

Chapter 13

Noise Pollution

Noise denotes confused, disagreeable and irritating sound, causing a lot of disturbances to the people. Noise may be of two types, viz. (i) meaningful noise which is intended to draw the attention of a person or people nearby, as in the case of a baby crying or a person in danger, calling for help. (ii) Meaningless noise made at the time of quarrel or any social or political disturbances. These will be very much annoying, as well as unwanted. But, these type of sounds may be wanted by the people who are interested in that and paid for them. Hence, what is noise to one may be music to another. Any sound which is soft and rhythmic may be acceptable for a short period. But, when the sound becomes loud and random, it is disagreeable to the person.

Thus, noise is an unwanted and unwarranted sound created at a wrong time and in a wrong place, causing physical and psychological disturbances to the people who are subject to the hearing of that noise. Noise is a pollution in the otherwise silent atmosphere and is the result of various types of human activities. Excessive noise may be the cause of hearing impairment, increasing accidents and decrease in the efficiency of the people. Noise pollution will be very high in industrial and urban centres than in rural areas where it will be occasional.

Mechanics of noise and its measurement

We should understand the elementary mechanics of noise in contrast to ordinary sound of communication between persons. What exactly we mean by *loudness* as a human perception? Sound has several physical properties like "frequency" and "intensity". It spreads in the air like compressed waves. Just as a piece of stone is dropped into the water giving expanding circles of water-waves from the centre to the periphery, the sound waves move and reach the person's ear. This is exactly the "frequency" of the sound. "Pitch" is the human perception of sound frequency and intensity. Sound is also an energy which depends on the intensity per unit area. The term "Hertz" is the measure of sound energy, or unit of frequency equal to one per second.

Human beings can hear only if the frequency exceeds some limit which is called 'audible'. The range of frequencies of human speech may be from 200 to 3000 Hz. Sound with very high frequency, say more than 20,000 Hz is called 'ultra sound' and which is too low, i.e., below 20 Hz is called 'infra sound'. The response to ear to sound is proportional to the logarithm of its intensity or pressure. (The loudness of the sound is expressed in terms of unit called "Decibel" (dB). In Latin 'deci' is 'ten' and 'bel' is the logarithm of a ratio. The decibel of a sound is measured in terms of ratio of intensity of reference sound.) The formula is:

$$\text{Decibel or dB} = 10 \log \frac{\text{Sound intensity measured}}{\text{Reference sound intensity}}$$

Zero dB is just the threshold of hearing. If a sound is 100,000 times louder (more intense) than the reference level, it would be called 50 decibel sound or 50 dB. The reference sound intensity is based on U.S.A's criterion in which the intensity is 10^{-12} watts per square meter. This sound intensity is barely audible. If two persons carry on normal conversation, it will be around 60 dB sound level. In the places of heavy traffic, the sound pressure will be 80 to 100 dB. A motor-cycle's sound at a distance of 25 feet will have 90 dB; a jet plane at the time of take off will give about 150 dB sound; and for space rocket, at the time of launching will be 170 dB. Generally, if the sound exceeds 70 dB, it will be annoying and if it exceeds 140 dB the sound will become painful.

Measurement of noise levels in decibel is done with an instrument called sound level meter. It consists of three internationally accepted weighting networks, viz., A, B and C. Industrial noise levels are measured with weighting network 'A' and accordingly, the readings are designated as dBA (decibels measured on network A)

Acceptable noise levels for different situations are given in the Table 13.1

Table 13.1
Acceptable Noise Levels

Location	Acceptance noise level range, dBA.
Indoor:	
1. Radio, T.V. Class room	25 - 30
2. Hotels, Conference hall	35 - 40
3. Offices and Court rooms	40 - 45

Location	Acceptance noise level range, dBA
4. Public offices and Banks	45 - 50
Outdoor:	
1. Urban residential area	35 - 45
2. Urban business area	45 - 50
3. City	45 - 55
4. Industrial area	50 - 60
5. Rural area	25 - 35

Recommended Sound Level

Exposure to too much of noise for a protracted period every day can impair hearing. Any noise levels exceeding 75 dBA for more than eight hours a day, would lead to deafness. Other effects include hypertension, disturbance in sleep, speech interference etc. According to a World Health Organisation (WHO) study, 35 dBA of sound level is recommended for good sleep. If the sound level exceeds this, either the sleep will be disturbed or it will be very difficult to sleep. On the basis of extensive research into human response and preferences, the W.H.O has recommended noise assessment criteria in the form of noise exposure limits which are as follows:-

Table 13.2
Noise Exposure Limits

Environment	Recommended maximum level dBA
Industrial: Occupational community	
(Urban)	75
(i) Day time	55
(ii) Night time	45
Indoor: Domestic	
(i) Day time	45
(ii) Night time	35

Further, standards to control urban noise pollution have also been laid down. The recommended ambient noise level limits for the various areas are as follows:

Table 13.3
Ambient Noise Level Limits

Area	Day time (6 AM to 9 PM) dBA	Night time (9 PM to 6 AM) dBA
Industrial area	75	65
Commercial area	65	55
Residential area	55	45
Silence Zones:		
100 meters around: Hospitals Educational Institutions Courts	50	45

CAUSES OF NOISE POLLUTION

There are various causes for the noise pollution in the modern world and the sources contributing to this are too many and most of them are symbols of civilisation, development and progress of society.

Automobiles and industrial units are the primary source of noise pollution. These, besides creating water and air pollution, also contribute to noise pollution to the localities nearby.

Jet planes, trains, generators and fast moving trucks create lot of noise pollution, besides vibrations on the surface of the earth.

In cities, construction of buildings, especially multi-storied ones are the principal sources of noise. Bull-dozers, cranes, compactors, excavators, concrete mixers etc., create abominable noise, besides the exact construction work through pile foundation, moulding, drilling, polishing for mosaic flooring etc.

In industrial centres, the working of the engines, rotary drills, riveters, pumps, motors, furnaces, turbines, compressors, vibrating screens and many pneumatic equipment also contribute their share of noise pollution.

In heavy traffic zones, the noise created exceeds tolerance limits of city limits. Besides, the structural defects of the moving traffic, blowing of horns, using horns of various kinds with blaring sounds, the unethical driving of the vehicle and use of horns, particularly in the public transport system and truck drivers even in 'No Horn' zones would add to the problem of sound pollution. Narrow streets and roads, encroaching the platforms of the pedestrians by hawkers and vendors, indiscriminate parking of vehicles for loading and unloading, non observance of the rules of the road, disobeying traffic signals and driving very fast with bravado spirit etc., cause frequent traffic jams leading to unnecessary hooting and blaring of horns and consequent wordy quarrel.

Market places in any city or town are noted for their disturbing noises. But, in many cities and towns in India, these markets will not be provided with separate market yards or entities and in most cities the markets will function on the roads and streets. The noise of the road and the noise of the market would become unbearable, causing severe damage to the health of the people of the locality.

Another disquieting feature in our country is the display of loud speakers, recorded music at high pitch, firing of crackers during festivals, social, religious and political functions. The noise pollution during periods of general elections or local elections is well known. Most of the people in our country are quite indifferent to the effect of noise on others. India is one of those few countries of the world, permitting many unsocial activities and also processions of agitating strikers, disgruntled politicians and dissatisfied groups of the society, without much concern for the general welfare of the public. In this context the state of affairs in foreign countries like Japan, USA, France and Switzerland is worth noting, as well as emulating. In these countries the loud speakers are banned and the traffic noise is highly regulated. In Japan, flights are not permitted to land or take off during night hours.

In addition to noise pollution outside, modern civilization and culture of living have added to the pollution inside the buildings as well. Modern dwellings are associated with many types of utility articles and gadgets to make living easy and comfortable. In modern days, barring the "lowest income" group, all sections of the society make use of radio, TV sets, tape-recorders, wet-grinders, mixies, washing machines and also two-wheelers which are sources of noise pollution inside the buildings. Affluent groups make use of motor for water-lifting and generator for electricity. All these modern equipment of cultural living contribute towards noise pollution.

Effects of Noise Pollution

Noise pollution may lead to many disturbances in human system. It may be physiological or psychological.

The primary effect of noise is the *disturbance of sleep* for human beings. Noise interferes with deep sleep and thereby interrupts sleep. For human beings, good sleep is absolutely essential for maintaining physical health and also emotional stability. Too much of aggravating noise and frequent disturbance of sleep will lead to *emotional disturbance* and also distress, which may ultimately lead to mental illness. For getting sound sleep, the noise prevailing in the ambient air should be less than 40 dBA. Noise beyond this level will disturb sleep. Dogs barking during the night and telephone ringing will have sound decibels ranging from 55 to 75 dBA, by which we are disturbed.

Sounds exceeding 45 dBA and ranging upto 65 dBA will cause *disturbances in the digestive system*. These noises will be mostly occupational and street noises which will be non-rhythmical and also annoying. Sounds exceeding 65 dBA and ranging upto 85 dBA caused by cracker sounds, working of mixer, working of motor etc., may cause *strains in the nervous system* causing anger, violence and other disturbing emotions leading to *mental illness*. Noises beyond 85 dBA and upto 120 dBA are most offending caused by trucks plying, trains, aeroplanes and factories. The impulses transmitted through these sources attack ear drums, gradually making a person *deaf*.

At high levels of pollution beyond 120 dBA, there are greater chances of the *impact on respiratory system, causing dizziness, disorientation, loss of physical control, nausea and vomiting*. Nerve fibres inside the ear carry sound impulses of shrill sirens and trumpets to the medulla of the brain, wherefrom they are transmitted to other parts of the brain, including centre of consciousness and other centres regulating breathing, blood pressure etc. Hence, very high sound near the ear may lead to the person becoming *unconscious*. High sounds may cause increased secretion of many hormones, which in turn *aggravate blood-sugar levels and decreasing efficiency of liver*.

Noise generated in factories and industrial units affect the workers first and they are susceptible to occupational hazards. For them, even short exposures to intense noise can shift upward the hearing threshold, while prolonged exposure over a long period produces a damaging effect on hearing, resulting in *partial deafness*. In some cases, it may cause "Tinnitus" (i.e., ringing sound inside the ear)

Noise measurement equipment

There are various types of instruments and equipment to measure the intensity of noise prevailing in the air at a particular place. These are: (1) Sound level meter (2) Octave Band Analyser

(3) Cassette Recorder (4) Magnetic Tape Recorder (5) Pen Recorder.

Sound level meter is an equipment with a microphone and amplifier in which the pressure of the sound received is transferred into a proportional electric signal indicated by a meter. These are used for evaluating sound pressures on linear or weighted scale.

Octave Band Analyser is an additional accessory which can be fitted in sound level meter. This gives information regarding the frequency content of a noise to identify the noise source and also in selecting ear protectors.

Cassette Recorder is used for storage of noise for evaluation. It can be used for digital recording of sound pressure levels for computer evaluation. Magnetic tape recorder is used to record the noise more accurately and this instrument is fed through a sound level meter or microphone.

Pen Recorder can be fed from a sound level meter or from a magnetic tape recorder. This gives a continuous record of sound pressure level against time. This data can be used either for storage or for obtaining approximate statistical levels by inspection. There are various codes, standards and guidelines for noise measurement and also monitoring indoor and outdoor situations.

NOISE CONTROL MEASURES

In India, the Environmental (Protection) Act, 1986 recognises noise pollution as an offence, and as per section 6(1)b of the Act, the government is empowered to make rules and regulations to control the pollution, including noise pollution. Besides this, Indian Penal Code, the Motor Vehicles Act 1939, and the Industrial Act, 1951 also contemplate on noise pollution. In spite of these legal measures, the problem could not be tackled effectively and it continues to cause inconvenience to the people. The main reasons for this are as follows:

(i) The concept of noise pollution is rather vague and it is very difficult to set up a standard of permissible limit. Though by human perception we may perceive what is noisy and what is not so noisy etc., the concept differs from individual to individual and also the circumstances. What is noisy to elders may not be so for youngsters. (ii) Secondly, it is very

difficult to measure the intensity of noise pollution in a region, as the process requires many sound measuring equipment and monitoring the levels of sound to prescribe standards for noise pollution. Non-availability of appropriate equipment and personnel with adequate training in this branch of Physics may be one of the causes. (iii) Thirdly, the lack of will on the part of the government to enforce the provisions of the Act. Lack of enthusiasm on the part of the people to cooperate with the government in these matters and also the loopholes in the law which make the offenders escape easily with little punishment make the implementation of legal measures very difficult.

However, the following approaches to noise-control measures would give better success:-

(a) There may be practices prevailing at present in our social, cultural, religious and political activities which contribute to noise pollution. These practices and procedures could be modified to minimise the noise.

(b) Effectively shielding the noise at the source itself, by using sound-mufflers and silencers.

(c) Isolating noisy centres far away from the town or city. For example, the factories and airports may be isolated from the town limits.

(d) Using noise preventing devices by the people, like ear plug and sound mufflers.

In industries, the problem of noise should be controlled by effectively implementing the provisions of the Act. This will have two approaches, viz., (i) Administrative Control (ii) Engineering control. The former is a short term measure which protects the workers from exposing to much of pollution beyond permissible limits. Work by rotation and controlling the noise inside the factory etc., come under administrative methods. In the latter approach, the measures on the engineering side of the factory could be introduced to reduce the noise at source; controlling the noise in its path; and finally protecting the personnel affected.

Using of *Mufflers* and *Silencers* should be encouraged in all industrial machinery to reduce the noise. A muffler or silencer is a pipe or duct properly shaped for reducing sound transmission, while at the same time will not affect the working of the parts inside or free flow of gas. There are two types of this contrivance; one is *dissipative silencer* and the other one *reactive silencer*. The former type works on the principle of absorbing noise with acoustical absorbent linings in it;

while the latter works on the principle of reflecting and containing the sound within. Some mufflers will combine both these effects. Adequate designing of the machines in appropriate places fitted with mufflers depending on the frequency and intensity of the noise would contain the noise very effectively. Besides, there are many techniques in 'engineering' by which the noise could be controlled.

On the workers side of protection from noise disturbances, Ear-plugs should be used by the workers while on duty inside the room where machinery works. There are different types of ear-plugs depending upon the nature of the work and extent of pressure created by the noise from machinery. In some cases, Ear-muffs and Helmets may be used where complete isolation and protection of the ears are warranted. Isolation of workers in an air-conditioned antechamber while the processing operation is going on may also be attempted in automated plants, where only a few workers attend the processing operations.

Awareness about ill-effects of noise pollution should be created among the workers by properly educating them. Above all, the public should be educated through various media about the various causes and serious consequences of pollution. The awareness created should be such as to make them cooperate with the government in the programme of noise control.

There should be strict administrative measures to prohibit the use of public address system; use of amplifiers and also other instruments causing disturbances, especially during odd hours and night.

Noise made by vehicles could be reduced by totally banning honking and streamlining traffic flow, besides ensuring good body and silhouette designs. More than anything else, the rules framed in keeping noise levels low should be strictly implemented. All products used in automobiles including horns should be labeled according to noise standards.

NOISE POLLUTION IN THE DEPTHS OF THE SEAS

In making noise pollution, man has not left any part of the globe. His increasing activities result in the disturbance of even oceans. The depth of the oceans and seas are increasingly disturbed with man-made sounds, in addition to natural sounds.

Recently, in the *Acoustical Society of America* in Denver, many scientists exhibited evidences and also expressed their concern about the welfare of marine mammals threatened by noise of human origin.