AN ASSESSMENT OF THE AIR QUALITY STATUS OF PARTICULATE MATTER IN TWO INDUSTRIAL SITES

(NIGER FLOUR MILLS AND LAFARGE (UNICEM) CALABAR CROSS RIVER STATE)

BY

*Henshaw, Henrieta Nta[a] Orok Etim Effiom[b]
Department of Chemistry y Cross River State College of Education, Akamkpa

Abstract

This study is focused on assessing the air quality status of particulate matter pollution in two industrial nuclei (Niger Mills Flour Industry and UNICEM/LAFARGE cement industries) in Calabar Cross River State, Nigeria. The imperative for the study derives from the recognition that particulate matter(PM) as one of the six criteria pollutants has a significant human and ecological implication in our environment. Pm has been implicated for many deleterious effects on human health. The study objectives include: (i)determination of the volumetric concentration of particulate matter in the ambient air, (ii) understanding of the nature of particulate constituents, (iii) isolation of particulate constituents from other pollutants and , (iv) ascertaining the permissible levels of pollutants and comparison of the air quality status of the two areas. The literature explored such thematic areas as human and environmental impact of particulate pollutants, and air quality standards and indices. The methodology involved the employment of specialized instruments in sampling and recording the air quality status in selected stations mapped out by the Global positioning system GPS) in the two industrial sites. The field air sampling were conducted in two seasons dry seas in (Feb 2018) and wet season (May. 2018) the obtained results were presented in tables(Tables 1-4). These table were further summarized and compared with the Federal Ministry of Environment (FME) air quality criteria (Table5-8). The findings reveal that the ambient air quality of two location were not exceedingly above the Federal Ministry of Environment (FME) permissible limits. Secondly, that air quality status at Flour Mills is higher than that of the UNICEM/LAFARG cement industry are. Thirdly, that the air quality status at large is more homogenous than that of the flour mills area at Calabar central area. Finally that health implication of air quality assessment of the two areas is not threatened in the short run.

EXECUTIVE SUMMARIES

The study aims at investigating the air quality status of particulate matter (PM) pollutants in two industrial locations in Calabar and environs. The two sites located apart are the main industrial nuclei in Calabar economic activities, areas. The choice is envisaged based on the recognition that air pollution impact has implications for human health. The problem identification stems from the recognition that studies of this nature is at best scant in the proposed area concerned and that the human environmental impact assessment is of dire necessity due to its implication for human health. The research objectives are formulated to: (i) to determine the volumetric concentration of pm in the areas. (ii) examine the concentration of PM in the areas.(iii) isolate pm pollutants from other pollutants in the area(iv) to ascertain the relative permissible level of pollutants in relations to Federal Ministry of environment (FME) in the industrial sites

The methodology encapsulates description of the research design, description of area of study, description of the instrument/equipments which include, Gasman detector,(Crown model), hydrogen sulphide (H_2S) range 0-10m, sulphur dioxide (So2) range 1-10ppm, nitrogen (iv) oxide (No2) range 0-10ppm, carbon monoxide (Co)0-500ppm , particulate matter (cassela-ams 950 therman GPRS for determination of coordinates of locations and elevations. The methods and procedures for air quality data collection were explained based on their relevant and specific use contexts.

In each station two sets of data were collected, one for dry season and the other for wet season. The values of the parameters obtained were recorded in tables 1-4 under data presentation. These were provide the ambient quality status for the locations sampled. These values were accordingly transposed to ‘mean’ ambient air quality concentrations of those parameters for the FMG standard limits (tables 5-8).

The mean values replicated the ambient air raw data collected for the two stations in two seasons each. The results indicate that the mean values of PM in the two areas were different for the two areas were different for the two sites. It is more homogenous for Mfamosing (UNICEM) and variegated for Niger Mills (Flour mills). The overall implication is that the air quality status at Nigeria mills is more tolerable to human health or of better quality than at UNICEM (LAFARG)

1.1 Introduction

Air quality assessment is a vital component of environmental quality evaluation in the atmosphere. Ambient air quality determines the quality of life of the people in an area. Poor air quality is synonymous with poor human health in a given environment. Through a long terrain of history, sufficient ignorance was exhibited concerning the value of air to human health sustainability.

With the outset of the Industrial Revolution in Britain and its impact on Europe and other parts of world, the industries and other human activities were carried out without concern for appropriate environmental standards (De Bliz, 1976). This situation led to the occurrence of air pollution episodes that were experienced in different parts of the developed world regions such as that of MEUS valley (Belgwumoith), Donora valley, pensylvannia (1948), London smog , 1952 and 1965 , and that of Chilago and California. Several casualties and death tolls were reported in those areas. This situation produced the arousal of consciousness towards environmental quality considerations and air quality assessment in particular.

Consequently the first world convention on human environment (The United nations Conference on Human Environment -UNCHE) was organised to direct attention to environmental management in all spheres of the environment(law and Smith 1995, Utang and Ibu, 2004). Following this conference, the United Nations Environmental programme was established with headquarters at Nairobi, Kenya as the sole environmental coordinating agency.

Following this development several environmental regimes, conventions and treaties have been organized to focus attention to human environmental activities.

Environmental legislations and standards have been provided with "principles' and "agreements" reached or enunciated by the regulating bodies or organizations for ecocentric/ friendly environmental management.

Air quality standards and criteria are equally set by different countries and agencies to ensure compliance to safe air quality criteria. The standard set limits for safe, moderate high and extreme levels of air pollution for different categories of air pollutants such as particulate matter(PM) Nitrogen Oxides (No No_2) sulphur oxide(So So_2) and carbon dioxide or carbon monoxides (Co). The safety and health limits set for these pollutants are called criteria or standard and hence the pollutants are called criteria pollutants.

Different countries have their environmental management agencies such the United States Environmental Protection Agency (USEPA), Canadian Environmental Protection Agency (CEPA) and in Nigeria, the Federal Ministry of Environment (FME). At the global level, the World Health Organization (WHO) has its standards that forms the basis of comparison for other nations and is called the WHO standards.

Particulate matter(PM) is an important criteria pollutant due to its nature and composition. Following Rahmans report (2016) particulate matter is composed of solid or liquid particles small enough to be suspended in the atmosphere. PM industries primary pollutants such as dust and soot as well as secondly pollutants such as sulphates and nitrates. They damage respiratory tissues, when inhaled. Their sizes are measured in microns such as PM_{10} which is dust while PM_{22} pollution results from combustion processes.

1.2 Statement of the problem

Notwithstanding inherent benefits of the industries in the economic emancipation of the people in the area, the ecological and human health impact of the pollutants is enormous.

Ecologically, particulate pollution has direct impact on atmospheric weather systems in such areas as reduction of insolation leading to drought or rainlessness caused by sulphate aerosols, obscuring visibility , reduction. Of photosynthesis in plant foliage and so on. Particulate matter pollution of aquatic ecosystems can lead to increase of Biological Oxygen Demand (BOD) and death of aquatic species. In the due course, it can lead to water crises due to the effect of PM materials in contaminating water bodies reducing it unfit for other uses. It also has the adverse effect of reducing the aesthetic value of areas.

The human health impact has equally been sufficiently documented in the literature such as its effects in diseases of the tracheas and respiratory organs, incidence of asthma, visual impairments or blindness and others too numerous to mention

All such concerns and the need to practically evaluate the true perspective of the pollution in the areas provides the driving force for the study.

1.3 Purpose/objectives of the study

The overall aim of this study is to assess the air quality status of particulate matter pollution in the selected sites in Calabar , Cross River State, Nigeria

The specific objectives are as stated below

- To determine the volumetric concentration of particulate matter pollutants in the immediate and ambient air in the area
- To examine the nature of the particulate constituents in the vicinity of the study
- To isolate particulate pollutants from other pollutant constituent in the area
- To ascertain the permissible level of concentration of pollutants in relations to Federal Ministry of Environment standard limits
- To compare the air quality status of particulate concentration in the two industrial sites (Flour Mill and LAFARGE).

Literature review

2.0 Overview

Montgomenry (2000) .described particulates to includes smoke(soot) and ashes from fuel (manly coal) combustion. Dust released during industrial processes and other solids from accidental and deliberate burning of vegetation. Particulates may also be produced from a variety of other sources such as solid mining operations, Landscape excavation during construction and/or from natural sources such as a evolian materials blown down from desert land by wind or tephra materials from volcanic eruption (Upla . 2006)

They are also known as atmospheric aerosols, atmospheric particulate matter or atmospheric suspended particulate matter. There are microscopic particles of solids or liquids. It is said not to be a single pollutant but a mixture of different chemicals. Some of the particulates such as dust and soot are large enough to be seen by the naked eye.

Estimates of different ratio of particles includes 3.5 million from industrial activities and additional sources from natural activities such as volcanic eruption, natural forest fires, erosion of dust by wind and blowing up of salt spray from sea surface (World Resources institute (WRI 2021).

2.1 Health And Environmental Impact Of Particular to Pollutants

Particulate pollutants have been implicated as one of the most hazardous pollutants Montgomery (2001) reported that the nature of the problems posed by particulate pollution depends on the nature of the pollutants. He stated that dense smoke is unsightly ash from power station or industrial locations causes enormous expenses on clearing up. Some of them are carcinogenous. Some do contain heavy metals which are toxic or radioactive.

Thus it was concluded that control of particulate matter is a matter of health and aesthetics (Monogomery 2001). Numerous studies have revealed that exposure to particulate matter pollution is associated with increase in mortality and a number of health effects (Kan et al 2008, Docleary, 2009).

International Agency for Research on cancer classified particulate pollutants as carcinogenic to

humans, (WHO ,2013).
Particulate matter with an acrodynamic diameter of 10 μm is particularly DANGEROUS in case of human health because PM_{10} can penetrate into the respiratory tract (Schwatze et al, 1993, Wang , et al 2009 Weave et al 2012). These scholars further reported that exposure to PM10 ambient air can cause several hazardous health effects such as asthma exacerbation and respiratory illness chronic bronchitis, lung, irritation, cancer mortality and increase hospital; admission (Sicard et al 2011, Jeong, 2103, Neisi et al 2016).

2.3 Air quality standard and indices

Basically air quality criteria are expressions of the latest scientific knowledge based on the experiences of experts (Wark and Warner 1976). They indicate qualitatively and quantitatively the relationship between levels of exposure to pollutants and the short and long term effects on health and welfare (Staff report 1968 , Wark and Warner 1976). They are descriptive in the sense that they describe the effects that can be expected to occur when pollutants levels reach or exceed certain specific figures for a specific time period (Ubong and Gobo 2001). They delineate the effects from, a combination of contaminants as well as from individual pollutants. The criteria are an essential step in providing qualitative basis for air quality standards. A number of air quality criteria have been established by USEPA (United states Environmental protection agency(NAPCA, 19689. 1970 and 1971). Standards unlike criteria are prescriptive. They prescribe the pollution level that cannot legally be exceeded in a specific period in a particular geographic region.

Nigeria under the auspices of the Federal Ministry of Environment has its ambient air quality standards (NAAQS)for different categories of pollutants measure in microns (μ) per cubic meter(m^3).

The World Health Organization (WHO) has its guidelines and standards for different pollution such as lead(Pb) , Nitrogen oxides(Nox), Oxygen(O2), Carbon monoxide(Co) and particulate matter (PM) (Rahman, 2016) following Rahman 2016) there are few types of air quality standards in the world measure the quality of air. He reported that in Canada air pollution and associated Health risks are measured with the air quality Health index (A.QHI).

The AQHI provides numbers from 1-10^+ to indicate the level of health risk associated with local air quality. The risk level indicated is graduated as low(1-3), moderate (4-6), high(7-10) and very high (above 10 or10^+).

By and large air quality standards and guidelines are provided to regulate the maintenance of clean air quality in an area (Rahman , 2016).

Methodology

3.1 Research of design

The design for the study is field exploratory scientific design aimed at collecting air quality parameters from two sites engaged in similar environmental impact activities

3.2 Area of the study

The area of study comprise two separate but contiguous territories engaged in production of materials that pollute the environment. The two sites are Niger mills flour industry at Calabar and LAFARG (UNICEM) cement factory at Mfamosing Akpabuyo. The two areas properly fit into Calabar ecological Doman and came under Calabar before the creation of Akpabuyo.
Both UNICEM and Niger mills engage n the production of materials that emit particulate pollutants to the atmosphere which is what informed the choice of research topic
Ambient air quality studies were carried out at the Niger mills (Flour Industry Calabar, and UNICEM Mfamosing. This was done in order to ascertain the environmental condition of the area and impact assessment of the proposed project.

Equipments: Equipments Used Include

- Gasman gas dector (crown model)
- Hydrogen sulphide (H_2S), Range 0-10ppm
- Sulphur (iii) oxide (So_2) Range 0-10ppm
- Nitrogen (iv) oxide (No2) Range 0-10ppm
- Carbon Monoxide (CO) 0-5000ppm

2. Particulate matter (Casella- Ams 950)
3. Garman GPRS

Six (6) Sampling stations were located at the study areas taking into cognizance bearing through the GPRS to give a proper representation of the study areas. Different pollutant gasses were assayed for in order to determine their concentration in the air pollutant gasses that were assayed for; were Nitrogen IV Oxides (NO2) hydrogen sulphide (H_2S), sulphur IV oxide (So2),and carbon monoxide(Co). The concentration of suspended particulate matter (Pm) and magnitude of electromagnetic radiation EMR were determined.
All the aforementioned physical parameters were measured with the aid of environmental gas monitors and detectors. The concentration of pollutant gasses were measured in parts per million (PPM) while suspended particulate matter was measured in milligram percubic meter(mg/m^3) and electrogmagnetic radiation (EMR) in counts per minute(CPM). The mean concentrations of the paprameters across the six(6) different locations were determined aid compared with the federal ministry of environment standards for air pollution control in Nigeria.

Selected gaseous pollutants: concentration of some common air pollutants were determined during this study. Crown model gasman portable gas monitors were used to automatically detect the anibient concentrations of these pollutants in the project area with a view to acquiring the base line data for the project: the selected gaseous pollutants include So_2 No2 H_2S and Co. The gasman gas monitors manufactured by Crowcon uses electrochemical sensors which utilizes the principle of electrochemistry to determine the ambient concentration of gaseous.
Pollutants in the atmosphere. The monitor operates by gas diffusion in the sensor, which is (placed directly under the filter, when the atmosphere of the air under analysis comes in contact with the sensor , electrochemical changes bring about current or consumed (when current brings about chemical changes) is amplified and displayed on the output meter or LCD(liquid crystal display). These sensors which are very sensitive are each specifically made to detect a particular gas, specificity is made possible by the use of selective filters which are placed above the sensors, the

components are enclosed in plastic casing with control switch.

Hazardous dust or Suspended Particulate Metter (SPM): average concentration of fine suspended particulate matter SPEM whicxh are very hazardous to human health were obtained at the sampling stations using the 10mm particulate monitor known as HAZ-DUSTM manufactured by Environmental Devices Cooperation- The instrument is a portable direct reading particulate monitor that uses infra-Red(IR) electromagnetic radiation to sense airborne particles. The HAZ-DUST manufactured by environmental devices TM cooperation. The Hazadust adopts the principles of near-forward-right scattering which utilizes a light source-emitter and photo-detector positioned at 90^0 angle.

As particles transverse the sensing rolling they scatter IR at a forward angle 45-90 degrees. The amount of scattered light is directly proportional to the aerosol or fine particles of 10μm (10 below) diameter concentration in the air. The mass concentration readout(in out LCD) is expressed in milligrams per cubic meter(mg/m^3).

The instrument which complies with oshas organization of safety and Health Air contaminant exposure standards which can be used for all industrial and environmental particulate air monitoring applications.

Presentation of results

The determination of air quality was carried out at Niger mills and Unicem on 24th and 29th February respectively this was dry season date was obtained . Wet season on 15th and 16th May respectively in all the sampling stations. The mean concentrations of the fine suspended particulate matter (SPM), the gaseous pollutants are radiation measured in the study areas are as shown in table 1, 2 ,3 and 4 with the summary of mean concentration of sampling result and comparison with the Federal Ministry of Environment standards for air pollution control in Nigeria

DATA PRESENTATION (TABLE 1-8)

Table 1

Ambient air quality at the Niger mills flour industry Calabar (24/2/18) (Dry Season Data)

S/N	Sampling station	Location coordinates	Elevation Alt(m)	No_2 (ppm)	So_2 (ppm)	H_2S (ppm)	Co (ppm)	Hazdust (pm) (mg/m^3)	Rad (cpm)
1.	NMAQ1	04^{0}59′30.6″N 008^{0}19′58.3″E	62	1.90	2.00	1.90	2.95	0.17	21
2.	NMAQ2	04^{0}59′35.7″N 008^{0}20′02.3″E	60	1.90	2.10	1.80	2.55	0.18	15
3.	NMAQ3	04^{0}59′44.6″N	64	1.95	2.20	2.00	3.99	0.19	24

	008^{0}19′49.3″ E							
4. NMAQ4	04^{0}59′38.5″N 008^{0}19′47.1″ E	61	1.80	1.90	1.80	2.50	0.18	16
5. NMAQ5	04^{0}59′33.0″N 008^{0}19′47.1″ E	59	2.00	1.60	1.70	2.60	0.18	15
6. NMAQ6	04^{0}59′31.7″N 008^{0}19′50.4″ E	63	1.80	2.10	1.95	2.95	0.18	16
FMENV.LIMIT			0.0 0.10	0.5 0.10	8.0 0.50	10.0 0.500	25* 0.50	32*

Legend

NO_2 Nitrogen Dioxide

SO_2 Sulphur dioxide

H_2S hydrogen sulphur

Co carbon monoxide

Hazdust- particulate matter (pm)

Table 2

Ambient Air Quality Unicem (Nfamosing) (27th February 2018) Dry Season Data

S/N	Sampling station	Location coordinates	Elevation Alt(m)	NO_2 (ppm)	SO_2 (ppm)	H_2S (ppm)	Co (ppm)	Hazdust (mg/m3)	Rad (cpm)

1 NMAQ1	$05^0 04' 45.1''$N $008^0 30' 22.1''$ E	23	1.90	2.00	1.70	3.00	0.28	17
2 NMAQ2	$05^0 04' 46.9''$N $008^0 30' 30.9''$ E	22	1.80	2.25	1.90	2.90	0.26	29
3 NMAQ3	$05^0 04' 45.5''$N $008^0 30' 23.7''$ E	19	2.00	2.20	1.80	2.95	0.27	20
4 NMAQ4	$05^0 04' 45.3''$N $008^0 30' 17.4''$ E	20	2.01	2.30	1.90	2.95	0.27	13
5 NMAQ5	$05^0 04' 44.3''$N $008^0 30' 17.4''$ E	20	2.10	2.50	2.00	3.05	0.30	30
6 NMAQ6	$05^0 04' 46.5''$N $008^0 30' 28.5''$ E	20	1.90	2.30	1.80	3.00	0.27	22
FMENV.LIMIT			0.8	0.5	8.0	10.0	25*	32*
GAS DETECTION RANGE			0-10	0-10	0-50	0-500	0-50	

Legend
No_2 Nitrogen Dioxide
So_2 Sulphur dioxide
H_2S hydrogen sulphur
Co carbon monoxide
Hazdust- particulate matter (pm)

Table 3

Ambient air quality at the LAFARG UNICEM NFAMOSING (27th may 2018) wet season data

S/N	Samplingstation	Location coordinates	Elevation Alt(m)	No_2 (ppm)	So_2 (ppm)	H_2S (ppm)	Co (ppm)	Hazdust (mg/m^3)	Rad (cpm)
1	NMAQ1	05⁰04′43.2" N 008⁰30′11.9" E	16	1.80	2.20	1.90	2.95	0.24	17
2	NMAQ2	05⁰04′41.8" N 008⁰30′05.4" E	17	1.75	2.10	1.95	2.80	0.24	12
3	NMAQ3	05⁰04′39.4" N 008⁰30′01.6" E	16	2.00	1.95	1.80	2.75	0.24	15
4	NMAQ4	05⁰04′45.5" N 008⁰30′17.4" E	21	1.90	2.05	1.60	2.80	0.23	20
5	NMAQ5	05⁰04′45.5" N 008⁰30′24.3" E	21	1.90	2.00	1.75	2.90	0.25	17
6	NMAQ6	05⁰04′46.7" N 008⁰30′30.1" E	21	1.80	2.10	1.70	2.85	0.24	18
FMENV.LIMIT				0.8	0.5	8.0	10.0		12*
GAS DETECTION RANGE				0-10	0-10	0-50	0-500		

Legend

No_2 Nitrogen Dioxide

So_2 Sulphur dioxide

H_2S hydrogen sulphur
Co carbon monoxide
Hazdust- particulate matter (pm)

Table 4

AMBIENT AIR QUALITY NIGER MILLS FLOUR INDUSTRY CALABAR(16/5/2018 WET SEASON DATA)

S/N	Samplingstation	Location coordinates	Elevation Alt(m)	No_2 (ppm)	So_2 (ppm)	H_2S (ppm)	Co (ppm)	Hazdust (mg/m3)	Rad (cpm)
1	NMAQ1	05^{0}59′45.1″N 008^{0}20′03.6″ E	60	1.80	1.40	1.90	2.80	0.20	18
2	NMAQ2	05^{0}59′42.9″N 008^{0}19′39.8″E	61	1.70	1.80	1.60	2.80	0.20	22
3	NMAQ3	05^{0}059′49.7″N 008^{0}20′00.2″E	58	1.65	1.50	1.55	2.50	0.21	15
4	NMAQ4	05^{0}59′31.8″N 008^{0}19′53.5″E	59	1.75	1.50	1.95	2.60	0.21	20
5	NMAQ5	05^{0}59′50.5″N 008^{0}19′53.7″E	64	1.80	1.75	1.80	2.70	0.20	22
6	NMAQ6	05^{0}58′47.9″N 008^{0}21′10.8″E	72	1.85	1.50	1.85	2.70	0.21	17
FMENV.LIMIT				0.8	0.5	8.0	10.0	25*	32*
GAS DETECTION RANGE				0-10	0-10	0-50	0-500	0-50	

Legend
No_2 Nitrogen Dioxide
So_2 Sulphur dioxide
H_2S hydrogen sulphur
Co carbon monoxide
Hazdust- particulate matter (pm)

Table 5 : Summary of mean ambient air quality Niger Mills flour Industry in comparison with Federal Ministry of Environment standards. 16th May, 2018

REPLICATES TABLE 4.

S/N	PARAMETER	RANGE	MEAN	FM ENV. LIMIT
1.	NO_2 (ppm)	1.65-1.85	1.76	0.25
2.	SO_2 (ppm)	1.40-1.80	1.57	0.50
3.	H_2S (ppm)	1.60-2.95	1.78	0.80
4.	CO(ppm)	2.50-2.80	2.65	8.00
5.	RAD/EMR	0.20-0.21	0.20	10
6.	HAZ DUST(SPM)	17-22	19.0	32*

Table 6: Summary of mean concentration of ambient air quality results from Niger mills flour industry in comparison with Federal Ministry of Environment standards.24th February 2018(replicates table 1)

S/N	PARAMETER	RANGE	MEAN	FM ENV. LIMIT
1.	NO_2 (ppm)	1.80-2.00	1.89	0.25
2.	SO_2 (ppm)	180-2.20	2.02	0.50
3.	H_2S (ppm)	1.70-2.00	1.86	0.80
4.	CO(ppm)	2.55-3.00	2.76	8.00
5.	RAD/EMR	0.17-0.19	0.18	10
6.	HAZ DUST(SPM)	16-24	17.8	32*

Table 7: Summary of mean concentration of ambient air quality results from UNICEM in comparison with Federal Ministry of Environment standards. 27TH February, 2018 (replicates table 2)

S/N	PARAMETER	RANGE	MEAN	FM ENV. LIMIT
1.	NO_2 (ppm)	1.80-2.10	1.95	0.25
2.	SO_2 (ppm)	2.20-2.50	2.26	0.50
3.	H_2S (ppm)	1.70-2.00	1.85	0.80
4.	CO(ppm)	2.90-3.05	2.97	8.00
5.	RAD/EMR	0.26-0.30	0.27	10
6.	HAZ DUST(SPM)	17-30	21.8	32*

Table 8: Summary of mean Ambient air quality at LAFARG (UNICEM) in comparison with Federal Ministry of Environment standards. 15th May, 2018 (replicates table 1)

S/N	PARAMETER	RANGE	MEAN	FM ENV. LIMIT
1.	*NO_2 (ppm)*	*1.80-2.00*	*1.95*	*0.25*

2.	SO_2 (ppm)	1.95-2.20	2.26	0.50
3.	H_2S (ppm)	1.60-1.95	1.85	0.80
4.	CO(ppm)	2.75-2.95	2.97	8.00
5.	RAD/EMR	0.23-0.25	0.27	10
6.	HAZ DUST(SPM)	12-18	16.5	32*

Interpretation/discussion of results

Data was collected using relevant specialised used instruments as earlier explained under methodology. Criterion pollutants were sampled at determined locations and elevations and represented in tables as shown from table 1-4 for the ambient air greatly status of the two industrial sites- Niger mills flour industry Calabar and UNICEM (LAFARG) cement industry at Calabar. The primary criterion pollutant under investigation is the particulate matter (pm) which or couldn't be isolated from others because pm is derived from a variety of sources in combination with the others and others and also reaction between primary particulates with other compounds such as hydrogen sulphides could lead to the formation of secondary particulates which are dangerous to human health.

Filed data was collected in two phases each from these stations i.e dry season and rainy season respectively for each of the industrial sites

Table 1 represents air quality data at Niger mills flour industry based on dry Season ambient air quality 24/2/2018 while table 4 represents similar information in the same station for the rainy season 16/5/2018.

Accordingly table 2 and 3 represent ambient quality data collected for dry season and rainy at LAFARG (UNICEM) cement company 27th February and 15th may 2018 respectively.

Tables 5 and a6 are summaries of mean ambient air quality at Niger mill flour industry for wet season 16th May 2018 and dry season (24th February 2018 in comparison to federal ministry of environment (FME) air quality standards on the same bases tables 7 and 8 represent summary of mean ambient air quality of LAFARGE (UNICEM) cement company for dry season and rainy seasons respectively and equally in comparison to FME(criteria)

Results/findings

The results derived from the mean ambient air date collected in the filed for two seasons in the two industrial sites (Tables 1-4) are correspondingly replicated as mean ambient air concentrations in comparison with the federal ministry of environment (FME) standards (1 tables 5-8).

Table 5 replicates table 4 and indicated the mean ambient air quality standard for rainy seasons (16th may 2018) at Niger mill flour industry in comparison with Federal Ministry of Environment (FME) for each of the five criterion pollutants, the results indicates that No_2 mean value of 1.76 part per million (ppm) is higher than the five permissible limit of 0.25 the range sampled is 1,65-1-85.

This shows that No_2 is higher by 1.21 than the FME limit which implies that the No_2 concentration approached a deleterious level So_2 with a range 1.40-1.80 has a mean value 1.5 While the FME permissible limit is 0.50. this means that the concentration exceeds that FME limit by 1.00 this means that concentration trebles the allowable limit presented by FME it therefore implies that there is a possibility of chemical reaction between SO2 ns pm10 to form secondary particulates that are considered detirious hydrogen sulphide with a range of 1,60-2.80 has a man concentration of 1.78 which compared to the FME standards of 0.80 exceeds the limit triple times with an estimate value of 0.98ppm. it is another potential; possibility of formation of secondary pollutants on reaction with particulates (pm) in the presence photo chemical oxidants.

Carbon monoxides (Co) presents the highest mean concentration as shown by the range of 250-280pmm and exceeding the FME limit with a value of 2.76 as against the official value 8.00. the huge volumetric concentration may be explained based on emission of these gases from industrial plants as well as from the exhaust fumes of vehicle operating in the industry.

Electromagnetic radiation EMR or radiation emerge generally is lower than the FME permissible limits with a value of 0.20, it falls extremely below the FME limit of 10. This may be explained based on the possible interception of the insulation decreased by atmospheric aerosols earlier highlighted in the literature. This has grave implications for human health and ecological balance as a whole.

Hazdust (pm) with a mean concentration of 19.0 fall well below the FME LIMIT OF 32 PPM. This means that the deleterious impact of the pollutant cannot be expected in the short run. Overall the air quality status of the pollutants is variegated implying that the concentration of one is tending towards deleterious levels while other they are within the permissible levels.

Table 6 replicates table 1 is summary of mean concentration of ambient quality results from flour mills comparison with the FME limit for dry seas (24^{th} Feb 2018)

For each of the pollutants the values are higher than the FME limit except for Co , RAD/emr and hazdust(Spm)

In comparison of the seasonal mean values of each there is a slight difference in the dry season above the rainy season for each if the pollutants but ironically hazdust for the rainy season concentration is higher than the dry season value. This may be explained based on the recognition that the resident time for the aerosols or dust is higher in the rainy season than the dry caused by the presence of photo chemical oxidants which activate the formation of condensation nuclei (Anyadike 1986).

Specifically, nitrogen oxides has a slightly mean values (1-0.13) for the dry season concentration and above the wet season air quality SO_2 has a marked difference 1.10 approximately for the dry season. H_2S and co equal are higher in the dry season that wet season. By and large the differenceS are not too well marked to signify any form of immediate and long term health effects for both the industrial workers and the residents in the ambient air domain.

Tables 7 and 8 are replicates of tables 2 and 3 on ambient air quality status of particulate matter formation for two seasons (dry season 27/2 18) and wet seasons (15/15 18) derived from UNICEM (LAFARG) cement factory Mfamosing the summary of the mean concentration of the ambient air are clearly represented for the six parameters pollutants and equally compared (FME) permission limit. The parameters are NO_2, SO_2, H_2S, co RADEMR and HAZDUST (spp) respectively.

The results generally indicated that the mean ambient air quality is homogenous for both the dry season period and the wet season. It is also generally indicative that mean concentration of all the parameters for exceed the FME limit compared the observed values of the parameters at Niger mill flour industry at Calabar. For instance No_2 is 1.76 and 1.89 for the two season at Niger mills while itis respectively 1.95 and 1.95 for both seasons at UNICEM (LAFARG)MFAMOSING. Correspondingly

SO_2 mean values is 1.57 and 2,02 at Niger mills while it is 2.26 for both seasons at UNICEM (LAFARG). The inference is simply that the ambient air quality values is variable at Niger mills while is homogenous and with higher concentration at UNICEM (LAFARG) HAZDUST 19.0 and 17.8 at Nigeria mills while at UNICEM 21.8 and 16.5 for the two seasons. This means that for the two stations the volume concentration is variable. A number reasons can be adduced here such as seasonal effect in affecting particulate residence time or the volume of production which will certainly determine the level of particular emission to the atmosphere, from the our findings based our information or results it simply significant to infer that particulate production and other criteria pollutants concentration are higher at UNICEM (LAFARG) than that of extension the air quality stated is better at Niger mills than at UNICEM (LAFARG)

Conclusion

The results/ finding of this study indicate that certain pollutants level exceed the FME limits while other fall below it. Also the presence of secondary pollutants resulting from the reaction Nitrogen Oxides and sulphur oxides with photochemical oxidants showed that the air quality is tending towards a deterious state in some cases. Overall the air quality state at Niger Mills is variable and nor deleterious while that of LAFARG is homogenous and deleterious.

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