

OCCUPATIONAL HEALTH HAZARDS OF AIR POLLUTION ON WORKERS OF ASHAKA CEMENT FACTORY AND ITS ENVIRONS IN GOMBE, NIGERIA

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ABSTRACT

This paper sought to analyze the concentration levels of carbon monoxide (CO), nitrogen dioxide (NO₂) and sulphur dioxide (SO₂) selected because of their effects on the health and productivity of Ashaka Cement Factory workers. A portable Cowncan Tetra 3 gas analyzer was used in monitoring the concentrations of these pollutant gases in eight selected areas of Ashaka Cement Factory for five days per week from morning, afternoon and evening hours from July to October of 2018. Available outcomes showed that in Ashaka Gari alone, the average concentration of SO₂ per day was 35.77 ppm; CO was 0.127 ppm and NO₂ was 0.053 ppm. These values were far above the international body requirements when compared to the National Ambient Air Quality Standards (2012).; hence there were reported cases of cancer, asphyxia/stroke, heart related diseases, skin rashes, irritating eyes among the workers of Ashaka Cement Factory. This calls for adoption of measures to reduce these pollutants in order to protect workers against occupational hazards and reduced productivity.

Keywords: Ashaka cement, gaseous pollutants, Crowncon, health hazards, workers

1 INTRODUCTION

Air pollution is the loading of chemical or biological substances, gaseous or particulate matter and other harmful materials into the atmospheric environment resulting into changes in the natural characteristics of the atmosphere that can cause disease, death to humans, and damage to other living organisms such as food crops or the natural and built environment. The atmosphere being a complex natural gaseous system that is essential to support life on planet earth needs to be protected. Air pollution due to lime and cement producing industries has been found to cause serious occupational safety and health hazards [1]. People residing in the vicinity of these industries may be exposed to higher levels of pollutants and one of the most important impacts of cement manufacturing is the dust generated during storage, milling, packaging and transport. Atmospheric mineral dust, an important source of air pollution contains high concentration of many metals known to have toxic effects on environment and humans [2]. Stratospheric ozone depletion due to air pollution has also been recognized as a threat to human health as well as the earth's ecosystem. Indoor air pollution and urban air pollution are listed as two of the world's worst toxic pollution problems. According to World Health Organization [3]; 2.4 million people die each year from causes directly attributed to air pollution. In many places the pollutants are present in concentrations that cause harm to humans, animals, plant life and to property [4]. Furthermore, industrial plant smokestacks from cement and construction companies are some of the biggest contributors to poor air quality especially in urban development [5].

The health of the people working in Ashaka Cement Factory as well as the communities residing near the industry needs to be protected and educated on air pollution as it affects the residents

through soot and dust production from the factory that pollutes the whole area. People living near the area complained that every morning and evening is covered with soot and dust that affects the cleanliness of food and clothes found outside thereby compromising people's health such as breathing difficulties, asthma, wheezing and eye irritation, skin rashes. Those individuals already suffering from cardio respiratory disorder such as asthmatics are highly affected [6]. Pollutants generally act on the surfaces of the respiratory system, causing chronic respiratory and cardiovascular disease [7]. They may also alter important body functions such as oxygen exchange in the lungs, or oxygen transport in the blood. Irritant pollutants may lead to irritation and long term damage to eyes, nose, throat and other wet surfaces of the body. Deposition of particulate matter in the alveoli of the lung is quite serious as removal can be slow and soluble particles will be transferred to the blood stream [8]. In this study, the effects of gaseous air pollutants: carbon monoxide (CO), nitrogen dioxide (NO₂) and sulphur dioxide (SO₂) on Ashaka cement workers was analyzed and recommendations made for their possible reduction so that healthy working life within Ashaka and environs. can be achieved.

2 METHODOLOGY

2.1 Description of Study Area

The study was undertaken at Ashaka Cement Factory in Bajoga, Funakaye Local Government Area of Gombe state. The Local Government Area is bounded in the East by Gongola River and Lake Dadin-Kowa, beyond which lies Yobe and Borno States. The coordinates are: 10° 51'North 11°26'East in latitude and 10.850°North 11.433°East in Longitude. The total population of the area is 236,087 and it has an area of 1,415 km² (Figure 1).

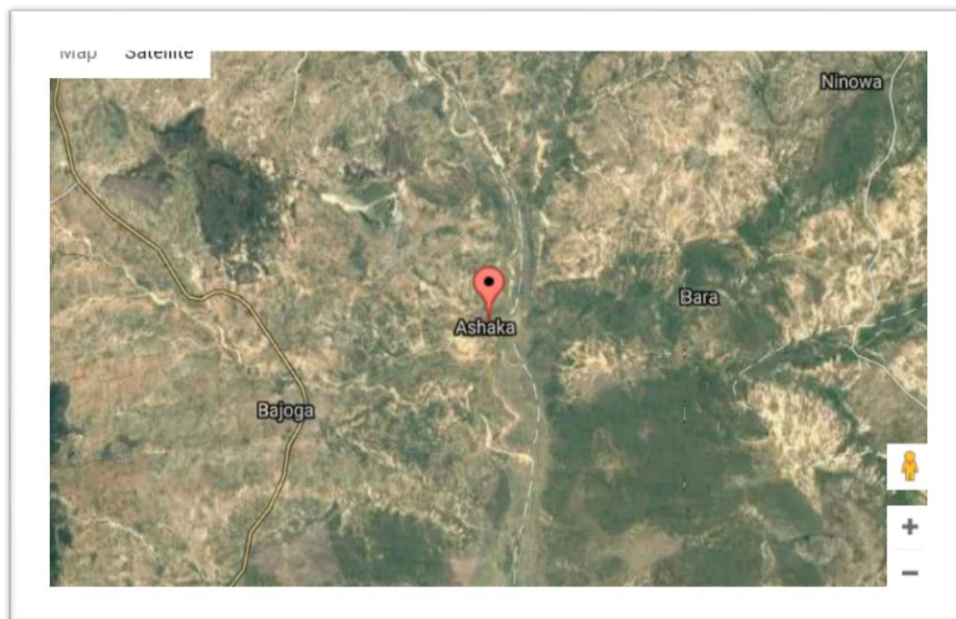


Figure 1. Imagery Map of Ashaka Area, Gombe State [5]

2.2 Method of Data Collection and Analysis

Concentration levels in parts per million (ppm) of three selected gaseous pollutants: CO, NO₂ and SO₂ were obtained from field measurements by the use of Crowcon (Tetra 3) with a model number IECEX BAS 05.0059, designed and calibrated to determine the concentrations of only three gaseous pollutants mentioned (Figure 2).



Figure 2. Crowncon Tetra 3 (Portable Air Monitoring Device) [10]

Based on this study, eight sampling stations were mapped out namely: Ashaka Gari (100 m), Alheri Angua (2 km), Jalingo (4 km), Boho (6 km), Gukkul (8 km), Funakaye (5 km), Nafada (8½ km), and Bade (9 km); representing settlements around the cement factory. Measurement of gaseous concentrations was carried out daily for five days from Mondays to Fridays been official working days per week. At those stations, air samples were measured at five selected areas. These locations were selected based on their population potentials and relative distance from the factory. The gas analyzer, Crowncon tetra 3 was calibrated at the field before use according to manufacturer's manual instructions. Results obtained from the field measurements were formulated into simple tables, bar chart and their effects and implications on the health of workers and other residents discussed.

3. RESULTS AND DISCUSSION

3.1 Air Pollution Concentrations in Selected Areas of Study

The types and concentrations of air pollutants (SO_2 , NO_2 and CO), measured across the sampling areas were presented in Table 1 as follows.

Table 1. Results of Air Emission Measurements at Sampling Points from Factory

Sampling Points	Mean pollutant Concentrations per Week in part per million (ppm)								
	SO_2			NO_2			CO		
	M	A	E	M	A	E	M	A	E
Ashaka Gari	25.0	45.3	37.0	0.012	0.025	0.016	0.026	0.053	0.048
Alheri Angua	11.1	23.0	17.0	0.055	0.066	0.015	0.072	0.037	0.083
Jalingo	6.84	17.42	9.00	0.038	0.092	0.083	0.016	0.062	0.090
Boho	19.31	30.44	25.35	0.089	0.018	0.040	0.015	0.035	0.065
Gukkul	7.55	18.35	14.56	0.047	0.011	0.009	0.061	0.008	0.049
Funakaye	28	40.0	30.8	0.006	0.026	0.048	0.026	0.083	0.038
Nafada	5.24	15.8	7.05	0.010	0.063	0.035	0.096	0.017	0.025
Bade	7.3	17.4	13.4	0.064	0.048	0.097	0.041	0.053	0.050

M – Morning hours (7:30 – 9:30 am); A – Afternoon hours (1:30 – 3:30 pm); E – Evening hours (4:30 – 6:30 pm).

It can be observed from the table above that the concentration of SO_2 ranged from 6.84 – 45.3 ppm recorded at Jalingo in the morning (7:30 – 9:30 am) and Ahaka Gari in the afternoon respectively. It also showed that the concentration limit of NO_2 was between 0.006 – 0.097 ppm in the

morning at Funakaye and in the evening at Bade while the highest value of CO (0.096 ppm) measured at Nafada in the morning and a lowest value of 0.006 ppm in the afternoon was recorded at Gukkul. Other areas like Alheri Angua, Jalingo, Gukkul and Bade have low values of SO₂ emissions accompanied with some high and low values of NO₂ and CO concentrations. This could be likely due to the fact that human population in those areas were quite low; hence less domestic and factory activities resulting into lower air pollutant emissions. Sulfur dioxide (SO₂) is a highly reactive gas, and the largest sources of SO₂ emissions are power plants and other industrial facilities that combust fossil fuels. It is linked with a number of adverse effects on the respiratory system. The threshold limit for SO₂ according National Ambient Air Quality Standards (2012) range from 0.04 – 0.25 ppm; for CO is from 0.03 – 0.05 ppm while for NO₂, it is from 0.053 – 0.100 ppm.

Nitrogen dioxide (NO₂) is one of a group of highly reactive gases formed from cars, trucks, buses emissions, power plants and other combustion sources. In addition to contributing to the formation of ground-level ozone and fine particle pollution, NO₂ is associated with a number of adverse effects on the human respiratory system. People who spend time on or near major roadways can experience short-term NO₂ exposures higher than the concentration exposure limits causing asthma in vulnerable children and the elderly. Carbon monoxide (CO) is a colorless, odorless gas emitted directly from motor vehicles and other sources powered by fossil-fuels. High CO concentration is absorbed through the lungs into the blood, where it binds with hemoglobin and reduces the ability of the blood to carry oxygen, a disease known as asphyxia.

3.2 Health Effects of Sulphur dioxide (SO₂) and Particles

The average results for SO₂ concentrations per day for a week as presented in Figure 3 was 4.80 ppm being the highest for Ashaka Gari sampling point; 2.20 ppm for Alheri Angua sampling point; 1.30 ppm for Jalingo sampling point; 2.50 ppm for Boho sampling point; 1.40 ppm for Gukkul sampling point; 2.60 ppm for Funakaye sampling point; 1.2 ppm for Nafada as the lowest pollutant recorded and 1.70 ppm for Bade sampling point.

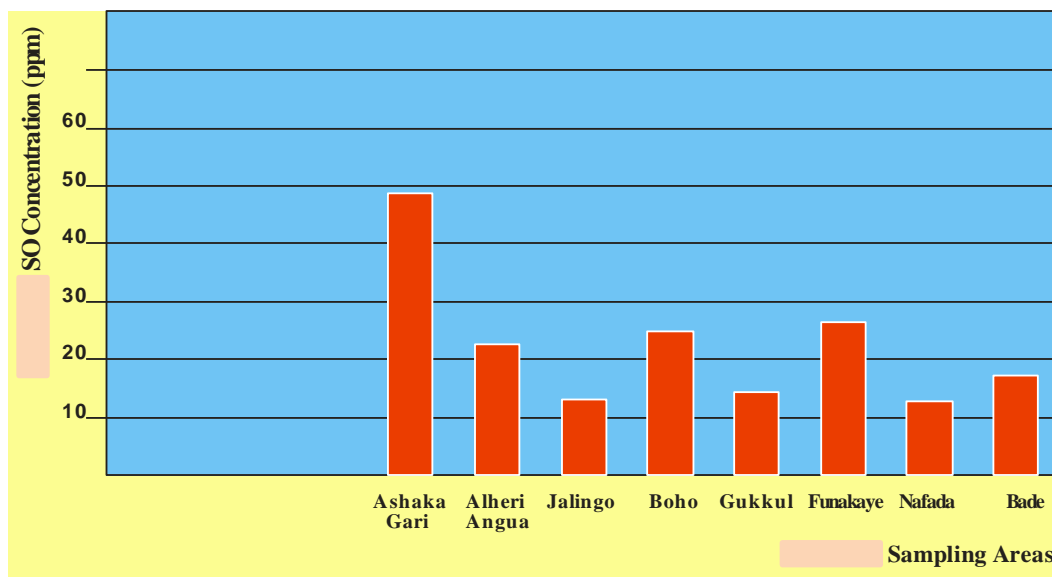


Figure 3. Sulphur dioxide SO₂ Measured Concentrations in each area around Ashaka

3.3 Sulfur dioxide

Sulphur compounds also enter the air from the smelting and refining industries as well as from burning municipal wastes. Respiratory illnesses such as bronchitis and carcinogens causing

cancer increase with sulphur oxide. These compounds have been found freely associated with particles of soot in the atmospheric air of the study area.

3.4 Results of Nitrogen oxide (NO₂) Measurements and Health Effects

The average results for NO₂ levels per day for seven days presented in Figure 4 ranged from 0.022 - 0.088 ppm as the lowest and the highest concentrations recorded at Ashaka Gari and Bade sampling point respectively.

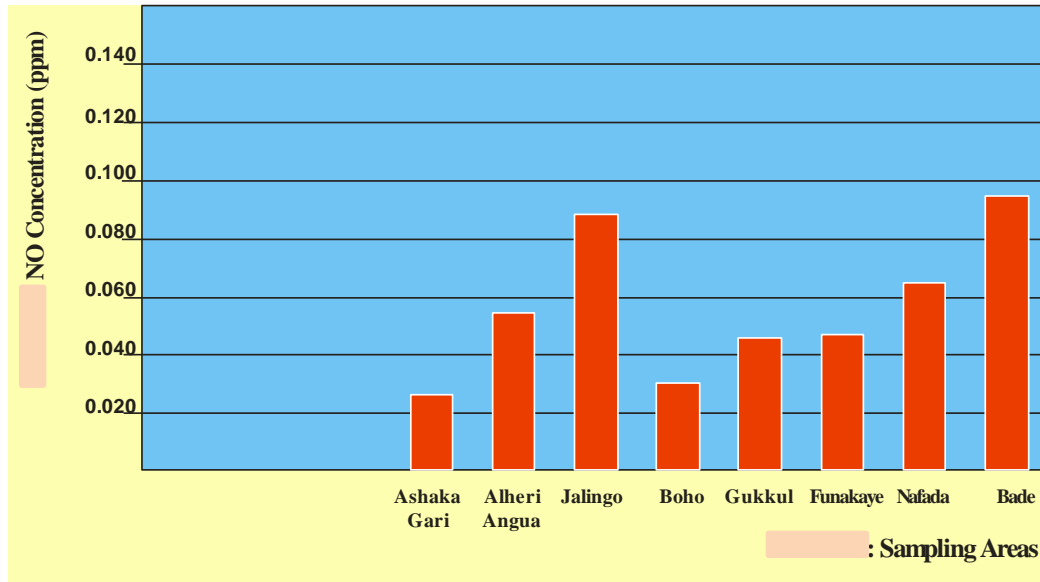


Figure 4. Nitrogen oxide (NO₂) concentrations in sampling points around Ashaka

Approximately 90% of the annual emissions of nitrogen oxides stem from the combustion of fossil fuels. One-third of these emissions were from motor vehicles operation.

Two effects of nitrogen dioxide on body functions have been noted. One is the greater effort required in breathing. Individuals with chronic lung diseases experienced breathing difficulty. Other research reports [9] have indicated positive relation between nitrogen dioxide concentrations and higher mortality rate from heart disease and cancer.

3.5 Average Carbon monoxide (CO) concentrations per week across sampling points

The results for mean CO levels per week presented in Figure 5 showed that the highest CO value of 0.090 ppm was measured at Jalingo sampling area while the lowest value of 0.044 ppm was recorded from Bale sampling point being the farthest point from the factory. However, this range of CO pollutant (0.044 – 0.090 ppm) falls within the international threshold limits.

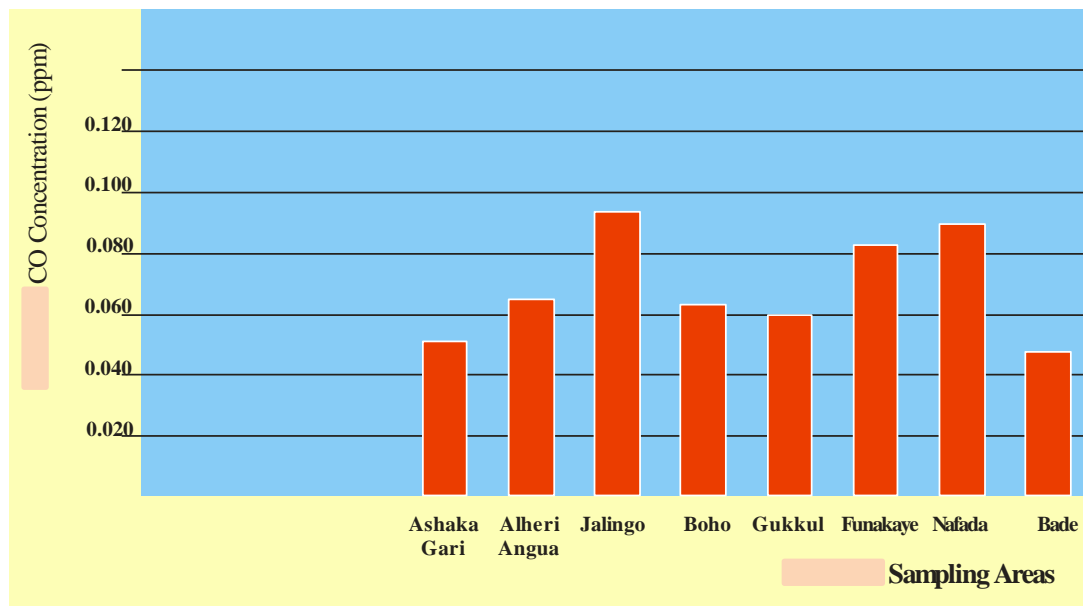


Figure 5. Carbon monoxide (CO) Concentration in each sampled area of Ashaka Factory

3.6 Health Effects of Carbon monoxide (CO) on Ashaka Cement Factory Workers

Factory plant is one of the sources of Carbon monoxide; for this reason, at high concentrations, it is a deadly poison. Hemoglobin, a complex protein present in the blood, transports oxygen from the lungs to the cells and carries carbon dioxide from the cells back to the lungs; thus reducing the productivity of workers in the cement factory. Some workers from the factory complained of hemoglobin related problems.

4 CONCLUSION

Based on the results obtained, it showed that there were high concentration values of the three selected pollutants of SO_2 (1.20 – 4.80 ppm), NO_2 (0.022 - 0.088 ppm) and CO (0.044 – 0.090 ppm) in Ashaka Gari Cement Factory and environs when compared to the threshold limit for SO_2 as from 0.04 – 0.25 ppm; CO was from 0.03 – 0.05 ppm while for NO_2 , it was from 0.053 – 0.100 ppm according to National Ambient Air Quality Standards. In Ashaka Gari alone, the average concentration of SO_2 per day was 35.77 ppm; CO was 0.127 ppm and NO_2 was 0.053 ppm. These values are far above the international body requirements; hence there were reported cases of cancer, asphyxia/stroke, heart related diseases, skin rashes, irritating eyes among the workers of Ashaka Cement Factory. This calls for adoption of measures to reduce these pollutants in order to protect workers against occupational hazards and reduced productivity. It has been recommended that policy makers on environmental pollution should try to implement the recent Goals of Climate Change Summit held at Poland, 2018 in order to control more effectively air pollution resulting from stationary and mobile sources of greenhouse gases in their member countries to achieve eco-friendly ambient air quality.

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