COMPARATIVE ANALYSIS OF DECIBEL LEVELS OF DIFFERENT CEMENT MANUFACTURING EQUIPMENT IN LIMESTONE DEPOSIT COMMUNITY TOWARDS A SUSTAINABLE ENVIRONMENT

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Abstract

Noise is a form of pollution particularly when it is loud, causes disturbance or unpleasant to hearing. The ecosystem is designed to be a habitat for all the organisms and the physical environment with which they interact but human activities are numerous and tend to interfere with the environment. This paper tends to compare the ambient noise level with the weighted decibels of sounds emanating from some cement manufacturing equipment like impact crushers, limestone & shale crushing machine, clink crushers, raw meal homogenizing machines, and some earth moving equipment within the industrial environment as perceived by our ears. It further focuses on the characterization of the noise from its source and measuring sound travelling through the air emitted by industrial machines using acoustic sound level meters. Field data were obtained from the three selected manufacturing plants within the geographical study areas using digital sound level meters to measure the volume and determine the ambient temperature while tachometers were used to measure some identified cement manufacturing engine operating speed at $^{+}_{-}$ 5% of the indicated reading. The field result shows that the noise levels are way far above WHO standard vis a vis the average threshold of hearing for human beings. It is hoped that a regulatory approach to environmental air pollution will help to control this anomaly.

Keywords: Environment, Human beings, Industrial noise, Pollution, Repercussions, Sustainable, Weighted-decibels

Introduction

Noise is a form of environmental pollution just as we have land, air, and water pollution. Noise is either a by-product of urbanization or industrialization and excess noise can annoy a worker or disrupt communication between workers and this can lead to costly accidents or mistakes. Although, land, air, and water pollution are well echoed by scholars, noise or sound pollution is generally not calculated or researched into due to its virtual. The cause is that the negative effects of other types of pollution on people are more noticeable. Nevertheless, noise pollution is a grave health issue to all humans as it robs us of sound rest and causes numbness or loss of hearing at the minimum standard of sound propagation. According to Hinchcliffe, (2002); the most noticeable negative effect of noise pollution is hearing loss or impairment According to Anake et al. (2012); hearing impairment is usually classified as an occupational hazard particularly when the victim is a factory worker or works in a factory that generates loud sound or noise. Furthermore, numerous sociological and psychological consequents of noise pollution occur and addition of other factors such as economic hassling and bustling activities trigger mental illness and abnormal human behaviour. Though, noise pollution keeps impacting adversely on fetal growth, frustration, and nervousness, mental health challenges such as sleep disturbance and insomnia, cardiovascular disorders in pregnant women, cardio-cerebrovascular diseases, type 2 diabetes, occurrence and medically unexplained physical signs, Oyedepo et al., (2013). Other auditory and non-auditory effects of noise on health are myocardial infarction occurrence, peptic ulcers, and disruption of communication and retentive capabilities in children.

Ibhadode et al..; (2018) described acoustic energy as the energy is released from particular objects of equipment or machinery and the energy radioactivity manner can normally be approximated by concluding that all sound energy from a specific item is discharged from a point source positioned at around the midpoint of the object. Certain disparity to this may be essential for prolonged sources at close listening locations. The sound energy emission form can commonly be viewed as isotropic (i.e. the energy emits alike in all directions) except there is signal that makes it different. This sound energy decreases with distance from the source that is proportional to the inverse square of the distance between the active point of source and any listening location hence sound is usually propagated through the air in comparatively straight pathways and can be investigated to pass through numerous alterations such as environmental absorption and refraction, which develop progressively more important with advancement of distance from the point of propagation; Asuquo et al., (2012). The noise could be altered by the presence of satisfactorily bulky substances that can absorb, screen, or reflect sound. This may result into allied decreases or increases in the sound pressure level at a precise listening location. Noise levels are measured with sound level meters that give several signals averaging and investigation options. Okokpujie et al., (2018) reported that the measurement outcomes are usually presented in decibels (dB) and the effect of environmental sound is possibly to be loudest at places where humans are associated with noise-sensitive situations. Hence, noise levels are usually recorded in dB(A) which comprises of the A-weighting frequency response that is according to the sensitivity of the human ear. The focal worries of environmental noise commonly associated with the obstruction of such events as sleep, relaxation, and discussion. Many structures of a precise noise, normally recognized as tonality, impulsiveness, modulation, and/or low-frequency mechanisms, can raise its possible disturbance. These structural parts tend to add to the statistical materials of the actual sound and thus increase its audibility; Usikalu et al., (2018). The hearing level of such a sound is also affected by the level and properties of supplementary ambient noise in the surroundings. Non-acoustic issues that can affect the particular audibility and annoyance probability of a precise noise comprise of the subjective value of the action producing the sound and the efficacy or else of any effort to regulate the sound. Adaptability of humans to various experience, noise individual personality, and differences can affect the reply given by a certain listener.

Methodology

This study was conducted in three towns: Ibese, Ewekoro, and Sagamu. The study areas lie on the limestone belt that stretches from Sagamu through Ewekoro, Sagamu, Ibese to the Republic of Benin. The study areas are located in Ewekoro, Sagamu, and Yewa North Local Government within the state boundaries of Ogun and Benin Republic. Ibese is located within the geographical coordinates (Latitude) 6^0 58^1 0`` North and (Longitude) $3^0$ $2^1$ 0`` East and it has an estimated population of 3,468,683 people (NPC, census 2005) while Ewekoro is located in the geographical coordinates (Latitude 6^0 56^1 00' North, and (Longitude) 3^0 13^1 00" East with an estimated population of 93,700 inhabitants. The three towns are covered predominantly by tropical rainforests and have wooded savannahs in the northwest. Plate 1 shows the sound level meter used for measuring noise levels of the industrial equipment.

Figure 7: Sound level meter

Sound level meters were deployed to the various industrial equipment noise sources on tripod stands and raw data were recorded at specific periods of the day with time intervals due to the continuous manufacturing processes going on within the cement plants. Table1 shows the dataset on industrial equipment noise of the daily noise level of different cement manufacturing equipment.

Table 1: Daily Noise Level of Different Cement Manufacturing Equipment.

Data Logger Sound Level Meter	$L_{Min.}$dB(A)	$L_{Max.}$dB(A)	$L_{10.}$dB(A)	$L_{50.}$dB(A)	$L_{90.}$dB(A)

Mechanical Equipment Numbering	M	A	E	M	A	E	M	A	E	M	A	E	M	A	E
84C- Cement mill	66	65	62	82	86	82	72	88	76	71	75	70	66	68	63
CR- Crusher	63	66	69	78	89	92	77	84	80	73	74	75	69	69	73
RM- Raw mill grinder	65	66	63	90	85	87	80	88	78	72	75	72	67	69	67
LSC- Limestone & shale crusher	45	43	31	67	65	63	56	56	55	48	49	45	46	45	41
PC- Power & control unit	63	63	65	86	89	83	82	79	80	77	75	76	72	70	70
DG-Diesel generator	68	64	66	88	88	82	97	80	78	79	74	74	72	68	69
BR- Boiler unit	73	75	73	83	85	90	91	96	87	79	83	78	75	77	75
CN-Cyclone / Air separator	90	87	89	65	70	78	60	55	67	92	89	94	80	80	84
Clinker crusher	68	71	73	61	71	68	67	65	85	98	88	86	88	86	89
CP- Compressor	70	73	71	71	76	74	70	76	76	81	84	89	89	89	90
M- Motor	70	73	76	78	78	80	80	84	84	60	65	68	89	90	95
Vibrating conveyor	70	73	91	97	99	86	86	92	78	77	84	84	86	88	89
Hammer Crusher	91	93	94	96	98	100	99	95	98	87	89	90	92	96	98
ValveSeat grinder	64	69	64	92	91	90	89	86	88	78	80	79	73	75	75
MX- Mixer	55	51	52	87	73	74	81	61	70	62	59	63	56	54	56
Impact crusher	51	50	48	79	72	71	75	71	68	59	64	59	55	55	53
EG- Emergency Diesel Generator	71	73	68	94	97	99	87	91	94	80	83	81	75	76	73
HC- Hammer crusher	60	62	66	84	83	84	74	81	82	68	73	77	63	66	71

FG-Floor grinder	70	73	91	93	99	86	86	92	78	77	84	73	72	76	78

Results

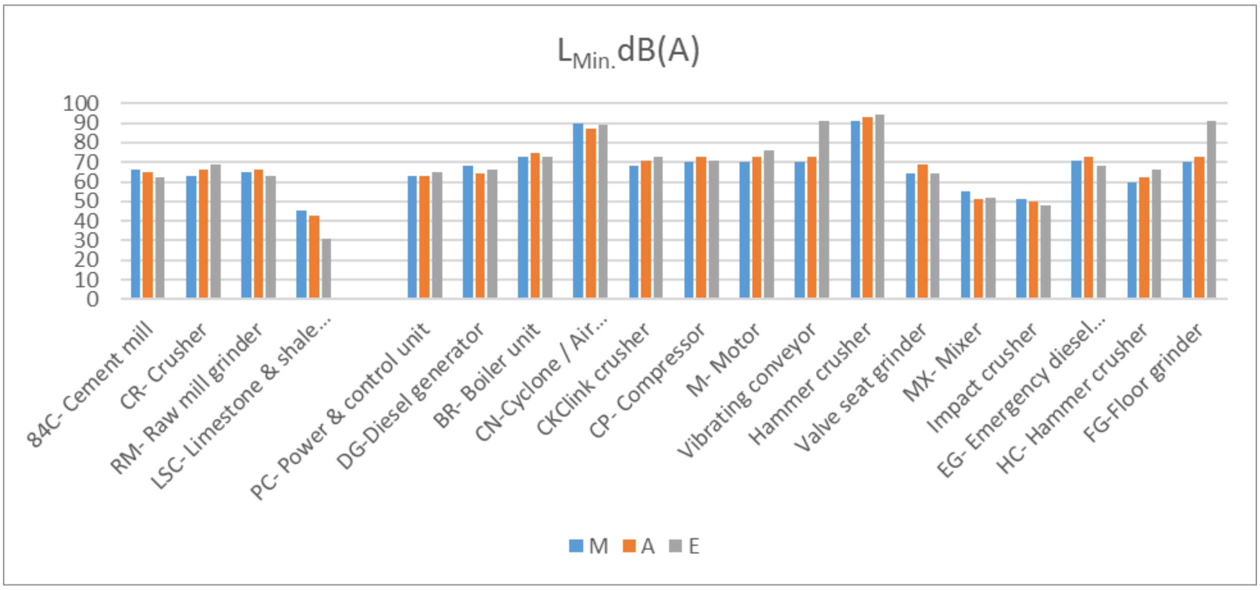

Figure 1: Comparative Analysis of Decibel Level of Different Cement Manufacturing Equipment Noise Level @ L_{min}

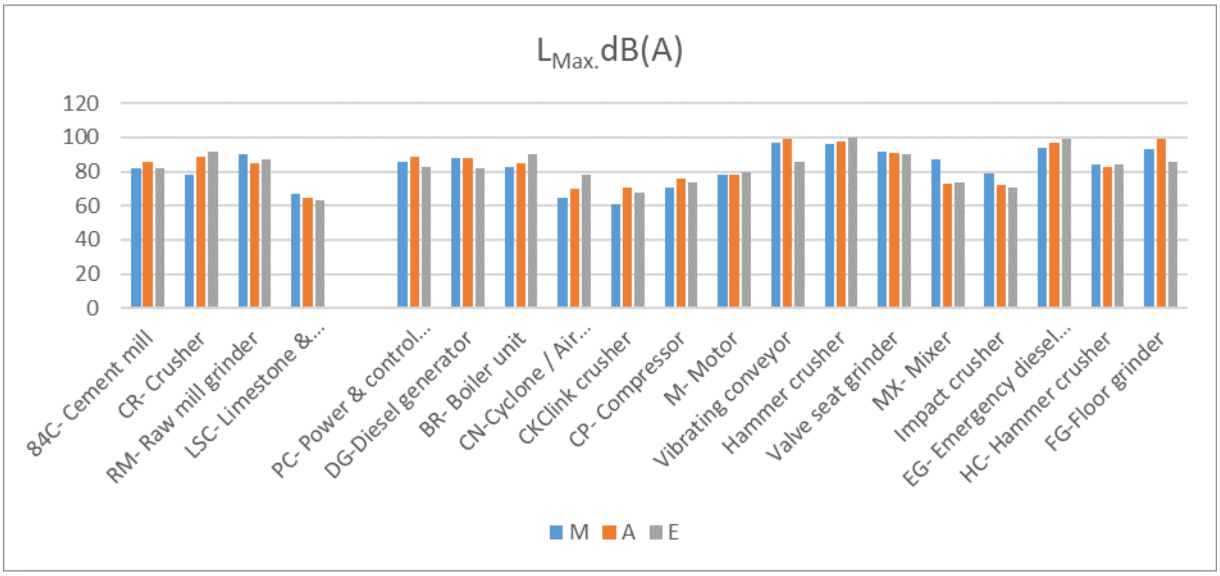

Figure 2: Comparative Analysis of Decibel Levels of Different Cement Manufacturing Equipment @ L_{max}

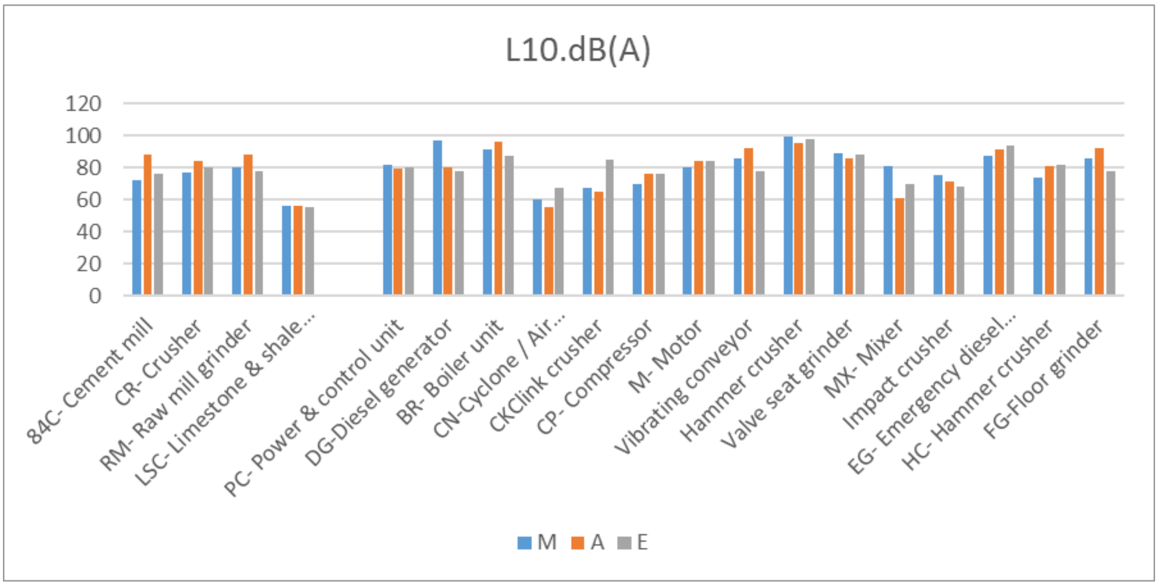

Figure 3: Comparative Analysis of Decibel Levels of Different Cement Manufacturing Equipment @ L_{10} dB(A)

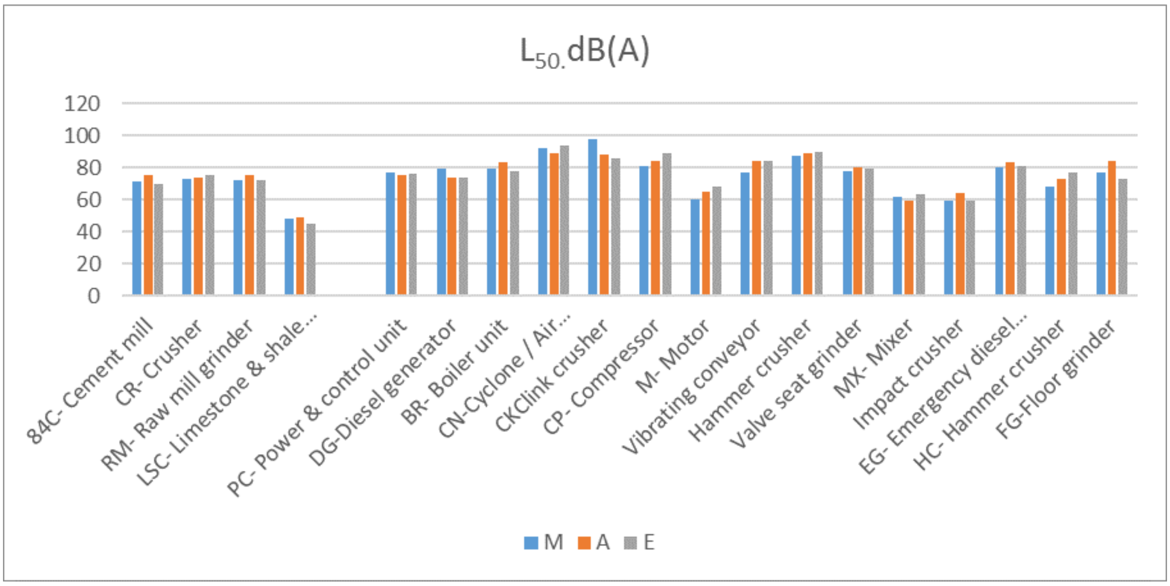

Figure 4: Comparative Analysis of Decibel Levels of Different Cement Manufacturing Equipment @ L_{50} dB(A)

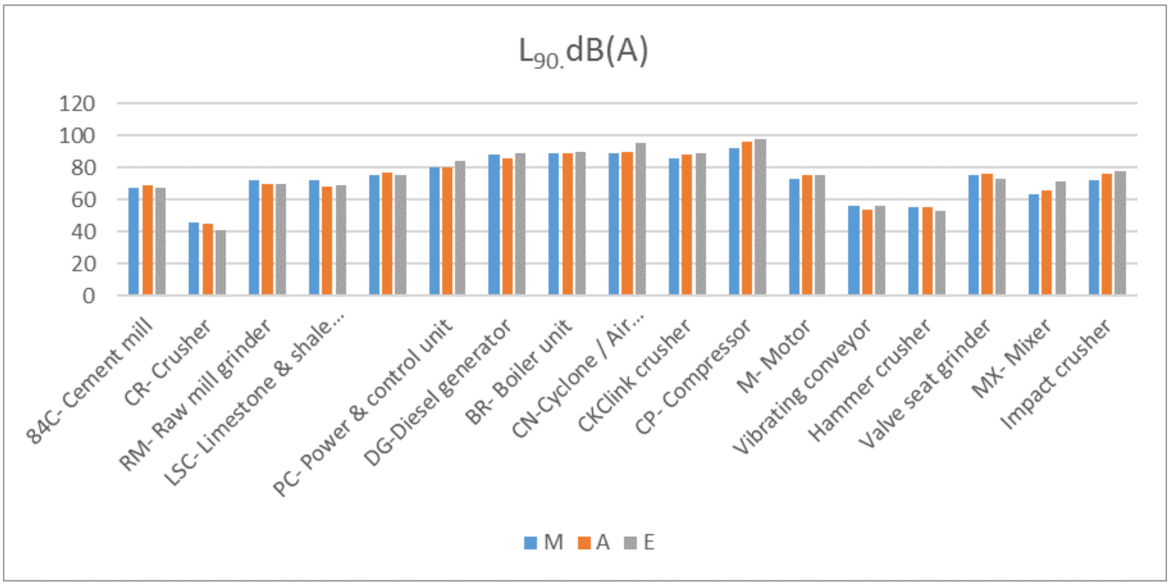

Figure 5: Comparative Analysis of Decibel Levels of Different Cement Manufacturing Equipment @ L_{90} dB(A)

Table 2 shows the WHO standard decibel levels for the Specific Noise level of Cement Manufacturing Equipment and the variation in noise level.

Table 2: Standard Decibel Levels for Specific Noise Levels of Cement Manufacturing Equipment

S/N	Specific Sources of Noise	Decibels (Db) (Max)
1	Cement mill	85
2	Cement Crusher	89
3	Diesel Generator	90
4	Boiler unit	60
5	Cyclone	98
6	Clinker Crusher	120
7	Compressor	85
8	Electric Motor	68
9	Vibrating Conveyor	60
10	Hammer Crusher	140
11	Valve Seat Grinder	68
12	Impact Crusher	102
13	Transportation Noise/ Haulage	70

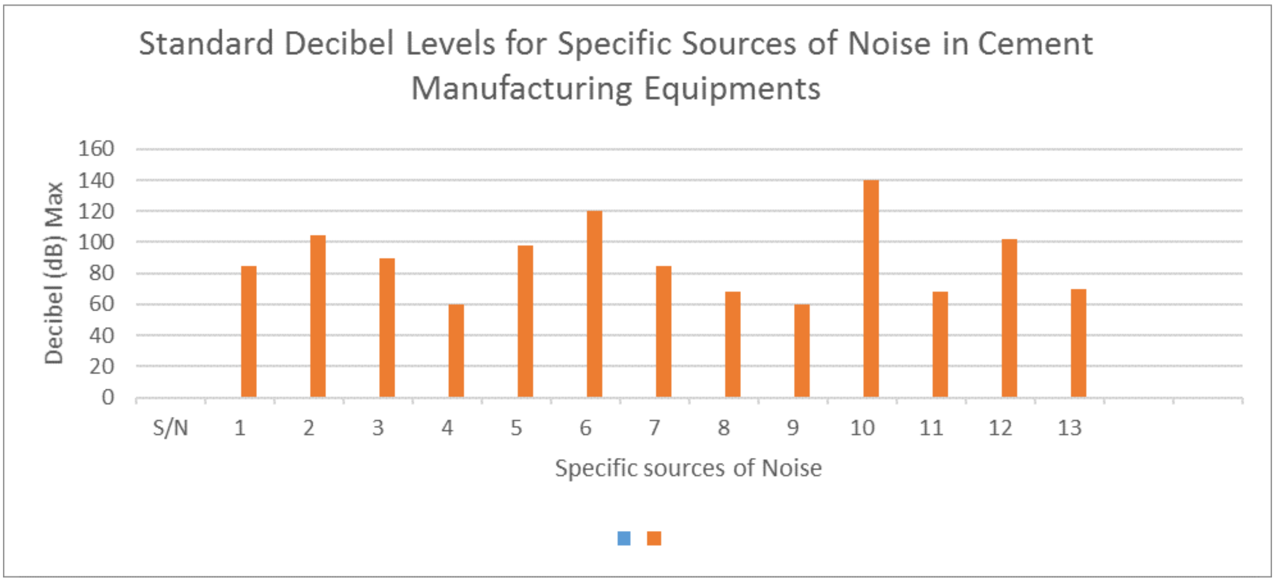

Figure 6: Standard Decibel levels for Specific Noise level of Cement Manufacturing Equipment)

Discussion

Table 1 shows the daily noise level measured at three different cement manufacturing locations at specific intervals (Morning, afternoon, and evening) for one week. The minimum and maximum noise level data were obtained and compared with the World Health Organization set the standard for human audibility level and from Figure 1at L_{min}, the highest noise level emanating from hammer mill crushers and Floor grinders ranges from 90dB to 100dB which far above the WHO recommendation of 89dB. This work could be likened to the research work of Aneke et al (2018) which determined the ambient air pollution tolerance index using some parametric values.

Table 2 presents the WHO standard decibel levels for the Specific Noise level of Cement Manufacturing Equipment and the variation in noise level for different cement manufacturing equipment as compared to the noise level L_{max}, @ 10dB, 50dB, and 90dB while Figure 6 shows the comparison vis a vis the equipment with the highest noise level. This is analogous to the research study of Akpan et al. (2012) in which industrial noise, doses, and effects were considered.

Conclusion

This research studied the noise level of some major cement manufacturing equipment in the cement manufacturing environment of Ibese, Ewekoro, and Sagamu communities using digital sound level meters. Efforts were made to compare the geometric increase in the noise level concerning the minimum noise standard recommended by WHO and it could be deduced that the sharp rise in noise level is a result of the service year of some cement equipment and poor environmental regulation and enforcement policies.

Acknowledgment

We wish to acknowledge the collaborative efforts of all past and present researchers in the field of environmental sustainability particularly Engr. Prof. O. J. Oyedepo, Engr. Prof. O. B. Bolaji, and other co-respondents who assisted in the course of carrying out this research work.

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