consequences for our actions and work to improve air quality for future generation. The management of air pollution problems cannot be over emphasized hence we must avoid the reoccurrence of the pollution problems we are facing today

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