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ASSESSMENT AND ANALYSIS OF POLLUTION IN MINING INDUSTRY: A CASE STUDY OF CHINESE GOVERNMENT COMPANY (CGC), KOGI STATE

[1*]MOMOH Monday Itopa, [2]THOMAS Ayodele, [2]ERINOMO Sunday, [2]ADEMOH Jimoh, [3]OGBODO John Friday, [2]ADAMS Ademola Christopher, [4]LAWAL Salawu

[1]Department of Foundry Engineering Technology, Kogi State Polytechnic, Nigeria
[2]Department of Mineral and Petroleum Resources Engineering, Kogi State Polytechnic, Nigeria
[3]Department of Metallurgical & Materials Engineering, Kogi State Polytechnic, Nigeria
[4]Department of Mechanical Engineering, Kogi State Polytechnic, Nigeria
**Corresponding author: rhodave2011@gmail.com*

ABSTRACT

This study assessed and analyzed the levels of noise and dust pollution generated during granite quarry operations at the Chinese Government Company (CGC), Itakpe, Kogi State. The aim was to determine pollution levels generated during quarry operations and compare them with WHO standards. Field measurements were carried out using a Digital Sound Level Meter for noise and a Portable Dust Monitor for particulate matter (PM_{10} and $PM_{2.5}$). Data were collected at eight operational stations including drilling, blasting, crushing, loading, haulage, administrative, and residential areas. Results showed that noise levels at blasting, drilling, and crushing areas exceeded the WHO occupational limit of 85 dB, with the highest value of 102 dB recorded at the blasting zone. Dust concentrations (PM_{10} and $PM_{2.5}$) were also above WHO limits in most operational areas, particularly at the crushing and drilling sections. The study concludes that quarry activities significantly contribute to environmental noise and dust pollution.

Keywords: Dust, Noise, Pollution, Quarry

1.0 INTRODUCTION

Mining and quarrying activities are important contributors to infrastructural development and economic growth in Nigeria. Granite quarrying provides aggregates and crushed stones required for construction of roads, bridges, dams, and buildings. Despite the economic benefits associated with quarrying, the industry is often characterized by serious environmental challenges, such as noise and dust pollution.

Noise and dust generated during drilling, blasting, crushing, screening, and transportation processes constitute major occupational and environmental hazards in quarry operations. These pollutants affect workers directly and may also impact nearby communities and ecosystems. Continuous exposure to excessive noise can result in hearing impairment, stress, and cardiovascular disorders, while prolonged inhalation of dust particles can lead to respiratory diseases such as silicosis, asthma, and chronic bronchitis (Basner et al., 2019).

The increasing demand for construction materials in Nigeria has led to rapid expansion of quarry activities, thereby increasing environmental concerns. In many quarry environments, pollution control measures are either inadequate or poorly enforced. Consequently, there is a need for systematic assessment and analysis of environmental pollutants generated during quarry operations.

In Nigeria, many quarry sites operate with limited environmental monitoring systems and inadequate pollution control technologies. Research by Adebayo *et al* (2020) revealed that particulate concentrations in several Nigerian quarries exceeded permissible limits due to insufficient dust suppression measures.

The Chinese Government Company (CGC) quarry site in Itakpe is one of the major granite production sites in Kogi State. The site contributes significantly to local economic activities through employment generation and supply of construction materials. However, concerns have been raised regarding the potential environmental and health impacts associated with its operations. This study therefore seeks to provide empirical data on noise and dust pollution levels at the quarry site.

2.0 METHODOLOGY

To achieve the objectives of this study, a combination of field observations and direct environmental measurements was adopted. Noise levels were measured using a digital sound level meter, while dust concentrations were determined using particulate matter monitoring equipment. Measurements were carried out at selected locations within the quarry and in nearby residential areas to determine the extent of pollution and its variation with distance from the source. The results obtained were compared with national and international environmental standards, including those established by the World Health Organization (WHO), the Federal Ministry of Environment (FMEnv), and the National Environmental Standards and Regulations Enforcement Agency (NESREA). The methodology was designed to provide accurate and reliable information regarding the environmental impacts of quarry operations at Abobo Quarry and to determine whether pollution levels fall within acceptable limits.

2.1 Research Design

The study adopted a descriptive and experimental research design. The descriptive aspect of the study involved the observation and documentation of quarry activities, environmental

conditions, pollution sources, and the characteristics of the study area. The experimental aspect of the study involved direct measurement of environmental parameters using standard monitoring instruments. Noise levels and dust concentrations were measured at various locations within and around the quarry site under actual operating conditions. The use of field measurements allowed for the collection of primary data, which provides a more reliable basis for environmental assessment than secondary information obtained from previous reports or publications.

According to Ediagbonya et al. (2021), environmental pollution studies require both qualitative and quantitative approaches because pollution impacts are influenced not only by measurable parameters but also by operational practices and environmental conditions. Therefore, the integration of descriptive and experimental methods provided a comprehensive assessment of noise and dust pollution in the study area.

2.2 Description of the Study Area

2.2.1 Location and Accessibility

The study was conducted at Chinese Government Company (CGC), Granite Quarry located in Itakpe, Okehi Local Government Area of Kogi State, Nigeria. The quarry lies within the north-central region of Nigeria and forms part of the mineral-rich Basement Complex terrain. The area is strategically located near the Itakpe Iron Ore Mining District and is accessible through major road networks connecting Lokoja, Okene, Itakpe, and other neighboring communities.



Fig 1: Map of Nigeria showing Kogi state

2.2.2 Geology of the Study Area

The geology of Itakpe is part of the Nigerian Precambrian Basement Complex, which consists predominantly of igneous and metamorphic rocks. The major rock types found in the area include granite, gneiss, schist, quartzite, and iron ore-bearing formations. The granite

deposit being exploited at Abobo Quarry occurs as a massive intrusive igneous body characterized by high strength, durability, and resistance to weathering.

Granite is one of the most important construction materials used in road construction, concrete production, railway ballast, and building works. Quarrying of granite involves mechanical and explosive methods that generate substantial amounts of dust and noise. Drilling operations create fine rock particles, blasting generates shock waves and dust clouds, while crushing and screening processes produce continuous noise and particulate emissions. The geological characteristics of the granite therefore directly influence the nature and magnitude of environmental pollution generated during quarry operations.

2.3 Reconnaissance Survey

Prior to the commencement of detailed field measurements and environmental monitoring, a reconnaissance survey was conducted across the study area. The purpose of the survey was to obtain preliminary information about the quarry environment, identify major operational units, assess accessibility to sampling locations, and determine the most suitable points for noise and dust monitoring. Reconnaissance surveys are important in environmental studies because they provide an understanding of site conditions and help ensure that sampling locations accurately represent the environmental conditions being investigated (Akinbile and Yusoff, 2020).

During the survey, all major quarry operations were observed and documented. Particular attention was given to activities known to generate significant amounts of dust and noise, including drilling, blasting, crushing, screening, loading, stockpiling, and transportation. The proximity of residential settlements, administrative buildings, and access roads to the quarry operations was also assessed. This information was necessary for determining potential pollution exposure zones and selecting representative monitoring stations.

2.4 Field work for Research

Eight monitoring stations were established at strategic locations within the study area. These included the drilling section, blasting zone, primary crushing plant, secondary crushing plant, loading area, haulage road, administrative section, and a nearby residential community. These locations were chosen because they represent the major operational units and areas likely to experience varying levels of environmental pollution.

Table 1: Monitoring stations

STATION CODE	LOCATION DESCRIPTION
S1	Drilling area
S2	Blasting zone
S3	Primary crusher
S4	Secondary crusher
S5	Loading point
S6	Haulage road
S7	Administrative office
S8	Nearby residential area

2.5 Noise Measurement Procedure

Noise monitoring was conducted at each sampling station during periods of active quarry operation. At every monitoring location, the sound level meter was positioned approximately 1.5 metres above ground level, corresponding to the average height of the human ear. This arrangement ensured that the measurements accurately represented the sound exposure experienced by workers and residents.

To minimize interference, measurements were taken away from large reflective surfaces that could distort sound readings. Multiple readings were obtained at regular intervals and the average value was calculated to improve reliability. Repeated measurements were necessary because quarry noise levels vary depending on operational activities, equipment usage, and environmental conditions.

Measurements were taken during drilling operations, blasting activities, crushing processes, loading operations, and transportation activities. The average noise level for each monitoring station was calculated using the expression:

$$L_{avg} = \Sigma L_i / n$$

Where:

L_{avg} = Average noise level (dB)

L_i = Individual noise reading (dB)

n = Number of observations

The calculated average values were used for subsequent analysis and comparison with regulatory standards.

2.5.1 Standard used for comparison

The measured values were compared with the World Health Organization (WHO) environmental guidelines.

Table 2: WHO Noise Guidelines (2018)

EXPOSURE SITUATION	RECOMMENDED LIMIT (dB)
Occupational (8hours/day)	85 dB
Occupational (15minutes)	100 dB
General environment	55dB (day), 45dB (night)

2.6 Dust Sampling Procedure

Dust monitoring was conducted during active quarry operations to capture representative particulate concentrations generated under normal working conditions. Measurements were taken at each sampling station established within and around the quarry environment. At every monitoring location, the particulate monitor was positioned at approximately breathing height, usually between 1.2 and 1.5 metres above ground level. This arrangement was adopted because it represents the typical exposure level experienced by workers and nearby residents.

Measurements were taken under relatively stable weather conditions to reduce variations caused by sudden changes in wind speed, rainfall, or atmospheric disturbances. At each station, several readings were recorded over a specified monitoring period and average values were subsequently calculated. Repeated measurements enhanced the reliability of the dataset and reduced the influence of random fluctuations.

Dust monitoring was conducted at locations representing the major sources of particulate emissions within the quarry. These included the drilling section, blasting area, crushing plant, screening unit, loading section, haulage road, stockpile area, and nearby residential settlements. Monitoring multiple locations provided information on the spatial distribution of dust concentrations and enabled the identification of pollution hotspots within the study area.

The collected data were recorded systematically and prepared for subsequent statistical analysis and comparison with environmental quality standards.

2.6.1 Dust Pollution Standard Comparison

Table 3: WHO Dust quality guidelines (2021)

Pollutant	Average time	Guideline value
PM_{10}	24 hours	45 µg/m³
	Annual	15 µg/m³
$PM_{2.5}$	24 hours	15 µg/m³
	Annual	5 µg/m³

2.7 Determination of Dust Concentration

The concentration of airborne dust was determined by measuring the quantity of particulate matter present in a known volume of air. The measured values were expressed in micrograms per cubic metre (µg/m³), which is the standard unit used in air quality assessment. Dust concentration provides an indication of the level of environmental contamination and the potential health risk to workers and nearby residents.

The concentration of particulate matter was calculated using:

[C = frac{M}{V}]

Where:

C = Dust concentration (µg/m³)

M = Mass of particulate matter collected (µg)

V = Volume of air sampled (m³)

Higher dust concentration values indicate greater levels of air pollution and increased risk of respiratory health problems. The calculated values were used to evaluate the environmental condition of the quarry and compare pollution levels at different monitoring locations.

3.0 RESULTS

3.1 Results of Noise measurements

WHO standard: Occupational-85dB for 8hours/day, general environment-55dB(day).

Table 4: Average measured noise level compared to the WHO standard

Station	Location	Average noise level (dB)	WHO standard (dB)	Compliance
S1	Drilling area	89	85	Exceeds
S2	Blasting zone	102	85	Exceeds
S3	Primary crusher	98	85	Exceeds
S4	Secondary crusher	92	85	Exceeds
S5	Loading point	85	85	At limit
S6	Haulage road	84	85	Complies
S7	Administrative office	70	85	Complies
S8	Residential area	56	55	Slightly exceeded

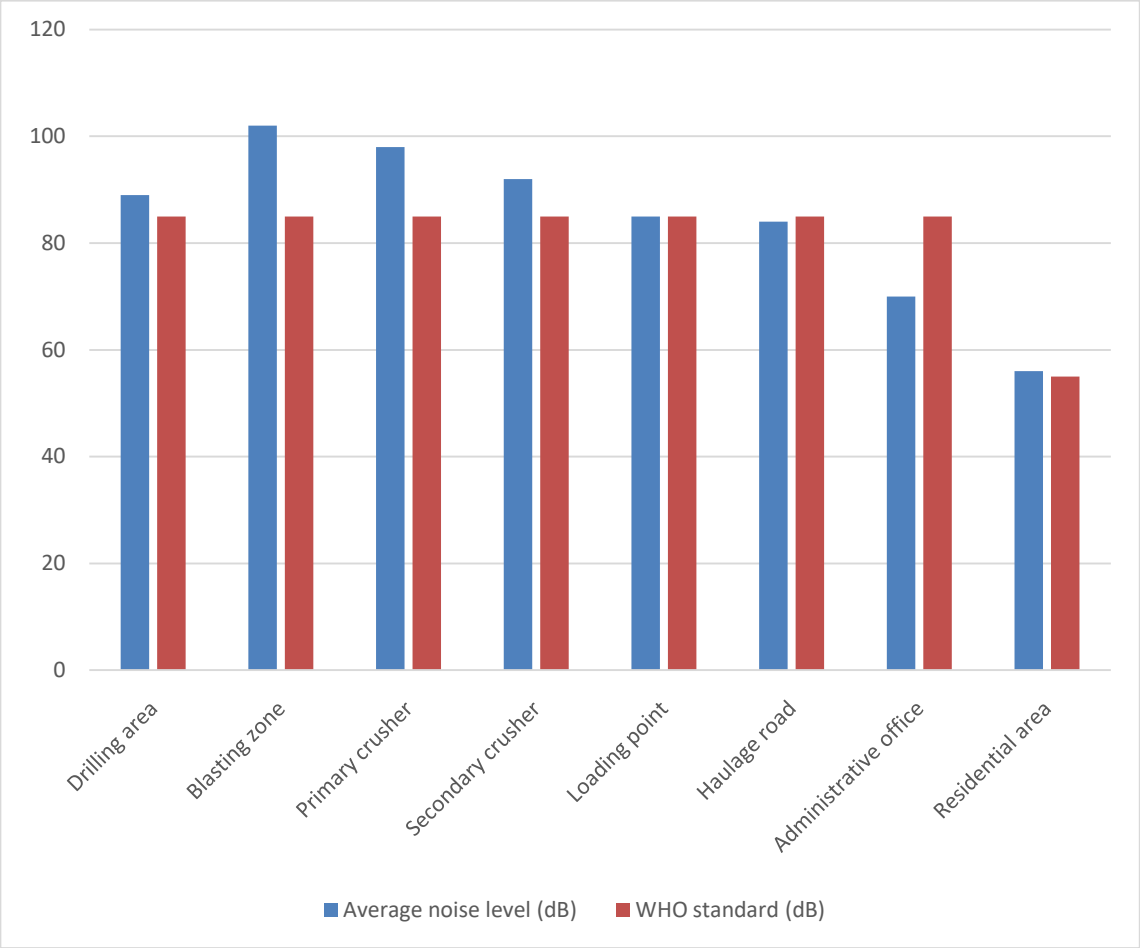


Fig. 2: Measured noise level compared with WHO standard

3.2 Results of Dust measurements

WHO standard: PM_{10} (24hours)=45µg/m³, $PM_{2.5}$ (24hours)=15µg/m³

Table 5: Chart showing measured noise level compared to the WHO standard

Station	Location	Measured concentration (µg/m³)		WHO guideline (µg/m³)		Compliance
		PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	
S1	Drilling area	118	45	45	15	Exceeds
S2	Blasting zone	108	50	45	15	Exceeds
S3	Primary crusher	121	60	45	15	Exceeds
S4	Secondary crusher	106	53	45	15	Exceeds
S5	Loading point	96	40	45	15	Exceeds
S6	Haulage road	83	34	45	15	Exceeds
S7	Administrative office	43	12	45	15	Complies
S8	Residential area	37	9	45	15	Complies

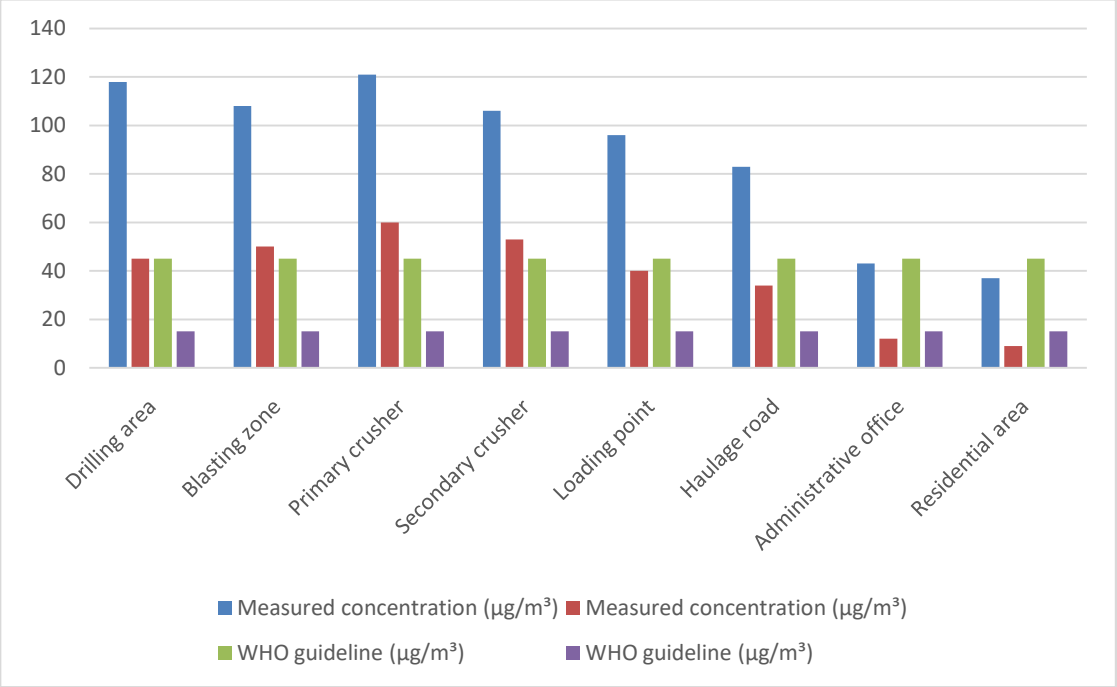


Fig. 3: Measured dust concentration compared with WHO standard

3.3 Discussion of results

Noise level at drilling, blasting and crushing area exceeded the World Health Organization (WHO) occupational limit of 85dB.

Noise at the nearby residential area (56dB) slightly exceeded the WHO general environment limit of 55dB

Dust concentration (PM_{10} and $PM_{2.5}$) where above WHO limits at all operational stations except Administrative office and residential area that are in compliance.

Despite the company using water suppression at the crusher, there's still excess dust observed during crushing operations.

The high dust levels are attributed to the nature of the rock, dryness of the environment, movement of vehicles and inadequate dust control measures.

4.0 CONCLUSION

Based on the findings of this study, it can be concluded that quarry operations at Chinese Government Company Granite Quarry constitute a significant source of environmental noise and dust pollution. Activities such as drilling, blasting, crushing, loading, and haulage were identified as the major contributors to pollution generation within the quarry environment.

The results showed that noise levels recorded at the drilling, blasting, and crushing sections exceeded the WHO occupational exposure limit of 85 dB, while dust concentrations measured at several operational units exceeded WHO guideline values for $PM_{2.5}$ and PM_{10}. These findings indicate that workers operating in these areas are exposed to environmental

conditions that may adversely affect their health and wellbeing if appropriate control measures are not maintained.

The study also established that quarry-generated pollutants extend beyond the immediate operational areas and may affect nearby residential communities. This was evident from the noise and dust levels recorded within the residential monitoring station and the visible deposition of dust on surrounding surfaces.

Although the company has implemented water suppression at the crushing plant, the effectiveness of the system appears limited, as excessive dust emissions were still observed during crushing activities. Consequently, the current dust control measures alone are insufficient to adequately protect workers and the surrounding environment from particulate pollution.

Therefore, while Chinese Government Company, Granite Quarry contributes significantly to the supply of construction materials and economic development, there is a need for continuous environmental monitoring, improved dust suppression technologies, and stricter adherence to occupational health and environmental management practices to ensure sustainable quarry operations.

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