Ambient Air Sulphur (IV) Oxide Concentration Monitoring In The Suburb Of A Large Commercial City In The South Eastern Nigeria.

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Abstract: In this research work, West-Gaeke method was used to determine the ambient air SO_2 concentration in Aba township area. The sampling was carried out from March to December 2013 covering the wet and dry seasons of that year. The mean concentrations over the year during dry and wet seasons were 0.180 ppm and 0.149 ppm respectively. The wet season concentration was 9.42 % lower than the dry season concentration due to rain attenuation. The highest concentration obtained was 0.259 ppm at Asa Nnentu Market (Latitude $05^0$03'55, Longitude $007^0$21'43) during the dry season while the lowest concentration was 0.082 ppm at Plot 204 Obohia Road (Latitude $05^0$05'27, Longitude $007^0$21'36) during the wet season. The values obtained in this work are higher than the limit of the Federal Environmental Protection Agency of Nigeria (FEPA) of 0.001-0.01 ppm for air quality standard which shows that the area is polluted by SO_2.

Key words: Sulphur(IV) oxide, Monitoring, West-Gaeke, South Eastern Nigeria, Concentration, Ambient air, Locations.

1: INTRODUCTION

Recent studies have shown that Environmental pollution is one of the causes of deteriorating living conditions as the breathing of safe air is as important as safe water or food. The human population in developed and developing nations has no other option than to breathe polluted air from biomass combustion and other diffused sources (Albalak *et al*., 1999). The quality of ambient air is determined by the extent of pollution of the environment. Air pollution is the presence of unwanted materials in the atmosphere that could be harmful to both plants and animals. Air pollutants are classified into two groups: criteria and hazardous air pollutants. The criteria pollutants are commonly found air pollutants that can have adverse effect on health and the environment. They include particulate matter, oxides of Nitrogen, Oxides of Sulphur, Carbon (II) Oxide and Lead (USEPA, 2012). These criteria pollutants are toxic and dangerous to health. Apart from being present naturally in air, they have also been introduced into the air through various types of anthropogenic activities like combustion processes that occur in the engine of vehicles, forest-burning, electricity generating plants, decaying of accumulated organic and domestic wastes, and other industrial processes (Dara, 2000). Epidemiological studies have shown that air quality has a strong link to human health and wellbeing (Zhu, *et al*. 2002). Because to this, the World Health Organization (WHO) has continued to publish and update air quality guidelines of some air pollutants such as Particulate matter (Pm), Ozone (O_3), Hydrogen Sulphide (H_2S), Nitrogen (IV) Oxide (NO_2), Sulphur (IV) Oxide (SO_2) and Carbon (II) Oxide (CO), to provide information on monitoring and reducing the health impact of these air pollutants (WHO, 2006).

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Air pollution in some developing nations is still a serious environmental problem, and many cities in the world are exposed to high levels of air pollution. Research has also shown that SO_2 and NO_2 cause respiratory and cardiovascular diseases in both children and adults (WHO, 2011). The establishment of air quality data is very important especially in the suburb of urban areas where vehicular emissions and gaseous emissions from decaying materials, combustion processes and industrial processes are a common phenomenon. Aba is a commercial and industrial city located in South Eastern Nigeria. The city is characterized by large industrial activities and the accompanying high human activities resulting in emissions that might increase the levels of harmful pollutants that may ultimately have adverse effects on animals, plants and structures. This study therefore seeks to determine and establish baseline data on the quality of ambient air in the suburb of Aba metropolis by obtaining information on the level of SO_2 in the ambient air of Aba industira/commercial city suburb.

MATERIALS AND METHODS

2.1 Monitoring Site (Mapping Area)

This work was carried out in the suburb of Aba. Aba is an industrial town in Nigeria located on latitude 5^o 09^o 07" N and longitude 7^o 20' 22' E. The city being in tropical rain forest region in Nigeria, experiences two distinct climatic seasons: the dry and the wet seasons (Iloeje, 1981). Aba is an industrial urban center due to the presence of many industries such as International Glass Industry, Tonimas Chemical Industry, Bond of Plastic Industry, De Ultimate Paint Industry etc that serve as major point sources for gaseous pollutants. Apart from industries, the the is dominated by mobile sources of SO_2 from the expanse of road network across the city. The estimated human population of Aba is 1,020,900 according to the 2009 Nigerian Population census (National Population Census, 2009). Figure 1 is a map showing the 10 sampled locations while Table 1 lists the 10 locations sampled and their coordinates.

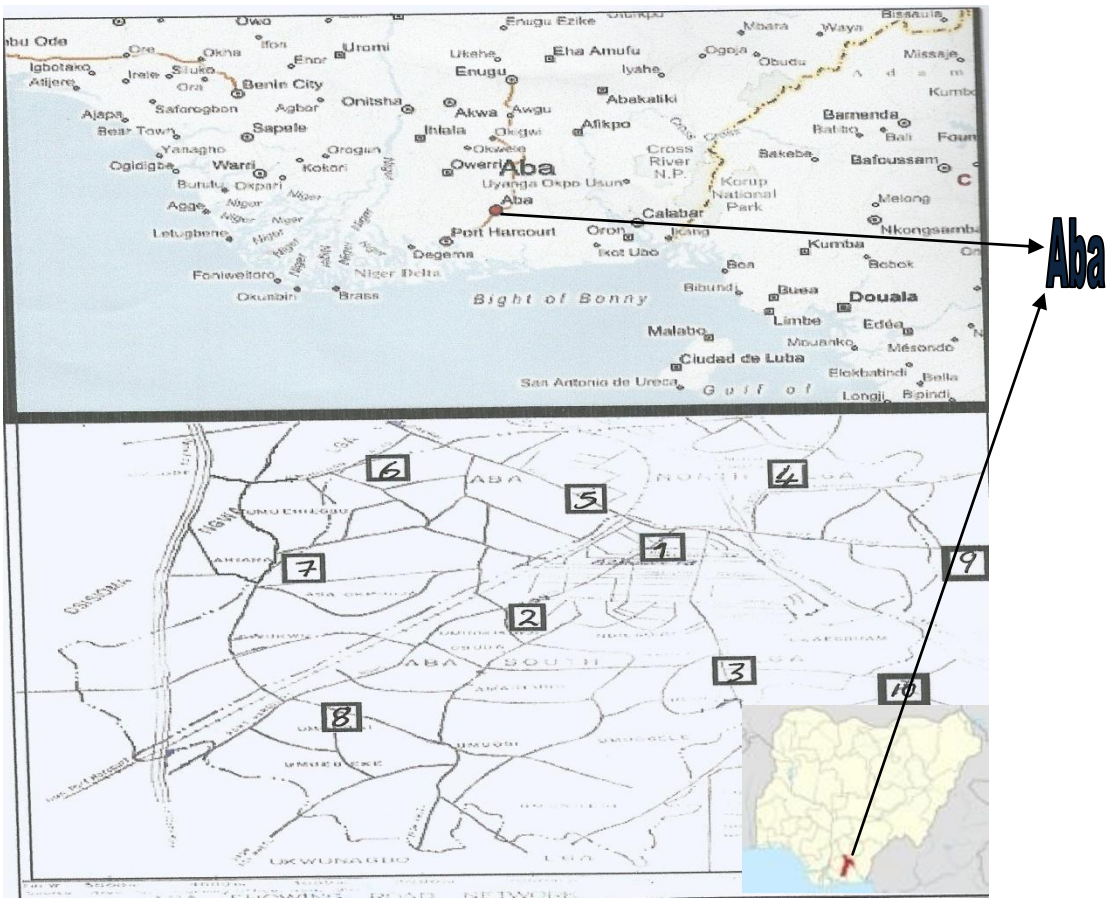

Figure 1: *Map of the suburb area in Aba, Nigeria showing the 10 sampled sites*

Table 1: 10 *sampled locations with their coordinates*

S/No	Locations	Coordinates		
		Latitude (^{0}N)	Longitude (^{0}E)	Altitude(M)
1	Asa Nnentu Market Main Gate	05^{0}03’55	007^{0}19’43	57
2	Plot 204 Obohia Road	05^{0}05’27	007^{0}21’36	60
3	Iheorji Secondary School	05^{0}04’49	007^{0}22’45	59
4	Plot 268 Clifford Road	05^{0}06’15	077^{0}22’08	54
5	Plot 140 Ikot Ekpene Road	05^{0}06’45	007^{0}23’36	52
6	Plot 1 Azikiwe Road	05^{0}06’33	007^{0}21’43	59
7	Olaz Oil Filling Station at Osisioma	05^{0}08’57	007^{0}19’49	66
8	Plot 200 Azikiwe Road	05^{0}06’28	007^{0}22’41	58
9	Ulasi Primary School	05^{0}06’08	007^{0}22’39	47
10	Plot 4 Eziukwu Road	05^{0}06’51	007^{0}21’59	67

2.2 METHOD

The West-Gaeke method was used in this work (West-Gaeke, 1956). In this method, air exposed samples were treated in a solution of potassium tetrachloromercurate (TCM). A dichlorosulphitomercurate complex formed then reacts with pararosaniline and formaldehyde to give the intensely coloured pararosaniline mehtylsulphonic acid. The absorbance of the coloured solution was measured with Spectrophotometer at 560 nm.

3: RESULTS AND DISCUSSION

3.1 Results

Figures 2, 3, 4 and 5 illustrate the results obtained across the 10 sites sampled. Figure 2 shows the monthly variations of SO_2 concentration during the wet season while figure 3 shows the monthly variations of SO_2 concentration during the dry season at the various sampling sites. The seasonal variations of SO_2 across the various sites is presented in figure 4 while figure 5 illustrates how average concentration of SO_2 varies at different locations

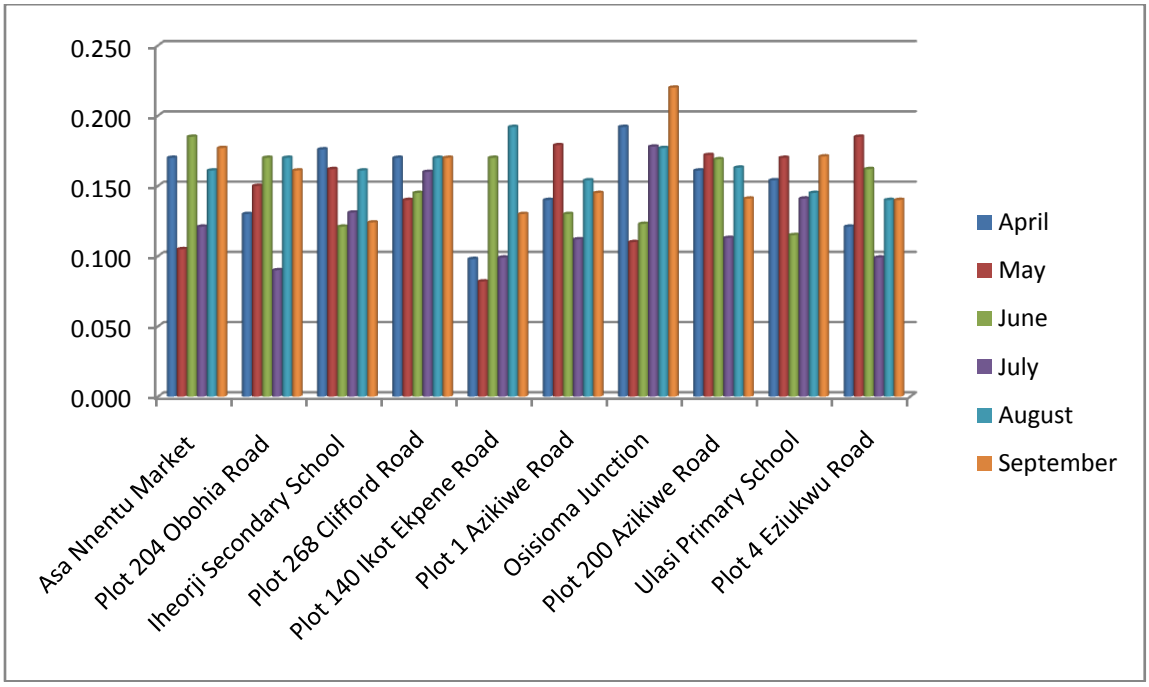

Figure 2: *Monthly variation of SO_2 in the various sampling locations during the wet season*

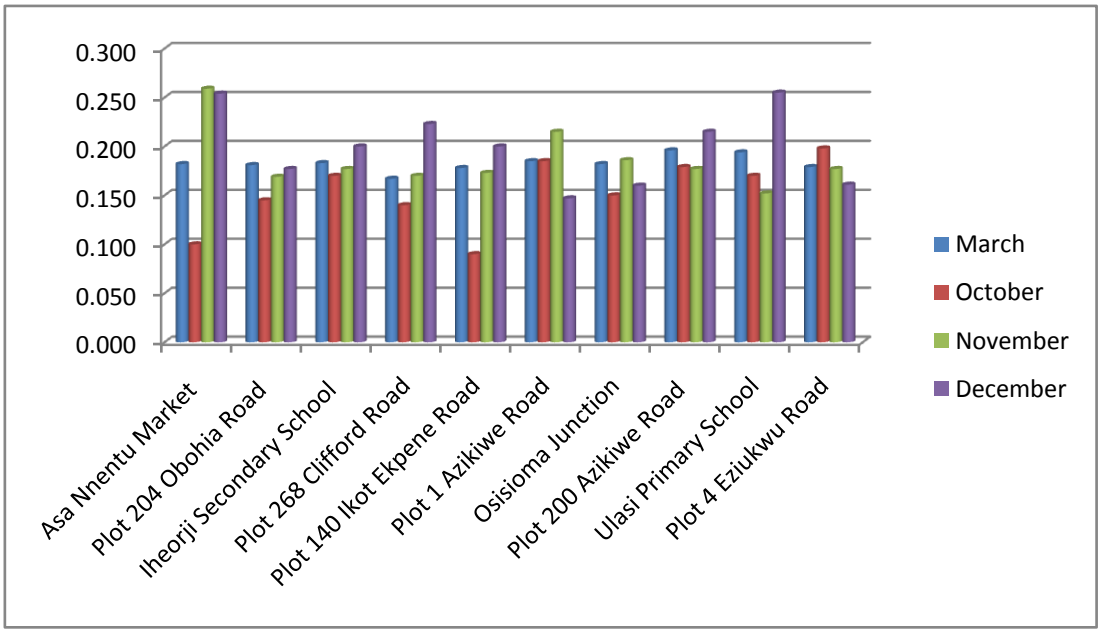

Figure 3: *Monthly variation of SO_2 in the various sampling locations during the dry season*

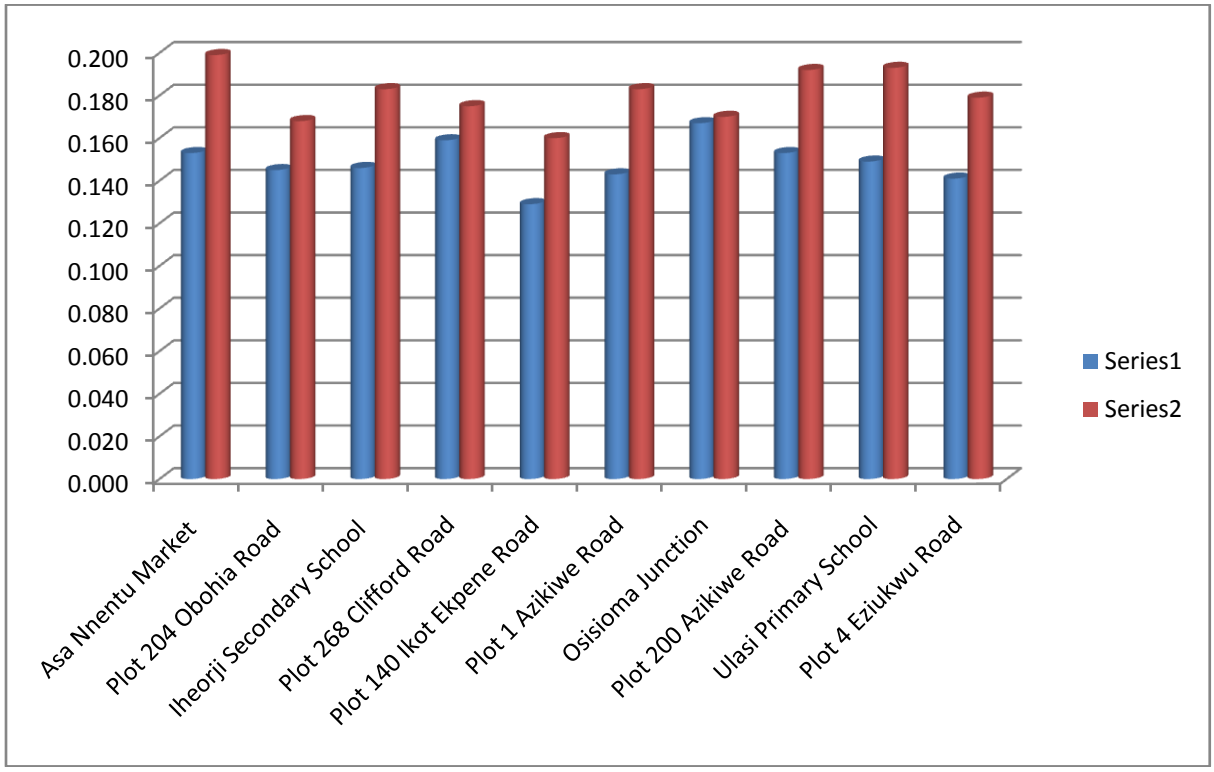

Figure 4: *Seasonal variations of SO_2 at various locations*

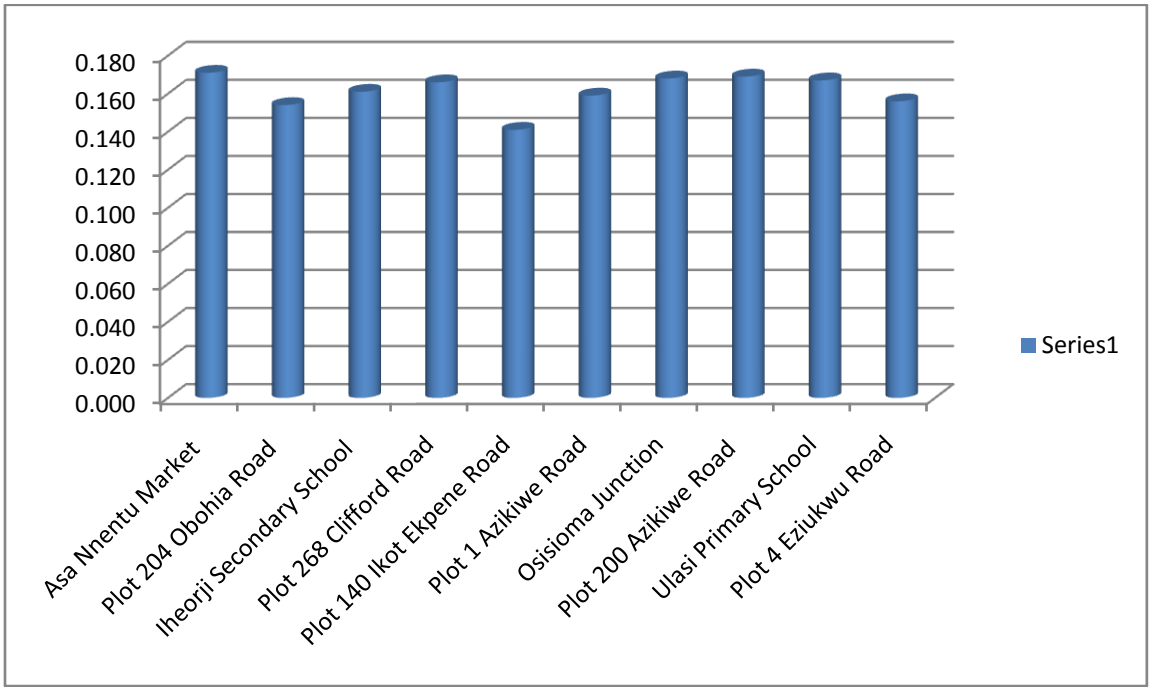

Figure 5: *Variations of average concentration of SO_2 at different locations*

3.2 Discussion

The mean monthly variations of SO_2 concentrations across the 10 sampled sites in the suburb of the commercial city of Aba are shown in figures 2, 3, 4 and 5. The results ranged from 0.082 ppm at Plot 204 Obohia Road in July to 0.259 ppm at Asa Nnentu Market in November, 2013. The range of other results obtained at different locations are as follows: Asa Nnentu Market (0.100-0.259 ppm), Plot 204 Obohia Road (0.090-0.181 ppm), Iheorji Secondary School (0.121-0.200 ppm), Plot 268 Clifford Road (0.140-0.223 ppm), 140 Ikot Ekpene Road (0.082-0.200 ppm), Plot 1 Azikiwe Road (0.112-0.215 ppm), Osisioma Junction (0.110-0.220 ppm), Plot 200 Azikiwe Road (0.113-0.215 ppm) and Plot 4 Eziukwu Road (0.090-0.185 ppm). Comparison of results obtained at different locations showed that the SO_2 concentration varies from one site to

another. Figures 5 showed that Asa Nnentu Market (0.171 ppm), Plot 200 Azikiwe Road (0.169 ppm) and Osisioma Junction (0.168 ppm) and Ulasi Primary School (0.167 ppm) and Iheorji Secondary School recorded highest level of SO_2 concentration among all the sites sampled. Those areas have so many SO_2 generating activities some of which include refuse dump site, high volume of traffic, use of generators as alternative source of power etc. It was also observed that the amount of SO_2 in the residential areas (Plot 1 Eziukwu Road, Plot 1 Azikiwe Road, Plot 140 Ikot Ekpene Road and Plot 204 Obohia Road) is relatively lower than the level of SO_2 in the market, industrial and high traffic areas. Figure 4 compared the seasonal (dry and wet seasons) variations of SO_2 concentrations at different locations in the city. The results obtained during the dry season ranged from 0.090-0.259 ppm while wet season's results ranged from 0.082-0.220 ppm (Fig. 4). Generally, the results showed that there was increase in the pollutant concentration during the dry season. The mean concentration over the year during the dry season is 0.180 ppm while that of wet season is 0.149 ppm. The major reason for the low concentration in wet season is precipitation. SO_2 is water soluble and dissolves in rain water during the wet season. The rain converts the SO_2 in the atmosphere into H_2SO_4 which is washed away to the sea. On the other hand, lack of precipitation and burning of Sulphur containing materials increased the concentration of the SO_2 in the dry season. This seasonal variation which shows that concentration of SO_2 is usually higher in the dry season corresponds to the work reported by Abdul Raheem *et al.* (2009) which observed that SO_2 concentration in Ilorin was higher in the dry season. It was also observed that in all the sites sampled, November and December have the highest concentration level. The months are usually the peak of dry season with little or no rainfall in the tropical rain forest zone which Aba is located (Iloeje, 1981). The mean of the monthly average of SO_2 concentration within the suburb of Aba (0.161 ppm) exceeded the standard regulatory limits (FEPA) of 0.001-0.01 ppm. The result when compared to the SO_2 concentration in Kano State which ranged from 3.21-5.18 ppm (30 minutes exposure) according to Okunola *et al.,* (2012) showed that the level of SO_2 in sampled area was lower than that of Kano metropolis. The study also shows that SO_2 pollutants level of the suburb of the commercial city of Aba should be constantly monitored by the relevant agencies. The results were analyzed statistically using SPSS (version 20). The analysis of the results of the two seasons showed that there was a significant difference (P= 0.05) between the results of the dry and wet seasons.

3.3 Conclusion

The results showed that Aba Metropolis is polluted with SO_2. The concentrations of SO_2 obtained at all sites were above the standard limit stipulated by FEPA (2001) especially during the dry seasons. This implies that traffic and industrial emissions of SO_2 within the commercial city Aba are not within the safe limits. Hence, the results revealed that transport and industry related pollution in Aba is significant with potentially hazardous health consequences. From the study one can clearly discern a decrease in concentration during the wet and increase in the dry season in most of the sites. It is therefore important that the relevant agencies initiate programmes that would help monitor, improve and protect the ambient air quality of Aba Metropolis.

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