ANALYSIS OF THE ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT OF NOISE POLLUTION IN ELEME PETROCHEMICAL COMPANY LIMITED

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ABSTRACT

The impact of noise on the staff of Eleme Petrochemical Company Limited (EPCL), third parties, and resident/host communities was studied. Data collection involved physical identification of noise sources and spot reading of noise levels at 1.0m *from source. The spatial measurements along the selected routes and estimate of dispersion rates were carried out. About one hundred and eight (108) noise sources were identified and subsequently grouped in terms of equipment types as: air cooler/fans* (47%), *pumps* (37%), *compressors* (6%, *and office areas and others (10%). In spatial variation of noise level measurements, eight* (8) *routes were identified numbering A Hand a total of 6.32 kilometers of distance and* 523 *point locations were covered. The measurements were taken at 25 meters interval for a period of four days. In addition to noise level measurements for equipment (noise sources), spot readings were equally taken at the office buildings and other designated areas. Also, questionnaires were administered to 100 workers whose daily activities expose them to different levels of noise at different durations. Results showed that the exposure of workers to noise levels were high to very high in all the areas apart from the office areas. Also, several of the workers suffer from various noise-induced sicknesses and their levels of productivity have been reduced by* 31.4% *on the average. Urgent measures for curtailment of noise and ultimate protection of the worker's health were presented. Low use of the available earmuffs showed the need to educate all categories of EPCL staff on the dangers of noise pollution.*

INTRODUCTION

Noise is an aspect of sound that is not pleasurable [1]. It may be defined as unwanted or extraneous sound from such sources as industrial machinery, airplanes, trucks, pumps, turbines, generators, steam traps and others. Noise affects man both physically, psychologically and socially [2, 3]. It can damage hearing, interfere with communications, causes annoyance, tiredness and reduces efficiency [4]. Noise has a significant impact on the quality of life, and in that sense, it is a health problem in accordance with the World Health Organization's (WHO) definition of health. Along these lines, a 1971 WHO workshop group stated that noise must be recognized as a major threat to human well-being [5]. The effects of noise are seldom catastrophic, and are often only transitory, but adverse effects can be cumulative with prolonged exposure. Noise induced hearing loss can indeed impair the quality of life, through a reduction in the ability to hear important sounds and to communicate with family and friends. In addition, noise can interfere with the teaching and learning process, disrupt the performance of certain tasks and increase the incidence of antisocial behaviour. There is also some evidence that it can adversely affect general health and well-being in the same manner as chronic stress. These include exacerbation of hypertension and psychosis, and elevation of blood pressure [6].

Noise seems to have greater effects after than during exposures. The most common after effects include reduction in tolerance for frustration, increase in anxiety, changes in mood, increased reaction time in performance, sleep disruption, hearing loss, and disruption of communication [5-9].

Interest in noise control studies is only recent in Nigeria. This interest may be attributed to the current guidelines and standards for environmental pollution by the Federal Environmental Protection Agency [10]. It is envisaged that if proper monitoring and enforcement of the guidelines on permissible noise exposure limits are carried out, a great deal of compliance on the part of the industrial establishments will be achieved [1]. The Federal Environmental and Protection Agency (FEPA) recommended that daily noise exposure for workers should not exceed 90 decibels, dB (A) daily for 8 hour working period.

Prolonged noise exposure which leads to deafness or loss of hearing is influenced by the age of an individual, individual susceptibility, total Energy content of the noise, the spectrum of the noise (spatial effect), the duration of exposure, and continuity or intermittence of the noise (Transient effect) [11, 12]. The effects of noise pollution on workmen exposed to such noise can be appreciated when they are placed on periodic medical examination to isolate affected workers for possible rehabilitation or redeployment [12]. It is also possible to assess workers noise sensitivity rating and evidence of any hearing loss through personal interactions and questionnaire approach. Individuals should protect themselves with ear plugs or muff ear protectors particularly when noise levels exceed 85 decibles.

In Eleme Petrochemical Company Limited (EPCL), activities are carried out by both moving and static machines with attendant high noise levels. Workers of the EPCL who man the machines are being exposed to these high level noise daily for at least 8 hours, and exposure may continue for years. Even at levels below those that cause hearing loss noise pollution produces problems some of which had already been discussed. From the discussion above the objectives are:

(i) Identification of the various sources of noise pollution and the contribution of each source in Eleme Petrochemical Company limited.

(ii) Determination of the noise pollution levels in the plant complex and comparison of these with permissible limits from the Federal Environmental and Protection Agency (FEPA).

(iii) Determination of the possible effects of noise pollution on productivity, efficiency and its economic implications.

(iv)Determination of the spatial noise level distribution pattern, dispersion rates and minimum distance required in siting residential buildings close to the complex.

LIMITATIONS OF THE STUDY

The main problems encountered in this study is the paucity of material that treated the subject area in literature. More staff respondents treated the questionnaire with levity, making its distribution and collection last longer than planned. Access to the company's records was not easily obtained and most times completely not obtained at all. Besides, the measuring instruments were difficult to obtain as a very limited number are available in the country. The equipment was hired at a very exorbitant price with stringent conditionalities attached.

STUDY BACKGROUND

The Eleme Petrochemical Company Limited (a subsidiary of the Nigerian National Petroleum corporation), the study area is located in Akpajo Eleme town along Port Harcourt Onne express way in Rivers State of Nigeria. The company which is the largest in West Africa is in business to profitably manufacture a range of petrochemical products that are competitive both in the local and international markets by providing basic and intermediate feedstock to various end users to produce key products, like plastics, synthetic fibres, detergents, and fertilizers. Other benefits derivable from the usefulness of the company include provision of basic petrochemical raw materials locally, utilization of natural gas resources, provision of job opportunities, acquisition of modern technology, diversification of economy and industrial expansion.

The complex which was commissioned in 1988 is made up of four specialized plants each producing special grade of product. They include Olefins plant, polypropylene plant, polyethylene plant and butene 1 plant. The four plants have a total production capacity of 300,000 tons of ethylene; 120,000 tons of propylene; 22,000 tons of butene 1,127,000 tons of polyethylene, and 80,000 tons of polypropylene per year.

The Eleme petrochemical complex is an assembly of various types of both moving and static machines with attendant high noise levels. These machines include air cooling fans, boilers, compressors, condensers, heaters, gas flare system, reactors, water injection plants, pumps, turbine generators, steam traps and values, engine driving pump and back pressure manifold.

MATERIALS AND METHODS

Study Area

The Eleme petrochemical complex occupies a land space of 900 hectares. For the purpose of this research work, the entire complex is divided into five zones. They are: olefins plant (zone 1); power plant and utilities (zone 2); polypropylene plant (zone 3); polyethylene and Butene 1 plants (zone 4); and entire administrative office areas (zone 5). These zones are separated by network of roads. The complex is bounded on the South by the NNPC housing estate and an express road leading to Onne, on the East and West by the Wharf, and on the North by the Eleme community

Measuring Transient Noise

Noise variations with the passage of time may be taken as transient noise. Transient noise is measured with a Type 2 sound level meter (industrial grade meter) but the results must be reported in statistical terms. The common parameter is the percentage of time a sound level (SL) is exceeded, denoted by the letter 'L' with a subscript. For example, NL_{10} = 70 dB (A) means that 10% of the time, the noise is louder than 70 dB (A) as measured on the A scale. Transient noise data are collected by reading the SL at regular intervals. These values are then ranked and plotted, and L values read off the graph. One widely used parameter for gauging the perceived level of noise from transient sources is the noise pollution level (NPL) which takes into account the variability of impulse (sudden) noises [13], and is expressed as

$$NPL\ in\ dB\ (A) = NL_{10} - NL_{90} + \left(\frac{NL_{10} - NL_{90}}{60}\right)^2 \qquad [1]$$

NPL is usually taken as the upper limiting value and also employed to correlate the exposure limits in the environment [1].

Precautions On The Procedure For Field Survey And Data Collection

To ensure reliability and accuracy of the procedure used, the under mentioned precautions were initially taken.

(i) Noise level meter was calibrated before and also after measurement
(ii) A sketch of the location of the measuring instruments, position of sources, measurement position, and local reflecting surfaces which may affect measurements was made (Fig. 1).
(iii) For out door measurements the meteorological conditions, especially wind direction and strength, temperature and humidity were noted.
(iv) Measurements were carried out noting down relevant equipment settings such as A weighting and so on.
(v) Changes made to equipment settings, unusual occurrences and other information were noted.

Spot readings/at Noise sources

The complex premises was grouped into five (5) zones for initial noise level measurements and interactions with the officers in-charge of the various units. A direct read out noise level meter (metrosonic type 3080) was used. The interaction exercise was followed by the physical identification of the existing sources of noise generation. A total of about three hundred (300) noise sources were identified during the survey and were later grouped in terms of "types of equipment:" air cooler/fans (47%), pumps (37%), compressors (6%) and others (10%).

The data collected during the preliminary survey were useful in isolating one hundred and eighty (108) noise sources deserving detailed data collection. In the plant areas, the following noise sources were considered for data collection: Air cooler/Fans, boilers, compressors, condensers, heaters, gas flare, turbine generator, stream traps/valves, reactors, pumps, furnaces, pre-heater, overhead cooler, blender, blending blower, draught fan, extruder, booster fan, silos, control room, warehouse, drum, filter, storage base, air-receivers, dryers, chiller, diesel engine generator, pneumatic valve, main control room, river plant control room, electrical control room, operators change room, mechanical workshop, surge vessel and separator.

In the office areas, the sources include administrative building (reception, visitors room, ground floor, second floor); Industrial clinic (waiting room, treatment room, engine room); operation and technical building (reception, ground floor, first floor); staff canteen, fuel dump, muster point, security gate, communication system, car park, fire station etc.

Spot readings of noise levels from all noise sources (Operational during the period) were taken at L_{10} meter from the noise source at intervals of 10 seconds for a total period of 100 seconds. The transient variation of noise levels were taken at four different locations around the noise source for four days. However, noise measurements were taken at about 12.15 hours near environmental and public affairs department when people were going for break. This time was chosen because of vehicular traffic and high attendant noise levels associated with break period. Noise level measurements taken at the office buildings and other designated areas was to assess the daily level of noise some staff were exposed to. In these areas noise level measurements were taken in the morning hours which were regarded as the peak hours for most office operations.

Measurements of Spatial Variation of Noise Levels

The identification of the locations of noise sources aided in the selection of the routes for the study of spatial distribution and dispersion of noise pollution. A point was located at the premises called the zero point or reference point 'R'. Standing at the designated point four different routes were generated and chosen as follows: E, W, N, and S. The EPCL fence is the boundary line from where all the distance were measured to the reference point. The spatial variation of noise levels were measured at 20 meters intervals along the four (4) different designated routes to cover the entire EPCL premises. In this measurement a total distance of 4.22 kilometers and 211 point locations for spot readings were covered. The distances of the routes from the fence are shown in Table 1.

Table 1: Distance of the routes from the fence.

Route	Distance(m)	Points
E	1400	70
W	620	31
N	1200	60
S	1000	50
Total	4.220	2.11

The readings were taken for four days and all the 211 point locations were covered each day,

Questionnaires

Sample Size: In determining the sample size, a sample error of 10% was allowed, therefore, giving a 90% assurance that the result obtained will be quite representative of the employees. Since the total catchment population is finite, and known, the sample size was determined using the formula below

$$n = \frac{N}{1 + N(e)}$$

where N = population of workers, n = sample size, and e = Allowance error

F or this research, this implies that

$$n = \frac{2000}{1 + 2000(0.1)^2} = 95$$

Therefore, the sample size of 100 staff was used.

Questionnaire was then administered to 100 Eleme Petrochemical Company

Limited staffs who works in the various plant units. About fourteen questions were designed and tailored to these areas of need.

(i) Staff job identification as per noise exposure at the plant, his/her age bracket and average working hours per day.

(ii) Staff safety Via ear muff protection, its degree of convenience, comfort and performance to an alternative; and

(iii) Staff noise sensitivity rating and evidence of hearing loss.

RESULTS AND DISCUSSION

Analysis of Results

The NPL values were calculated In Tables 2-6.

Spot Noise Readings/Measurement

The rating of noise sources as low, high and very high was based on the exposure limits recommended by the Federal Environmental and Protection Agency FEPA [10]. Ninety (90) decibels or less, corresponding to eight hours exposure limit per day, was rated as moderate. Beyond the critical value of 90 dB (A), that is a threshold limit for commencement of hearing damage, exposure limits were either high or very high.

During field measurements it was observed that a noise level of 90 dB was high enough to mask speech or communication. Any worker exposed to this noise level definitely needs an ear protector for protection. The noise rating [14] is given below as:

1) Low for NPL< 70 Db (A)
2) Moderate for NPL>70 80Db(A)
3) High NPL>80 90Db(A)
4) Very high for NPL> 90 dB (A)

A total of 108 noise measurements were taken. The 92 of such measurements were either high or very high. Interaction with some of the workers in the plant revealed that some of them have developed some hearing loss. Most of them either shout for them to hear you.

Table 2: Noise level in Olefin Plant Area (Pumps)

S/N	Noise source	Average noise level BB (A)	Recommended noise level BB (A) shes duration	Remarks on noise level in comparison with FEPA recommend
1	Spitter C_3 Reboiler candy pump	86.7	90	Very high
2	Hydro carbon cycle pump	93.8	90	Very high
3	Green oil wash pump	94.2	90	Very high
4	NGL condenser pump	97.5	90	Very high
5	Pressure BFW pump	108.4	90	Very high
6	NGL pyrolysis furnance (1 H 01A)	99.5	90	Very high
7	NGL Reflux pump	112.8	90	Very high
8	NGL Pyrolysis furnance (1 H 01E)	97.8	90	Very high
9	NGL pyrolysis furnance (1 H 01F)	96.8	90	Very high
10	Condensate pump	110.5	90	Very high
11	Water circulation pump	111.8	90	Very high
12	Propylene transfer pump	88.1	90	High
13	Debutanizer Reflux pump	96.9	90	Very high
14	Debutanizer Reflux pump	97.3	90	Very high
15	C_4 Hydro generation Recycle pump	93.6	90	Very high
16	C_3 splitter Reflux pump	87.3	90	High
17	C_2 splitter Reflux pump	90.8	90	Very high
18	De ethanizer Bottom pump	98.3	90	Very high
19	Ethylene Product Pump	92.0	90	Very high
20	Boiler blow down pump	101.6	90	Very high
21	C_5 fractionators Reflux pump	86.2	90	High
22	C_5 Heary duty E and S pump	89.1	90	Very high
23	NGL pyrolysis furnance (1 H 01B)	99.1	90	Very high
24	Reactor (HR 12A)	100.0	90	Very high
25	Steam generator/Boiler	96.1	90	Very high
26	NGL pyrolysis furnance		90	Very high
27	Steam generator/Boiler (1 SA 1A)	96.6	90	Very high
28	Reactor (HR 12B)	102.8	90	Very high
29	Propylene cooler (1 E 76)	92.9	90	Very high
30	NGL pyrolysis furnance (1 H 01D)	102.0	90	Very high
31	Reactor (HR 12C)	98.5	90	Very high
32	Steam generator/Boiler (1 SG 1B)	103.4	90	Very high
33	Steam trap/leak close to Boilers	115.3	90	Very high
34	Process gas dryers	110.5	90	Very high

Table 3: Noise level in power plant and utilities (compressors)

S/N	Noise source	Average noise level BB (A)	FEPA Recommended noise level BB (A) shes duration	Remarks on noise level in comparison recommend actions
1	ASU chiller compresso (26 k 2)	113.2	90	Very high
2	Chiller package (26 PA 2)	107.3	90	Very high
3	Demin plant supply pump	94.9	90	Very high
4	Raw water supply pump	90.1	90	Very high
5	Cooling tower make up water	95.6	90	Very high
6	Exchange for the vapourizer	95.6	90	Very high
7	Five water pump	85.5	90	Very high
8	NGL refrigeration compressor	108.8	90	High
9	Process liquid Dranyer	78.2	90	Very high
10	Flame point	98.8	90	Very high
11	Knockout Drum	86.8	90	Very high
12	Filter	97.2	90	Very high
13	Condensate storage drum	97.2	90	Very high
14	Compressor drum (22 D 3B)	97.0	90	Very high
15	Compressor drum (22 D 3A)	97.0	90	Very high
16	Compressor drum (22 D 3C)	96.7	90	Very high
17	Compress (25 D 2A)	98.0	90	Very high
18	Air Receiver (25 D 2B)	109.0	90	Very high
19	Air Receiver (25 D 2A)	110.4	90	Very high
20	Compressor (25 K 1D)	96.5	90	Very high
21	Compressor (25 K 1c)	98.2	90	High
22	Turbine generator (21- GT 1)	96.0	90	Very high
23	Filter (22 F 1A)	102.9	90	Very high
24	Compressor (25 K 1E)	97.2	90	Very high
25	Steam teak/ trap close to flame point	111.7	90	Very high

Table 4: Noise Level in Polyethylene and Butene - 1 Plant (Cooler/Fans)

S/N	Noise source	Average Noise level dB(A)	FEPA Recommended Noise level dB (A) 8hrs duration	Remarks on noise level in comparison with FEPA Recommend actions
1	FE Feed Regeneration Boiler	97.5	90	Very high
2	Tropical Protection Cooling Fan	98.4	90	Very high
3	Polyethylene Lab	73.1	90	Very high
4	Blender (BL 601 C)	104.9	90	Very high
5	Hot Oil Pump (3 PA 608A)	99.2	90	Very high
6	Protection Cooling Fan (3 EN 101A)	94.6	90	Very high
7	Protection Cooling Fan (3 EN 101B)	97.8	90	Very high
8	Protection Cooling Fan (3 EN 101A)	98.3	90	Very high
9	Water circulation Pump	100.2	90	Very high
10	Blender (3L 605B)	96.3	90	Very high
11	FE Compressor (3 K 101A)	93.3	90	Very high
12	Blender (BL 601A)	104.9	90	Very high
13	Blender (BL 601 F)	105.2	90	Very high
14	Purge blower (6 K- 606C)	96.3	90	Very high

Table 5: Noise level in the polypropylene plant

S/N	Noise source	Average noise level dB (A)	FEPA Recommended noise level dB (A) 8hrs duration	Remarks on noise level in comparison with FEPA Recommend actions
1	Booster Fan (06 K 802A)	96	90	Very high
2	Blower (06 K 1001B)	97	90	Very high
3	Blower (06 K 803A)	97	90	Very high
4	Blower (06 K 10012A)	88	90	Very high
5	Blower (06 K - 801B)	93.3	90	Very high
6	Control Room	68.1	90	Very high
7	Silo (06 D 10221 G)	94.7	90	Very high
8	Silo (06 D 10221 H)	95.2	90	Very high
9	Silo (06 D 10221 J)	95.0	90	Very high
10	Reactor Pump (06 P 201)	94.1	90	Very high
11	Reactor Pump (06 P 202)	90.6	90	Very high
12	Recycle gas compressor(06 PA 301A)	87.9	90	High
13	Refrigeration Unit (06 PA 601)	98.2	90	Very high
14	Nitrogen Blower (06 K 502A)	95.3	90	Very high
15	Blender Blower	98.2	90	Very high
16	Warehouse	79.3	90	Moderate
17	Lab	73.5	90	Moderate
18	Heavy dirty oil Pump	108.5	90	Very high
19	Extruder (AG 801 A)	91.0	90	Very high

Table 6: Noise level in the office areas and others

S/N	Noise source	Average Noise level dB(A)	FEPA Recommended Noise level dB (A) 8hrs duration	Remarks on noise level in comparison with FEPA Recommend actions
1	Senior Staff Canteen	77.8	90	Moderate
2	Reception (Admin. Building)	81.3	90	Moderate
3	Junior Staff Canteen	76.0	90	Moderate
4	Reception (Ops and Tech Building)	76.8	90	Moderate
5	Engine Room (Industrial Clinic)	77.0	90	Moderate
6	Second Floor (Admin. Building)	74.2	90	Moderate
7	Gas Lab	73.5	90	Moderate
8	Visitors room (Admin. Building)	75.7	90	Moderate
9	Corridor (Training Building)	73.3	90	Moderate
10	Management Canteen	73.6	90	Moderate
11	Fuel dump	74.4	90	Moderate
12	Muster point	73.7	90	Moderate
13	Ground Floor (admin Building)	75.7	90	Moderate
14	First Floor (Ops and Tech Building)	72.9	90	Moderate
15	First Floor (Admin. Building)	72.9	90	Moderate
16	Treatment room (Industrial Clinic)	71.0	90	Low

For the Olefins plant area, all the thirty four (34) noise measurements were either high or very high. The workers in this area need to be protected from the high noise level they contend with daily (Table 2). For the power plant and utilities area all the twenty five noise measurements were either high or very high. Workers in this area also need protection from high noise levels (Table 3). A similar protection is required in the polyethylene and butane -1 plant Area where all the fourteen (14) noise level measurements were either high or very high. Only 2 out of 19 noise measurements in the polypropylene plant area were below 80 dB (A). This shows that the staffs working in this area are exposed to either high or very high noise levels. This noise level should be reduced to a manageable level. In the office areas all the sixteen (16) noise measurements were either low or moderate. The workers in this area do not need protection. However, the facilities in these areas should be upgraded to reduce the noise levels further.

Serious attention should be given to the ways of mitigating the level of noise pollution which are jeopardizing the health of EPCL workers. Thorough inspection of all the noise generating machines is necessary in order to identify those with noise in excess of the manufacturers' specifications. The affected machines should be repaired or replaced. A long term plan of controlling noise at source should also be explored. This may be achievable by removal of the noise producing process and its substitution with a quieter one. Another alternative might be the resisting of the sources to a less sensitive noise area.

Since noise is transmitted from the source to the receiver by one or more transmission paths, introduction of enclosures and barriers can help curtail sound pollution. However, the introduction of the above control measures to the existing facilities may imply a modification of the facilities with its attendant cost implications. It is therefore recommended that these control measures be installed in new similar facilities Control at source is usually a very cost-effective method, but its application is limited by safety and maintenance considerations. At the EPCL noise can be effectively controlled at the receiver end by encouraging the use of protective devices among the workers.

Spatial Variation of Noise Level

The measured noise levels in decibels plotted against distance in meters for each of the four noise routes are shown in Figures 2 to 5. Route A (plot RA) shown in Fig.2 covers a total distance of 700 meters measured from the road crossing (The reference point B); that is, on the fence. At the bench mark (BM) or reference point R, NL was 97.4 dB *(A)* and increased to 82 dB (A), 100 meters away from the bench mark due to the proximity of a noise source in the process unit. Along this route, certain major noise sources were located such as pumps, steam traps, compressors and blending plants. Beyond the 100m points, the noise level fell to 76 dB (A). About an additional 60m away it rose to 81 dB (A), to 83 dB (A) in the next 40m points and then, 60m away fell to 75 dB (A). It rose to 88 dB (A) in another 180m and finally fell to 70 dB (A) on the fence, all depicting a non linear variation As evident from the plot RA, as the noise level dispersed away from source way sudden rise indicated proximity to a fresh noise source.

The second, third and fourth plots (RB, RC and along the routes B, C, and D) covered individual distances of 1400 1000, 1200 respectively (Figs 3 to 5). Similar to Fig.2, Fig.3 exemplified non linear variations with rise and fall in NL with respect to distance along its route due to sparsely located noise sources. On the other hand, Fig.4 and 5, though non linear, exemplified the effect of sparsely located noise sources at the bench mark with much interference from additional noise sources located close to the BM. The trend depicted one of the lowest noise levels at a source (BM) , a rise in NL some distance away and equally a decay away from the source with minor interruption near the terminal point.

In fact, the interference as per the noise decay rates along routes RC and RD were due to the proximity of a waste water treatment plant and a truck drivers' facility. The noise levels in Figs. 2 and 3 were similar to those of figs 4 and 5.

The rate of noise dispersion may be taken as the amount of decay in decibels per unit distance in meter. The average rate of noise dispersion was obtained from Figs. 2 and 3 as 0.052 dB (A) per meter; whereas from plots RC and RD (Figs. 4 and 5) the value is 0.062 dB (A) per meter. Use can be made of these noise dispersion rates along the applicable routes in the EPCL premises to estimate noise levels beyond the block fences or boundaries of the premises. The dispersed noise levels at the three fenced boundaries along the routes A, B and C, and at the entrance gate along the route D were determined as 63.4, 57.0, 40.0 and 53.0 respectively. In effect, noise levels generated within the EPCL premises are spatially well dispersed; and at the block fence (boundaries) noise Levels are far below the FEPA's recommended permissible limits. Thus, any noise emitted to the neighbourhood way not constitute a health hazard.

Questionnaire Response Analysis

About 75.5% of the respondents joined the services of EPCL under 20 to 29 years; 21.4% from 30 to 39 years; 2% from 40 49 years; 1 % from 50 59 years and none from 60 years and above. Among many effects of noise pollution is that of accelerated presbycousis process (impairment of hearing acuity with age). Presbycousis appears from the age of 30 onwards and becomes noticeable after the age of 40 [12].

Apparently about 75.5% of plant workers were 30 years or less and thus the effect of any accelerated presbycousis process on workers could be easily appreciated. Average time spent in the plant on a typical working day is grouped as follows: 12% of the respondents spend 1 to 6 hrs while 88% spend more than 8 hours per day. Thus there is some over exposure risk of a fraction of the plant workers to high noise levels.

On the use of earmuffs, three questions were asked about staff degree of convenience, comfort and preference to an alternative. The degree of convenience in putting on earmuffs at noise facilities were rated and about 51 % responded as "manageable" while the rest accepted either "very convenient" or "inconvenient". In terms of duration of wearing earmuffs, the following responses were noted: 4% of respondents used it for less than 2 hours; 16% used it for 2 hours, 11 % used it for 3 hours, 11 % used it for 4 hours and 11 % never wore earmuffs.

On the issue of preference of an alternative to earmuffs, sixty percent (60%) of the respondents would prefer on alternative to the earmuffs in use while 40% were contented with its use. On the average, the staffs of EPCL are yet to come to grip the convenience and comfort of using earmuff on one hand, and the hearing loss on the other hand. There is need to educate all categories of EPCL staff on the dangers of noise pollution through training programmes (in house) or short course. Regarding the degree of noise tolerance and reaction, 73.5% claimed that noise was annoying and distracting, 18% was less disturbed; 4% was definitely comfortable, and 3% was indifferent.

Next is the sitting preference in relation to noise tolerance in large gatherings: 42.9% preferred front row; 48.8% middle row; and 8.3% last row. The results therefore indicated that a good fraction of the respondents were sensitive to noise pollution, and others had already developed hearing difficulties of different degrees. As regards pre-employment and/or pre-deployment hearing conditions, 33% had their level of hearing the same as at the time of entry. The hearing ability of 41.8% of the respondents was reduced by 50% while the reduction is below 50% for 18.4% of the respondents. No staff had totally gone deaf.

A good number of the respondents (48.9%) had their productivity reduced to 48%; 23.5% of the respondents had their productivity reduced by 50%, and 27.6% of the respondents maintained the same productivity status/level. The average productivity (80%) was been reduced by 31.4%. This is an area where the health control measures could serve useful purpose: that is the implementation of the periodic medical examinations to isolate both high-risk individuals (those highly susceptible to noise pollution effects) and affected workers for rehabilitation and redeployment.

CONCLUSION

Noise pollution studies were conducted in Eleme Petrochemical Company Limited to determine the sources of noise pollution and the influence of noise pollution on workers health. There are about 300 noise sources which were grouped in terms of equipment types. Of all the five groups only one was non-polluting. The noise levels in the other 4 are critical, ranging from high to very high. Results from both actual noise measurements and questionnaire revealed serious impacts of noise on the health and productivity of the workers. In order to mitigate the impact of noise pollution, the following recommendations have been made:

l)Equipment should be discarded when higher noise level generation persists. Besides, aging equipment must be avoided completely if noise level far exceeds the recommended FEPA values.

2)The company should perform regular inspection and preventive maintenance in order to ensure compliance of noise level with the FEPA standards.

3)Public enlightenment should be stressed among the workers both in the use of protective gadgets and the hazard effects of exposure to excessive noise.

4)The company should promote the use of environmentally friendly equipment by phasing out end-of-pipe technology.

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