

Noise pollution in a Refining & Petrochemical Company in Nigeria.

J.O. Osarenmwinda¹ and A.A Onojoserio²

Department of Production Engineering, University of Benin, P.M.B 1154, Benin City, Nigeria

ABSTRACT

Nowadays, the concern about noise pollution is acquiring considerable importance especially in industrial environment where there exist a lot of machineries and equipment. The aim of this study was to determine the level of noise pollution generated by some plants specifically Carbon Black Plant, Power Plant & Utilities, Waste Water treatment Plant and Fuels Plant in Warri Refining & Petrochemical Company (WRPC), Warri, Nigeria and recommend strategies for noise control. Noise level data was obtained from the environmental monitoring unit of WRPC for period April to November, 2012. The results showed that the noise level exceeded the 85 dB(A) WHO recommended limit for industrial area in the Carbon Black Plant, Power Plant & Utilities and Fuels Plant in WRPC but was lower than 85 dB(A) in Waste Water treatment Plant section of WRPC. It was observed that such noise pollution can present health problems to the workers. Recommendations have been made to the company in this study to remedy these problems and challenges.

Keywords: Carbon black plant, fuel plant, noise pollution, refining and petrochemical company, waste water plant.

I. INTRODUCTION

Noise pollution is an act in which displeasing human or machine created sound that disrupts the activity of balance of human or animal life is introduced to the environment. It can equally be described as an unwanted or excessive sound dumped into the environment without regard to the adverse effects it may have. It is an undesirable by-product of our modern way of life. Industrialisation and modernisation has given rise to a new form of pollution, noise [1]. Gradually, noise has become an important environmental pollutant and in big cities is considered by the World Health Organization (WHO) to be the third most hazardous type of pollution, right after air and water pollution [2].

In contrast to many other environmental problems, noise pollution continues to grow and is accompanied by an increasing number of complaints from people exposed to the noise. The growth in noise pollution is unsustainable because it involves direct as well as cumulative, adverse health effects. Noise effects have various impacts on mental and physical health and disturbance in daily activities. It may affect sleep, conversation, leading to perception of annoyance and causes hearing loss, cardiovascular problems as well as affecting task performance [3, 4].

The need for studies regarding urban noise pollution and its consequences on the environment has motivated various researchers on the problem in several countries [5-8]. Singh and Jain, [9] reported the measurements of noise levels in residential, industrial and commercial areas in the capital city of India, Delhi that commercial areas have the highest

noise levels followed by industrial and residential areas. This is in contrary to the finding of Oyedepo and Saadu, [8] who carried out measurement of noise levels in busy roads/road junctions, residential, industrial, commercial and passenger loading parks areas in Ilorin city, Nigeria. The result showed that industrial areas have the highest noise levels followed by busy roads/road junctions, passenger loading parks and commercial areas.

In Nigeria, there are high noise exposure levels in the formal (manufacturing and mining) and informal occupational sector (small industries such as vehicle repairing, metal-working and milling) as well as the non-occupational sector (urban environmental and leisure). Awareness of hazard amongst employers, employees and the public is however very low. In most developing countries like Nigeria, noise in industrial areas are increasing risk factors for hearing impairment [8]. Nigeria lacks both effective legislation against noise and programmes to prevent noise-induced hearing loss. Where they exist, they are often poorly enforced and implemented [8].

In Nigeria, the problem of noise pollution is wide spread. Several studies report that noise level in metropolitan cities exceeds specified standard limits. A comparative study of noise pollution levels in some selected areas in Ilorin metropolis, Nigeria was carried out [8]. This study was conducted to compare the noise pollution levels at busy roads/road junctions, passenger loading parks, commercial, industrial and residential areas in Ilorin metropolis. The results of the study showed that industrial areas have the highest noise pollution levels (110.2 dB (A))

followed by busy roads/road junctions (91.5 dB (A)), passengers loading parks (87.8 dB (A)) and commercial areas (84.4 dB (A)). According to the researchers it was concluded that the city is environmentally noise polluted and industrial machineries and road traffic are the major sources of it. Ighoroje *et al.*, [10] investigated the level of noise pollution in selected industrial locations in Benin City, Nigeria. The average ambient noise level in Sawmills, Electro-acoustic market and food processing industrial areas was determined to be above 90 dB (A). This noise level is well above the healthy noise level of 60 dB (A). Ambient noise levels were measured both indoors and outdoors in eight tanning industries in Kano, Nigeria by Sonibare [11]. The average noise level measured ranged between 70.1-95.2 dB. The result of the study showed that in the production floor, workers were exposed to marginally high noise level. Onuu,[12] studied the sound levels and spectra of industrial noise of nine industrial layouts in Calabar, Cross Rivers State of Nigeria and found the octave band pressure levels to be well above 85 dB (A) which is the starting point where hearing damage risk is thought to be imminent. From the survey, they also found that the deafening level produced by the machinery noise was as high as 115 dB (A). Omubo-Pepple *et al.*, (2010) investigated the effect of noise-induced hearing loss within Port Harcourt metropolis, Nigeria at two locations and concluded that the noise pollution within Port Harcourt International Airport has adverse effect on the environment and recommended that if certain protective measures were not taken that it will result to induced hearing loss and other psychological and pathological effects. Oyedepo and Saadu,[14] carried out a study on assessment of noise level in sundry processing and manufacturing industries in Ilorin metropolis, Nigeria. In this study, five selected processing and manufacturing industries were evaluated and compared the noise emitted by individual industrial machinery. Findings showed that hammer mill machine from mineral-bearing rock-crushing mills produced the highest average noise (98.4 dB (A)). The percentages of machines that emits noise above Federal Environmental Protection Agency and Occupational Safety and Health Administration recommendations (90 dB (A)) were from the soft drink bottling industry (83.3%), the beer brewing and bottling industry (42.9%), the tobacco making industry (71.4%), the mattress making industry (11.1%) and minerals-bearing rock-crushing mills (87.5%). An overview of industrial employees' exposure to noise in sundry processing and manufacturing industries in Ilorin metropolis, Nigeria was carried out by Oyedepo and Saadu,[15]. In this study, the average noise exposure level (L_{Aeq}) in minerals-bearing rock-crushing mills, soft drinks

bottling, beer brewing and bottling and tobacco making industries was found to be above 85 dB (A). The noise level in these industries was well above the healthy noise level of 60 dB (A) recommended by World Health Organization (WHO). The researchers concluded that the workforce in these industries is at high risk of developing Noise Induced Hearing Loss (NIHL) and other associated ailments due to excessive occupational exposure to noise. Noweir *et al.*, [16] examined The noise pollution in the utilities industries in Saudi Arabia. The results indicated that the highest noise exposure existed in the cable, the concrete and the construction supplies, and the glass industries where the noise level was higher than 85dB(A) while the lowest exposures existed in the food processing and dairy products and breverage industries where all average measurement was lower than 85dB(A). They concluded that such noise can present health challenge to the workers.

In comparison with other pollutants the control of environmental noise in industrial environment has been hampered by insufficient knowledge of its effects on humans and a lack of sufficient data, especially in developing countries like Nigeria. There is widespread and increasing excessive noise exposure in industrial areas and existing evidence indicates that noise pollution mostly in industrial area may have negative impacts on human health has justified research in order to provide better understanding of noise pollution problems and control [17]. This study therefore focuses on noise pollution generated by some plants specifically Carbon Black Plant, Power Plant & Utilities, Waste Water treatment Plant and Fuels Plant in Warri Refining & Petrochemical Company (WRPC), Warri, Nigeria and recommends strategies for its noise control.

II. SCOPE OF WORK AND PLANTS STUDIED

This study is restricted to four plants out of the seven plants in the WRPC. This is because the four plant ran smoothly without breakdown within the period under investigation which was from April to November, 2012 with the exception of the month of July 2012 when general shutdown for maintenance to be carried out. The plants studied are as follows:

2.1. Carbon Black Plant

This is a plant that uses reactor with gas or oil to produce carbon black; product is used as rubber strengthening and filling, colorant and ultraviolet light.

2.2. Power Plant & Utilities

WRPC have two types of power plant, the steam turbine and the gas turbine. Both systems are a device that extract thermal energy from pressurized

steam and gas and uses it to do mechanical work on a rotating output shaft, which in turn is used to drive an electric generator.

2.3. Waste Water Treatment Plant

This is the plant that removes petroleum contaminants, hazardous materials and suspended solids from wastewater prior to discharge to the local watershed or publicly owned treatment facility or reused.

2.4. Fuels Plant

Through distillation and chemical reactions, the refinery converts crude oil into a variety of valuable fuels and other lubricants as well as feedstock for other downstream processes.

III. METHODOLOGY

3.1. Method of data collection

The study was done with noise level data obtained from the environmental monitoring unit of WRPC for four plants which were: Carbon Black Plant, Power Plant & Utilities, Waste Water treatment Plant and Fuels Plant. Data obtained was for a period April to November 2012 with the exception of the month of July 2012 when there was general shutdown for maintenance purpose.

The environmental monitoring unit used an integrated Average Sound Level Meter, model NO. CR812B that was developed by the Cirrus research PLC, in UK for capturing their data. The instrument was placed on the broad band mode and measurement duration was 15 minutes at each location for each plant studied. The calibration of the instrument was checked before and after each set of measurements as recommended by ISO [18]. The reading was taken on daily basis but reports and presentations were done on monthly basis, thereby making the data used for the study to be on monthly average.

IV. RESULTS AND DISCUSSION

4.1. Data presentation

Table 1-4 shows the as received noise level at the different locations for the Carbon black plant, Power plant & Utilities, Waste water treatment plant and Fuels plant respectively for period April – November, 2012.

4.2. Discussion of results

4.2.1. Carbon black plant

For Carbon black plant the noise level for blower area, bagging area and carbon black control room ranged from 55.6 – 96.8 Db(A), 57.5 – 65.2 Db(A) and 48.6-55.8 Db(A) respectively (Table 1). The average noise level for blower area, bagging area and control room during the period under review was 70.97 Db(A), 60.94 Db(A) and 52.48 Db(A)

respectively (Table 1). These value is lower than the WHO limit of 85 Db(A). However for the blower area it was observed that in the month May, 2012 the noise level was 96.8 Db(A). This exceeded the WHO limit of 85 Db(A) and was also found to compare favourably with the value average noise of 98.4 dB(A) obtained by Oyedepo and Saadu [14] in study of the noise emitted by hammer mill machine from mineral-bearing rock-crushing mills. The other months may have been below the 85 dB(A) WHO limit since the plants were not running.

4.2.2. Power plant and Utilities

For Power plant and Utilities the noise level for steam turbine, gas turbine and compressor ranged from 79 – 97.5 Db(A), 84.2 – 97 Db(A) and 88.5 – 100.5 Db(A) respectively (Table 2). The average noise level for steam turbine, gas turbine and compressor during the period under review was 91.8 Db(A), 93.31 Db(A) and 96.55Db(A) respectively (Table 2). These value is higher than the WHO limit of 85 Db(A) which is the starting point where hearing damage risk is thought to be imminent. This noise level was found to compare favourably with the noise pollution value of above 90 dB (A) obtained by Ighoroje *et al.*, [10] in selected industrial locations (Sawmills, Electro-acoustic market and food processing industrial areas) in Benin City, Nigeria and above 85 dB (A) obtained by Oyedepo and Saadu [15] in sundry processing and manufacturing industries in Ilorin metropolis, Nigeria.

4.2.3. Waste water plant

For waste water plant the noise level for the plant area and waste water plant control room ranged from 63.5 -73.8 Db(A) and 46.3 – 54.7 Db(A) respectively (Table 3). The average noise level for the plant area and waste water plant control room during the period under review was 67.12 Db(A) and 51.64 Db(A) respectively (Table 3). These values are lower than the WHO recommended limit of 85 Db(A). This was found to compare favourably with the value of below 85 Db(A) obtained by Noweir *et al.*, [16] for food processing and dairy products and beverage industries in Saudi Arabia.

4.2.4. Fuel plant

For fuel plant the noise level for reforming unit, topping unit and fuel control centre ranged from 79.2 – 94.9 Db(A), 62.7 – 93.9 Db(A) and 82.2 -99 Db(A) respectively (Table 4). The average noise level for reforming unit, topping unit and fuel control centre during the period under review was 85.27 Db(A), 85.18 Db(A) and 91.32 Db(A) respectively (Table 4). These value is higher than the WHO recommended limit of 85 Db(A). This noise level was found to compare favourably with the Ambient noise levels of between 70.1-95.2 dB obtained by Sonibare *et al.*

[11] for eight tanning industries in Kano, Nigeria and Onuu,[12] with values above 85 dB(A) in nine industrial layouts in Calabar, Nigeria. This values was also found to compare favourably with noise level obtained by Noweir *et al*, [16] with noise level above of 85 Db(A) for cable, the concrete and the construction supplies, and the glass industries in Saudi Arabia.

V. CONCLUSION

From the study we can conclude that there was high noise pollution in WRPC level due to the fact that the noise level in carbon black plant, power plant and utilities and fuel plant exceeded the WHO recommended limit of 85 Db(A) for noise level in industrial enviroment. High noise levels in industry may reduce productivity and the efficiency of workers. Additionally, a lot of industrial accidents are caused by excessive noise. Furthermore, industrial noise in plants, depending on the spectral distribution and amplitude may annoy, interfere with speech and hearing, accelerate presbycusis or cause irreversible hearing damage. It also has pathological danger.

.Based on this high noise pollution in WRPC the following are strongly recommended:

- ❖ Use Personal protective equipment (PPE) e.g. ear muff/plug should be made a must for every workers and visitor to the plants.
- ❖ The core staffs that work in these various plants should be place on periodic medical checkup; this is to ensure that none of them is having health issues as a result of exposure to these high noise levels.
- ❖ The locations of these plants should be built with sound proof materials if possible since this will go a long way to reduce the noise level that those that reside with the plants enviroment will receive.
- ❖ Training on the effect of exposure to this noise pollution should be hold periodically, this is to make the workers aware and know when health issues arises as a result of continuous exposure to the noise pollution.
- ❖ Hazard signs of noise pollution should be placed in strategic positions of the various plants; this is to pass warning and caution to workers.

REFERENCES

- [1] N.Singh and S.C. Daver. Noise pollution: Sources, effects and control. *J. Human Ecol.*, 16,2004, 181-187.
- [2] WHO, *United Nations Road Safety Collaboration: A Handbook of Partner Profiles.* (World Health Organization, Geneva, Switzerland,2005).
- [3] A. Piccolo, D. Plutino and G. Cannistraro, Evaluation and analysis of the environmental noise of Messino. *Applied Acoustics*, 66,2005, 447-465.
- [4] A.Jamrah, A. Al-Omari and R. Sharabi, Evaluation of traffic noise pollution in Amman, Jordan. *J. Environ Monitor Assess.*, 120,2006, 499-525.
- [5] J.U Ugwuanyi, I. Ahemen and A.A. Agbendeh,. Assessment of environmental noise pollution in Markurdi Metropolis, Nigeria. *Zuma J. Pure Applied Sci.*, 6, 2005, 134-138.
- [6] Q. Zeid, M. She and I.R. Abdel-Razia, measurement of the noise pollution in the community of Araba. *ACTA Acoust.*, 86,2000, 376-378.
- [7] D. Zheng, X. Song and T. Chen, Study on personal noise exposure in China. *Applied Acoustics*, 48, 1996, 59-70.
- [8] O.S. Oyedepo. and A.A. Saadu, A Comparative study of noise pollution levels in some selected areas in Ilorin metropolis, Nigeria. *Environ. Monit. Assess.* 158, 2009, 155-167.
- [9] B.B Singh,. and V.K. Jain, A Comparative study of noise levels in some residential, industrial and commercial areas of Delhi. *J. Environ. Monitor. Assess.*, 35,1995, 1-11.
- [10] A.D.A Ighoroje, C. Marchie and E.D. Nwobodo. Noise induced hearing impairment as occupational risk factor among Nigerian traders. *Niger. J.Physiol. Sci.off Publ.Physiol. Soc. Niger.*,9,2004,:14-19
- [11] J.A Sonibare,.F.A Akeredolu, I. Latinwo and B.O. Solomon, . Impart of tanneries on ambient noise level in Kano, Nigeria. *Afr. J. Eviron. Asses. Manage.* 8,2004,1-18.
- [12] M.U Onuu, Measurements and analysis of road traffic noise and its impact in parts of South Eastern Nigeria. *Ph.D. Thesis, University of Calabar, Calabar, Nigeria.* 1992
- [13] V.B Omubo-Pepple, M.A Briggs-Kamara and I. Tamunobereton-an,. Noise pollution on port Harcourt metropolis:Sources,effects and control.*Pac. J Sci. Technol.*,11,2010,592-600
- [14] S.O Oyedepo, and A.A. Saadu, Assessment of noise level in sundry processing and manufacturing industries in Ilorin metropolis, Nigeria. *Environ. Monit. Assess.*, 162,2010, 453-464.
- [15] S.O Oyedepo, and A.A. Saadu, The Changing noise climate in Ilorin metropolis, *J. Environ. Eng. Sci.*, 25,2008, 797-808.
- [16] M.H Noweir,I.M Jomaah and A.O Bafail,. Noise pollution in the utilities industries in

Saudi Arabia. *Asian Transactions on Engineering.*, 2(2) 2012, 18-21.

- [17] Georgiadou, E., K. Kourfidis and I. Ziomas, Exploratory traffic noise measurements at five main streets of Thessaloniki, Greece. *Global Nest: Int. J.*, 6, 2004, 53-61.

- [18] ISO, .International standards:acoustic-guidelines for the measurement and assessment of exposure to noise in aworking enviroment. ISO9612:1997

Table 1:Carbon black plant noise level

Location	April	May	June	August	Sept	October	November	Average Value
Blower area	72.9 dB(A)	96.8 dB(A)	60.5 dB(A)	75.6 dB(A)	67.4 dB(A)	55.6 dB(A)	68.0 dB(A)	70.97 dB(A)
Bagging area	62.3 dB(A)	65.2 dB(A)	63.9 dB(A)	60.3 dB(A)	57.5 dB(A)	59.5 dB(A)	57.9 dB(A)	60.94 dB(A)
Control room	53.1 dB(A)	55.8 dB(A)	53.3 dB(A)	48.6 dB(A)	49.3 dB(A)	52.6 dB(A)	54.7 dB(A)	52.48 dB(A)

Table 2:Power plant and utilities noise level

Location	April	May	June	August	Sept	October	November	Average
Steam turbine	95.6 dB(A)	97.0 dB(A)	97.5 dB(A)	87.1 dB(A)	79.1 dB(A)	91.9 dB(A)	94.6 dB(A)	91.8 dB(A)
Gas turbine	96.0 dB(A)	97.0 dB(A)	95.1 dB(A)	94.2 dB(A)	84.2 dB(A)	91.9 dB(A)	94.8 dB(A)	93.31 dB(A)
Compressor	88.5 dB(A)	94.4 dB(A)	98.5 dB(A)	100.3 dB(A)	99.5 dB(A)	97.5 dB(A)	97.0 dB(A)	96.55 dB(A)

Table 3:Waste water plant noise level

Location	April	May	June	August	Sept	October	November	Average
Plant area	73.8 dB(A)	71.4 dB(A)	66.0 dB(A)	63.5 dB(A)	63.8 dB(A)	66.5 dB(A)	64.9 dB(A)	67.12V
Control room	54.7 dB(A)	53.5 dB(A)	51.7 dB(A)	46.3 dB(A)	50.0 dB(A)	52.9 dB(A)	52.4 dB(A)	51.64V

Table 4:Fuel plant noise level

Location	April	May	June	August	Sept	October	November	Average
Reforming unit	94.9 dB(A)	88.3 dB(A)	87.0 dB(A)	79.2 dB(A)	80.6 dB(A)	84.5 dB(A)	82.8 dB(A)	85.27 dB(A)
Topping unit	93.9 dB(A)	90.2 dB(A)	91.9 dB(A)	78.5 dB(A)	62.7 dB(A)	85.8 dB(A)	93.3 dB(A)	85.18 dB(A)
Fuel Control centre	93.9 dB(A)	99.0 dB(A)	92.8 dB(A)	84.6 dB(A)	82.2 dB(A)	91.7 dB(A)	95.1 dB(A)	91.32 dB(A)

Source: Environmental monitoring unit of WRPC