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IMPACT OF NOISE POLLUTION ON HUMAN HEALTH AT INDUSTRIAL SITE AREAS

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Abstract: Noise pollution is considered as more important environmental problem, especially in the industrialized and developed countries. Industrial noise is an important source of noise pollution, which annoys and disrupts the daily activities of workers. This study focuses on the industrial noise and its effects on workers. The Noise measurement and survey studies have been carried out at concrete traverse, cement, iron and steel and textile factories. A questionnaire was completed by 256 of workers during this study in order to determine the physical, physiological, and psycho-social impacts of the noise on humans and to specify what kind of measurements have been taken both by the employers and workers for protection from the effects of noise. It has been specified, during the surveys, that the noise levels detected in all the industries are much above the 80 dBA that is specified in the regulations: 73.83% of the workers in these industries are disturbed from the noise in their workplaces, 60.96 % of them have complaints about their nervous situations, 30.96% of these workers are suffering hearing problems although they had not had any periodical hearing tests and they are only 10% of workers were using ear protection equipment. The conclusion drawn from this study is that the technique or the combination of techniques to be employed for noise control depends upon the extent of the noise reduction required, nature of the equipment used and the economy aspects of the available techniques.

Keywords: Industrial noise, noise effect, psychological effects, physiological effects.

1.INTRODUCTION

Numerous forms of environmental pollution have appeared these include: (radioactive pollution, light pollution, and noise pollution). Thus, environmental pollution, particularly noise pollution is a significant problem facing the modern era, an era of advanced and sophisticated technology, so instead of human activities being consistent with this progress and development, it took place at the expense of the environment, Due to the lack of accurate scientific knowledge about noise pollution in most countries and its impact on workers in factories and companies, therefore its impact on the national economy as a whole, Our study was created to discuss the economical expenses of noise pollution, its influence on the profits of corporations, and how to handle the problem of noise pollution and limiting its negative impact on economies and societies.

Noise is one of the physical environmental factors affecting our health in today's world. Noise is generally defined as the unpleasant sounds which disturb the human being physically and physiologically and cause environmental pollution by destroying environmental properties. The general effect of noise on the hearing of workers has been a topic of debate among scientists for a number of years. Regulations limiting noise exposure of industrial workers have been instituted in many places. For example, in the U.S., the Occupational Noise Exposure Regulation states that industrial employers must limit noise exposure of their employees to 90 dBA for one 8-h period. This permitted maximum noise exposure dose is similar to the Turkey Standard, which is less than 75 dBA for one 7.5 h period. Exposure to continuous and extensive noise at a level higher than 85 dBA may lead to hearing loss. Continuous hearing loss differs from person to person with the level, frequency and duration of the noise exposed..

2. LITERATURE SURVEY

One of the most important issues that are worthy of studying is "Noise Pollution", which affects individuals as well as the society. Due to the fast pace of modernization and the high-tech life, environmental Pollution has become popular

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nowadays. This study focuses on economic and social aspects which are crucial in noise pollution which sharply affects laborers' performance and industrial firms' profits. It has been concluded that noise pollution has affected worker performance and production. Therefore industrial factories and firms have fitted barriers to avoid the transfer of noise to other parts of the factory.

This study focuses on the industrial noise and its effects on workers. Thirteen different industries chosen randomly in Duhok city, in Kurdistan region, North of Iraq. To cover this study an instrument for measurement the sound level was used, in addition to a questionnaire contains (38) questions to study all the possible reported effects of noise on humans, (90) workers of different industries were chosen, the questionnaires were analysis to determine how much employees were affected by high noise levels in the workplace. During the survey, it has been specified that all industries noise levels measurement are much above the maximum (OSHA) exposure limits. 81.11% of workers are annoyed from the noise in their workplaces. To determine whether the effects of noise were statistically significant or not, a Chi-Square test was used. At a level of significance, $p \leq 0.05$, a relationship between duration of employment years and feeling annoyed are statistically significant. It was found that the physiological and psychological effects of noise i.e. headache, disturbs their peace of mind, nervousness, stressful, speech interference and insomnia are statistically significant. However, dizziness is statistically not significant. 65.56% of respondents in these industries are suffering from hearing problems, 34.44% of them have complaints about ringing in ears and only 8% of workers were used EPE..

Construction sites grinds out deep noises, mostly from vehicles, equipment and array of machineries. Surplus noise is not only infuriating and diversionary, but can lead to hard of hearing, blood pressure, sleeping trouble and awful stress. High noise levels in construction escalate the nature and environment. Among various pollutions noise pollution from construction industry is one of the important contributions for the environment. The objective of this paper is to study some general information about the noise generated by the activities of construction. This imprecise consciousness data includes review of all noise level and their effects due to construction. The general study contains the circumstances which affects due to noise pollutants of construction sites in various places, methods and the results used in the reviews.

3. PROBLEM IDENTIFICATION

There are four main categories of industrial activity that are particularly relevant to the study of noise: product fabrication, product assembly, power generation, and processing. Noise is generated in all of these activities, with the majority occurring at the lower end of the frequency spectrum. While people around an industrial facility and the people within it are both affected by industrial noise, it is the workers within the plant that generally bear the brunt of most of it.

Product fabrication, the first category of industrial activity, can be a highly noisy operation. In metal fabrication, the cutting, shearing, pressing, and riveting of metal products can be very noisy. For example riveting a large steel structure can produce noise levels greater than 130 dB. Molding, another type of product fabrication, can also be highly noisy with its use of high-pressure air in the operation, pneumatic control, and cooling of molding machinery. Plastic molding has been reported to produce noise at levels greater than 100 dB.

The second category of industrial activity, product assembly, also produces dangerous noise levels. The activities within this category often produce broad-band noise that includes high levels of higher-frequency noise due to the operation of electric and pneumatic tools, such as grinders and impact wrenches. Most of the noise emitted in power generation, the third industrial category, is produced by turbine generators and air compressors, though some noise also derives from devices such as fans and blowers. Processing, the final industrial category, includes activities such as oil refinery. Major sources of noise in this category are furnaces, heat exchangers, pumps, compressors, and air and steam leaks. industrial noise production, and lists "motor noise, fan noise, transformer noise, aerodynamic noise, hydraulic system noise, impact noise, bearing noise, gear noise and vibration-induced noise" as a noise due to industrial machinery.

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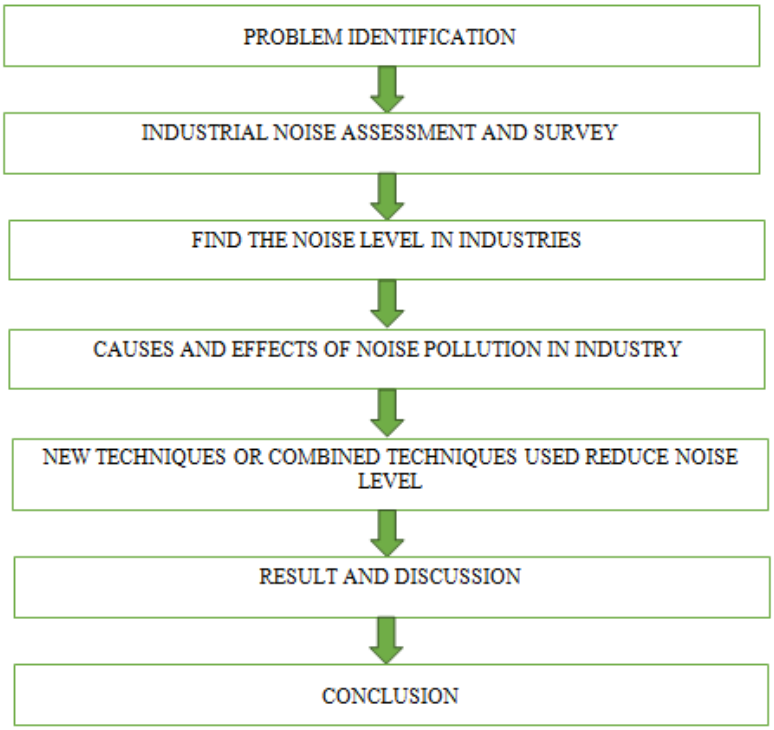
4.METHODOLOGY



4.1 Types of Noise

Environmental noise has been doubling every ten years. Noise is classified as:

1. Industrial Noise
2. Transport Noise and
3. Neighbourhood noise

4.2 Causes of Noise Pollution In Industry

In this section, the fundamental mechanisms of noise sources are discussed, as well as some examples of the most common machines used in the work environment. The sound pressure level generated depends on the type of the noise source, distance from the source to the receiver and the nature of the working environment. For a given machine, the sound pressure levels depend on the part of the total mechanical or electrical energy that is transformed into acoustical energy. Sound fields in the workplace are usually complex, due to the participation of many sources: propagation through air (air-borne noise), propagation through solids (structure-borne noise), diffraction at the machinery boundaries, reflection from the floor, wall, ceiling and machinery surface, absorption on the surfaces, etc.

Therefore any noise control measure should be carried out after a source ranking study, using identification and quantification techniques. The basic mechanism of noise generation can be due to mechanical noise, fluid noise and/or electromagnetic noise (Allen, 1970 and ISO/TR 11688). The driving force for economic development is mainly the endeavour to produce consumer goods ever more cost-effectively. From the point of view of the machine manufacturer, this generally means offering products with a low space, material, energy and production time requirement (smaller, lighter, more economical and more productive). At the same time account is being taken increasingly of resource conservation and environmental friendliness, although the rise in noise levels which frequently goes along with increased output and productivity is often overlooked. Personnel are then exposed to higher noise levels than before, despite.

Noise-reducing measures taken in the machine's design. This is because the noise emission rises non-linearly because of higher rotary and travelling speeds in machine parts. For example, for every doubling of the rotary speed the noise emission for rotating print machines rises by about 7 dB, for warp knitting looms 12 dB, for diesel engines 9 dB, for petrol engines 15 dB and for fans is between 18 to 24 dB. For the purpose of comparison: the doubling of sound power produces an increase in emission of 3 dB only. But even previously quiet procedures are often replaced by loud ones for reasons of cost, e.g. stress-free vibration instead of annealing for welded parts. In some cases new technologies also

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result in higher emissions; for example, with the use of phase-sequence-controlled electrical drives, the excitation spectrum shifts further to high frequencies, which results in a greater sound radiation from large machine surfaces. This means that some new noise problems are closely related to the use of modern technologies.

4.3 Factors of Noise Pollution in Industry

Main Sources of Industry Worksite Noises

a) Diesel power generators
b) Cutting and welding processes
c) Heavy machinery like trucks
d) Transport of materials
e) Demolition
f) Maintenance and Repair

Process	Typical Noise Levels
TIG	up to 75 dB(A)
MMA	85 - 95 dB(A)
MIG	95 – 102 dB(A)
Plasma cutting (hand-held up to 100A, cutting up to 25mm thickness only)	98 – 105 dB(A)
Flame gouging	95 dB(A)
Flame cutting	up to 100 dB(A) (typically above 90 dB(A) when cutting thicknesses above 40 mm)
Air arc gouging	100 – 115 dB(A)
"Deslagging"/chipping	105 dB(A)
Grinding	95 – 105 dB(A)

Table 4.1 Typical Noise Level in Welding

The Noise Levels Created By Industry Equipment Will Vary Greatly Depending On Factors

1. The type of equipment
2. The specific model
3. The operation being performed and
4. The condition of the equipment

4.4 Effects of Noise Pollution In Industry

- ✓ Hearing Problems
- ✓ Health Issues
- ✓ Sleeping Disorders
- ✓ Cardiovascular Issues
- ✓ Trouble Communicating
- ✓ Effect on Wildlife

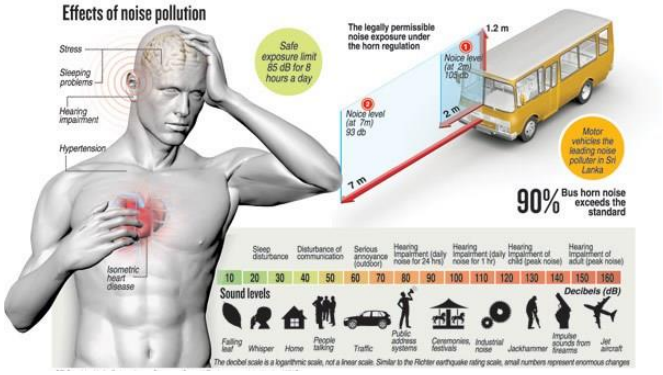

Figure 4.1 Effects of noise pollution

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Species that depend on mating calls to reproduce are often unable to hear these calls due to excessive man made noise. As a result, they are unable to reproduce and cause declining populations. Others require sound waves to echo-locate and find their way when migrating. Disturbing their sound signals means they get lost easily and do not migrate when they should. To cope up with the increasing sound around them, animals are becoming louder, which may further add to the pollution levels. This is why understanding noise pollution can help us lower the impact it has on the environment.

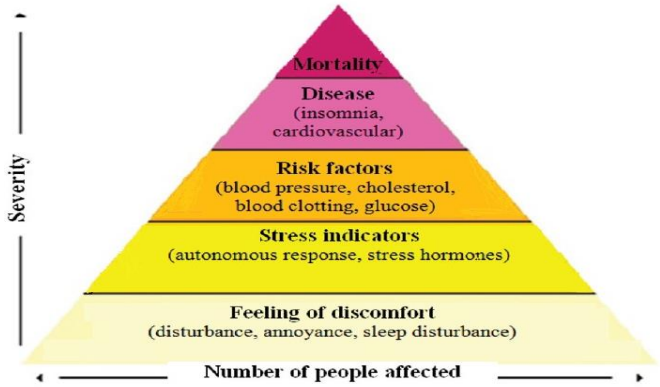

Figure 4.2 Effects of Noise Pollution

4.5 Physiological Effects

The physiological manifestations of noise pollution are several as mentioned below

1. Headache by dilating blood vessels of the brain.
2. Increase in the rate of heart-beat.
3. Narrowing of arteries.
4. Fluctuations in the arterial blood pressure by increasing the level of cholesterol in the blood.
5. Decrease in heart output.
6. Pain in the heart.
7. Digestive spasms through anxiety and dilation of the pupil of the eye, thereby causing eye-strain.
8. Impairment of night vision.
9. Decrease in the rate of colour perception.
10. Lowering of concentration and affect on memory,
11. Muscular strain and nervous breakdown.
12. Psychological Effect

The Psychological Manifestations of Noise Pollution Are

1. Depression and fatigue which considerably reduces the efficiency of a person.
2. Insomnia as a result of lack of undisturbed and refreshing sleep
3. Straining of senses and annoyance as a result of slow but persistent noise from motorcycles, alarm clocks, call bells, telephone rings etc.
4. Affecting of psychomotor performance of a person by a sudden loud sound
5. Emotional disturbance.

For a talkative person, the most important effect of noise pollution would invariably be that noise interferes with our conservation. So, noise is annoying and the annoyance depends on many factors not merely the intensity of the sound but also repetition, because even a sound of small intensity (e.g. dripping tap or clicking of clock) may become annoying, simply by repetition.Some of the well- known effects of noise on human beings and the relation of noise pollution level and its harmful effects

5.NOISE POLLUTION ACTS

Section 2 (a) of the Air (Prevention and Control of Pollution) Act, 1982 includes noise in the definition of 'air pollutant'. According to Section 2(a), air pollution means any solid, liquid or gaseous substance including noise present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment. According to the Encyclopedia Britannica, with respect to acoustic, noise is defined as any undesired sound. In Chambers 21st Century Dictionary, the definition of noise has undergone a change. Noise pollution stands carved out as a phrase separately from noise. The two are defined as under: Noise means a sound; a harsh disagreeable sound, or such sound; a din; and Pollution means an excessive or annoying degree of noise in a particular area, e.g., from traffic or aero plane engines. Pollution is a noise derived from the verb pollute. Section 2(c) of

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the Environment (Protection) Act, 1986 defines environmental pollution to mean the presence in the environment of any environmental pollutant. Section 2(b) of the said Act defines environmental pollutant to mean any solid, liquid or gaseous substance present in such concentration as may be, or tends to be injurious to environment . Noise can be described as sound without agreeable musical quality or as an unwanted or undesired sound. Thus, noise can be taken as a group of loud, non-harmonious sounds or vibrations that are unpleasant and irritating to ear.

5.1 Industrial Noise Measurement Technique

This study has been carried out at concrete traverse, iron and steel, cement and textile factories around. Actual noise levels in these industries have been measured and their maximum and minimum values have been placed in the associated Tables. A sound level measuring instrument (TES 1350 Sound Level Meter) was used in these measurements. Measurements results have been recorded by holding the instrument at a height of 1.5m from ground in living and working environments of the workers in order to determine the noise levels to which the workers are exposed. Iron and steel industry was not operating during this study, but a survey has to be conducted also in this industry due to the high level of noise incorporated and large number of workers involved in the iron and steel industries. For this purpose, noise levels corresponding to the iron and steel industry have been taken from a similar study made in the past.

Noise Measurement Results

As shown in Table 5.1 the highest noise among these industries was detected at the cement (106 dBA) andconcrete traverse (107 dBA) factories. Comparison ofthese results with the standards taking place in the Noise Control Regulation shows that none of the industries subject to this survey are meeting the associated standards.

Industries	Max (dBA)	Min (dBA)
Textile	99	75
Iron & Steel	100	77
Cement	106	70
Concrete Traverse	107	80

Table 5.1 Industrial Noise Measurement Results

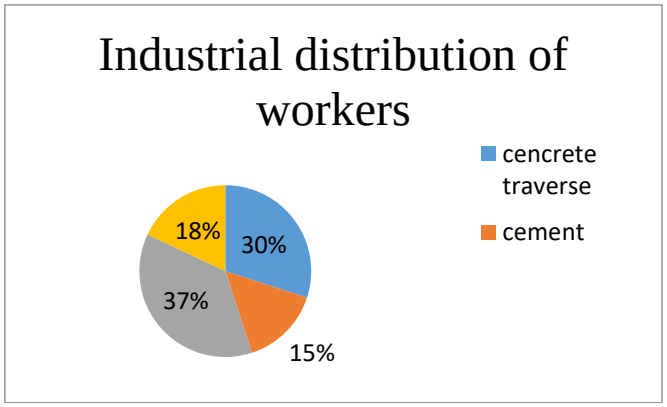

Figure 5.1 Industrial Distributions of Workers

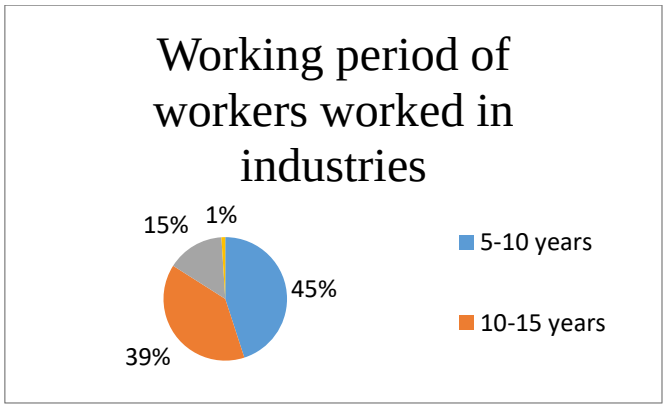

Figure 5.2.Working Period of Workers Worked In Industries

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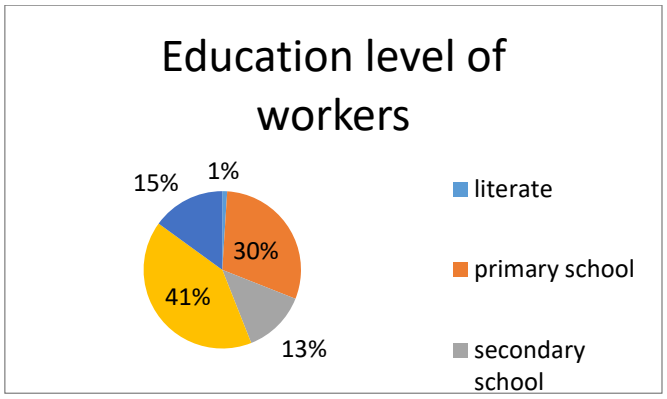

Figure 5.3 Education Levels of Workers

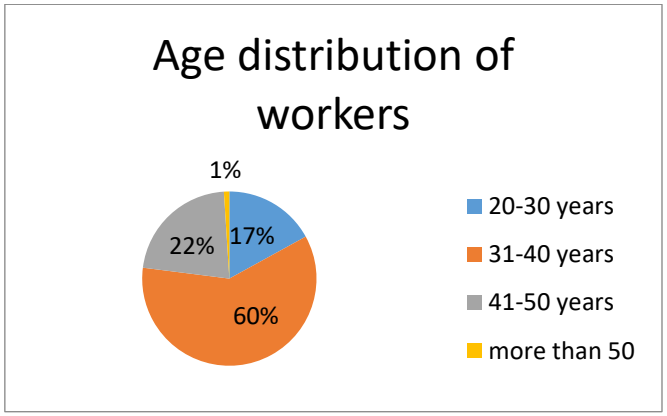

Figure 5.4 Age Distribution of Workers

When the ages, working periods and education levels were compared, it has been specified that the majority of the workers were from service period range of 5-10 years, age range of 31-40 years and are generally high school graduates.

The following points have been determined during the studies;

- In the concrete traverse factory, 28% of the workers in the production department are exposed to a noise level of 107 dBA while 74% of the workers in the whole factory also were exposed to a noise level much above the standards specified in the Noise Control Regulations.
- In the textile factory, 60% of the workers were exposed to a noise level of maximum 106 dBA and they are working at the mill department.
- At textile and cement factories, the majority of the workers are working in very noisy environments. Looking at the level of disturbances from industrial noise in these industries, 73.83% of the workers (189 participants) have complaints about high level of noise in general. As shown in Table 2, the concrete traverse factory among these industries is the one with the highest level of disturbance from noise (maximum of 107 dBA). The rate of disturbance was never below 60% in any one of the factories, indicating that the problem of noise exists in all these industries.

By examination of the rates of disturbance in the workers depending on their working periods, it has been observed that there is no significant relation between the working periods and the disturbances from noise. As shown also in Table 3, the rate of disturbance from noise among the workers working for 5-10 years is 73.68% while this rate is 100% among workers working for more than 21 years. These results are considered to be statistically important, but they are not yet convincing. The workers have been asked about the type of their complaints, and 60.96% of the 228 workers responding to this question have complained about nervousness. When all the industries are considered individually, it has been specified that maximum level of nervousness complaint was determined at the cement factory having a noise level of 105 dBA (67.65%)

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Industries	Annoyance from Noise					
	Yes		No		Total	
	N	%	N	%	N	%
Textile	35	77.78	10	22.22	45	17.6
Iron & Steel	70	72.92	26	27.08	96	37.5
Cement	24	61.54	15	38.46	39	15.3
Concrete Traverse	60	78.95	16	21.05	76	29.8
Total	189	73.83	67	26.17	256	100

Table 5.2 Annoyance Levels of Industrial Workers

Working period (Years)	Annoyance from Noise					
	Yes		No		Total	
	N	%	N	%	N	%
5-10	81	71.68	32	28.32	113	44.66
11-15	77	77.78	22	22.22	99	39.13
16-20	28	73.68	10	26.32	38	15.02
>20	-	-	3	100.00	3	1.18
Total	186	73.52	67	26.46	253	100

Table 5.3 The relationship between working periods and level of annoyance of workers

Annoyance	Industries									
	Textile		Iron & Steel		Cement		Concrete Traverse		Total	
	N	%	N	%	N	%	N	%	N	%
Nervousness	27	64.29	46	57.50	23	67.65	43	59.72	139	60.96
Dizziness	5	11.90	7	8.75	7	20.59	4	5.56	23	10.09
Insomnia	6	14.29	8	10.0	3	8.82	17	23.61	34	14.91
Tiredness	3	7.14	15	18.75	0	0	7	9.72	25	10.96
carelessness	1	2.38	4	5	1	2.94	1	1.39	7	3.07
Total	42	18.42	80	35.08	34	14.91	72	31.57	228	100

Table 5.4 Annoyances Observed By Workers in Different Industries

Industries	Hearing complaints					
	Yes		No		Total	
	N	%	N	%	N	%
Textile	18	40	27	60	45	17.57
Iron & Steel	23	23.96	73	76.04	96	37.5
Cement	13	33.33	26	66.67	39	15.23
Concrete Traverse	25	32.89	51	67.11	76	29.68
Total	79	30.86	177	69.14	256	100

Table 5.5 Hearing complaints at different industries

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Industries	Hearing Test					
	To be done		Not be done		Total	
	N	%	N	%	N	%
Textile	21	46.67	24	53.33	45	17.57
Iron & Steel	19	19.79	77	80.21	96	37.5
Cement	18	46.15	21	53.85	39	15.23
Concrete Traverse	57	75.00	19	25.00	76	29.68
Total	115	44.92	141	55.08	256	100

Table 5.6 The level of hearing test in Industries

Carelessness is the disturbance type with the lowest rate of appearance (3.07%). Looking at Table 5.3, it is possible to state that the most significant disturbance caused by noise is nervousness. Examinations made on the type of hearing problems indicate that 30.86% of the workers are generally complaining about illnesses like ringing and leakage in the ears as well as hearing loss (Table 5.6). Distribution of hearing problems according to industries is 30.86% concrete traverse, 33.33% cement, 23.96% iron and steel, and 40% textile factories. As seen in these results, the textile industry was the one where the highest level of complaints (40%) determined with regard to the hearing complaints among the industries at Sivas. Looking at the relationship between hearing problems and noise disturbance, it has been observed that com plaints of 34.9% of the workers disturbed from noise are related to hearing problems, indicating that noise is affecting the hearing members. When workers were asked to answer the question "did you have any hearing tests before?" it was determined that 44.92% of the workers had hearing tests; and, with regard to the distribution to industries, it has also been determined that most of the tests had been carried out at the concrete traverse factory (Table 6). Factory manager's expressions about having such tests each year support this fact. The rate of hearing tests made in the iron and steel industry is 19.79% and it indicates that these tests are not carried out there on a yearly basis. These results have also been found statically important ($p < 0.05$).Examination of the hearing test results indicated that 77workers (30.70) have hearing loss and, according to these results, distribution of these workers with hearing problems to industries is: 37.66% in concrete traverse factory, 25.97% textile factory, 20.77% iron and steel factory, and15.58% cement factory (Table 5.6). These results have not been statistically important ($p > 0.05$). As indicated by the results, the cement factory has the lowest noise level value (15.58%) among the industries with high noise levels. The cement factory has a 30.76% rate of hearing loss in its process. As can be understood from this result, the workers have refrained from giving correct answers to the questions on their hearing problems due to the factory being a private sector organization. It is very normal to observe that 37.68% of the workers with hearing losses are working at the concrete traverse factory having a maximum noise level of 107 dBA. As shown in Table 7, 85.94% of the workers in the above industries do not have annual hearing tests. The rate of annual hearing tests in concrete traverse factory is 35.53%. This rate in the other industries is much under 10%. It shows us that hearing tests are made only at the concrete traverse factory each year or at least once in every two years. It has been observed that there are noise problems in all the industries at which these measuring and questionnaire studies have been conducted. For this reason, it has been necessary to make a survey on the level of using the ear protection accessories for protection against noise and it has been determined that the rate of using them was 32.94%. According to the survey results, the rates of using ear protection accessories are: 7.69% in the cement factory and 60% in the concrete traverse factory ($p < 0.05$). This subject has not been reviewed as there was no relationship between usage of ear protection accessories and the level of noise in the factories. When workers were asked what kind of measurements should be required to protect them from noise, a great majority of them pointed out that measurements should be taken at the sources of noise. The rate of 9.31% supporting the use of ear protection accessories indicates that workers do not prefer the use of such protection devices.

6.METHODS OF NOISE CONTROL

The combat of noise is a problem of work and is represented by the assembly consisting in noise sources, the propagation medium of the acoustic energy and noise receptors.

The methods of noise control are

1. Methods of noise control at source
2. Methods of noise control on the pathways
3. Methods of noise control at receiver.

Combating at source, on transmission path from source to receiver constitute the active protection and the reducing noise on the transmission paths or at receiver is the passive protection. The methods of reducing noise at source are the most efficiency of assuming that since the design phase of a system or a car to consider solutions to obtain their quiet operation.

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9.RESULT AND DISCUSSION

It has been determined during our measurements that the noise levels in all the above industries are much above the noise level of 80dBA specified in Noise Control Regulation.

Industries	Hearing Test					
	be done		Not done		Total	
	N	%	N	%	N	%
Textile	1	2.22	44	97.78	45	17.57
Iron & Steel	5	5.21	91	94.79	96	37.5
Cement	3	7.69	36	92.31	39	15.23
Concrete Traverse	27	35.53	49	64.47	76	29.68
Total	36	14.06	220	85.94	256	100

Table 9.1 The condition of periodical hearing tests done by workers working different industries

According to results of the questionnaire applied to the above industries:

1. 73.83% of workers in the industries are disturbed from the noise in their workplaces.
2. Noise causes the problem of nervousness on workers at a rate of 60.96%.
3. 30.86% of the workers have ailments like ringing in the ear, hearing losses, etc.
4. 85.94% of the workers do not have periodical hearing tests.

Ear protection accessories are being used in the industries by a rate of 32.94%. The rate of using ear protection accessories at the cement factory at which the noise level is the highest is at 7.69%. As indicated, the industries at Sivas have the problem of noise.

CONCLUSION

Noise pollution is a form of environmental pollution it's not any less dangerous than other types of pollution, therefore interest in it was raised newly because of its consequences on members of noise exposed societies according to the location and time periods. Most of our day-to-day activities, by knowingly or unknowingly every one of us contribute to generate noise pollution. Often neglected, noise pollution adversely affects the human being leading to irritation, loss of concentration, loss of hearing. Efforts shall be made to identify the sources of noise pollution and the reasons for increase of noise levels. Efforts shall be made to reduce the undesired noise levels from noise generating sources. This leads to marginal reduction of noise levels at the source. If it is still un-bearable then scientific methods of noise control can be employed. The Statutory Regulations have prescribed the noise level exposure limits. In this project we attempted to measure the damage economically, of what noise pollution leaves of losses on individuals and diverse economic projects. As a result of the study and observation, it shows that machines and equipment produce high levels of noise and there are attempts to use barriers to stop noise from spreading to other sections. Factories distribute protecting equipment to lower noise levels to the permitted limit like sound proof materials and ear plugs. The study shows the effect of noise on a worker's performance, that it has negative effects on their health and efficiency, and that it causes losses for workers, factories and the overall economy. Whereas the study has shown that noise pollution has no effect on the profitability of industrial factories.

Recommendations

1. The problem of noise should be taken into consideration during their establishment phases (construction of the building, allocation of the machinery, etc.).
2. Use of the latest technology should be provided in the industries.
3. Authorized persons should arrange the working periods for workers according to the level of noise in workplaces.
4. New workers who will work at noisy workplaces should be subject to hearing tests and other tests regarding related illnesses.
5. Suitable protection accessories should be provided for the workers who will work in noisy environments and they should be trained on regular usage of such accessories.
6. Hearing tests should be performed periodically each year at noisy workplaces.
7. Employers and workers should be trained on noise and its effects on human health.

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