Environmental Implication Of Ashaka Cement Works

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ENVIRONMENTAL IMPLICATION OF ASHAKA CEMENT WORKS

BY

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A RESEARCH PROJECT RERPORT

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IN APPLIED GEOLOGY

APRIL, 2009

DECLARATION

I here by declare that this project work was carried out by Jimoh Muhammad Tijjani under the supervision of Professor D.M Orazulike. This project has been read and approved as meeting the requirement for the award of degree of Bachelor of technology (applied geology). References to publish literatures have been duly acknowledged.

....

M. T Jimoh Date

.... 11 May 2009

Prof. D.M Orazulike Date

(Project Supervisor)

CERTIFICATION

I declare that this project work entitled "lives and environmental implications of Ashaka cement wor.ks (Environmental geology)", submitted by Jimoh Muhammad Tijjani meets the school of science requirements for the award of degree of Bachelor of technology (Applied geology).

....11 May 2009.

Prof. D.M Orazulike Date

(Project supervisor)

.... 19-11-09

Mall A.S Maigari Date

Programme Coordinator

....

Prof. M. S Sessay Date

Dean School of Science.

....

. External examiner Date

DEDICATION

I dedicate this research project work to Allah for sparing my live and granting me his mercy to become what i am today.

ACKNOWLEDGEMENT

My sincere appreciation and acknowledgement goes to my supervisor Prof. D.M Orazulike who out of his tight schedule still spear me maximum attention throughout the research work. I most also express my appreciation and acknowledgement to my lecturers Prof. E.F.C Dike, Dr. M.B Abubakar, Mall. Ahmed Isah Haruna, Mall. Ahmed Tukur, Mr. Timothy Bata, Mr. D.A Bassi (Project Coordinator) and Mall. A.S Maigari (Programme Coordinator).

Without mentioning names, my appreciation and acknowledgements also goes to my colleagues in the NIMET office for there mutual cooperation during the course of this educational pursuit.

Still my appreciation goes to the young geologist i.e my friends and colleagues in the university. And lastly my wholehearted appreciation to my family for giving me what it takes to have a peaceful HOME.

ABSTRACT

The study of the environment around Ashaka cement works has been carried out by investigating the chemical composition of the cement dust as well as that of water taken from the vicinity. The dust is generally highly enriched in silica (SiO_2) and contains moderate amount of other oxides like calcium oxide (CaO) and aluminum oxide (Al_2O_3) in the samples from the immediate surroundings of the factory/works area. The chemical constituents of the dust invariably alter the chemistry of the atmosphere, the soil and that of water in the surroundings. There are wide spread speculations on the health effect of dust which could lead to respiratory related diseases. From the result obtained, it is obvious that the industrial operations from Ashaka cement works have serious environmental implication and disturbed public health. The communities located within a radius of about 3 km from the plant are most likely to be affected by the inhalable dust. The dispersion of this dust is highly influenced by the wind system of the study area. Although, more multi-disciplinary research in this area is desirable. Further more; it was deduce that portable waters in some residential areas like workers village and Bajoga are not fit for consumption due to high Coliform and bacteria count. However, Salmonellae and Sihigalae bacteria which are responsible for typhoid fever. are found. This may account for the high statistics of typhoid fever cases as confirmed by the medical records officer of Bajoga general hospitals.

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CHAPTER ONE

1.1 INTRODUCTION

Environment is a major issue which confronts industry and business in today's world on daily basis. Environmental protection is a prime concern of today's civilization in view of the impact of global warming and its disastrous effect. Studies worldwide have indicated that the emission from both human as well as industrial activities have resulted in the increase of the average global temperature by around two (2^0C) during the last century and if the current pattern of the emission from different human or industrial activities continues then the average global temperature will rise further in the next century The effect of global warming are far far-reaching, including melting of ice caps, change in vegetation zone, reduction in biodiversity, changes in winds and season and etc. This would result in flooding of large areas, submergence of many low-lying island countries. (World meteorological day report, 2008).

Geology is the study of the earth. Environmental geology has to do with the geology of the surroundings. Its studies what is in the atmosphere and the surface of the earth in relation to the ecosystem.

Many environmental problems cannot be fully assessed and solve using geologic data alone. The problems vary widely in size and in complexity. In a specific instance, data from other branches of science (such as biology, chemistry, or ecology), as well as economics, polities, social priorities etc may have to be taken into account (Carla, 2000).

Cement industries contribute significant to the global warming which is turns play a vital role in elevating the levels of dust pollution in the atmosphere and subsequently imbalances the environment. Ashaka works is a cement processing factory and the processing of cement releases into air, dust particles from the cement raw materials. Environmental geological study of the area involves the study of the composition of the dust, some of which may be harmful to life.

1.2 AIMS AND OBJECTIVES

Generally speaking, the major aim of this project is to evaluate the impact of dust released in the cement works on the immediate environment. This is accomplished by determining the elemental and chemical composition of cement raw material dust, the concentration of these chemical components in the dust and the nature of the particulate. Hence, the effects of these chemical/elemental components on humans will be evaluated.

To achieve the above objectives, the following research steps are taken:

- Identify through chemical analysis elemental/chemical composition and their concentration in dust samples.
- Determine which among these have been known to be hazardous to health and at what levels.

These steps require:-

Quantitative information about the amount of each constituent of the raw materials, including the proportion contributed to the air, water or land. Interrelations of distributions over time, of pollutant concentrations in the environment as inferred from seasonal variation in dust output and dose-response data for populations and materials to determine the health impact for a given moment or period of time.

1.3 SCOPE OF RESEARCH

This research will in particular focuses on general environmental quality assessment and impact quantification with respect to their mitigation measures. This would be achieving by combination of extensive literature review and preliminary survey of the area in order to generate geology and meteorological data. Also sampling location would be selected within the

Ashaka environment and neighboring communities for the purpose of collecting sample for laboratory analysis.

Some of the earliest research carried out on the effect of cement dust on vegetation are:-

(Pierce 1909), he found blocked stomata in *Vitis vinifera*; (Ramgasamy and Jambulingan 1973) found reduced seed set in Zeamays; (Hindy et.al 1990) reported lack of uptake of vanadium present in the dust in *Triticum aestivum, Zeamay;*. (Farmer 1993) did a comprehensive review of the effect of dust on vegetation. This review describes the physical and chemical characters of a range of dust types. The effect of dust on crops, grassland, trees were identified. However, one of the research is done on the effect of cement dust on animal by (Bagatto and Shorthouse 1992) on the accumulation of Cu and Ni in successive life stages of the gypsy moth (*Lymantria dispar*). They found that it affects the tissue of pupae and adult during local development. The most resent of the research known to me is Aigbedion Iyayi (2004 P & F document) Environmental impact assessment of Ashaka cement works. There have been many speculations among cement factory workers and the inhabitants of the surrounding villages in Gboko, Nkalagu and Ashaka, on the effect of this cement dust on their lives. People living in such areas are believed to be prone to more frequent attacks. Catarrh and other breathing-related health conditions are feared to be most rampant in these areas. These health conditions are speculative and will remain so until the views are backed by scientific data.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 LOCATION AND ACCESSIBILITY

Ashaka Cement Factory is located close to jalingo Village about 10km away from Bajoga, approximately 80km N.E of Gombe town, Gombe State . It is bounded by latitude $10^0$50'N and $11^0$20'E and $11^0$31'E. Access into the factory is through roads constructed by the company to the factory and its surroundings including the country club, the workers village and the management staff quarters.

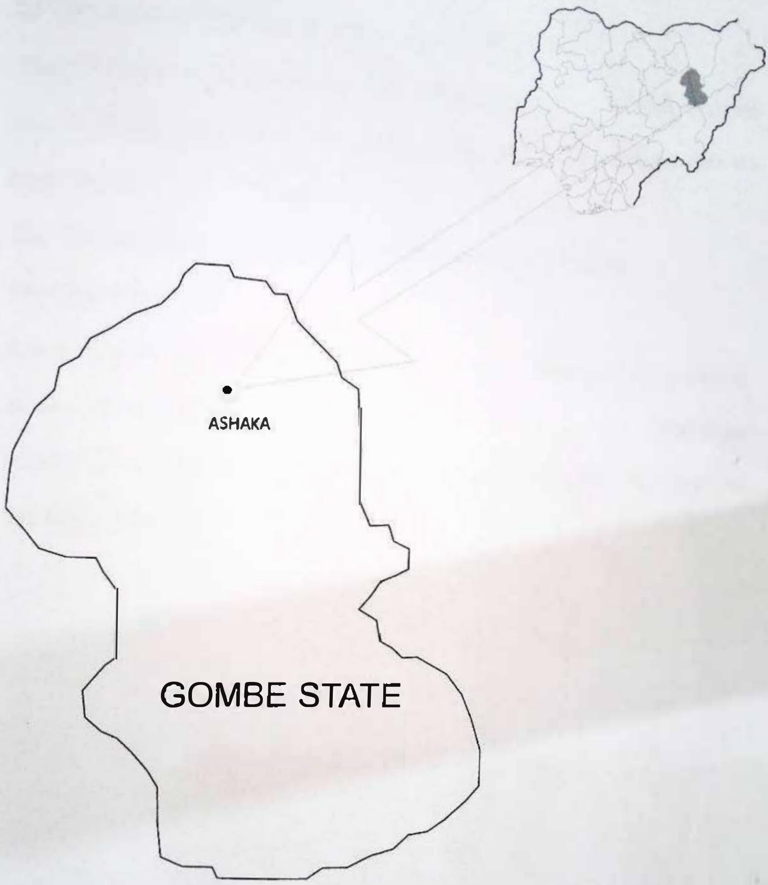

Fig 2.1 Location map of the study area (Ashaka cement works)

2.2 REGIONAL GEOLOGY AND STRATIGRAPHY

Three different paleo-geographic areas are recognized in the North Eastern Nigeria (Popoff et.al, 1986), from the southern part to the northern part we have: the upper Benue Trough.

The "Zambuk ride", a basement high inside the Gongola Trough.

The Chad Basin

Ashaka area lies within the northern margin of "Zambuk ridge". This ridge is an area of reduced thickness of sediments and of face changes. The ridge trends NE-SW and stretches from Biu Massif through Zambuk and Gombe to Kaltungo (Table 2.1).

Table 2.1The stratigraphic succession of upper Benue trough. (After Carter et.al, 1963)

			BENUE	ZAMBUK	RIDGE GOMBE AREA CHAD BASIN
Pleistocene					
Paleocene					Unconformity Kerri-Kerri formation Uncomformity
Upper Cretaceous	Maastrichtian		Lamja sst		Gombe sandstone
	Senonian	Campanian Santonian Coniacian	Numanha -Fm. Sekule-Fm	Gulani sst	Fika shales
	Turonian	Upper	Jessu FM Dukul FM		
		Lower			
				Pindiga Formation	Gongila FM
			Yolde Formation		
	Cenomania		Upper Middle Lower	Bima sst	Bima sst Bima sst
Lower Paleozoie-Pre-Cambrian	Crystalline Basement.				

The stratigraphy of Zambuk ridge is detailed in (Carter et.al 1963) and is summarized in the following section. The Pre-Cambrian and Older Paleozoic Basement Complex consisting of granites, gneiss, migmatites with subordinate gabbros and diorites. The Baseemnt is overlain unconformably by Cretaceous and Tertiary sedimentary formations which started the deposition of the Continental Bima sandstone of late Aptian-Upper Albian. It consists of feldspathic sandstone, medium to coarse grained. Thick interbeds of siltstones and mudstones overlies the Basement Complex. The Bima Sandstone is overlain by the transitional Yolde Formation of Upper Albian – Upper Cenomanian. It is made up of sandstones, thinly bedded mudstones, shelly limestones and shales. The Yolde Formation is overlain by marine Pindiga Formation of Upper Cenomanian, consisting of limestone and shales with inter beds of calcareous sandstone and shelly limestone in the Upper part. North of the Zambuk ridge, towards the Chan Formation, the Pindiga Formation passes laterally into a sequence of limestones, sandstone and shales, Gongila Formation below, and the Fika Shales above. Both formations thicken towards the North-East, away from the ridge.

The Pindiga Formation is overlain unconformably by Gombe Sandstone of Upper Maastrichtian. It is a deltaic deposit of sandstones, shales, siltsones and ironstones. Kerri-Kerri Formation consist of sandstones, sandy clays and silts fluvial continental origin. This formation marked the end of sedimentation of the Zambuk ridge, but towards the Chad Basin it is overlain unconformably by Miocene-Lower Pliocene Biu lava flow and basalts, which in turn is unconformably overlain by the Lacustraine Chad Formation of Upper Pliocene – Pliestocene consisting of Lacustriane to deltaic and fluviatile clays, sands and gravels. This information is restricted to the Chad Basin sector.

2.3 GEOLOGY OF STUDY AREA

The study area consists of two depositional basins: the Benue Basin and the Chad Basin, which were deposited during the Upper Cretaceous times (Carter, et.al 1963).

Okafor and Ofoegbu 1988, in a gravity and magnetic study confirmed the existence of one of these Basins. The generalized Geology of Ashaka and adjoining areas of North Eastern Nigeria is shown in figure 2. Essentially, the stratigraphic succession in study area consist of continental Bima Sandstone which unconformably overlies the Pre-Cambrian Basement, the marine Gongila Formation and the marine Fika Shales. The Gombe Sandstone and Kerri-Kerri Formations are not represented in the study area. They seem to have been removed by erosion. Also, the Chad Formation does not occur here at the Basin margin but in the interior, about a hundred kilometers to the North East (Oti, 1988).

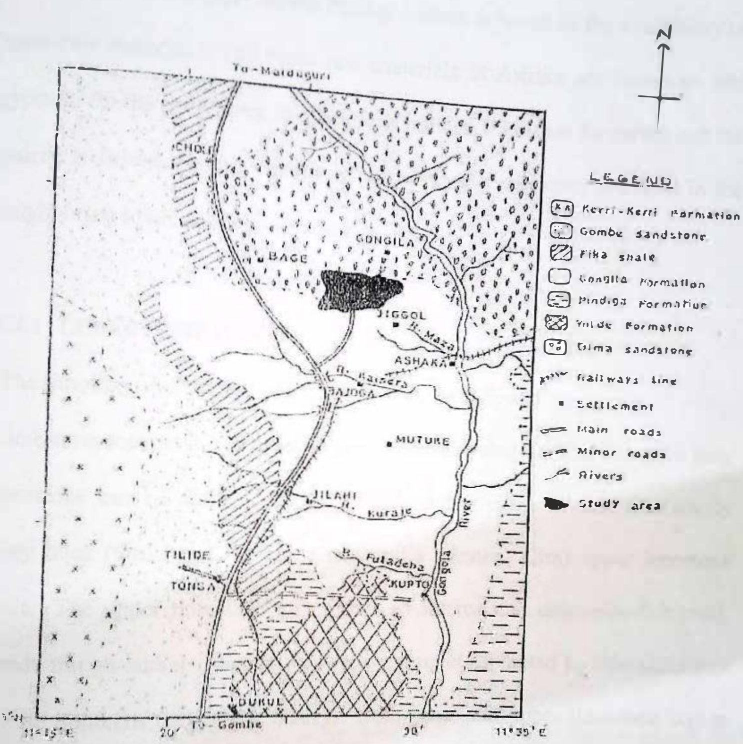

Fig 2.2: Sketch of geological map of Ashaka N. E. Nigeria showing the study area (Modified after Carter et al, 1963)

2.4 ECONOMIC GEOLOGY OF ASHAKA AREA

The location of Ashaka Cement PLC at Ashaka is based on the availability of basic raw material. The basic raw materials in Ashaka are limestone and gypsum. In the study area, the factory is built on limestone formation and the quarry is situated in the vicinity of the company. Gypsum is mined in the neighboring town of Mada and Gadaka.

2.4.1 LIMESTONE ($CaCO_3$)

The lithology and outcrop characteristics are as follows:

Limestone separated by brownish grey laminated shales. The brownish grey limestone can be divided on account of outcrop character into a relatively very thick (9m) basal limestone unit and a thinner (1.5m) upper limestone unit. The upper limestone unit shows an intercalated ammonite-rich marl, grade trough lateral facies change into a couplet separated by thin shale unit in the Southern part of the quarry. Both basal and upper limestone bodies constitute proven reserve of 490 million tones. This amount is estimated to last the company for about four decades at the present production rate. Therefore the reserve of limestone as an essential raw material justifies the sitting of the Ashaka Cement Factory in this location.

2.4.2 GYPSUM ($CaSO_4.2H_2O$)

This industrial mineral found as seams 2cm thick – 10cm thick. The seams occur parallel to shale/clay beds. Occasionally, gypsum seams are seen cutting across bedding and at right angles to the horizontal seams at Mada, as many as six seams were counted within a ½ meter sequence of shale/clay rock (Fika Shale) in a pit about ½ meters deep. These seams may reoccur at greater depth depending on the thickness of the host, the Fika Shale.

At Gadaka, gypsum occurs at break of slope with only a few centimeters of top soil about it. In this locality, the commodity also occurs along steam channel and gullies.

Gypsum occurrences in the study area is restricted to the Turonian Fika Shales. It is note-worthy that this formation grades into the Pindiga Formation. In this latter formation, gypsum has also been reported (Carter et.al 1963) and has been investigated by Orazulike (Orazulike, 1986 & 1989). (Haruna, 1998) chemical data (Table 2.2 on this deposit show it to be pure gypsum and of good quality, chemically.

Table 2.2 Chemical composition of gypsum from the vicinity of Ashaka in%

(After Haruna, 1998)

	RHM – 61	RHM – 62
$CaSO_4.2H_2O$	82.42	89.11
$CaSO_4$	0.00	2.48
$CaCO_3$	0.00	0.00
M_gCO_3	0.42	0.42
SiO_2	13.85	6.85
Al_2O_3	1.80	0.67
Fe_2O_3	0.22	0.16
Na_2O	Not determined	Not determined
K_2O	Not determined	Not determined
Undetermined	1.29	0.31
Total	100.00	100.00
Combined water (H_2O)	17.25	18.65
Moisture (H_2O)	1.25	0.83
CO_2	4.26	2.48
CaO	24.87	26.98
SO_3	33.88	42.91

Trace metal concentration in ppm.

Rb	-	21.0
Zr	-	10.0
Ba	-	27.0
Zn	-	16.0
Pb	-	6.0
V	-	20.0

CHAPTER THREE

3.1 METHODOLOY AND INSTRUMENTATION

3.2 FIELD WORK

The field work took me two (2) weeks 13th to 27th October 2008 in the vicinity of Ashaka works factory and environment. The dust samples and water samples were technicaly collected.

Hospital records of Asthmatic cases and other breathing related health condition, as well as water borne health problems were very difficult to get both from the company clinic and Bajoga General Hospital because of too much bureaucratic bottle neck. All my required meteorological data were given to me by the Nigerian meteorological Agency, Ashaka Airport inspectorate Office/Station

3.3 MEASUREMENT OF LEVEL OF ATMOSPHERE DUST POLLUTION:

The apparatus used are as follows:

- Conical flask (collectors)
- Funnels
- TOP load-weighing balance
- Desiccators
- Pellet cap
- Metal thong

- Vane anemometer
- Furnace
- Oven

3.3.1 CHEMICALS AND REAGENTS

- Distilled water
- Stearic acid

3.3.2 MACHINES:

- XRF (x-ray fluorescence machine)
- Pellet machine
- Milling machine

3.3.3 APPARATUS USED FOR WATER QUALITY ASSESMENT:

3.3.4 PHYSICAL PARAMETERS MEASUREMEN:

Apparatus used are as follows:

- PH meter
- Glass wares-weakness
- Turbidity meter
- Conductivity meter

3.3.5 CHEMICALS AND REAGENTS:

- PH buffer solution, PH 4.5, PH7, PH9.5
- Distilled water
- Sample water

3.3.6 ANALYSIS OF CHEMICAL PARAMETERS:

3.3.7 TOTAL HARDNESS:

Apparatus used are as follows:

- Titration set-up

REAGENTS

- EDTA (Ethylenediamine tetraacetic acid disodium salt)
- Sample water
- Distilled water
- Buffer solution
- Standard solution
- Standard calcium solution
- Indicator solution.

3.3.7.1 TOTAL ALKALINITY

Apparatus:

- Titration set-up
- Calibrated measuring cylinder (100ml)

REAGENTS

- Phenolphthalein indicator
- 0.01N sulphuric acid (H_2SO_4)
- Methyl orange indicator
- Buffer solution pH 8.3
- CO_2 free distilled water.

3.3.7.2 TEST FOR CHLORIDE:

Apparatus:

- Titration set-up

- Measuring cylinder

Reagents:

- Potassium chromate solution
- 0.0257N of silver nitrate solution
- 0.0282N of sodium chloride standard solution
- Distilled water
- Sample water

3.3.7.3 TEST FOR IRON

Apparatus:

- Hach spectrophotometer
- Two calibrated cell bottles

Reagents:

- Water sample
- Ferrover iron magnet indicator
- Distilled water

3.3.7.4 DISSOLVED OXYGEN (DO)

Apparatus:

- Dissolved oxygen meter with electrode
- Glass beakers

Reagents:

Distilled water

Sample water

3.3.7.5 HEAVY METALS TEST

Apparatus:

- Atomic absorption spectrophotometer (AAS)
- Exchange column

Reagents:

- Calibration solutions
- Ion exchange resin

3.4 BACTERIOLOGICAL PARAMETERS:

Apparatus:

- Autoclave
- Hot-air sterilizing oven
- Incubator
- Pipette (1ml graduated in 0.1ml)
- Volumetric flask
- Petri dishes
- Sample bottles
- PH meter
- Membrane filtration equipment
- Adsorbent pad

Reagents:

- M-coliform broth (MF-endo medium)
- Ethanol
- Distilled water
- Sample water

LEVEL OF ATMOSPHERIC DUST POLLUTION AROUND ASHAKA CEMENT WORK AND NEIGHBOURING COMMUNITY

SAMPLING PROCEDURES AND ANALYSIS

SAMPLING PROCEDURE FOR DUST

Dust sample were collected from ten locations namely Railway Station 0.6km SSE from source, central administrative block 0.3km west from source, workers village 1.5m East from source, Management Estate 4.0km NW from source, former quarry pit 2.5km North from source, Jalingo Village 2.0km SW from the source, Bajoga village 10.0km SW from source, Badabdi Village 5.0km NW from source, Feshungo village 1.0km SWW from source and Juggol Village 5.0km NE from the source (Fig. 3.1).

The logic behind collecting my sample from different direction and at different distance from source (Ashaka Cement work) is to investigate the impact of the wind system on concentration of the elements/dust particles in question.

A wide mouth conical flask of about 600ml capacity was thoroughly rinsed with distilled water and dried in an oven for two hours at about 50°C. It was allowed to cool in desiccators and weighed. A funnel was then placed in the conical flask. Both the funnel and the flask were tapped together for rigid support. The set-ups were placed at each of the sampling locations generally at heights between 1 – 1.5meters above ground level for seven days. The conical flask was recovered from the field for each of the sampling locations which comprise rail station, CAB, workers village, management estate, former quarry pit, Jalingo village, Bajoga town, Badabdi village, Feshingo village and Juggol village. The recovered flask was placed in a furnace and allowed to dry for 2 hours at 50°C. It was then allowed to cool in a dessicator and reweighed. The total atmospheric burden (mg/m^3) and the total dust or settleable particulate ($mg/m^2/week$) were calculated for each of the sampling period respectively.

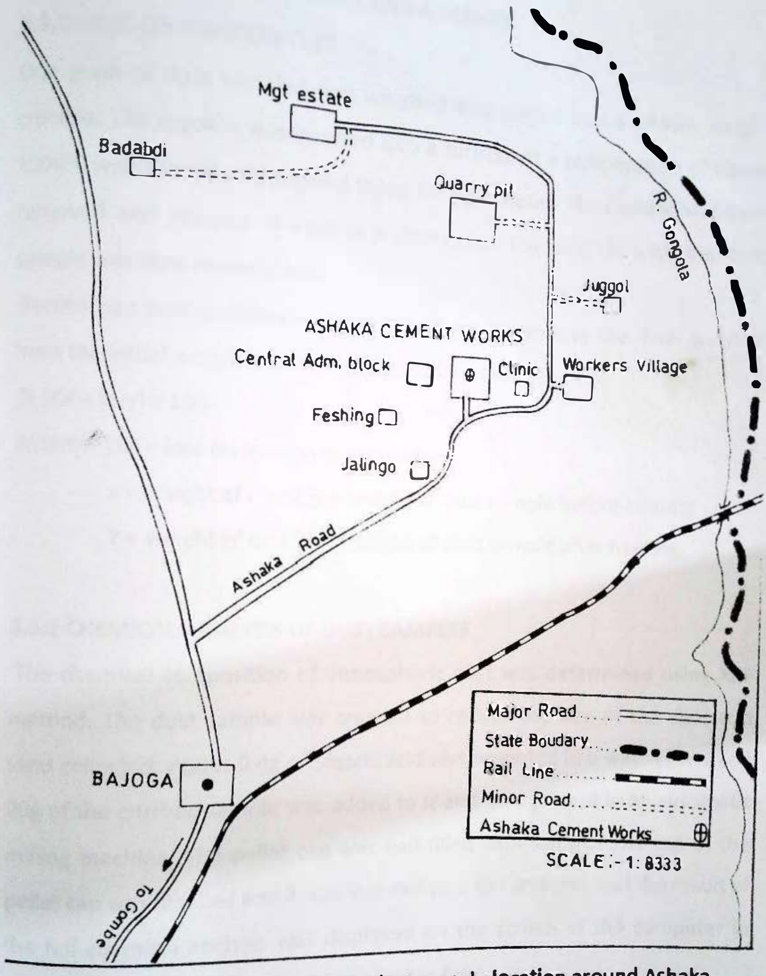

Fig. 3.1: Schematic map showing dust sample location around Ashaka Cement works, Gombe state

3.5 LABORATORY PROCEDURE AND ANALYSIS

3.5.1 LOSS ON IGNITION TEST

One gram of dust sampled was weighed and placed into a known weight crucible. The crucible was inserted into a furnace at a temperature of about 1000°C with the aid of the metal thong for 30 minutes. The crucible was then removed and allowed to cool in a dessicator. The crucible with the dust sample was then re-weighted.

Percentage loss ignitions were obtained by subtracting the final weights from the initial weight and multiply by 100, as thus;

% LOI = (x-y) x 100

Where; LOI = loss on ignition in percentage

x = weight of crucible + weight of dust sample before heating

Y = weight of crucible + weight of dust sample after heating.

3.5.2 CHEMICAL ANALYSIS OF DUST SAMPLES

The chemical composition of atmospheric dust was determined using XRF method. The dust sample was crushed to reduce the size of the dust and sand collected. About 0.4g of Stearic acid was weighted in a watch glass and 20g of the crushed sample was added to it and then ground in an automatic milling machine. The pellet cap was half-filled with sample. The top of the pellet cap was labelled and it was inserted into XRF analyzer and the result of the full chemical analysis was displayed on the screen of the computer in percentage as shown in table 4.3 in chapter four.

3.6 SAMPLING PROCEDURE FOR WATER

Water samples collected include sampled from workers village, Jalingo village, Bajoga town and one of the pure water producers in Ashaka, where tap water, boiled and filtered water and dug water were sampled. Suitable plastic sampling bottles, thoroughly washed, rinsed and sterilized were used for the collection of samples. Every sample bottle was clearly labeled for easy identification and to avoid error.

3.6.1 PREPARATION AND ANALYSIS OF SAMPLES

The samples collected were immediately taken to the laboratory for analysis. Each ample was analyzed for the following parameters: -

1. Physical parameters:
    - PH
    - Turbidity (NTU)
    - Electrical conductivity (ms/cm)
    - Total dissolve solid (mg/l)
    - Temperature (^{o}c)

2. Chemical parameters:
    - Total hardness (mg/l)
    - Total alkalinity (mg/l)
    - Chloride (mg/l)
    - Dissolve oxygen (mg/l)
    - Heavy metals (mg/l)

3. Bacteriological parameters:

- Total coliform count (CFU/100ML)
- Total bacteria count (CFU/100ML)

3.7 LABORTORY EXPERIMENTAL PROCEDURE:

1. PH value:

The activated electrode (PH) was standardized with a known PH buffer solution of 4.5, 7 and 9.5, the electrode was then rinsed with dissolve water and dipped into the sample and its PH value was determine and recoded.

2. Turbidity

The turbidity was calibrated with a standard solution. The sample was placed into a small beaker and slotted into a turbidity meter sample holder. The turbid value was determined and recorded in NTU unit.

3. Electrical conductivity:

The conductivity meter was calibrated with a standard solution and the electrode was then rinsed with distilled water and dipped into the sample and its conductivity value was determine and recorded.

4. Total Dissolve Solid (TDS)

The activated electrode was standardized with standard solution and rinsed with distilled water. The electrode was then dipped into the sample and its TDS value was determined and recorded in mg/l.

5. Temperature: (°c)

The electrode was rinsed with distilled water and the meter switched to a temperature measurement. The electrode was then dipped into the sample and the temperature was recorded.

6. Total Hardness (mg/l)

A clean burette was rinsed with a little quantity of the 0.01N EDTA (Ethylenediamine tetraacetic acid) and filled to zero mark with the acid. The Erlenmeyer flask was rinsed with distilled water, where 25ml of sample was diluted with 50ml of distilled water inside. One (1) ml of buffer solution ($Na_2B_4O_7$. $10H_2O$) was then added to the water sample. This was treated with 0.01N EDTA to the end point. The end point was found as fairly blue, instead of sharp blue end point.

Masking reagent (NaCN) was added to the solution and the titration was continued slowly to the end point. The end point was reached when the last reddish tinge changed to sharp blue.

Calculation:

$$\text{Hardness (EDTA) as mg/l } CaCO_3 = \frac{V \times A \times 1000}{\text{Volume of sample used}}$$

Where; V = ml titration for sample

A = mg of $CaCO_3$ equivalent to 1ml EDTA titrant.

Therefore A = 0.95 mg of CaCO3

7. Total alkalinity (mg/l)

A clean burette was rinsed with a little quantity of 0.01N H_2SO_4 and filled to zero mark with the acid. The conical flask was also rinsed with distilled water and 25ml of sample water measured with a measuring cylinder was poured into the flask. Two (2) drops of phenolphthalein indicator was added to the sample, but there was no colour change, meaning that phenolphthalein alkalinity present is zero (PA = 0).

Two drops of methyl orange indicator was added to the colourless solution, which changed to yellow. This was then treated with the 0.01N H_2SO_4 to the end point. The end point was reached when the yellow colour changed to faint pink.

Calculation:

$$\text{Total Alkalinity (mg/l) } CaCO_3 = \frac{V_T \times M \times 100{,}000}{\text{Volume of sample.}}$$

Where; V_T = volume of the acid used

M = molarity of the acid used.

8. Chloride

A clean burette was rinsed with a little quantity of 0.0257N $AgNO_3$ and filled to the zero mark with the $AgNO_3$ solution. The conical flask was rinsed with distilled water and 50 ml of the sample measured and poured into the conical flask.

One ml of potassium chromate (K_2CrO_4) indicator was added to the sample in the conical flask and treated with 0.0257N $AgNO_3$ to the end point. The end point was left for comparison with the blank solution which was prepared when 1ml of K_2CrO_4 was added to a 100ml of distilled water and then 0.2ml of 0.282N standard solution of $AgNO_3$ was also added into a conical flask with a gentle shake.

Calculation:

$$\text{Chloride (mg/l)} = \frac{(A - B) \times M \times 70{,}900}{\text{Ml sample}}$$

Where; A = ml $AgNO_3$ used for titrating sample

B = 0.2ml $AgNO_3$ used for titrating blank

M = molarity of $AgNO_3$ used for titrating water sample.

9. Dissolved Oxygen (DO)

The beaker and electrode were rinsed with distilled water to remove any dirt on them. The beaker was filled with the water sample. The electrode was held in the air to set it saturated with oxygen. Then electrode was then dipped into the beaker containing water sample to a level of 213 heights. The reading of the dissolved oxygen was taken and recorded.

10. Heavy Metals.

Consider silver metal as an example: silver is separated from interfering element by elution from an exchange column using a HCL solution. The eluviate was spirited into the aor-acetylene flame, spectoral energy at 2820A^0 from a silver hollow cathode tube was passed through the flame and the absorbance rate was measured and recorded.

The spectrophotometer was calibrated with a known concentration of silver (0.01mg/l)

Silver % $= (A-B) \times {}^{C}/ml \times 10$

Where; A = mg of Ag per ml of final test solution

B = mg of Ag per ml of final reagent blank solution

C = Final volume of test solution

ml = volume of sample in final volume of test solution.

11. Total Coliform Count (CFU/100ml)

Four clean and sterilized volumetric flasks of capacity 100ml were obtained. With the aid of pipette 1ml of sample was drawn and discharged into the flasks and was make to the marked with distilled water. One ml of this solution was withdrawn with the aid of pipette and discharge into another flask, distilled water was then added until it reaches 100ml mark. This operation was repeated several times. The dilution factor was computed from the number of dilution made tube 10^2

Three Petri dishes was obtained and adsorbent pad was placed in each of them. Two (ml) of m-coliform broth solution was withdrawn and dispersed o each adsorbent pad. With the aid of pipette volumes of diluted samples made was withdrawn. Each of them was making up to a 100ml, which was filtered through membrane filter with the aid of vacuum pump. The filter membrane was placed in the adsorbent pad containing the broth solution. The set-up was placed in an incubator at 3515°C for 24 hours. The greenish metallic shining colonies on the filter membrane was observed and the colonies was counted and recorded.

Calculations:

$$\text{Total coliforms /100ml} = \frac{\text{coliform count} \times 100 \times D}{\text{Volume. (ml) of diluted sample filtered}}$$

D = dilution factor for the samples.

12. Total bacteria count (CFU/100ml)

- Water samples was prepared and diluted
- Culture media was prepared (for the re-enrichment of bacteria and fungi in water sample.

This is necessary because these organisms may be denatured during water treatment.

- For treated water sample, a liquots was transferred into a specific volume of liquid culture media and was incubated at 37ºC for 18 hours.
- Four (ml) of water samples was added onto the surface of well dried solid media, which was divided into four quadrants by ruling the back of the container with pencil, where 1ml was added at each quadrant.
- The container was rotted on the bench several times which resulted into evenly spread of water innoculum on the surface of the solid agar.
- The container was allowed to dry and it was then placed upside down into incubator for 72 hours.
- The plates was examined after every 24hours and the colonies found was counted and recorded
- The plate with highest number of colonies was selected and recounted using magnifying hand lens.

Calculations:

TVCC (CFU/ml) = value of count x dilution factor.

CHAPTER FOUR

4.1 RESULT AND INTERPRETATION

Five water samples and Ten dust samples were collected from Ashaka Cement work and surrounding environment.

Table 4.1: Chemical composition of Water Samples in PPM

Water samples points	Zn	Cu	Fe	Cl	Co	Cd
Pw1 Workers Village (Tap)	0.62	0.08	0.9	32.8	0.12	0.001
Pw2 Jalingo Village (Borehole)	0.26	0.02	0.85	10.9	0.17	0.001
Pw3 Jalingo Village (dug water)	0.23	0.03	0.73	145.7	0.15	0.001
Pw4 Worker Village (Pure water production)	0.21	0.01	0.29	66.4	0.14	0.001
Pw5 Bajoga Village (Borehole)	0.23	0.01	1.25	32.8	0.14	0.001
Mean Value	0.31	0.03	0.804	57.72	0.144	0.001
World Health Organisation (WHO 2005)	1	0.1	0.3	200	0.01	0.01

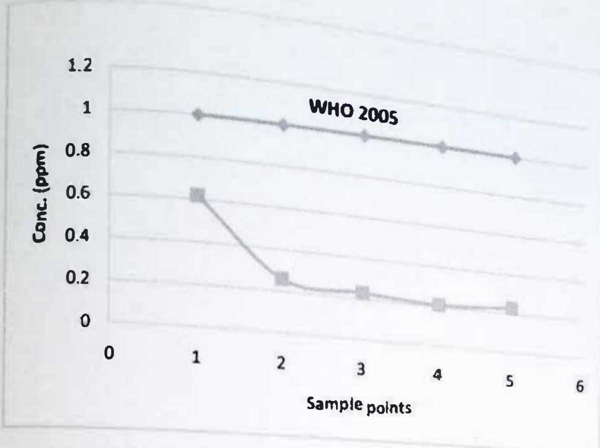

Fig 4.1 Graph of Zinc (Zn) concentration at sample points.

Zinc (Zn)

Five water samples were analyzed for Zn as shown in the graph. The concentration of Zn for each sample falls within the WHO permissible limit. The highest concentration is 0.62 ppm (sample pw1) and this corresponds to workers village (Tap), while the lower concentrations of 0.21ppm (sample Pw4) correspond to workers village (pure water producer).

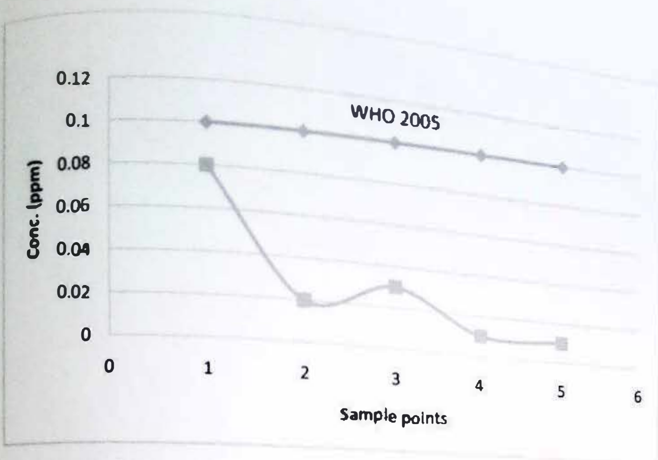

Figure 4.2 Graph of copper (Cu) concentration at sample points

opper (Cu)

ve water samples were analyzed for Cu as shown in the graph the oncentration of copper for each sample falls within the WHO permissible nit. The highest concentration of Cu is 0.08ppm (sample Pw1) and this orrespond to workers village (Tap) uses for supplying water for both rinking and domestic use. While the lower concentration 0.01ppm (sample w4 and Pw5) correspond to workers village (pure water producers) and ajoga village (Borehole).

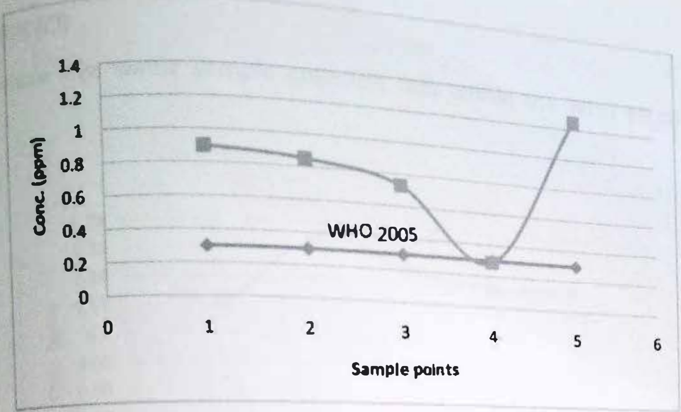

Figure 4.3 Graph of Iron (Fe) concentration at sample points

IRON (Fe)

Five water samples were analyzed for Fe as shown in the graph, the concentration of Fe fall above WHO permissible limit. This may result from iron rust of water pipe lines. Only Pw4 falls just below the WHO limit.

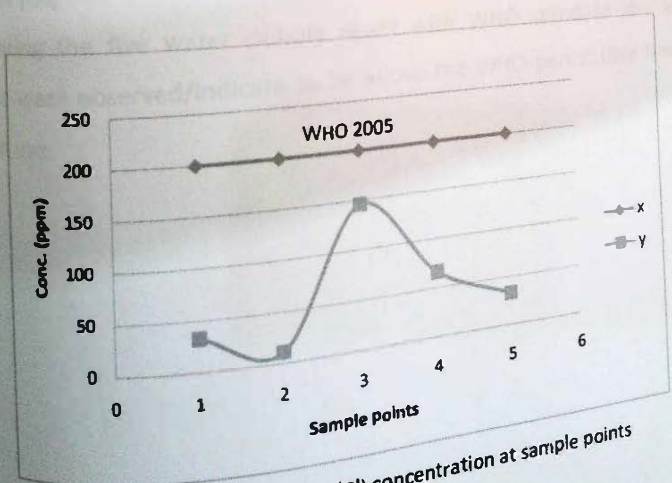

Figure 4.4 Graph of Chlorine (Cl) concentration at sample points

CHLORIN (Cl)

The whole five water sample collected falls within the WHO permissible limit.

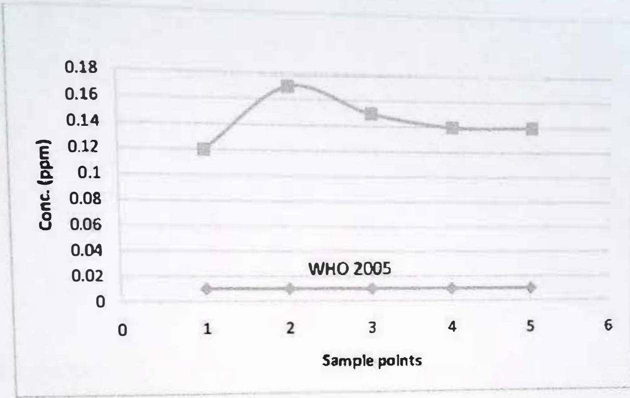

Figure 4.5 Graph of cobalt (Co) concentration at sample points

COBALT (Co)

Comparing the five water sample result with WHO standard the whole sample were observed/indicate to be above the WHO permissible limit for human use.

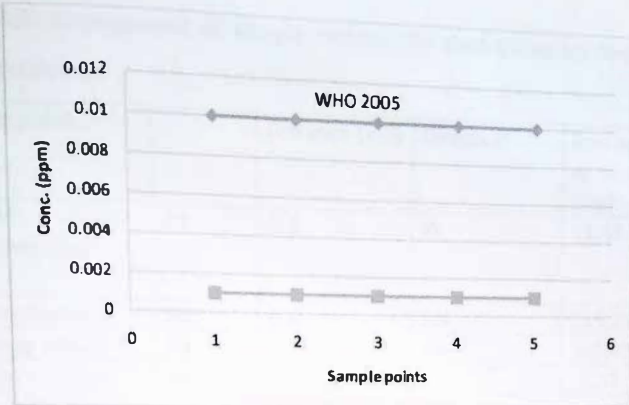

Figure 4.6 Graph of cadmium (Cd) concentration at sample points

CADMIUM (Cd)

From the graph the whole sample points indicated to have generally lower value of Cadmium by tens when compared with WHO permissible limit. i.e. WHO value is 0.01ppm while the test results is < 0.001ppm.

Table 4.2: Arrangement of sample location for dust according to distance and direction

Sample point		Distance (km)	Direction	Average weight of dust collected (mg)
Central administrative block	P1	0.3	W	19.35
Railway station	P2	0.6	SSE	115.25
Feshingo village	P3	1.0	SW	340.43
Worker's village	P4	1.5	E	18.52
Jalingo village	P5	2.0	SW	249.18
Former quarry pit	P6	2.5	N	16.29
Management estate	P7	4.0	NW	16.58
Juggol village	P8	5.0	NE	16.65
Badabdi village	P9	5.0	NW	18.34
Bajoga village	P10	10.0	SW	35.70

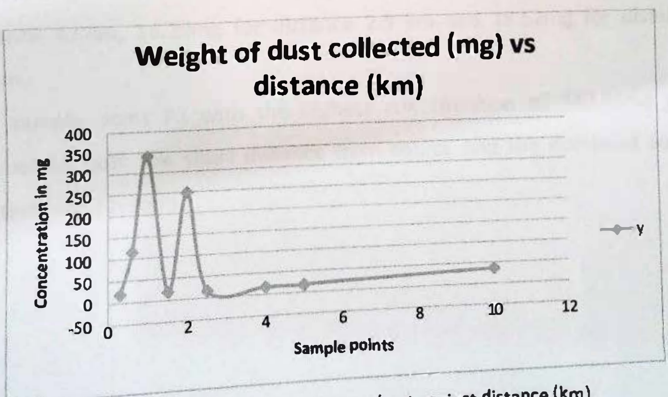

Figure 4.7 Graph of dust collected (mg) against distance (km).

Graph of sample point at X axis and distance and concentration at Y axis. From the graph P_2 0.6km SSE, P_3 1.0Km SW and P_5 2.0Km has the higher values of concentration of dust settlement this may be because of their closeness to the source.

But P_1 0.3Km W, P_4 1.5Km E and P_6 2.5Km N has lower value of concentration of dust settlement, even with their closeness to the source, the low concentration of the dust sample may result from the wind system of the project area i.e. they are not at the windward side of the dominant wind system (South westerling wind).

P_7 4.0km NW, P8 5.0km NE and P9 5.0km NW their low concentration may be as a result of their distance from source and at the same time not at windward side.

P_{10} 10.0km SW with the highest distance of about 10.0km, the dominant (South Westerling) wind system favor the concentration 35.70mg compared to 18.34mg for distance 5.0km, 16.65mg for distance 5.0km, 16.58mg for distance 4.0km, 16.29mg for distance 2.5 km and 18.52mg for distance 1.5km.

The sample point P3 with the highest concentration of 340.43mg was favored by both the short distance from source and the dominant South westerly wind system.

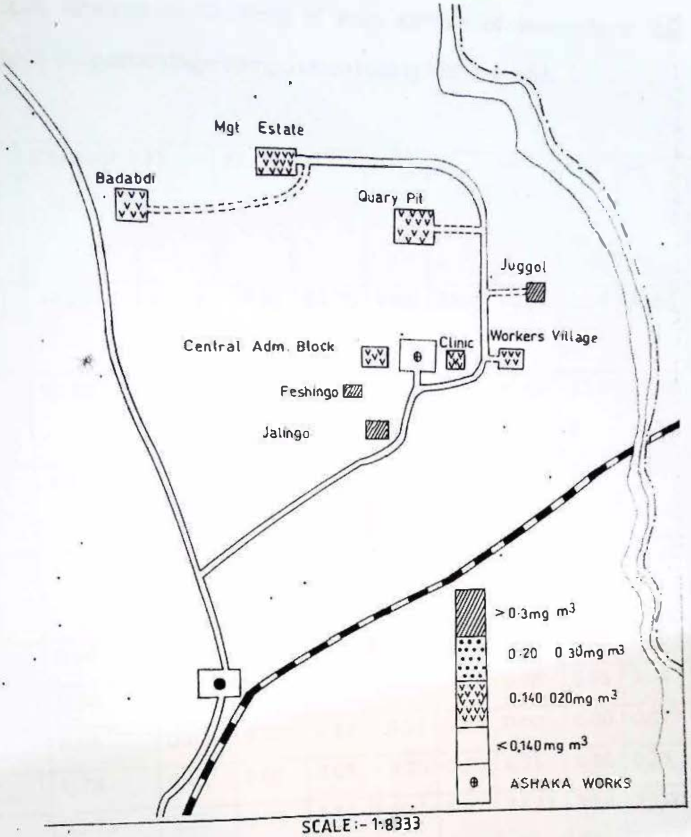

Fig. 4.1 Level of atmospheric burden mg/m^3 around Ashaka cement works Gombe state

Table 4.3: Analysis of 16.00mg of each sample of atmospheric dust and Limestone (in percentage composition) using XRF method.

ound	Relative molecular mass	Limestone	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
	60	14.29	62.32	79.62	84.70	49.67	83.44	14.55	20.40	49.66	14.55	53.44
	56	41.98	4.43	2.26	1.72	13.28	1.81	40.60	37.00	13.22	40.00	15.32
3	102	4.34	14.90	6.99	6.42	6.70	7.28	4.00	4.00	6.78	4.44	15.23
O3	160	1.70	4.41	2.82	2.81	20.32	2.25	2.12	3.50	20.32	2.23	2.92
O	40	0.54	0.35	0.18	0.03	0.33	0.44	0.55	0.40	0.33	0.52	0.00
	94	0.80	4.94	3.51	3.51	4.04	3.74	0.78	0.55	3.04	0.77	0.00
O	62	0.05	0.27	0.38	0.32	0.57	0.45	0.00	0.00	0.57	0.12	0.00
	80	0.78	0.09	0.07	0.05	0.25	0.05	0.75	0.50	0.25	0.88	0.00
		33.71	6.96	3.86	1.55	10.12	1.57	34.22	30.40	10.00	34.22	13.21

Si = 28.08, Ca = 40.08, Al = 26.98, Fe = 55.85, Mg = 24.31, K = 39.10

Na = 22.99, O = 16.00, S = 36.06, and Li = 6:94

From the table the dust sample can generally be said to be highly enriched in Silica, (SiO_2) and contain moderate amount of other oxides like CaO and

Al_2O_3 are highest in the sample from the immediate surrounding of the factor work area.

Further research will reveale, if the relative atomic weight of these oxides/ compounds have effect on the relative mobility of the oxide from primary environment to the secondary environments.

TABLE 4.4: METEOROLOGICAL DATA OF THE PROJECT ENVIRONMENT

Month	Mean temp. (°C)	Rainfall (mm)	Relative Humidity (%)
October, 2007	32.5	2.50	27.0
November, 2007	30.0	0.00	31.0
December, 2007	29.5	0.00	22.0
January, 2008	28.0	0.00	21.0
February, 2008	30.5	0.00	24.5
March, 2008	32.5	0.00	26.5
April, 2008	31.0	36.00	28.4
May, 2008	36.5	43.00	31.0
June, 2008	34.5	120.50	28.0
July, 2008	33.5	217.50	25.0
August, 2008	30.5	254.50	23.0
September, 2008	35.0	128.00	24.5

Source: Physical laboratory Ashaka works (2008)

TABLE 4.5: WIND SPEED AND DIRECTION OF ASHAKA

Month	Wind run in knots)	Direction
October, 2007	142.80	NE'ly, E'ly and NW'ly
November, 2007	138.50	NE'ly, mainly
December, 2007	172.60	NE'ly, and N'ly mainly
January, 2008	168.46	Mainly NE'ly, and N'ly
February, 2008	129.26	NE'ly, mainly
March, 2008	160.45	Mainly NE'ly, and N'ly
April, 2008	186.09	NW'ly Nn'ly and SW'ly
May, 2008	170.38	E'ly, W'ly and SW'ly
June, 2008	169.05	Become changeable I
July, 2008	159.80	direction
August, 2008	152.25	Mostly W'ly and S'ly
September, 2008	150.00	Mostly w'ly and S'ly
		W'ly, NnW'ly and SW'ly

N.B 1 knots = 1.853 km/hr.

Source: Nigerian Metrological Agency, Ashaka Airport Inspectorate Office (2008).

CHAPTER FIVE

5.2 DISCUSSION OF RESULTS

5.2.1 AIR QUALITY

A preliminary survey showed the mean annual temperature and rainfall of the area to be 27-30°C and 120 mm respectively, while the percentage relative humidity was found to be less than 30% and the highest monthly mean wind speed recorded was the month of June, about 169.05 knots, and mostly south-westerly in terms of direction.

Tables 4.2 is the results obtained for atmospheric deposition rates and dust cover which shows that the dust deposition rates were high near the plant and tailed off with increasing distance from the plant. During the two sampling periods, the northeast wind was predominant. Accordingly, Feshingo and Jalingo villages which were on the windward direction of the plant recorded the highest average values of 0.6508 mg/ m^3 (340.43mg) and 0.5351mg/ m^3 (249.18mg) dust deposition rates respectlvely. Similarly lower deposition rates of 0.1242mg/m^3 (35.70mg) and 0.1432 mg/ m^3 ([illegible]) were recorded at Bajoga town and railway statlon which are 10 km and [illegible] km southwest and Eastwards from the source respectively. The relatively lower value was due to

1. Bajoga long distance of 10km from source even though it is in windward direction.

2. Railway station of just 0.6km from the source is in the leeward position of the wind system

The pattern of distribution of dust particles observed above can be explained in terms of sizes and length of time in the air before deposition. The smaller the particles, the lower will be the density and the lengthy time they are airborne and vice-versa. The very fine dust particles are further suspended as aerosols. This has the most serious health implications because they are easily inhaleable dust.

Considering the FEPA ambient dust limit of 25µg/m^3 or 0.25 mg/m^3, the sites that are above the FEPA standards, are Feshingo and Jalingo villages with values of 0.6508 mg/m^3 and 0.5351 mg/m^3 respectively. The high dust deposition rates were due to the relatively higher Silica to Calcium ratio of the atmospheric dust and the harmattan dust. Therefore, Feshingo village is the worst affected by particulates emissions from Ashaka cement works in terms of public health, followed by the Jalingo village.

The wind speed and direction plays a very vital role in the distribution of dust particles around Ashaka cement works. Dust emissions into air around Ashaka visibility, reduce solar illumination and causes respiratory discomfort. It also complicates respiratory diseases and can pose unhealthy site when deposited on the surface of objects. These inhaleable dust particles in the atmosphere may cause severe health hazard causing or aggravating bronchitis and lung diseases (Ross, 1972).

Again when they settle eventually, they may cause other nuisance such as dirtying the clothes and household properties. All these possible consequences may be collectively and individual of serious economic impacts. In fact, there has been an evidence of dirtying of clothes, severe itching and asthma attack on the workers and the citizens of the neighboring communities.

5.2.2 WATER QUALITY

A summary of the results together with WHO standards for discharge into public drains was presented in table 4.1 for portable water. Five portable water samples were collected from the following locations: House number K37 in the workers village (tap), Jalingo village (bore hole), Jalingo village (dug water), Fasaha sachet water and Bajoga town (bore hole). The results of the analysis shows that all the samples are within permissible limits, except for coliform count and bacteria count which are high in pw_1 and pw_3. The water from these two sources is not fit for consumption due to high coliform and bacteria count. The bacteria were grown on DCA and they were positive or isolated and the type bacteria found was salmonellae and sihigelae which are responsible for typhoid fever.

Furthermore, all the samples contain iron in excess of the specified standards for drinking water. This may be as a result of corrosion in distribution piping network. Nevertheless, the federal ministry of water resources standard as well as WHO guidelines specified that higher value of iron up to 10 mg/l is acceptable.

For waste water analysis, three samples were collected from interceptor 1, oxidation pond and from dispatched gate (dry). The results of the analysis showed that all the parameters analyzed are within the permissible limits, except for coliform and bacteria count which are high and numerous.

Ashaka cement obtains its water supply from boreholes and from River Gongila for domestic and process use. Therefore, this wastewater that contained high coliform count and numerous bacteria was normally discharged into the river and recycle back for use.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1: CONCLUSIONS

The level of the atmospheric dust pollution around AshakaCem works and the neighboring communities was evaluated; the mean total dust fall was estimated for each of the sampling locations over a period of seven days for two periods and the percentage chemical composition of the dust samples was determined. From the results obtained, it appears obvious that the industrial operations from Ashaka cement works have serious environmental implications and disturbs public health. The communities located within a radius of about 3 km from the plant are most likely to be affected by the inhaleable dust. The dispersion of this dust is highly influenced by the wind system of the study area.

Based on the analysis of potable water, it was deduced that worker's village (pw_1) and Bajoga village (pw_5) are not fit for consumption due to high coliform and bacteria count. However, salmonellae and sihigalae bacteria which are responsible for typhoid fever are found.

Furthermore, the iron contents in all the samples exceeded the Specified standards for drinking. Nevertheless, the FMEnv as well as the WHO guidelines specified that higher values of iron up to 10 mg/L are acceptable. Based on the analysis carried out on waste water, it was deduced that there was a very high amount of coliform and bacteria in both the samples. The waste water was normally discharged into the river which is the main source of water supply to the Ashaka works and its neighboring communities.

6.2: RECOMMENDATIONS

Ashaka cement works is situated around public buildings and does continue to operate at the prevalent risk of public health and the environment. Protecting the environment by the company should apply some mitigation measures to safeguard the helth of human in the vicinity of the cement works.

Recommended measures include;

- Use of alternative fuel such as tyres, SLF
- Use of low waste and low pollution technologies
- Use of performance indicators
- Waste water treatment, recycling and conservation

- Noise control measures
- Solid waste management
- Workers safety measures
- Medical and other social services development

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