STUDYING OF NOISE POLLUTION GENERATED FROM INDUSTRIES

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Abstract

The main objectives of this study were to measure noise levels generated by machinery that the workers were exposed to at three industrial facilities in Iraq, which are the textile factories, the rubber making factories and the cement- brick making factories, also to assess if these levels were within acceptable limits. Unfortunately, such standards limits of noise pollution are not available in Iraq.

Noise measurements were taken at each hour for a period of 8 - hour working day over two weeks at each facility. Results obtained from this study showed that employees at al industrial facilities, at particular machinery, were subjected to more than the allowable maximum limits of noise exposure comparing with UK and OSHA standards without any kind of ear protection. In Iraq there are no regulations to abate noise in the working environment. This study indicated that, the concerned environmental and health organizations in Iraq should be compelled to establish noise level standards and controls to safeguard the health of workers and the public at large.

Introduction

It is mainly in the industrialized countries, noise is perceived as a serious environmental nuisance. As with all pollutants, it reduces the quality of life and causes a significant health hazard. People living adjacent to busy roads and workers in factories tend to have higher blood pressure. High noise levels at work can exacerbate existing health conditions. In addition to the risks to human health, noise pollution has negative ecological impacts on species sensitive to noise. High noise levels of sufficient duration may be caused temporary or permanent hearing loss. This is generally associated with those working in industrial plants or operating machinery. [1]

Noise pollution comes from a wide variety of sources, including :

- Traffic
- Industrial equipments
- Construction activities
- Sporting and crowd activities
- Low-flying aircraft

The main objectives of this study were to measure noise levels generated by machinery that the workers were exposed to at four industrial facilities in Iraq , Also to asses if these levels were within acceptable standards.

Materials and Methods

Sound is a compression wave, and its' amplitude represents alternating high and low pressure. These waves are measured in pressure units like N/m^2. As in the case with other wave phenomena, intensity is the square of the amplitude. The intensity of sound wave is measured in watts, a unit of power. When a person hears sounds of different intensities, the total intensity heard is not the sum of the intensities. Rather, the human ear tends to become overloaded or saturated with too much sound. Another

statement of this phenomenon is that human hearing sums up sound intensities logarithmically rather than linearly. A unit called the *bel* was invented to measure sound intensity. This unit is an inconveniently large unit. More convenient, and now in common usage, is the *decibel* (dB). Sound intensity level in dB is defined as : [2]

$$IL = 10 \log_{10} \left(\frac{I}{I_o} \right)$$

Where :
IL: sound intensity level (dB)
I : sound intensity, in watt
I_o: intensity of the least audible sound, usually given as 10^{-12} watt

Since intensity is the square of pressure, an analogous equation may be written for sound pressure level (SPL) in dB:

$$SPL. (\text{as dB}) = 20 \log_{10} \left(\frac{P}{P_{ref}} \right)$$

Where :
SPL (dB) : sound pressure level, in dB
P : pressure of sound wave, N/m^2
P_{ref} : some reference pressure, generally chosen as the threshold of hearing, 0.00002 N/m^2

Two principal weighting networks have been established, A and C. The most important is the A network since there is general agreement that traffic, machinery, industrial and neighborhood noise can be appropriately measured using this network. Sounds at higher frequencies (number of sound pressure waves that pass per unit time, in Hertz)ranging from (1 to 5 kH) are given considerably more weight on the A network. Sound pressure levels measured on the A scale are referred to as dB.A. The C network incorporates little modification by frequencies. [1], [4]

Sound pressure levels are expressed in decibels, The threshold of human hearing is about (10 dB) with pain occurs in the range of (130 - 140 dB), and human ear can hear sound over a wide range of frequencies from (20 – 20000 Hz) [3].

Sound intensity can be measured with modern instrumentation (ISO 9614) [6]. A portable, sound level meter consisting of a microphone, an amplifier, a frequency-weighing circuit (filters), and an output scale, as shown in figure (1), was used to measure the sound pressure level generated by the machinery at the studied factories. Calibration was done before and after use by using sine wave signal generated by a built-in oscillator. [7]

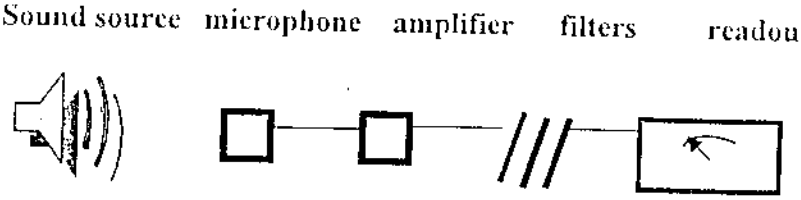

fig.(1) : schematic representation of a sound level meter

Measurements procedure were applying according to standards [5], however, the microphone was placed at a height of (1.2 m) above the ground surface, and the

distance between the noise generated machinery and the worker's ear was within one meter, and the meter was placed by the worker's ear. The presence of adjacent sound reflecting surfaces can make the noise field stronger or weaker. Therefore, the sound meter was placed at the appropriate position for accurate measurements.

The industrial facilities that were selected for the purpose of this study are:

- Hilla textile factories
- Najaf rubber making factories
- Najaf light cement – brick making factories

The employees are working six days a week with one day off on Friday, because it is a public holiday. Working hours at textile and rubber making factories are from 7:00 a.m. to 3.00 p.m. in the first hour shift and from 3:00 p.m. to mid night for the second hour shift, with a 30 minutes break. Some workers tend to work in two hour shifts to earn extra money. While in light cement - brick factory working hours are from 6:30 a.m. to 5:30 p.m. The workers are exposed to continuous noise during working hours. The estimated exposure time to noise levels at this facility exceeds 8 hours per day, although exposure duration was considered 8 hours for the purpose of this study.

Noise measurements were taken at each hour for 8- hour working day over two weeks at each facility. From 12/2/2002 to 26/2/2002 for Hilla textile factory, and from 12/3/2002 to 26/3/2002 for Najaf light cement brick factories, while noise measurements for Najaf rubber factories were conducted from 12/4/2002 to 26/4/2002.

Results Obtained

Several measurements were recorded at each facility and the range, average and standard deviation of them were recorded in tables below at activities with major sound sources for each industry.

Table (1) : Noise levels (SPL) measured in Hilla textile factories

Machine type	SPL (as dBA)		
	Range	Average	Standard deviation
Jacard machines	80 – 88	85	1.1
Weaving machines	85 – 99	95	1.2
Mercerizing machines	91 – 120	110	3.1
Desizing machines	89 – 105	98	2.8
Dying machines	88 – 98	95	1.1
Printing machines	83 – 115	100	2.9
Scouring and bleaching machines	89 – 99	96	3.3

Table (2) : Noise levels (SPL) measured in Najaf rubber factories

Machine type	SPL (as dBA)		
	Range	Average	Standard deviation
Rubber building machines	88 - 106	99	1.4
Rubber cutting machines	86 – 98	95	1.8
boilers	91 – 115	105	2.6
Materials mixing machines	95– 111	98	1.3

Table (3) : Noise levels (SPL) measured in Najaf light cement-brick factories

Machine type	SPL (as dBA)		
	Range	Average	Standard deviation
Mixing slurry silo	84 – 99	97	7.9
Mixing waste silo	85 – 100	95	2.5
Vapor ovens	91 – 107	100	6.8
boilers	89 – 112	98	2.8
Air compressors	87 - 114	107	1.9

Table(1) shows the noise level in Hilla textile factories, where mercerizing machines show the highest average(110) dBA, while Jacard machines have the lowest(85) dBA. Table(2) reveals the noise levels in Najaf rubber factories, where boilers produce the highest average of noise (105) dBA as compared with the rubber cutting machines (95) dBA. Table (3) shows the noise level in Najaf light cement – brick factories, where air compressors show the highest average(107) dBA as compared with the others especially mixing waste silo (95) dBA.

Discussion

Because of the strong objective component in the perception of noise, physical measurements of noise pollution provide only partial picture of the real problem. One of the most reliable indicators of the problem is therefore public opinion. The opinion poll on the environment conducted by the European commission in 1982, showed that noise was seen as sound which represents important environmental problem at the local level. Similarly, the incidence of official complaints by the public about noise nuisances give a useful measure of the extent of the problem. According to this situation, the problem is getting worse, numbers of complaints in England and Wales have doubled between 1975 and 1985, whereas in France (1986), approximately 25% of the population were exposed to an average daily noise level of more than (65 dBA), in Germany the figure is 15 – 20 % . [5]

In the industrial environment, the *British Noise at Work regulations* of 1989(UK standards) indicated that the maximum allowable exposure to noise is (90 dBA) for 8 hours [5], while the *Federal Occupational Safety and Health Administration* (OSHA) sets limits for noise in the workplace. Table (4) lists these limits.[8]

Table (4) : OSHA maximum permissible industrial noise levels

Sound level (dBA)	Maximum duration during any working day (hr)
90	8
92	6
95	4
100	2
105	1
110	0.5
115	0.25

90 dBA level of noise for eight hours working day is not consistent with opinion of some researchers and health agencies which insist that 85 dBA is the correct limit. This inerement from (85 to 90 dBA) is actually an increase of about four times the sound pressure, remembering the
Logarithmic nature of the decibel scale.

The hearing damage potential of a given noise source depends not only on its' level but also on its' duration. It is generally accepted that a sound level below (75 dBA) is not harmful, while a single sound above 140 dBA may produce permanent hearing damage. Between these two levels, the amount of hearing damage varies with the sound level, the period of exposure and the individuals susceptibility to noise. Other contributing factors are the number and length of quiet periods between exposures, the type of sound (continuous, intermittent, or impulsive), and its frequency distribution [5].

The United States National Institute of Occupational Safety and Health (NIOSH) showed that (30 to 50 %) of American workers in heavy industries were subjected to high noise levels, and that (40 %) of the loss hearing workers were attributed to excessive noise exposure in the workplace, also it was found that (49 %) of workers are subjected to high noise levels that exceeded the (OSHA) standards [3].

Tables (1,2 and 3) show that the workers at al industrial facilities, at particular machinery, were exposed to more than the allowable maximum duration of noise exposure comparing with UK and OSHA standards which equivalent to (90 dBA) for 8 hours. The highest levels of noise that recorded at Hilla textile factories, Najaf rubber factories, and Najaf light cement-brick (see tables 1,2, and 3) were (110 , 105, and 107 dBA) respectively as average values over an 8 hour exposure. All these values are exceeding the allowable limits(90 dBA), while these levels don't reaching the limit of (140 dBA) which is known to create instant pain to any human recipient.
The low values of standard deviation computed for recorded data indicated that these data are approaching from its average for all facilities.

Conclusion and recommendation

This study showed that the workers at all industrial factories were exposed to high noise levels exceeding allowable standards of UK and OSHA criteria. The control of noise is possible at three different stages of its transmission:

1- Filtering of produced sound.
2- interrupting the path of the sound.
3- protecting the recipient.

The source could be modified by the acoustic treatment to machine surfaces, design change, etc. The transmission path of the sound could be modified by containing the source inside a sound insulation enclosure, by the construction of a noise barrier or by the provision of absorbing materials along the path. The protection of the receiver by altering the work schedule or by the provision of ear protection is mainly applicable to those working with noisy machinery. When the studied facilities were constructed, none were assessed for there environmental and adverse health impacts.

Noise was considered just another annoyance in a polluted world, not much attention was given to it. Now we have enough data to show that it is a definite health hazard occured among our more serious pollutants. With available technology, it is possible to lessen noise pollution. However, the solutions cost money, and private enterprise will not provide them until forced by the government or the public. Noise abatement is very important within any work environment. To abate noise, legislation must be set and enforced. The concerned environmental and health agencies in Iraq must produce regulations to abate such noise at work levels. Temporarily, other countries' regulations could be adopted, such as, British Noise Work Regulations of 1989 (UK standards) or the US Occupational Safety and Health Administration standards of 1996 (OSHA standards).

Within these regulations both the employer and employee have there role in abating noise in the work environment, also, industrial facilities should not be given planning permission unless environmental impact assessment (EIA) studies have been preformed on them which investigate and consider noise generated by machinery and point out possible mitigation measures by for example, suggesting the installation of sound enclosures or sound barriers. Further than, adverse impacts of hearing loss include disability in sound detection and in recognition and identification of sound sources in the work place. These can result in accidents and damage. Management responsibilities for noise levels should be involve monitoring, audiometric testing, hearing protection, record keeping, and the posting of signs. These components of environmental and health management are very crucial in safeguarding the health of the employees.

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دراسة تأثير التلوث الضوضائي المتولد من الصناعات

الخلاصة

ان الهدف الأساسي من هذه الدراسة هو قياس مستوى الضوضاء المتولدة من المكائن والتي يتعرض لها العاملين وذلك في ثلاث مجالات صناعية في العراق وهي مصانع نسيج الحلة، مصانع اطارات النجف ومصانع الطابوق الأسمنتي الخفيف في النجف ، وايضا" تقييم هذه المستويات بمقارنتها مع الحدود العالمية المسموحة خصوصا" ان العراق يفتقر لمثل هذه المحددات . اخذت القياسات في كل ساعة من ساعات يوم العمل (٨ ساعة/ يوم) ولمدة اسبوعين لكل صناعة.

بينت النتائج ان العاملين في كل المصانع قيد الدراسة يتعرضون الى مستويات من الضجيج تجاوزت الحدود المسموح بها وحسب المواصفات العالمية (UK) و (OSHA) وبدون اي نوع من انواع الحماية للأذن. وتضمنت الدراسة اعداد التوصيات اللازمة لتشريع مواصفات قياسية محلية يتم متابعتها من قبل المنظمات التي تعنى بالصحة والبيئة في القطرمن اجل ضمان سلامة العاملين وسلامة المجتمع عموما".