Measurement, Survey and Assessment of Air Quality in Portharcourt, South-South Nigeria

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Abstract: *A 13-days mean concentration of sulphur dioxide (So_2), Nitrogen dioxide (No_2), Hydrogensulphide (H_2s), Particulate matter (PM10), Ammonia NH_3, Methane CH_4,and Carbon Monoxide (CO) were measured in some areas of portharcourt. The measurements were made in an effort to characterize air pollution in the urban environment of portharcourt to assist in the development of an air quality index. The data was analysed using descriptive statistics (mean) and was used to create multi bar charts, t- test was performed to compare means for seasons and pearson's correlation was used to determine correlation between pollutants, meteorological data. Statistics were performed using the comprehensive statistical software (SPSS Version 17). The analysis shows that there were significantly strong positive correlation between SO_2 concentration and all other parameters and there were significantly negative correlation between NO_2 concentration and all other parameters.*

Keywords: *Measurement, survey, Air quality, portharcourt, pollutants, Nigeria.*

1. INTRODUCTION

For many decades, until the early 1970's Governments, Industrialists and Development Practitioners attempted to isolate the concept of environment from the development process. The environment in the form of land water and air became inevitably the dumping ground for different kinds of wastes, made up of solid, liquid and gaseous materials.

Progressively, therefore, natural resources that constituted the basis of life came under serious devastation. Hence the incidence of land, water and air pollution in different part of the world including Nigeria. Such environmental pollution poses a serious survival threat not only to human development and animal populations, but also to food security in particular and the ecosystem in general.

Oil exploration in the Niger delta region of Nigeria has grossly reduced the quality of air in the region and beyond.

To protect air quality in Nigeria, the (FEPA) Federal Environmental Protection Agency has mandated air quality standard for the following air pollutants sulphur dioxide (SO_2), Nitrogen dioxide (NO_2),Hydrogensulphide (H_2s) and Particulate matter (PM10). Nigeria has been reported as the number one national gas flarer on the planet both absolutely and proportionally, about 46% of Africa's total and the most gas flared per tonne of oil produced (Cedigaz, 2000). The report also indicates that Nigeria accounted for 19.79% of the global figure. (Orubu, 2000) undertook a study of the concentration of ambient air pollutant in the region and concluded that pollutants are highest in the Niger Delta region. This study suggests that Nigeria oil fields contribute more to global warming. There are numerous human activities which results in the release of potential toxic substances into the atmosphere (Aas et al, 1999; Campbell et al, 1994). From human activities the primary source of air pollutants today is evident from waste products released into the air from the exhaust of internal combustion engines and boilers and furnace of industries, plants and homes (Park; 2005).

2. STUDY AREA

MAP SHOWING THE SAMPLING LOCATIONS IN RIVERS STATE
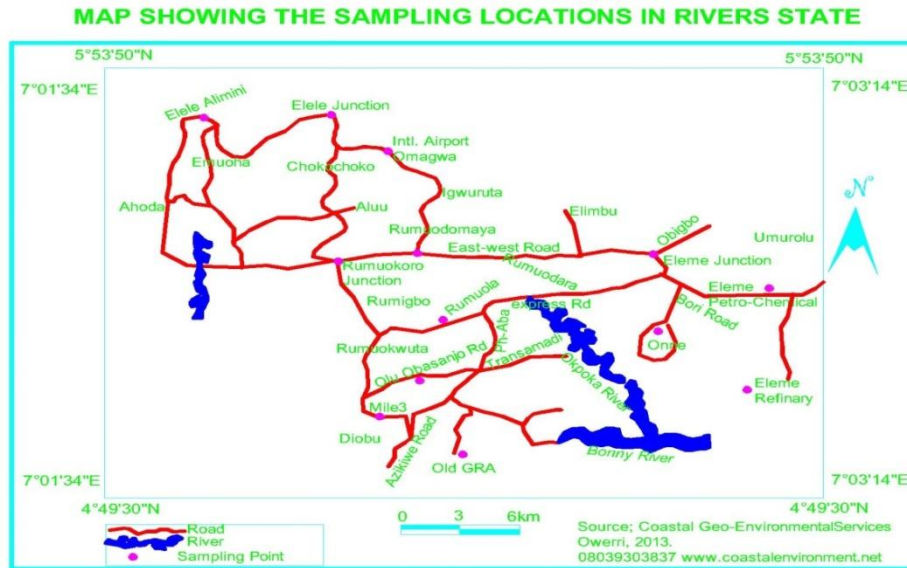
Fig1. *Map of the Study area showing the sampling locations*

Port Harcourt is situated at latitude 4.78° North and longitude 7.01° East and 468 meters elevation above the sea level with a population of 1,148,655 people.

3. EQUIPMENT EMPLOYED

Hand held mobile Crowncon Gasman monitors with model CE 89/336/EEC equipment were used to detect the presence and precise quantity of the following individual gases.

- Sulfur dioxide SO2
- Nitrogen Dioxide NO2
- Ammonia NH3
- Methane CH4
- Carbon Monoxide CO
- Hydrogen Sulphide H2S
- Particulate Matter

Hydrogen Sulphide H$_2$S   Nitrogen Dioxide NO$_2$ Carbon Monoxide CO

Sulfur dioxide SO$_2$

Ammonia NH3

Methane CH$_4$

Particulate Monitor

Global Positioning System Device: Gas monitoring and evaluation/sampling is a spatial phenomenon, thus it is very essential to determine the accurate geographical coordinates for the sampling points. In this survey, we used a Garmin Etrex 10 GPS device to track the coordinates of the points sampled.

Timming: This survey is spatial-temporal in nature (it happens over time and space), therefore time of the samples were taken using GMT watches.

ArcGIS: Geographic Information Systems was applied using ArcGIS 9.3 software to map the sampled locations.

Table1. *Identification of sampling stations with geographical coordinates.*

S/N	Time	Sampling Point	Land Use	SO_2	N_2	NH_3	CH_4	CO	H_2S	PM	Coordinates
1	9.00	PortHacourt Air Port, Omagwa	Business	0.1	0.07	001	001	051	0.01	14	293485, 554577
2	10.00	RumuokoroJunct.	Commercial/ Highway Traffic	0.07	0.09	001	001	053	0.02	10.4	277985, 538158
3	11.00	Agip Petroleum	Industrial	0.05	0.05	001	001	036	0.01	9.2	275605, 531443
4	12.00	Mile3 MktDiobu	Commercial	0.08	0.06	001	001	035	0.02	10.5	277145, 531078
5	12.20	Ikoku Spare Part Mkt, OluObansjo	Commercial/ Traffic	0.065	0.07	001	001	035	0.02	8.5	277960, 531216
6	12.45	Mummy-B Rd,GRA	Residential	0.04	0.04	000	001	036	0.03	9.1	279295, 533566
7	1.15	Rumola Bridge	Commercial/ Traffic	0.08	0.06	001	001	034	0.01	10.7	278942, 534412
8	1.45	Eleme Junction-Onne Rd.	Mixed/Traffic	0.059	0.06	000	001	036	0.04	9.5	286598, 535955
9	2.00	Eleme Petro-Chemical	Industrial	0.1	0.06	002	003	057	0.059	9.2	289154, 532194
10	2.30	Onne Wharf	Business	0.04	0.05	001	002	035	0.01	11.3	295765, 521980
11	3.00	Eleme Refinery, Okrika	Industrial	0.08	0.06	00.5	001	035	0.05	10.5	289739, 527456
12	5.00	EleleAlimiri	Village	0.02	0.04	001	001	037	0.02	8.2	249663, 559589
13	5.45	Elele Junction	Commercial/ Traffic	0.07	0.06	000	001	035	0.05	8.45	257650, 564271

4. RESULTS AND DISCUSSIONS

Figure 1 shows the variation of air quality parameters in portharcourt and 2 shows the mean variation of air quality parameters for morning hours and afternoon it is observed that gases like CO and PM are higher in concentration in some areas than other area because they are less dense than air and therefore moves faster than air. Table 1 shows the identification of sampling stations with geographical coordinates and table 2 shows the descriptive statistics of the selected air quality parameters in the study locations and provides a standard deviation of the air parameter while figure3 shows (Pearson) correlations co-efficient analysis of the relationship between the selected air quality parameters in the area. The descriptive statistics result also provides the mean proportion of the air quality parameters with their N- value. The result of the pearson's correlation coefficient of air quality parameter as shown in tables 1 and 2 shows that there were significantly strong positive correlation between SO_2 concention and NO_2 concentration between SO_2 concentration and NH_3 concentration between the concentration of SO_2 and CH_4 concentration between SO_2 concentration and CO concentration between SO_2 concentration and H_2S concentration between SO_2 concentration and concentration of PM ($P < 0.005$) respectively.

However there were significantly negative correlation between NO_2 concentration, CH_4 concentration and between NO_2 concentration and H2S concentration. Also significantly negative correlation between PM concentration and CH_4 concentration between PM concentrations and H_2S ($P < 0.05$).
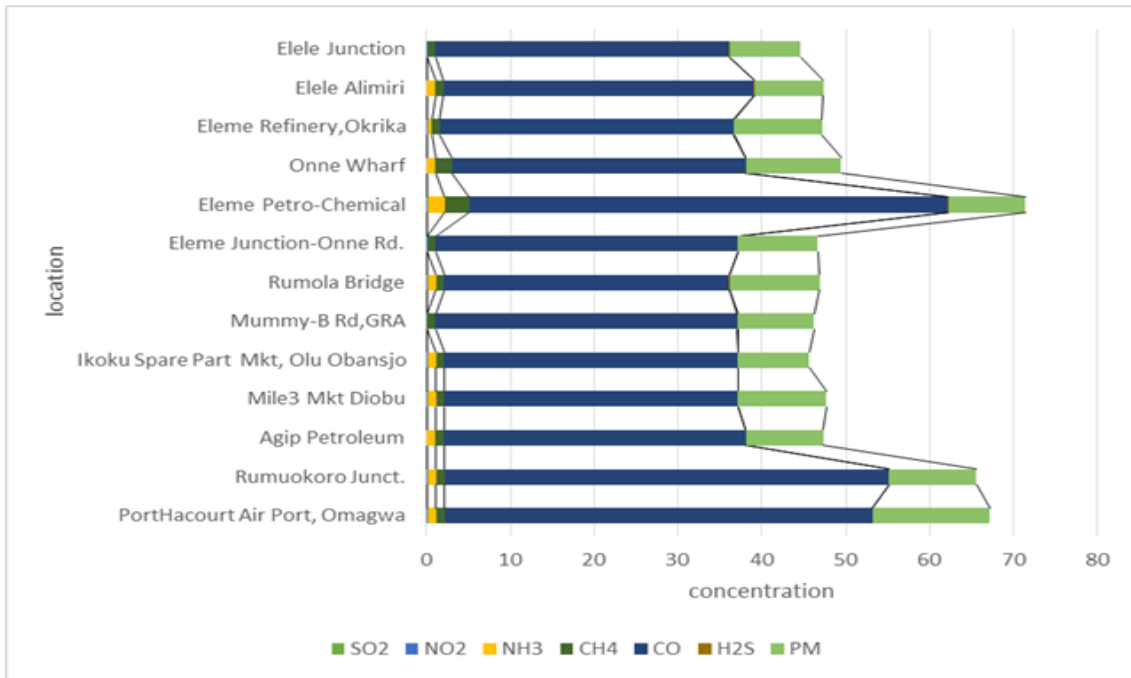
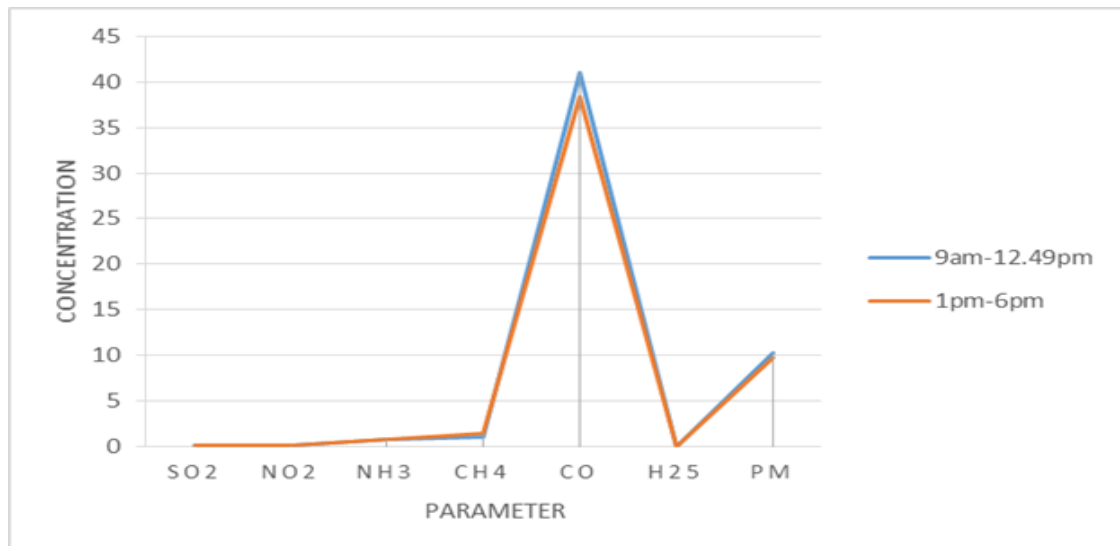**Figure1.** *Variation of air quality parameters in Portharcourt.*

Figure2. *Mean variation of air quality parameter for morning and afternoon.*

Table2. *Descriptive statistics of the selected air quality parameters in the study locations.*

		Descriptive Statistics	
	Mean	Std. Deviation	N
SO2	.0657	.02364	13
NO2	.0592	.01320	13
NH3	.8077	.56045	13
CH4	1.2308	.59914	13
CO	39.6154	8.13980	13
H2S	.0268	.01735	13
PM	9.9654	1.55609	13

Table3. *Correlations (Pearson) for the air quality parameters in the area.*

		SO_2	NO_2	NH_3	CH_4	CO	H_2S	PM
SO_2	Pearson Correlation	1	.616[*]	.347	.253	.532	.291	.494
	Sig. (2-tailed)		.025	.245	.405	.062	.334	.086
	N	13	13	13	13	13	13	13
NO_2	Pearson Correlation	.616[*]	1	.204	-.081	.524	-.011	.347
	Sig. (2-tailed)	.025		.505	.792	.066	.970	.245
	N	13	13	13	13	13	13	13
NH_3	Pearson Correlation	.347	.204	1	.640[*]	.576[*]	-.162	.173
	Sig. (2-tailed)	.245	.505		.019	.039	.597	.571
	N	13	13	13	13	13	13	13
CH_4	Pearson Correlation	.253	-.081	.640[*]	1	.515	.381	-.018
	Sig. (2-tailed)	.405	.792	.019		.072	.200	.955
	N	13	13	13	13	13	13	13
CO	Pearson Correlation	.532	.524	.576[*]	.515	1	.187	.324
	Sig. (2-tailed)	.062	.066	.039	.072		.540	.281
	N	13	13	13	13	13	13	13
H_2S	Pearson Correlation	.291	-.011	-.162	.381	.187	1	-.403
	Sig. (2-tailed)	.334	.970	.597	.200	.540		.172
	N	13	13	13	13	13	13	13
PM	Pearson Correlation	.494	.347	.173	-.018	.324	-.403	1
	Sig. (2-tailed)	.086	.245	.571	.955	.281	.172	
	N	13	13	13	13	13	13	13

5. CONCLUSION

The emission of these gases Sulphur dioxide SO2, Nitrogen dioxide NO2, Amonnia NH4, Carbon Monoxide CO, Hydrogen Sulphide H2S and Particulate matter as greenhouse gases has been contributing greatly to environmental problems in the Niger Delta as the hub of oil production in Nigeria as indicated in this study. Several studies have shown the links between greenhouse gases, air pollution, ozone layer depletion and chronic health challenges. As recorded by (Samet, Dominici and Curriero, 2000.) stating that greenhouse gases are major contributors to air pollution for which its level has been linked strongly to mortality and morbidity from cardiopulmonary and cerebrovascular diseases, lung cancer and infant mortality in United States of America.

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