NOISE MEASUREMENT EVALUATION AND CONTROL

CASE STUDY OF CADBURY NIGERIA PLC.

BY

ADAMU ISMAILA UKWUMONUN

98/7650EH

A PPROJECT SUBMITED TO THE DEPARTMENT OOF CHEMICAL ENGINEERING, FEDERAL UNVERSITY OF TECHNOLOGY, MINNA

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF B.ENG. (CHEMICAL).

OCTOBER 2003.

DECLARATION

I do hereby declare that this work was carried out by me under the supervision of DR. D. F. Aloko and presented in partial fulfillment of the requirement for the award of Bachelor of Engineering (B. ENG.) degree.

	16-10-2013
SIGNATURE	DATE

CERTIFICATION

This is to certify that this project work was carried out by Adamu I. U. (98/7650EH) and that I have supervised, read and approved this project work which is proper in scope and quality for the partial fulfillment of the award of Bachelor Degree in Chemical Engineering .

16-10-2003

PROJECT SUPERVISOR (DR. D. F. ALOKO) — DATE

HEAD OF DEPARTMENT (DR. F. A. ABERUAGBA) — DATE

EXTERNAL SUPERVISOR — DATE

PROJECT CO-ORDINATOR (ENGR. M. A. OLUTOYE. — DATE

DEDICATION

This project is dedicated to Almighty Allah for his mercy and to my beloved parents and MRS. Adamu Ahmadu

ACKNOWLEDGEMENT

First of all, I will like to thank my parents for their support and encouragement till this very moment; my brother, sisters and the rest of my family who have in their own way tendered core and support in all I have been doing, to see that I succeed in the attainment of my goals.

I will like to show my appreciation and gratitude to my supervisor, Dr. D. F. Aloko, who saw it that I understand what I was doing a d ensure that I followed proper procedures, which made my work easy going.

My special thanks also go to Alh. and Hajiya Yahaya Oyibo and all my friends who have contributed one way or the other to see that I succeed in my endeavours.

ABSTRACT

The research work on Noise measurement evaluation and control was carried using Cadbury Nigeria, Plc Ikeja Lagos as case study. To achieve this. Daweh sound level meter was used. The industry was divided into ten units with each unit consisting of different noise sources. From each unit, measurement of noise levels in dB(A) were taken using the operator's position as references point, and at different intervals of distance 50m, 100m, 200m, 300m, 400m and 500m away from the unit, within and outside the factory. The sound power of each source was obtained and the equivalent continuous noise level (leq) for each unit calculated. From the results obtained, it was found that the magnitude (level) and effects of occupational noise at 50m and 100m from the reference point (centre of the industry) and within neighbourhood distance 200m, 300m, 400m, & 500m gave 65.44 dB(A), 59.42dB(A), 53.40dB(A), 49.88dB(A) and 45.44dB(A) respectively. Therefore, for 50m and 100m the noise generated lies within the acceptable unit but at 200m - 500m residential house should not be located there.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Sound can be defined as an atmospheric airborne vibration perceptible to the ear whatever its Source. Noise may be defined operationally as audible energy that adversely affects or may affect the physiological and psychotically well being of people [WHO 1995]

Noise usually means unwanted or undesired sound. Consequently, a particular, sound may be noise to one person and not to others or noise at one time and not at another time. Sound loud enough to be harmful may be called noise without regard to its other characteristics (Smith et al, 1996).

Noise is usually considered to be unwanted sound, and therefore the presence of an observer (or receiver] of the noise is an important factor in any noise control problem.

The overall noise problem therefore involves not only the scientific and engineering aspects of noise generation, propagation, scattering and absorption, but the psychological effects of noisiness and annoyance, physiological effects such as hearing damage, social considerations, economic consideration and legal aspects. (Bugliarello et al, 1978).

Industrial noises are generated from industrial processes and activities such as grinding, milling. Jigging, scraping etc. In rotating and reciprocating machines, noise is produced through vibration caused by imperfectly balanced parts. The amplitude of such noise varies with operating speed, usually increasing exponentially with speed while in many machines, more noise is produced by materials being handled than by the machines proper.

Industrial noise varies in loudness, in its frequency components and in uniformity. It may be almost uniform in frequency response and constraint in level, large rotating machines. Such a place as textile mills with many machines in simultaneous operation. Often are like this.

An automobile assembly line shows this steady noise with many momentary or impact noises superimposed on it. Other industries show continuous background noise at relatively low levels, with intermittently occurring periods of higher noise levels. (Pfafflin and Zeigher, 1976).

Industrial noises also vary in their frequency characteristic-Large slow – moving machines usually produces noise of higher frequency.

Industrial noise measurement are invariably made with a sound level meter. The meter consists of a microphone, amplifier, filter bank (or weighing network) a detector, and an indicating meter. The electrical signal produced by the microphone is essentially proportional to the sound pressure. At the diaphragm, and this electrical signal must then be analyzed in terms of its frequency components (Liptak, 1974).

Noise measurement are usually carried out industrially for one of three purposes;

I To gain an understanding of the mechanism noise generation so that method of engineering control of the noise can be applied.

ii To rate the sound field at different locations a scale that is related to the physiological or psychological effects of noise on human beings

iii To rate the sound power output of a source, usually for future engineering calculations that will result in an estimate of the sound pressure produced by the source at a given location. (Liplak, 1974).

In recent times, the A-weighted sound level has become a widely- used measure of the effects of noise on man, both psychological, and is reasonably good indicator of noisiness or loudness. No one on planet can escape the unwanted sound that we call noise a disturbance to our environment escalating so rapidly as to become one of the major threats to the quality of lives.

1.2 OBJECTIVES OF THE PROJECT

The objectives of this project are:

(i) To measure noise generated at Cadbury Nigeria Plc, Agidingbi, Lagos, using a sound level meter (noise meter).

(ii) Prediction of occupational and environmental noise problem produced by the industry specified distances from the reference point.

(iii) Prediction of neighbourhood noise level at various distances away from the industry.

1.3 SCOPE OF STUDY

(i) This project work covers measurement evaluation and noise control generated at Cadbury Nigeria Plc, Agidingbi, Ikeja of Lagos only.

(ii) The measurement was made with a sound level meter, the sound pressure as the measured parameter.

(iii) All the date were collected and measured during the day. (night excluded).

(iv) The analysis and predication were based strictly on measured data from the industry. Thus it is only applicable to Cadbury and it environment.

1.4 JUSTIFICATION

Industrial processes and activities generate noise that impinges both upon the workers in the plants and the neighborhood around the plant. Due to adverse effect on the general health (hearing, Physiological, psychological etc. of the workers and subsequent reduction in production and economic loss, there is a need to measure, model and assess the noise generated from such industry.

This is done to reduce or eliminate the adverse effect of the noise and to initiate noise control Programme. This has an overall positive effect on productivity, Public comfort and working environment hence, this project is justified.

CHAPTER TWO

LITERATURE SURVEY

2.1 NOISE: DEFINITION AND PROPAGATION

Noise can be defined as unwanted, disturbing and harmful sound. It is an aural sensation caused by pressure variations in the air, which are always produced by some source of vibration. They may be from a solid object, turbulent motion of fluid; explosive expansion of gases or by other means. (Smith et al, 1990)

Sound propagation is usually described in terms of small variations in the pressure above and below the ambient (atmospheric) pressure that propagate with a speed of approximately 344m/s under normal atmospheric conditions. (Pfafflin and Ziegler, 1976).

Air cannot sustain a shear force so that the only type of wave possible is longitudinal; where the vibrations are in the direction of the motion. This is illustrated in Fig. 2.1.

These pressure fluctuations are of a vibrational nature causing the neighboring air pressure to change but no movement of the air takes place. Air pressure, which can be assumed to be steady, has these pressure fluctuations superimposed upon it.

2.2 NOISE PROPERTIES AND TERMINOLOGY.

Frequency: This is the number of vibrations or pressure fluctuations per second. It is expressed in hertz (HZ). A pure tone contains only one frequency. Most industrial noises have a broad band of frequencies covering the audio range of the human ear approximately 10HZ to 16HZ.

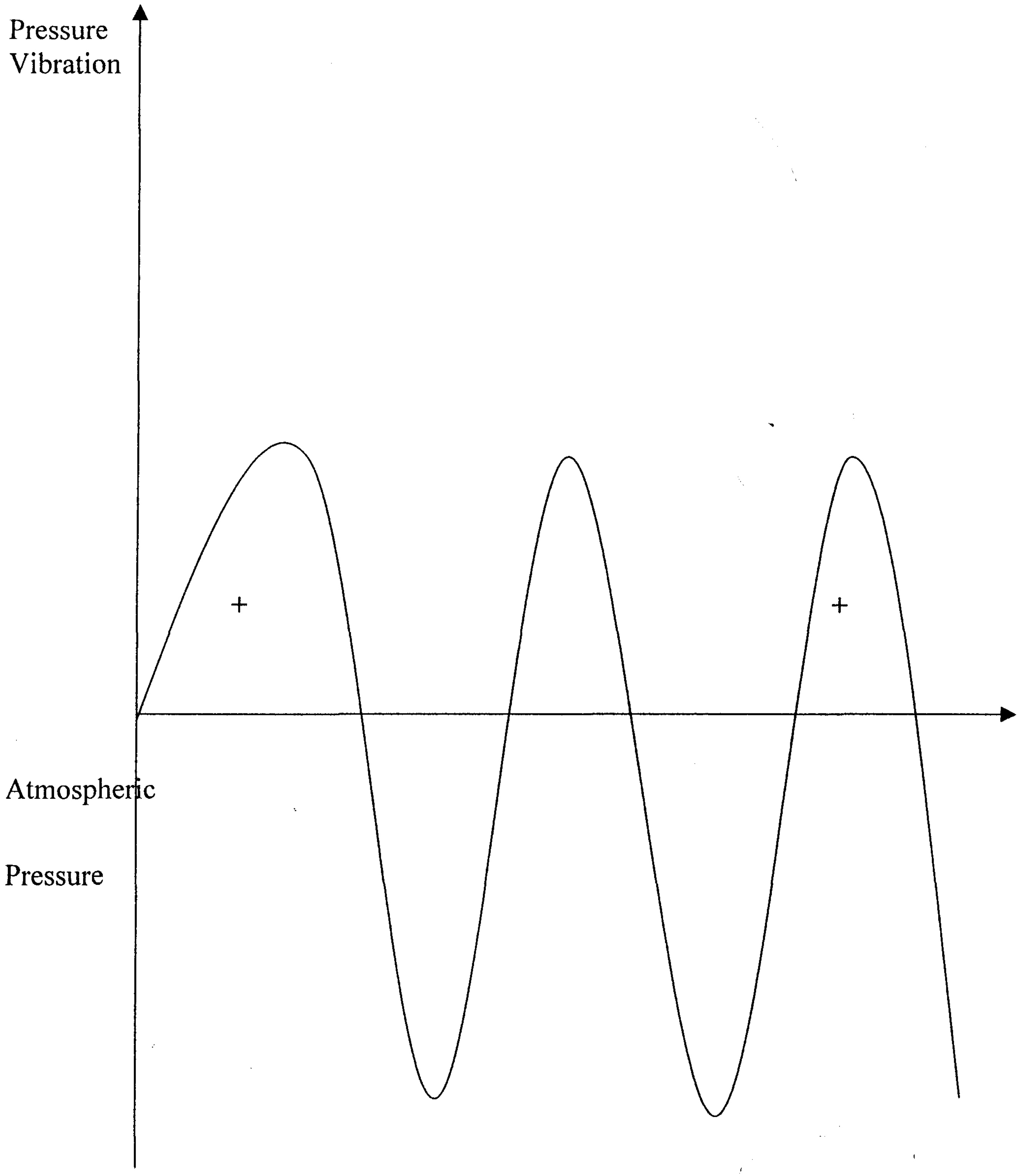


Fig. 2.1 Propagation of a sound wave

Wavelength: This is the distance traveled by the sound during the period of one complete vibration.

Velocity of sound in air:

Velocity = frequency x wavelength

It is expressed in m/s

Sound pressure: This is the small vibration above and bellow the ambient (atmospheric) pressure that is measured by most microphones in common use in the noise control field. It is a function of time, a sinusoidal function for pure tones, and a more – or – less random function for many noises.

Sound pressure level: This sound pressure level of a sound is equal to 20times the logarithm to the base 10 of the ratio of the root mean square pressure, P, to reference sound pressure, p; expressed in decibels (dB) [b]. The reference sound pressure, expressed in Pascal (pa), should be stated, but normally in air it is taken to be 2×10^{-5} pa.

It may be expressed mathematically by the formula;

$$Lp = 20 \log_{10} (P/P_0)$$

Where Lp is sound pressure level (dB)

P is the r.m.s. Sound pressure (pa).

P_0 is the reference sound pressure (pa)

Noise level: This noise level is a measure of noise taken on a sound level meter, which has electrical networks of standardized characteristics built into it. These networks attenuate the signal generated by sound at some frequencies and emphasized that at other frequencies, this being described as "frequency weighting". The network most commonly used for the measurement of noise from plant and sites is the A - network. This weight sound at different frequencies in a way, which corresponds generally with the frequency response of the human ear, Sound levels in decibels measured on the A – weighting network are given the symbol dB (A) and are indicated by dB (A). (BS 5228,1975).

Sound power level: The sound level, measure in decibels, of a source is equal to 10times the logarithm to base 10 of the ratio of sound power of the source; p to a reference sound power, p_0. The reference sound power, measured in watt (W), but normally it is taken to be 10^{-12} W. it can be expressed mathematically as:

$$Lw = 10 \log_{10} P/P_0$$

Lw = sound power level (dB)

P = sound power of the source.

P_0 = reference sound power (W).

When a source, radiating uniformly in all directions, is situated on a flat reflecting surface with no other reflecting obstacles, the sound waves propagate freely into hemispherical space and the sound power level is related to the sound pressure level at a radius of R, measured in metros (m), from the source by the following equation:

$$Lw = Lp + 20 \log_{10} R + 8$$

Where

Lw is the sound power level of the source

Lp is the sound pressure level

R is the distance (radius) from the source.

From practical purposes, the concept of an A – weighted sound power level can be used to derive the noise level dB (A) at a point distant R (m) from the sound by the following equation:

$$Lw(A) = Lp(A) + 20 \log_{10} R + 8$$

Where

Lw (A) is the A – weighted sound power level of the source (dB ref. 10^{-12}w).

Lp (A) is the sound level dB (A) at the radius R (m) from the source.

Equivalent continuous noise level: The equivalent continuous noise level, Leq, is the sound pressure level of a steady sound that has, over a given period, the source energy as the fluctuating sound in question. It is an average and is measured in dB (A).

The symbol Leq is normally used for the equivalent continuous noise level. Leq can be evaluated over aany chosen period of time, and the period refered to in a particular case is indicated in brackets, viz leq (1hr), leq (12hrs) etc.

For the noise limit concerned with protection against hearing damage which is set in the "code of practice for reducing the exposure of employed persons to noise'' the value of leq obtained for the actual exposure period of individual workers is 'normalized' to a standard of 8hrs, the normalized value of Leq then indicates a steady level, which would, in 8hrs, deliver the source energy as the actual noise for the actual period of exposure.

Measuring instruments can be used to indicate Leq directly. Such instruments are necessary where the noise is fluctuating irregularly or where there are sudden peaks or other pronounced changes from time to time.

The exact definition of Leq in mathematical terms, which holds no matter how the noise is fluctuating, is:

$$Leq = 10 \log_{10} 1/T \int_0^T \left[\frac{P_A(t)}{P_0} \right]^2 dt$$

Where

Leq is the equivalent continuous sound level dB (A) measured over the time period T

P_A (t) the instantaneous A-weighted sound pressure (pa) varying with time

to;

P_o is the reference sound pressure (Pa)

The alternative and approximate formula to be used for calculating Leq is:

$$Leq = 10\log 10 \; \frac{1}{T} \left[t_1 x\, 10^{L1/10} + t_2 x\, 10^{L2/10} + \ldots\ldots\ldots\ldots + tn\, x 10^{Ln/10} \right]$$

Where

L_1, L_2, L_3, ... Ln are individual noise levels maintained for short period of time;

t_1, t_2, t_3 ..... t_n are durations associated with the respective sound levels.

2.3. INDUSTRIAL NOISE.

Industrial noise is the noise generated from industrial activities and machinery. From the standpoint of noise, industrial activities can be grouped into four basic categories (Bugliarello et al, 1976).

Product fabrication (both molding, such as glass bottle manufacturing, and metal fabrication, such as can manufacturing);

Product assembly;

Power generation

Processing. (Bugliarello et al, 1976).

Each one of these activities generates noise, usually with most of its energy in the lower frequencies of the spectrum as shown by the table below Table 2.1 illustrates this.

TABLE 2.1: Source Characteristics of the most common industrial noise sources. ([illegible]: Bugliarello et al, 1978)

Type of Activity	Examples of products or Processes	Significant Characteristics
Product Fabrication	Boilers	Very noisy operations in
Metal Fabrication	Can	the metal stamping (cutting, shear, pinching, pressing etc); also riveting
Product Fabrication	Plastics	Major noise source;
Molding	Glass bottles	turbulent mixing with the atmosphere of high pressure air used in operation, pneumatic control and cooling of molding machines.

Product Assembly	Automobiles Aircraft Dishwashers Radio	Broad-band noise with highest levels at highest frequency, due to operation of electric and pneumatic tools.
Power Generation	Conventional thermal Power plant Nuclear power plants and	Some portion of plant indoor (turbine generator air compressor), other sources outdoor (transformer etc)
Process Plant	Oil refineries Steel plants	Major noise source: frequency of noised, heat exchangers, compressor, pumps, air and steam tanks.

2.3.1 Industrial Noise Sources

Industrial noise comes from a wide variety of sources, but the actual causes of the vibration, which constitutes noise, are relatively few: impacts of one thing on another (including the multiple impacts called scraping or abrading), turbulence of liquid or gas and explosive or implosive pulses (caused usually by a sudden change of state, from solid to liquid gas, or the converse):

Noise in liquid systems are usually radiated from pipes and values set into resonant vibration and not necessarily close to the source of energy. Turbulence can occur whenever there is change in the direction of flow and especially where there is change in pressure as well. Pressure controls and pressure reducers, controlling rather large amount of energy, can produce high noise levels. Table 2.2 lists a number of representative noise sources, illustrating the range of devices commonly encountered as noise source.

Table 2.2: Common Industrial noises (Source: Beranek, 1960)

Source	**Character**	**Cause**
Rotating Machines	Broad-band noise	Aerodynamicnoise,wind turbulence and vibrations
Internal Combustion	Broad band in lower frequency ranges	Exhaust and intake, aerodynamic noise.
Electrical Machines	Harmonics of line	Magnetic forces frequency
Air ducts	Broad band in higher frequency ranges	Wind noise, rattle and flutter.
Fans, lowers	Wide band but largely in frequency ramps	Motor noise, rattle and low housing and duct drumming
Pressure reducers	Wide band but largely in high frequency	Turbulence
Pumps and pipes	Wide band possibly any	Cavitations
Cavitations	Wide band, largely low frequencies	Multiple shocks and impact
Are furnace, Are welder	Low frequencies but broad band	Are-turbulence
Flames	Broad band random	Turbulence
Air, stream or gas venting	High frequency, random.	Turbulence

Presses, shears and punch and forging presses	High intensity; low frequency random.	Heavy impact, machine Vibration.

A more detailed list of noise levels found in specific operations and caused by specific machines in industry is given in

Table 2.3 List of Noise levels found in specific industrial operation (Source: Burns, 1973)

Noise levels (dB)	Industrial Activities
80 – 89	Textile dying, carding and combing, textile, most apparel manufacturing processes, Type setting, Fabric-coating process, chemical raw material processing, chemical finished product handling, steel products.
90 – 99	Food canning, food preparation, small and special purpose printing presses, many chemical manufacturing processes, many leather products manufacturing process, machinery assembly lines. Drills and bores, polishers, welding and cutting, both electric and oxyacetylene.
100 – 109	Grinders, Punch presses, Conveyors with steel products, forging operations, Boiler room, chemical and food mixers, plastic and rubber-molding machinery, many paper manufacturing machines, textile looms, sawing meat and metals.

119 – 120	Large drop hammer, Hammer mill, powerhouse, metal forming machines, gear-cutting machines, rolling mill, most core manufacturing processes for castings.
120 – 129	Chain saws, chipping operations on a large steel cutting, riveting on small structures
130 or more	Testing a jet engine or turbine Riveting a large steel structure

The table is based primarily on measurement by Karpus and Bonvallet (1953) in 40 plants selected from twelve manufacturing industries.

2.3.2 Neighbourhood Noise:

This is the noise to which anyone in the neighborhood is exposed to and which originate from the industry. Some of the typical avenues of noise transmitted by an industrial plant to the neighborhood are roof ventilators, open windows, team injectors, compressors, and diesel engines. Before the development of large mass transportation systems, when it was necessary to locate industrial plant close to the house of labour force, the noise propagated to the outside from industrial activities had a major impact on the worker's environment. Today, with the growth of both mass and individual means of transportation, the necessity of locating industrial plants in the immediate vicinity of residential areas has greatly reduced. (Bugliarllo et al, 1976).

2.3.3 Occupational Noise: This is the noise to which workers/anyone in the industry is exposed.

2..3.4 Background Noise: Usually, the sound level (noise level) produced by a source is measured in the presence of an ambient (or

Background) noise. It contributes to the overall noise level in any environment. For an industrial complex, it may be due to traffic wise, construction noise, from business transactions.

2.3.5 Effects of Industrial Noise on Public Health.

It is in the interest of public health to ensure that environments for work and living are such as to facilitate useful production, comfort, safety and health. A primary function of public health agencies is to prevent the growth of conditions which are unsafe or which adversely affect the health and welfare of citizens. Since noise is an unfavorable factor in the living environment; it is a subject of interest from the standpoint of public health.

There is normally some loss in productivity in high noise fields. This represents an economic loss to the industry; also to the individual and to society in general, and it is a total loss. Nowhere is anything gained to compensate for it. It has been estimated that the dollar cost of noise to industry in United States is several billions annually. (Liptak, 1974).

Deprivation of sleep and of rest is one of the worst results of neighborhood noise. Relatively low noise levels (50dB) have been found to disturb a deep sleep without waking the individual but rendering his sleep les restful and making him likely to be awakened in case of another noise. A 70 [dB] wakes most people. (Burns, 1974).

The physiological tension caused by lack of rest and sleep is a serious factor in comfort in everyday life. It can lead to social function between persons and among groups, to absenteeism from work and according to social workers, to disturbances and illegal actions.

Education suffers especially from such conditions. School rooms are noisy so that tired and inattentive students may take little note of learning tasks.

It must be conceded that human behavior shows ill effects. From too much noise and that, too high for comfort depresses and degrades civilized living conditions.

2.3.6 Physiological Effects Of Industrial Noise

Sudden and unexpected noise has been observed to produce marked changes in the body, such as increased blood pressure, increased heart rate, and muscular contractions. Moreover, digestion, stomach contractions, and the flow of saliva and gastric juices all stop since the changes are so marked, repeated exposure to unexpected noise should obviously be kept to a minimum. Other principal physiological changes are discussed below:

2.3.6.1. Cardiovascular Effects

Well-known studies of physiological effects of noise on cardiovascular functions in two groups of workers before, after, and at work are reported by (Kryter, 1962). The groups were textile workers exposed to 85-95dB and ball bearing – plant workers exposed to 114-120dB. The most significant change was a decrease in the maximum blood pressure during work, which was more apparent in noisy situation. A large fraction of the workers in the ball bearing plant showed lower heart rates. Noise, even at relatively lower levels, usually tends to constrict the peripheral blood vessels, in fingers, toes and abdominal organs, and to dilate those in the retina and the brain possibly leading to headaches. (Bugliarello et al 1976)

2.3.6.2 Hormonal Effects

The work of Levi showed that significant changes have been observed in the urinary excretion of adrenaline and non-adrenaline of workers exposed for a short time to noise in a simulated industrial situation.

2.3.7 Psychological Effects Of Industrial Noise

That mental state is generally influenced by physical well being needs little argument. Therefore, if reaction to sound stimulation disarrays the internal functioning of the body, psychological condition can be expected to undergo some modifications that may not be overt. (Kryter, 1960)

2.3.8 Effect Of Industrial Noise On Hearing

Noise may affect hearing in many ways that are broadly divisible into three categories: temporary threshold shift (TTS); permanent threshold shift (PTF) and acoustic trauma. In that order, they indicate in a general way the degree of severity of the exposure, which caused them.

2.3.8.1 Temporary threshold shift (TTS)

When a person of normal hearing is exposed to intense noise for a few hours, he or she suffers a temporary loss of hearing sensitivity called temporary threshold shift. The threshold of his or her hearing has been raised. After a sufficiently long rest from noise he or she usually recovers.

2.3.8.2 Permanent threshold shift (PTS)

In the case of someone exposed to intense occupational noise during the working day for a number of years, the stage is often reached where the temporary threshold shift has not completely recovered overnight before the next exposure. It appears that "persistent threshold shift'' is followed eventually by 'permanent threshold shift'. That permanent damage being done to hearing may often be indicated by sign of dullness of hearing, often together with tinnitus after exposure of noise at work. (Burns, 1973)

2.4 NOISE MEASUREMENT

Accurate noise measurements depend upon the correct choice of the most suitable equipment for the particular measurement situation and upon the correct use of this equipment by the operator.

Any piece of equipment, whatever it measures, can be thought of consisting of three parts (Fig. 2.2). First, there is the transducer. This is the sensor which converts the changes in the physical property to be measured into an electrical signals. This electrical signal is then subjected to a variety of processes, which condition the signal in the required manner. In sound level meters, for example, the various signal processes can include amplification, filtering, averaging and logging (i.e producing a logarithmic value of the signal). The processed signal is then fed to the final stage of the instrument, where it is displayed as a deflection of a needle over the scale of a meter; or as a digital display. (Smith et al, 1990)

The correct choice of equipment can depend upon a number of factors including:

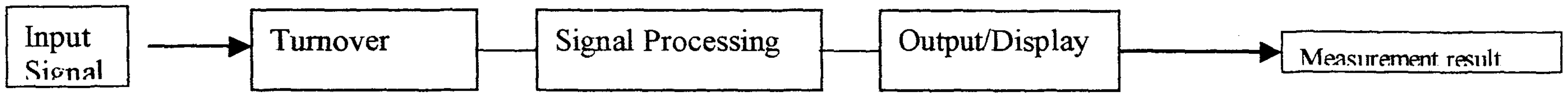
(1) The type of Noise and the way in which it is to be measured. Is it a steady noise for which the appropriate unit depends on an analysis of the frequency content of the noises? Is it a time – varying noises; such as traffic noises, which require a statistical analysis over a period of time? Is it an impulsive noise or does it have pure tone components?

(2) The accuracy required. Is it a precision measurement, involving controlled and standard measurement conditions, or is it a preliminary survey under field conditions?

(3) The conditions under which the instruments will be operating. Is it a quick field measurement, requiring a portable and battery – operated instruments; or is it long-term survey, requiring permanent semi – automatic mains – operated equipment?

There is a wide variety of equipment in use and because of modern development in electronics, particularly the introduction of digital techniques, rapid changes have recently occurred and are still taking place in sound measurement instrumentation.

Figure 2.2 *Elements of a Measurement System.*



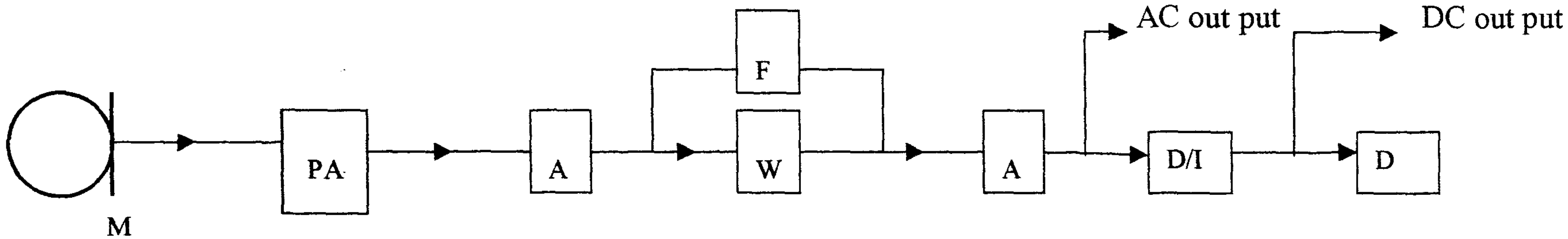


Figure 2.3 Block diagram of an analogue sound level meter:

(M) Microphone (A) Amplifier and Attenuator (D) Meter or display
(PA) Preamplifier (D/I) Detector / Indicator (F) Octave or one – third – octave filter
Source: Smith et al, 1990.

2.4.1 The sound level meter (Noise meter)

Fig. 2.3 shows a simplified block diagram of a typical analogue sound level meter (i.e. with a meter and needle displayed as opposed to a digital display) suitable for measuring fairly steady, non – impulsive noises.

2.4.1.1 Microphone

The microphone faithfully converts the sound pressure signal into a corresponding electrical signal. If for example the sound is a 1000 HZ, then the microphone produces a voltage, which varies sinusoidally with a frequency of 1000HZ. The amplitude of the voltage signal is proportional to the sound pressure amplitude. The microphone is the most important, and usually the most expensive, part of the whole instrument because any lack of faithfulness at this stage of the conversion can never be remedied by any subsequent electronics. The microphone is required, ideally, to match the performance of the human ear in the range of sound pressures and frequencies to which it can respond.

2.4.1.2 Amplifiers

The electrical signals produced by the microphone are very, very small, often only a few microvolts. They have to be amplified several thousands of times before they can be processed by detector and indicator circuits, and then displayed on the meter. Amplification takes place in several stages but Fig 2.3 shows it as two separate blocks, before and after the frequency-weighting network.

The first amplification stage, the preamplifiers, is particularly important. The preamplifier is designed to have high input impedance, which means it can deliver only small currents, and its output falls when a load is applied. It acts as a buffer between the microphone and the rest of the equipment. The function of the preamplifier is to deliver the signal at much lower out put impedance suitable for processing by the remaining circuitry in the sound level meter.

2.4.1.3 Frequency weighting Networks

Human hearing is not equally sensitive to all frequencies in the audible range. The weighting networks were originally designed to modify or weight the signal according to its frequency content in a way which attempts to stimulate the human hearing frequency response. In this way the final decibel figure indicated on the meter should relate more closely to the average human response to noise than a simple indication of its r.m.s sound pressure and energy content.

The weighting networks are based on the shape of equiloudness contours derived from research investigations into the way in which the sensation produced by a sound, called it loudness, depends upon frequency. Loudness varies with the level or intensity of sound as well as its frequency, so three weighting A, B and C where originally proposed for different level of sound. The B and C scales are now rarely used, and many sound level meter will only have the A scale which is the most convenient way of measuring almost all types of noise. The values of the weighting are fixed by international standards. An additional network, the D weighting; is based on human response to aircraft noise; it is intended for use in aircraft noise measurement.

2.4.1.4 The detector and indicator circuits

The detector and indicator circuits have three main functions;

1. They provide an rms value of the signal.
2. They average the rms signal over an appropriate averaging time.
3. They produce a logarithmic value of the rms signal so that the meter will read in decibels.

2.4.1.5 The meter

The meter scale is graduated in decibels and has been calibrated to read directly in decibels relative to 20pa. On many older-style sound level meters only a limited decibel range
(may be 20 dB) is displayed on the meter scale, and in order to cover the entire measurement range of the instrument, it is necessary to operate a range selector switch, which controls the attenuators in the amplifier circuits. (BS 4142, 1990)

2.4.2 Sound Pressure Measurements.

Basically, the purpose of a sound pressure measurement is to determine the noise level so that engineering action can be taken, or to rate the noise in terms of human response. The former requires data in octave – or one-third octave bandwidths, and the latter may require such measurements, although the use of a simple A-weighted level is becoming common. When making measurements around a given piece of equipment, the microphone is usually placed at a height of 1.5m and 1m from the smallest possible imaginary parallel pipe that surrounds the source. Measurements centered on the four sides are usually adequate, but for large source, additional microphone positions spaced 1m apart are useful. If the equipment is operator-attended, an additional measurement should be made at the operator's position.

2.4.3 Field Measurements

Field measurements are those measurements where little or no control over operating conditions is possible. Laboratory measurements are made in circumstances where source control is possible and conditions can at best be predicted. Usually less sophisticated equipment must be used for field work; consequently, the experience and judgment of the practitioner become extremely important (Pfafflin and Zeigler, 1976).

Background noise will normally be present, and often it will not be possible to maintain conditions while a machine under test is started and stopped. It is desirable to minimize the effect of background noise. Stationary noise source, if small; can be approached to within a meter or so; this raises the level of noise being measured relative to the background. For large source, this will seldom be possible; where the effect on a neighbourhood, of a large cooling tower for example, is being studied, the ingenuity and experience of the practitioner may be taxed to the utmost.

2.5 NOISE – CONTROL ENGINEERING.

The technology exists to solve many noise problems provided that the costs can be met to implement the noise control engineering solution. However; many problems could be solved more economically and more effectively if adequate planning had been taken to avoid them.

Therefore adequate methods of predicting noise levels in advance also form an important part of any noise- control programme. Day-today management is also important in ensuring that noise- control measures (such as the provision of enclosures around machines or a personal hearing protection) are properly used and maintained, and that personnel always adhere strictly to noise-reducing working procedures.

The formulation and implementation of a noise – control policy therefore involves the techniques of planning, management and economics as well as knowledge of the engineering principles. (Smith et al, 1990)

2.5.1 Planning for Noise Control

The wide varieties of situations in which noise control must be considered make it very difficult to present a straight forward description of the planning process for noise control.

However, many situations have severe features in common. This subject can conveniently be divided into two parts; environmental noise control and source noise control.

The latter involves planning for control of the noise produced by a particular source during the product development phase, and the former usually involves consideration of multiple sources, analysis of transmission paths, and selection of an appropriate criterion for a given environment.

One usually starts with an analysis of the overall problem. Estimates are made of the levels produced by one or more sources, usually on an octave band basis.

These levels are then modified by the attenuation expected over each of the transmission paths to the receiver, and finally the levels are combined to make an estimate of the environmental noise level at a given location. The estimated values are then compared with the criterion that has been selected.

If the noise environment is not satisfactory; plans must be made to:

(1) Change the location of the receiver.

(2) Increase the attenuation along the path, and

(3) To modify the levels of locations of the sources (or to select different sources).

One important point is that the highest level that contributes to the environmental noise level must be selected for modification because of the way that levels are added. As an example, if one particular source/path combination produces a level 50dB above the levels produced by a few other source/path combination, modifications of one of the latter levels will not produce a significant decrease in the total environmental noise level. When all source/path combinations contribute equally to the total environmental level balanced solution to the problem has been achieved, and changes in all of the source/path combinations are usually required to achieve further reductions in the environmental level. When a balanced solution has been achieved, the cost of additional noise tend to be high (Beranek, 1960.)

Planning for source noise control involves a selection of the measurement environment for the source, and a controlled test environment is usually selected so that repeatable data can be obtained. A measurement procedure and criterion must be selected as early as possible in the design stage because it is almost invariably true that the cost of noise control increases rapidly as a device progresses through the design cycle. Estimates of the noise levels and recommendations for design changes must be made in the initial design stage. Finally, plans must be made to evaluate the final product, and a program must set up to insure that the product meets its acoustical specifications when it is in production. The steps in noise-control programme are shown in fig. 2.4

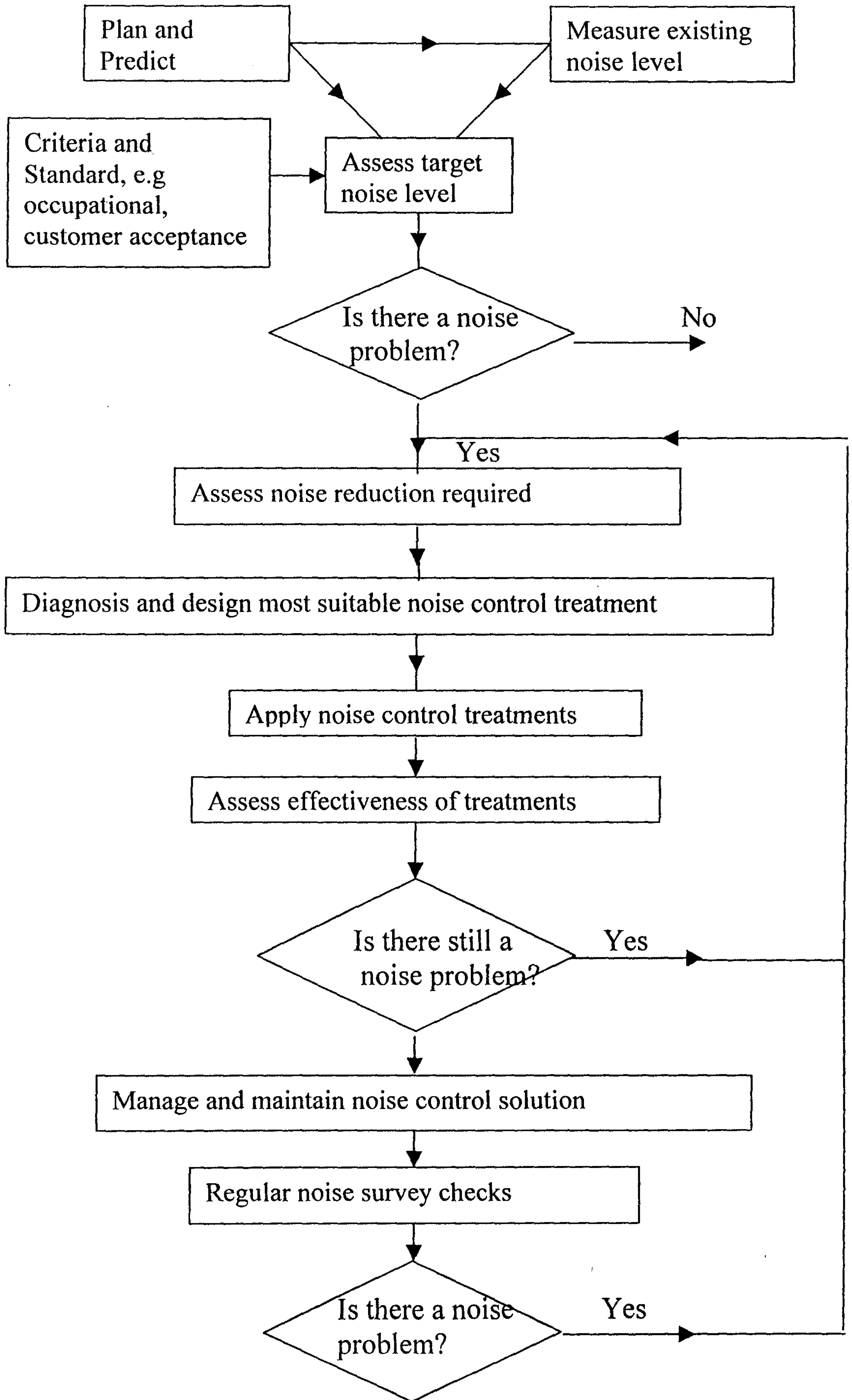


Fig 2.4 The steps in a noise control Programme.

2.5.2 Methods of noise control.

Several approaches to the noise control problem are generally used depending on the particular problem. Engineering control of the noise at the source is always desirable; and has been designated as the preferred method with respect to control of occupational noise exposure. For example, restricting the exposure time of employers to a given noise, or allowing the equipment to operate only at certain hours of the day or night. Legal control of noise has often been attempted and in some cases has proved to be effective. One of the major problems is that quantitative levels must usually be prescribed for effective legal control, and enforcement then requires sound measuring equipment and trained personnel to monitor the noise. While this may not prove to be a problem with respect to monitoring noise at an airport, control of a wide variety of community noise source is difficult.

Engineering control of noise requires application of the many techniques that have been developed for various noise control situations. One of the major considerations in source control is identification of the source noise. For equipment that operates sequentially, identification of the source by the time at which an event or impact occurs is most useful; and spectral information often provides relatively little guidance. (Liptak, 1974)

Control of environmental noise can only be achieved when an estimate of the levels of various sources that contribute to the environmental level is made, the attenuation on the paths from source to receiver is known, and a suitable quantitative criterion for the environmental noise level has been selected. Modification of the attenuation provided by the various paths is usually the most feasible methods of controlling environmental noise. For example, the location of the source (or receiver) may be changed to achieve a greater attenuation along the path. More commonly, the source is enclosed, and two most important factors are that the transmission loss of the enclosure must be adequate and that sound absorbing material must be used inside the enclosure to absorb the sound produced by the device.

As a last resort, the solution to a noise control problem may lie at the receiver's level. There are a variety of possibilities, depending whether the problem is one of occupational or environmental noise exposure. These include:

i. Control of exposure i.e. time working on noisy processes
ii. Job rotation
iii. Provision of personal hearing protection (e.g. earmuffs or earplugs).
iv. Provision of quiet working areas for time when not working on the noisiest processes
v. Regular audiometric monitoring of the hearing levels of personnel
vi. Provision of double-glazing and other extra noise insulation measures
vii. Provisions of noise barriers, close to the receiver
viii. Compensation
ix. Relocation

(Smith et al, 1990)

CHAPTER THREE

MATERIALS AND METHODS

3.1 METHODOLOGY

3.1.1 PRELIMINARY STUDIES.

A noise survey by walking around was conducted round Cadbury Nigeria Plc, Lateef Jakande road, Agidingbi, Lagos. The survey involved:

(i) Scouting for the sources noise in the industry

(ii) Sourcing for information on the sources of noise.

This includes the size of the sources, the operating conditions, mounting conditions and the acoustic characteristics.

iii Getting information about environment in which the measurement would be taken. Based on the result of the survey, the industry was divided into different units for easy measurement. Each unit consist of machines (equipment) and process that generate noise.

The units are:

i Sugar Confectionery

ii Making Area

iii Mint Factory

iv Trebor section

v Packing of mint section

vi Cold Room section

vii Cereal conversion plant

viii Tomapep section

ix Generator House

x Can Factory

3.1.2 APPARATUS USED

The following apparatus were used during the course of the field measurement:

(i) A sound level meter calibrated in dB (A)

(ii) A tape rule

(iii) Meter rule

(iv) Tripod stand

(v) Wind screen

(vi) Data recording book

(vii) Ear plug.

3.1.3 EXPERIMENTAL PROCEDURE

Measurements were made from each of the units in the industry. Each unit consists of noise producing machines and processes. From each of the machines in each unit, measurement were taken at following distances:

(i) Close range (1m)

(ii) 2m

(iii) 5m

(iv) Middle of the unit.

The distances were chosen to minimize the effects of background noise.

The sound level meter was set up as shown in fig 3.1

on the tripod stand at a measured distances from each of the machines. The meter was switched on and the response changed to 'A' weighting scale. The sound level from each of the distances.

Specified above for each machine was taken and recorded in the data book. This procedure was repeated for all the units.

The windscreen was used to prevent introduction of errors into the measurement by the wind noise.

All measurement were taken in the day and the times of measurement for each unit was recorded.

The earplug was worn throughout the period of measurement as a personal protective equipment against the adverse effect of the noise. The results obtained were tabulated for further analysis.

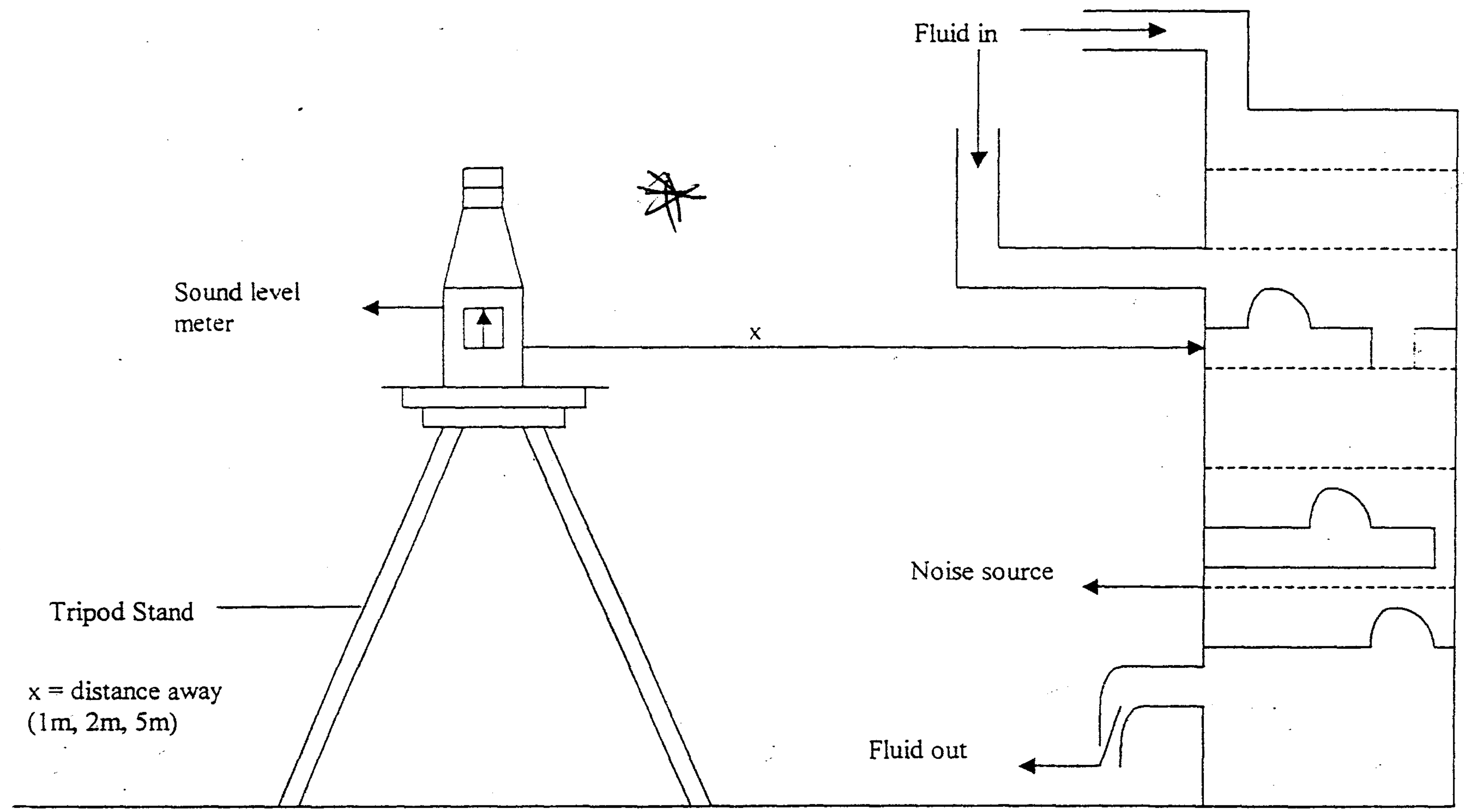


Fig. 3.1 Experimental Set – up showing the position of sound level meter relative to the noise source.

CHAPTER FOUR

4.0 RESULT

4.1 RESULT

The result, which include the noise levels, operating time and sound power for each machine in each unit are presenter in this chapter- The data are gotten from field measurement taken at Cadbury Nigeria Plc, Agidingbi Lagos.

UNIT 1 SUGAR CONFECTIONERY

Date of measurement: 10/12 /2002

Time: 10.00 a.m

Table 4:1 Noise date for sugar Confectionery

Noise Source	Noise Level At			Operating time (hr)	Sound Power ref. 10^{-12}
	1m	2m	5m		
Yamato I	90.0	85.0	76.0	7	98
Yamato II	94.0	86.0	80.5	7	102
21 8 M/C	90.0	86.0	78.5	6	98
Techni M/C	91.0	86.0	77.5	5	99
Najema	91.0	86.0	76.0	7	100

Noise level at the center of the unit is, 87db (A)

Unit II: Making area

Date of measurement 10/12/2002

Time of Measurement 2.00 p.m. - 4.00 p.m.

Table 4.2 Noise data for making area

Non Sound	Nose level At			Operation time (hr)	Sound power (ref. 10^{-12} W)
	1m	2m	5m		
Batch former	90.0	87.0	76.0	6.0	98
Ruttinaff	88.0	79.0	76.0	6.0	95
Cooking pot	88.0	78.5	73.5	6.5	96
Beneath Mazanmine floor	86.0	84.0	73.0	4.0	95
Sugar loading Area	88.0	82.5	74.5	6.0	94

Noise level at the centre of unit is 90dB (A).

Unit III: Mint Factory

Date Source 11/12/2002 Time 10.00 am

Table 4.3: Noise data for Mint factory

Noise Source	Noise level At			Operating time	Sound power (ref. 10^{-12} W)
	1m	2m	5m		
Hasokwa down	98.0	94.0	83.0	6	106
Hasokwa up	85.0	80.5	70.0	6	95

Noise level at the middle of unit is 86.5dB (A)

UNIT IV TREBOR SECTION

Date 11/12/ 2002

Time 12-2002

Table 4.4: Noise data for rebor section

Noise source	Noise level At 1m	2m	5m	Operating time	Sound Power (ref.10^{-12} W)
Wrapping 200m/c	86.5	82.0	73.5	5	94
Packing	50.0	48.0	37.5	5	60

Noise level at the centre of unit iv is 70.0 dB(A)

UNIT V: PACKING OF MINT SECTION

Date 13/12 2002

Time 9.00 a.m -1:00 p.m

Table 4.5 Noise data for packing of mint section

Noise Source	Noise Level At 1m	2m	5m	Operating time	Sound Power (ref. 10^{-12} W)
Cellotaping	84.0	80.0	70.0	7.5	93
Beet Pumping	85.0	80.0	71.0	6.0	95
Spreader	93.0	87.0	78.5	7.0	102
Mezzamind	82.0	76.0	67.0	7.0	90
Oven	83.0	77.0	63.0	6.0	92

Noise level at the middle of unit V is 60 dB (A)

Unit VI: Cold room section

Date 14/12/2002

Table 4.6 Noise level for cold room section

Noise source	Noise level At 1m	2m	5m	Operating times (hrs)	sound power (ref. 10^{-12}W)
Breaking machine 94.0	89.5	80.5		4	102
Pecking Machine	82.0	76.0	67.5	6	90
Machine room	84.0	78.0	67.5	6	92
Shrink wraper	73.0	67.0	58.5	6	80

Noise level at the Centre of unit vi is 80 dB (A)

UNIT VII: CEREAL CONVERSION PLANT

Date 18/12 2002

Time 9:00 am

TABLE 4.7 NOISE DATA FOR CEREAL CONVERSION

Noise Source	Noise level At 1m	2m	5m	Operating Time	Sound Power (ref. 10^{-12}W)
Making Machine	93.0	87.5	81.0	7	101
Mill down	93.0	88.0	81.0	7	101
Mill up	87.0	82.0	74.0	7	95
Gr/Mer	85.0	80.0	73.0	7	104
Filer pres	84.0	80.0	71.0	6	102
Le /vf	85.0	81.0	69.5	7	104
Weignard	86.5	81.5	72.5	7	105

Noise level at the of unit VII in 90dB (A)

UNIT VIII: TOMAPEP SECTION

Date: 18 12 2002

Time 2:00 p.m - 4.00 p.m

TABLE 4.8 NOISE DATA FOR TOMAPEP SECTION

Noise source	Noise level At			Operating time (hr)	Sound Power. ref 10
	1m	2m	5m		
Making Machine	75	71	62	7	82
Cooking pot	77	74	64	7	85.
Filling	85	80	74	6	93
Cooler	76	71	65	6	85
Packing room	77	73	65	6	88

Noise level at the center of the unit is 70 dB(A)

UNITIX: GENERATOR HOUSE

Date 19/12/2002

Time 9.00 am 12 noon

TABLE 4.9 NOISE DATA FOR GENERATOR HOUSE

Noise source	Noise Level At			Operating time	sound power (ref. 10^{-12} W)
	1m	2m	5m		
Generator 1	101	96	87	8	110
Generator 2	101	95	87	8	110
Generator 3	100	93	88	8	110
Generator 4	101	95	85	8	110
Generator 5	102	93	91	8	115
Generator 6	104	10096		8	115

Noise level at the middle of the house is 98dB (A)

UNIT X: CAN FACTORY

Date 20/12/2002

Time:- 9.00 am noon

TABLE 4.10 NOISE DATA FOR CAN FACTORY

Noise Source	Noise level at 1m	2m	5m	Operating Time (hr)	Sound Power (ref 10^{-12}W)
Flanger	94.0	89	805	6	102
Melting	10.5	96.0	86.0	7	110
Scamer	93	87.5	80.5	7	102
Fabricating Machine	101.0	96.5	88.5	4	110

Noise level at the center of the unit is 81 dB (A)

The equivalent continues noise level for each unit is calculated using the formula below

$$Leq = \frac{10 \log \mathbf{10} (t1 - 10^{L1/10} + t2 \times 10^{L2/10} + t3 \times 10^{L3/10} + tn \times 10^{Ln/10}}{T}$$

T = total time over which the Leq is required which for this project work in take to be 8 hrs.

For unit 1: Sugar confectionery

$$Leq = \frac{10 \log (7x\ 10^{9} + 6x\ 10^{9.4} + 6x10^{9} + 5x10^{9.1} + 7x10^{9.1}}{8}$$

Leq = 97.5dB (A) at 1m

For unit II: Making Area

$$Leq = \frac{10 \log (6x10^{9} + 6 \times 10^{8.8} + 6.5 \times 10^{8.8} + 4 \times 10^{8.8} + 6 X 10^{8.6}}{8}$$

Leq = 93.2 dB (A) at 1m

For unit III: Mint factory

$$Leq = \frac{10\log\mathbf{10} (6 \times 10^{9.8} + 6x 10^{8.65})}{8}$$

Leq = 98. 3dB (A) at lm

For unit IV: Trebor section

$$Leq = \frac{10\log (5x10^{8.65} + 5x 10^{50})}{8}$$

Leq = 84.5 dB (A) at 1m

For unit V: Packing of mint section

$$Leq = \frac{10 \log (7.5 \times 10^{8.4} + 6 \times 10^{8.5} + 7 \times 10^{9.3} + 6 \times 10^{8.2} + 6 \times 10^{8.2})}{8}$$

Leq = 93.9 dB (A) at lm

Unit VI: Cold Room Section

$$Leq = \frac{10\log (8 \times 10^{9.4} + 6 \times 10^{8.2} + 6 \times 10^{8.4} + 6 \times 10^{7.5})}{8}$$

Leq = 91.9 dB (A)

For unit VII: cereal conversion plant

$$Leq = \frac{10 \log (7x10^{9.8} + 8 x10^{8.4} + 7 x 10^{8.65} + 7 x 10^{8.7} + 7 x 10^{8.5})}{8}$$

Leq = 97.0 dB (A) at lm

For unit VIII: Tomapep section

$$Leq = \frac{10 \log (7 x 10^{7.5} + 7 x 10^{7.7} + 6 x 10^{8.45} + 6 x 10^{7.65} + 6 x 107.7}{8}$$

leq = 85.5 dB (A) at 1m

For unit IX: Generator section

$$Leq= \frac{10log (8x10^{10.1} + 8x10^{10.1}+ 8x 10^{10.2} + 8x10^{10.4})}{8}$$

Leq = 109.5 dB (A) at lm

For unit X: Can factory

$$Leg = \frac{10 \log 10 (6x10^{9.4} x 7x 10^{10.05} x 7x10^{9.3} x 4x 10^{10.1})}{8}$$

Leg = 103.0 dB (A) at 1m

The average sound power for each unit to collated using

$$Lav = \frac{10 \log_{10} (10^{LW/10} + 10^{LW2/10} + \ldots\ldots\ldots 10^{LWN/10}}{N}$$

N	=	Number of different sound power
Lav	=	average of the sound power
Lw1	=	first sound power
Lwn	=	nth sound power

The average sound power and the equivalent activators noise level for unit in tabulated in Table 4.11.

Table 4.11 list of average sound power and leg for each unit

	Unit	Lwarv	Leq dB (A)
i.	Sugar confectionary	99.68	97.5
ii.	Making Area	94.41	93.2
iii.	Mint Factory	103.32	98.3
iv.	Trebor Section	90.99	84.5
v	Packing of mint section	103.73	93.9
vi	Cold Room Section	102.69	91..9
vii	Cereal conversion plant	111.00	97.0
viii.	Tompep Section	88.35	85.5
ix	Generator House	120.14	109.5
x	Can factory	113.65	103.0

The reference point, where further calculations will be based is chosen to be the center of the industry (Bs 5228).

The sound power for the reference point of calculated by finding the average of all the power for each unit this is an appointment since sound power in not a function of distance.

Lwavy (at the reference point)

$$\frac{10\log_{10}(10^{9.968}+10^{9.968}+10^{9.099}+10^{3.373}+10^{10.269}+10^{11.10}+10^{8.855}+10^{12.014}\ 10^{11.368}}{10}$$

Lw = 107.42 dB (A)

Lwarv = 107.42 dB(A)

The noise level at 50m, 100m, 200m, 300, and 500m, from the reference points is calculated using the formula.

$SPL = LW - 20\log_{10} R - 8$

Where SPL = Noise level

LR = Distance from the reference point

LW = Reference point

Where R = 50m

Noise level = $LW - 20\log_{10} 50 - 8$

= 107.42 – 41.98

63.44 dB(A)

Where R = 200m

Noise level = 107.42- 54.02

= 53.40 dB (A)

Where R = 300m

Noise level = $107.42 - 20\log_{10} 300 - 8$

49-88 dB (A)

Where R = 400m

Noise level = 107.42 – 20log 400 -8

47.38 dB (A)

Where R = 500m

Noise = 107.42 -20log 300-8

45.44 dB (A)

TABLE 4.12: Noise level at various distance away from the reference point

Distance M	Noise level
50	65.44
100	59.42
200	53.40
300	49.38
400	47.38
500	45.44

Table 4.13 simulation result

Unit I: Sugar confectionary

Noise source	Noise level At			Operation time (hr)	sound power (ref.10^{-12}W)
	1m	2m	5m		
Yamato 1	90.0	84.0	76.0	7	98
Yamato ii	94.0	88.0	80	7	102
218 m/c	90.0	84.0	76.0	6	98
Techni m/c	91.0	85.0	77.0	5	99
Najemu	92	86.0	78.0	7	100

Table 4. 14

UNIT II: Making Area Operating Sound power

Noise source	Noise level At 1m	2m	5m	Operation time (hr)	sound power ref.10^{-12} W
Batch former	90.0	84.0	76.0	6	98
Ruffinate	87.0	81.0	73.0	6.0	95
Cooking pot Beneath	88.0	82.0	74.0	6.5	96
Mazanmine floor	87.0	81.0	73.0	4	95
Sugar loading area	86.0	80.0	72.0	6.5	94

TABLE 4.15

UNIT III: MINT FACTORY

Noise source	Noise level At 1m	2m	5m	Operation time (hr)	sound power (ref.10^{-12} W)
Hasokwa down	98.0	92.0	84	6	106
Hasokwa up	87.0	81.0	73.0	6	95

Table 4.16

UNIT IV: TREBOR SECTION

Noise source	Noise level At 1m	2m	5m	Operation time (hr)	sound power (ref.10^{-12} W)
Rapping 200 m/c	86.5	82.0	73.55	94	
Packing	50.0	48.0	37.55	60	

UNIT V: PACKING OF MINT SECTION

Noise source	Noise level At 1m	2m	5m	Operation time (hr)	sound power (ref.10^{-12} W)
Cello taping	84.0	79.0	71.0	7.5	93
Beet pumping	87.0	81.0	73.0	6.0	95
Spreader	94.0	88.0	80.0	7.0	102
Mezzamine	82.0	75.0	68.0	7.0	90
Oven	84.0	78.0	70.0	6.0	92

The equivalent continuous level for each unit is calculated using the formula below

UNIT 1:

$$Leq = \frac{10\log_{10}(t1 + 10^{L1/10} + t2 \times 10^{L2/10} + t3 \times 10^{L3/10} + tn \times 10^{Ln/10}}{8}$$

$$Leq = \frac{\log 10_{10}(7x\,10^{9} + 6x\,10^{9.4} + 6x10^{9} + 5x10^{9.1} + 7x10^{9.1}}{8}$$

Leq = 97.77 dB(A) at lm

UNIT II - Making Unit

$$Leq = \frac{10 \log (6x10^{9} + 6 \times 10^{8.8} + 6.5 \times 10^{8.8} + 4 \times 10^{8.8} + 6 X 10^{8.6}}{8}$$

Leq = 93.2 dB (A) at lm

UNIT III: MINT FACTORY

$$Leq = \frac{10\log\ (6 \times 10^{9.8} + 6 \times 10^{8.65})}{8}$$

Leq = 98. 3dB (A) at lm

UNIT IV:

$$Leq = \frac{10\log\ (5 \times 10^{8.65} + 5 \times 10^{5})}{8}$$

Leq = 84.5 dB (A) at 1m

UNIT V:

$$Leq = \frac{10\ \log\ (7.5 \times 10^{8.4} + 6 \times 10^{8.5} + 7 \times 10^{9.3} + 6 \times 10^{8.2} + 7 \times 10^{8.2})}{8}$$

Leq = 94.9 dB (A) at lm

CHAPTER FIVE

5.0 DISCUSSION OF RESULT CHAPTER FIVE

The rating scale shown in fig 4.2 and damage criteria (Noise limit) shown in table 4.18 were used an the criteria for judgment and discussion- The noise level from each of the unit was compared with the scale in fig 4.2 to determine whether it is acceptable of unacceptable Table 4.18 was to determine whether a noise control measure should be imitated or not this is done by computing.

$\sum ci/ti + C2 + C3/T3 + \text{-----} + Cn/Tn$

ci, c2 ----- are actual expensive times

T1, T2 ----- are permitted exposive times if the summation is < 1

i.e. $\sum_{i=1}^{n} c1/T1 \leq 1$, there is no need for noise actual measure

$\sum_{i=1}^{n} ci/T1 > 1$, then noise control measure should be initiated.

Unit 1 Sugar confectionary

Yamato II Engine Generate the highest level of noise the equivalent continuous noise level at the operator's level is 97.5 dB (A) this is noisy and unacceptable.

Since $\sum ci/T1 >$, therefore a noise control measure is initiated.

The operator of yamato II engine should wear larmuffs or the engine should be enclosed by a noise poor material like noise mat.

Table 4:18 Noise exposure limit occupational safety and health administration

Noise level dB(A)	Maximum Permissible
90	8.00
92	6.00
95	4.00
77	3.00
100	2.00
102	1.50
110	0.50
115	0.25

UNIT II: MAKING AREA

The Noise level generated by the entire machine falls within the tolerable limit.

This is acceptable and conducive for working therefore there is no need for noise control in the unit.

UNIT III: MINT FACTORY

Due to high level noise produced by haskwa down machine a control measure should be in place in between the operator and the machine the operator could also wear earmuffs

UNIT IV: TREBOR SECTION.

The noise level produced from this section falls within the acceptable noise limit

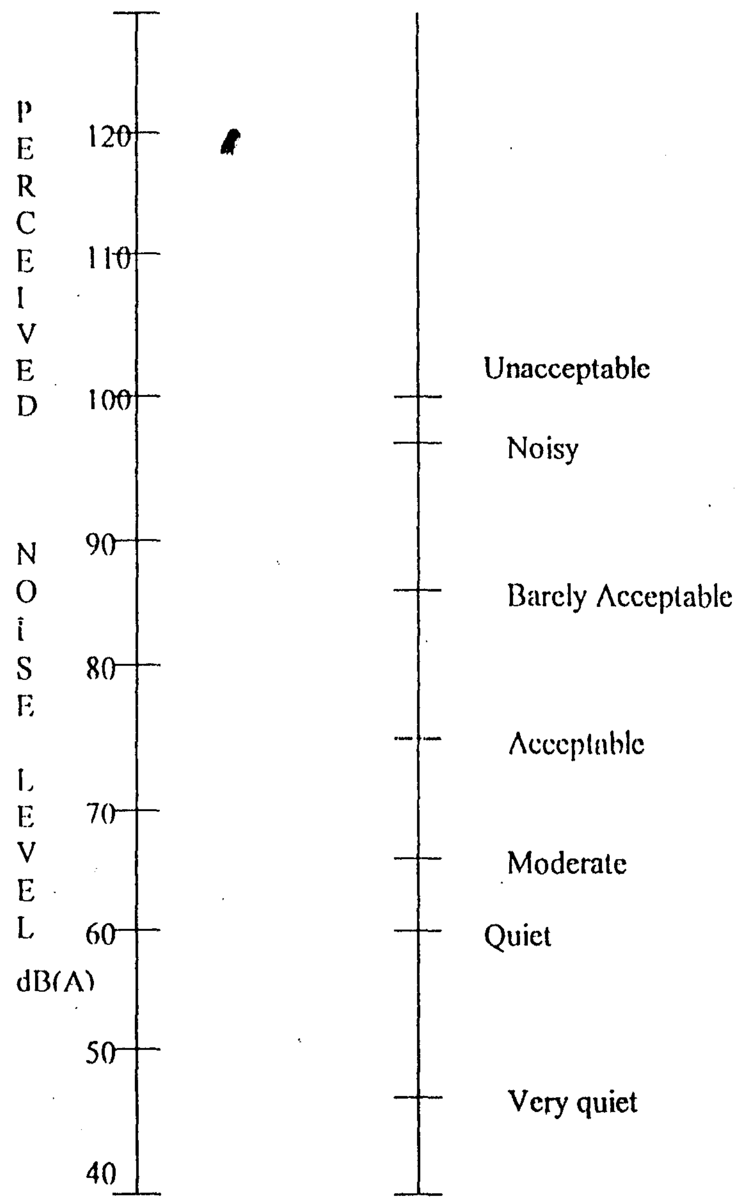


Fig 4.2 Judge equivalent Scale rating for noise level (Source: Chalupnik, 1970)

UNIT V PACKING OF MINT OF SECTION

The occupational noise level of this unit is generally within the acceptable limit except for the spread that generally a slightly high noise due to vibration to reduce the noise level coming from the spreads vibration of the integral parts of the machine should be reduce. This could be achieved by

i. Control of Resource
ii. Control of stiffness
iii. Vibration isolation
iv. Increase of Damping

UNIT VI: ROOM SECTION

The breaking machine produces the highest noise at the operator's level. Provision of personal bearing protection and like earplugs would reduce effect of the receiver's level.

UNIT VII: CEREAL CONVERSION PLANT

The operator of making machine and the mill should wear earplugs. In addition the walls of the machine could be insulated or double –glazed to reduce the emitted noise.

UNIT VIII: TOMAPEP SECTION.

The noise level from this section fall within tolerable limit.

UNIT IX: GENERATOR HOUSE

The General House produces the highest noise level out of the unit. This causes discomfort, annoyance, loss of concentration and threat to the hearing activity of the operators in the unit. As a result of this the following measure could be taken to reduce the effect at the operator's level and at the source:

(i) Control of exposure time through job rotation or shifting

(ii) Provision of personal hearing protection, through the use of earmuffs

(iii) Regular audiometric monitoring of the hearing level of personnel

(iv) Using acoustic enclosure for all the generating sets. This may be expensive, but the control would be effective.

UNIT X: CAN FACTORY

All the machines in this unit generate noise above the acceptable level- the personnel in this unit are advised to wear earmuffs during operation- the exposure time to the noise should be reduced through job rotation.

5.0.1 THE EFFECT OF OCCUPATIONAL NOISE AT 50M AND 100M FROM THE REFERENCE POINT

The calculated noise level at 50m and 100m are respectively 65. 44 dB (A) and 59 .42 dB (A) as shown in table 4.18.

These levels lie within the acceptable limit over 8 hour's exposure time during the day. This implies that the noise has negligible effect on the industrial worker or personnel. Those levels also favours the location of clinic and other noise sensitive central between the two distances.

In the presence of high noise form daily time and Schweppes the level could be raised to an unacceptable level during the right. However this could be prevented by making sure the noise emanating from these companies falls within the standard.

5.0.2 THE EFFECT OF NEIGHBORHOODS NOISE AT 200M 500M, 400M AND 500M FROM THE REFERENCE POINT

At 200m the calculated noise level generated by Cadbury Nigeria Plc is 53.40 dB (A).

The contribution of unsteady transportation noise form Isheri road and external noise from daily Times lead to an increase in noise level at the southern part of Cadbury at this distance.

Residential areas should not be located in this direction because of the adverse effect the noise would generate. At other directions at this distance the noise level are slightly lower.

Agidingbi village lies at the North - Eastern parts of the industry and between 300m and 500m from the reference point the noise level at this village. Form Cadbury is between 49.88 dB (A) and 45.44 dB(A). However ,this level is often increased by the transportation noise coming from isheri – road. The overall level as result of this fluctuation produces a negligible effect on the occupants of this village.

At the southwestern part of the company at this range of distance 300 m - 500m i.e. the occupants of talabi and fatai Doherty close, the noise is generally high. This is due to the contrbution of transportation noise from the street external noise from – Ajaokuta lead to deprivation of sleep at night. The estimated level of noise in the area is 70 dB(A). To reduce this, the management of Ajaotruta steel co. limited should be compelled to reduced the noise emanating from their industrial activities.

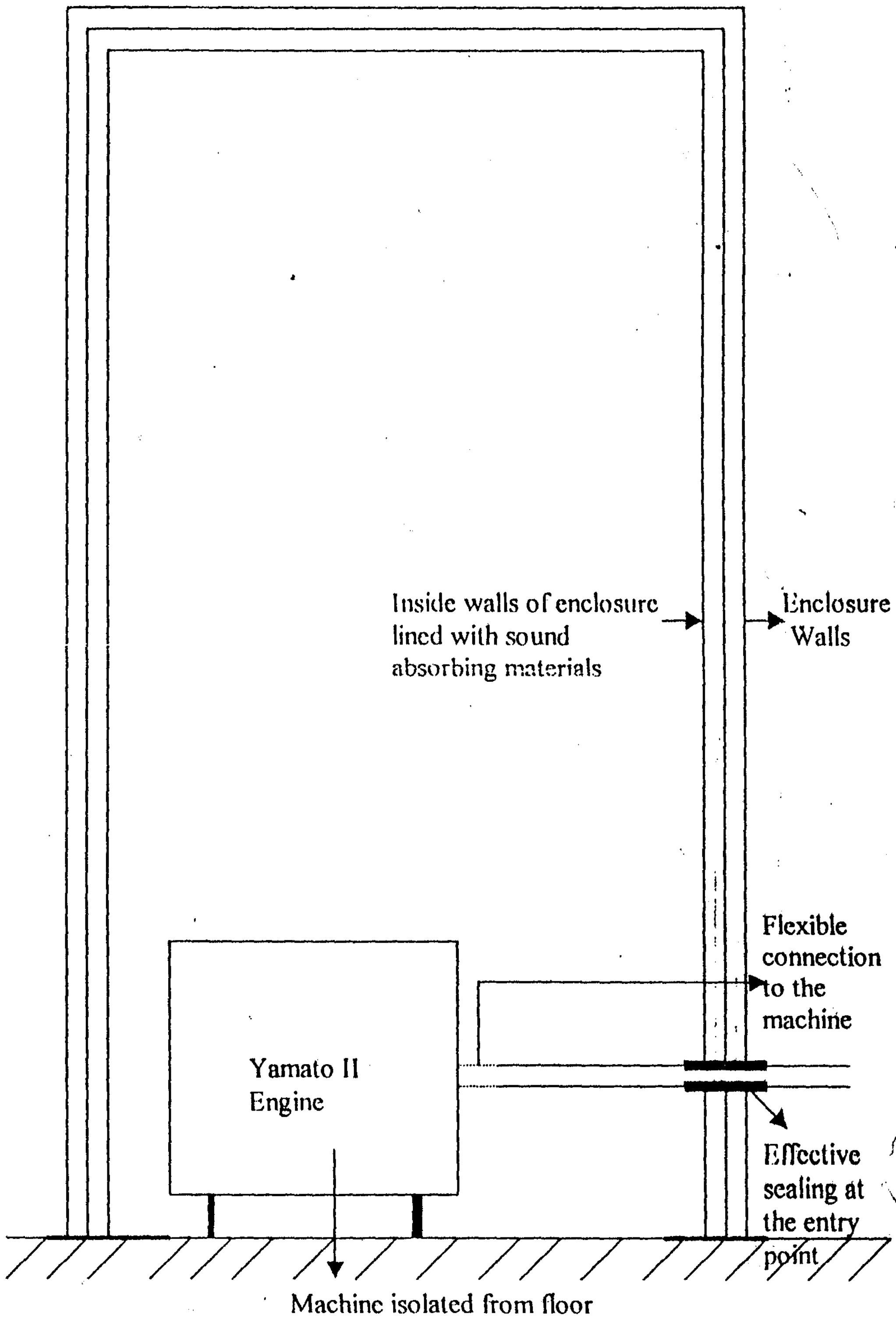


Fig 4.3 Acoustic enclosure of Yamato II Engine

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSIONS

The following conclusions can be drawn from this work.

1. Noise level in db (A) varies inversely with the distance i.e. the more the distance away from the source the lower the magnitude of the noise
2. The effect of high industrial noise is more severe and harmful to personnel closer to the source than those far away from the source.
3. The level (Magnitude) of occupational noise is higher than the level of neighborhood) noise with emanating form the industry.
4. Industrial noise measurement is necessary to gain an understanding of the mechanism of noise generation so that method of engineering control of the noise can be applied.
5. The generator house is the unit contributing major to the level of noise in the industry while packing in the least.

6.2 RECOMMENDATIONS

1. The operators in the following units sugar confectionery. Making area, packing of mint section cold Room section conversion plant, can factory and generator House should be provided with personal hearing protection e.g earmuffs to reduce the harmful effect of the noise.
2. Regular noise surreys and audiometric monitoring of the hearing level of the personnel should be carried out by properly trained personnel.
3. Industrial workers should be educated and informed on the purpose of noise control equipment and now it should be used.

4. Good working relations should be maintained with the people living and working nearby e.g . agidingbi villages. Management of Daily times Schweppes and Ajaokuta steel company limited.
5. Residential areas should be not be located between Cadbury and daily times (i.e. North south 200m from Cadbury) due to unfavorable high noise is this region.
6. For further study the following should betaken into consideration.

- The use of integrating sound level meter for direct measurement of equivalent continuous noise (leq).
- Correlation for background noise of the industrial complex to get accurate noise level produced by the sources (s)
- The effect of nearby sound reflecting absorbing or shielding startles on measured noise level.
- The use of digital sound level meter for faster and better result.

BIBLIOGRAPHY

1. Beranek, L.L (1960). 'Noise reduction'. Mc. Graw-Hull Book Company, New York.

2. Burns, W., (1973). 'Noise and Man'. Lippincott company, Philadelphia.

3 B5 4142 (1990). 'Commercial and Industrial noise'.

4. B5 5228 (1975). 'Noise control on construction and Demolition'.

5 B5 7445 (1991) 'General environmental noise'.

6 Chalupnik, J.D (1970) 'Transportation Noises' University of Washington press.

7 Bugliarello, G., Alexandre, A, Barnes J. and Wakstein, C. (1978) 'The Impact of Noise pollution: A socio - Technological introduction'. Pergamon press, New York.

8 Kryter, K.D,(1966). 'The effect of noise on man' Academic Press, New York.

9 Liptak, B.G. (1974) 'Environmental Engineers' handbook Vol.3, Land pollution, Chilton Book company, New York.

10 Morse P.M and ingand K.V (1968) 'Theoretical Acoustics'., Mc. Graw - Hill Book company, New York.

11 Pfafflin J.R and Ziegler E.N. (1976) 'Encyclopedia of Environmental Science and Engineering Vol. 2, Gordon and Breach Science Publishers, New Yor

12 Smith B.J, Peters R.J and Owens (1996) 'Acoustics and Noise Control' 2nd edition, Addson Wesley Longman Limited.

APPENDIX A

METHOD FOR THE GENARATION OF SIMULATION TABLE

(4.12 – 4.17)

SIMULATION EQUATION: SPL = LW – 20 LOG R - 8

WHERE

LW = Sound Power

R = Distance Away From The Noise Source

SPL = Noise Level

FOR TABLE 4.12

LW = 98

SPL = 98 – 20 log 1 – 8 = 90 at 1m (Yamato I)

SPL = 102 – 20 log 1 -8 = 94 at 1m (Yamato II)

SPL = 98 – 20 log1 – 8 = 90 at 1m (218m/C)

SPL = 99 – 20 log1 – 8 = 91 at 1m (Techni M/C)

SPL = 100 – 20 log1 – 8 = 92 at 1m (Nejema M/C)

SPL = 98 – 20 log2 -8 = 84 at 2m (Yamato I)

SPL = 102 – 20 log2 – 8 = 88 at 2m (Yamato II)

SPL = 98 – 20 log2 -8 = 84 at 2m (218 M/C)

SPL = 99 – 20 log2 – 8 = 85 at 2m (Techni M/C)

SPL = 100 – 20 log2 -8 = 86 at 2m (Najema M/C)

SPL = 98 – 20 log5 -8 = 76 at 5m (Yamato I)

SPL = 102 – 20 log5 -8 = 80 at 5m (Yamato II)

SPL = 98 – 20 log5 – 8 = 76 at 5m (218 M/C)

SPL = 99 – 20 log5 – 8 = 77 at 5m (Techni M/C)

SPL = 100 -20 log5 – 8 = 78 at 5m (Najema M/C)

I.e. LW = the sound power of each sub unit in a unit e.g. Yamato I = 98 = LW (where 98 = the sound power of Yamato I in UNIT I.

APPENDIX B

List of existing Noise Control measure at Cadbury Nigeria Plc Agidingbi Lagos.

i The use of noise mat a sound absorbing material on machines this the noise emanating from the suitable this is major cold in tomapep section.

ii Use of ear –plug to reduce the noise at the receives level.

iii Use of damping to control stiffnes and vibration.

iv Use of partitions/bariner between the nosy machine and the personnel.

v Use of absorptive silencers in duct system.