

NOISE POLLUTION

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Introduction:

Sound is an integral part of life. It has a great impact on the environment. Unusual sound can disturb any human being, birds, animals and their activities. Sound is a necessity within its usage limits. It is possible for us to communicate each other only because of sound. It is a tool for all communications.

Any undesirable sound is called as noise pollution. Environmental problems include many anthropological hazards, in which noise pollution is of primary significance. Though, noise is a controllable entity of the environment, on several occasions it is found to be uncontrollable. It creates severe impacts on life and induce unpleasant circumstances. Noise pollution is a public nuisance to the environment. The following modules are covered in this episode:

1. Characteristics of Sound and Noise
2. Noise pollution and its causes
3. Measurement of noise pollution
4. Environmental impact of noise pollution
5. Methods of controlling noise pollution.

1. Characteristics of Sound and Noise

Sound is a wave motion in air. It is caused by the vibrations of air molecules.

A sound wave is characterised by its frequency and an amplitude (magnitude). The number of compressions or rarefactions produced by a vibrating object, each second, is called as the frequency of a sound wave. The more rapidly an object vibrates, the higher will be the frequency.

The relationship of frequency f of a wave having a wavelength d and the speed of the wave, denoted as v , is :
 $f = d / v$. Frequency is measured in the unit called Hertz.

One hertz equals one cycle or vibration per second. Frequencies are laid out in octaves in the same manner as a piano key board. In the subject of music, the term octave means the interval between any two sounds having a frequency ratio of 2:1.

The frequency of 256Hz is approximately in the middle part on the piano and the higher octave is 512Hz. The top note is equal to 4096 Hz. (1000Hz equals 1 kHz). Based on frequency, sound is classified into the following ranges:

Infrasound when frequency is below 20Hz.

Audible sound with a range between 20Hz to 20 kHz.

Ultrasound above 20 kHz

Normal Speech range from 500- 2000Hz.

Wavelength is the distance between two crests or the troughs of a wave. The intensity of the wave depends on the amplitude of vibrations. As the frequency of waves increases, the wavelength decreases. Different sounds have different frequencies. The human ear is more sensitive to a wide range of intensities. Any louder sound is called as a noise.

Human ear can hear sounds with frequencies ranging from 20 to 20,000 hertz. Some animals can hear sounds with frequencies far above 20,000 hertz.

Pitch is the degree of highness or lowness of a sound as perceived by a listener. The frequency of a sound determines its pitch. Musical instruments can produce a wide range of pitches.

A tuning fork produces an almost pure tone, with only one frequency, or rate of vibration.
Musical instruments produce harmonic sound which contains many frequencies, called overtones.

Sound waves must travel through a medium. The speed of sound is much slower than the speed of light. Light can travel even in a vacuum. But a sound can not. The speed of sound depends on the properties of the medium of travel, like density and compressibility. Sound travels faster through liquids and solids than it does through air.

Sound travels about 4 times faster through water and about 15 times faster through steel.

The speed of sound through air is commonly measured at sea level at 15 °C. At that temperature, sound travels at 340 metres per second. However the speed of sound increases when the air temperature rises. For instance, sound travels at 386 metres per second through air at 100 °C.

Sound waves lose their intensity as they spread outward in all directions from the source. Thus, the loudness of a sound decreases as the distance increases between a person and from the source.

Jet planes sometimes fly at supersonic speeds. A plane flying faster than the speed of sound creates shock waves and strong pressure disturbances that build up around the aircraft. People nearer to that aerodrome can hear a loud noise, known as the sonic boom.

A noise can be defined as the unwanted or an unpleasant sound harmful to life. It comes due to

- 1) The intensity of sound waves
- 2) Its frequency
- 3) The time of exposure and
- 4) The continuity of sound.

Noise may be classified as hazardous noise or industrial noise
and disturbance noise or environmental noise.

Noise radiates from vibrating surfaces and from vibrating gases. Noises are also produced by vibrating objects that send out irregular vibrations at irregular intervals. Such noises include the barking of a dog and the roaring of a crowd.

Many machines and devices, such as
flour mills,
hand drills,
air conditioners,
vacuum cleaners, and
the engines of motor vehicles also produce noise.

Natural events like
earth tremors,
thunders,
volcanic eruptions and
cyclones also create noise.

Noise may be a single event impulse or a continuous impulse.

In impulsive sounds, the vibrations will start suddenly and die out quickly. Gunshots and fire crackers are impulsive sounds.

Any textile mill or a flour mill produces a series of impulsive sounds.

Noise has many Categories:

A noise is a combination of a number of frequencies. Based on its occurrence and time, it is classified into:

- 1) Steady state noise
- 2) Impact noise
- 3) Intermittent noise.

It is a fact that not all sounds are detectable by human ear.

The sound outside the range of human hearing is classified as ultrasound and infrasound. Ultrasound is the sound beyond the upper limit of normal hearing in which the freq. Exceeds 15 khz. Infrasound if the sound below the lower limit of normal human hearing with a freq. < 16 hz.

2. Noise pollution and its sources

Any disturbance made to the environment by creating an unwanted or uncontrollable sound is called as noise pollution.

Noise pollution is considered as an offence. It causes a major inconvenience to the people. It is a public nuisance. Noise does not pollute the air, water, or land, but it can cause discomfort and hearing loss in human beings and other animals.

Noise pollution comes from many sources.

Man-made noise pollution basically arises from industries and transport.

Jet planes,

vehicles,

railway engines,

motors of factories,

generators,

construction and mining machinery,

TV,

Radio sets and the public addressing systems are the tools making noise pollution.

Enormous Crackers are used during some occasions or festivals. Such activities create a very louder noise to the level of harming the public.

Sometimes, they may even cause deafness to children. The industrial noise caused by the continuous operation of mills, machines and pneumatic drills, is unbearable nuisance to the workers.

Sources of noise may be classified as single noise source and multiple source noise.

The sound intensities can be measured on a scale of values called a decibel (dB) scale. This is a logarithmic scale. It is the ratio between a measured quantity and an agreed upon reference level. The threshold of normal hearing is considered as a threshold value.

Twenty micropascals is the minimum level at which a person can hear a sound . This is defined as 0.0 dB.

The following table gives the noise levels in decibel scale of different environments.

0	Softest sound
10	Just audible
30	Ticking of a watch
40	Soft whisper
50	Light traffic / Business office
60	Normal Conversation / AC unit 6m away
70	Vacuum cleaner / Average traffic
80	Garbage disposal
90	Motor cycle /Train
100	Air compressor / Milling machine
110	Jet fly, farm tractor
120	Textile Loom, Auto Horn
130	Max. Recorded Rock Music
140	Siren
150	Jet Plane take off
180	Rocket Engine

The Environmental noise comes from various sources. They are

- a. Road Vehicle Noise
- b. Factory Noise
- c. Office Noise
- d. Building Noise
- e. Auditoria
- f. Railway noise
- g. Traffic Noise
- h. Aircraft and helicopter noise
- i. Pop Music Noise

3. Measurement of noise pollution

The study of sound began in ancient times. As early as the 500's B.C., Pythagoras, a Greek philosopher and mathematician, conducted experiments on the sounds produced by vibrating strings. Pythagoras is said to have invented the sonometer, an instrument used to study musical sounds.

A Sound level meter is an acoustic instrument designed to respond to a sound in the same way as a human ear hears it. It consists of a good quality microphone, an amplifying circuit, an indicating meter, power supply and tuned filters. It measures the sound in decibel scales.

A Decibel is a unit used in comparing sound pressure, voltage, power, and some other related acoustic and electrical quantities. It is represented by the symbol dB.

The noise levels are classified depending upon their effects as

1. very loud - 70 - 100 dB
2. uncomfortably loud - 100 - 130 dB
3. Painful - more than 130 dB.

There are two concepts or criteria related to the noise pollution.

They are:

1. Sound Pressure Level (SPL)-This is nothing but the human perception of sound. It is variable from person to person. It will also be varying in a city from morning (60 dB) to Evening (100 dB).
2. Noise Exposure Limits (NEL): The World Health Organisation(WHO) gives the Noise Exposure Limits to the human environments. This is the allowable level beyond which the noise can not be tolerated.

The NELs during day and night are given here in decibel scale.

Place / Environment	Day	Night
1. Industries	75	65
2. Commercial complex	65	50
3. Residential complex	55	45
4. Domestic areas	45	35

Educational Institutions,
Hospitals and
courts are coming under the fourth group.

4. Environmental impact of noise pollution

Sound is unwanted if it is annoying or distracting, or if it damages the hearing mechanism. People exposed to a loud noise for a long time may suffer temporary or permanent loss of hearing.

Noise pollution causes speech interference, physiological effects, behavioral effects, annoyance, effects on efficiency and mental health effects.

A loud noise can damage a person's hearing. Exposure to loud noises can lead to serious hearing loss by damaging the organ of Corti. Extremely loud noises, such as explosions or gun blasts, can produce sudden deafness.

Exposure to loud noise over a long period of time can also gradually cause permanent loss of hearing. Many people who work in extremely noisy environment like factories eventually suffer considerable hearing loss. Listening for long periods to the loud music, played by many rock music bands, can also damage hearing.

Workers continually exposed to loud noises may wear earplugs, earmuffs, or special helmets. The major health effects of noise pollution are varied. The serious effect is the impairing of hearing which comes due to the sudden damage of the auditory system by higher noise levels.

Impulsive noises are more dangerous than continuous noises and are capable of creating deafness. Very loud, sudden noise can damage the drum of the ear. Continuous exposure to some noise levels will also cause temporary and permanent hearing loss.

The noise level exceeding 75 dB for more than 8 hours daily can easily impair hearing.

The other effects of noise pollution are:

1. Hypertention
2. Disturbance to sleep
3. Speech interference
4. Stress reactions
5. Disturbance to working, writing and other activities.

The impact will be more to the workers of the industries. Some times noise pollution may affect the functions of the cardiovascular system, rate of heart beat and may cause fluctuations in the blood pressure.

Startle reaction is the one which is developed in the body when a sudden and high intensity pulse of sound is produced. Noise also cause headaches and irritability.

5. Methods of controlling noise pollution.

There are three basic techniques which could be adopted to control noise pollution.

They are

1. Reduce the source (at source level),
2. Interrupt the path of transmission and
3. Protect the receiver (ear).

Some of the preventive measures are :

1. Industrial Noise Control

- a. Reduction at source by replacing the noise producing machines with quiet alternatives. Eg. The Noise of a fan, can be minimized by reducing either the speed or increasing the blades.
- b. Sound proofing - equipment should be covered with insulating materials.
- c. Acoustic zoning of the environment.
- d. Protection devices to workers (use air muffs).

2. Community noise control

Certain areas of the township, city limits are to be declared as specific noise level zones so that noise could be controlled.

In some of the developed nations, People do not use the horns while driving the vehicles and automobiles. They mostly use signal lamps and indicators on roads. Participation of the Public with whole-hearted support is necessary in reducing the community noise.

Environmental acoustics involves the control of noise pollution, a widespread problem in many residential areas. Major sources of environmental noise include motor vehicles, aircraft, industrial plants, and heavy construction equipment.

Noise pollution can be controlled in three ways:

- (1) by quietening the source of the noise,
- (2) blocking the passage of noise from one place to another, and
- (3) by absorbing noise energy.

For example,
silencers reduce the noise of vehicle engines,
heavy walls that have no cracks or pores block noise, and
furnishings made of acoustic materials can absorb noise.

In many countries, laws require industries to reduce factory noise below specified maximum levels.

In buildings, thick or heavy walls and well-sealed doors and windows may be used to block the noise.

Acoustics also involves providing good conditions for producing and listening to speech and music in such places as auditoriums and concert halls.

Noise in a room may be reduced by carpeting, draperies, and upholstered furniture, all of which can absorb the sound. For additional sound absorption, acoustical tiles may be installed on the ceilings and walls. These tiles have tiny holes that trap the sound and prevent it from bouncing back into the room.

Insulation against sound, reduces the noise in factories and in machines used at construction sites. Some factories have sound barriers between the workers and the machines. Sound-absorption materials are molded to the machines to lower their noise level.

Legislation is a primary mechanism to control noise pollution. Noise pollution control acts have been proposed by national and global bodies. Rajasthan Noises Control Act(1963), Bihar control of use of Play of Loudspeakers Act 1955, MP control of Music and Noises Act 1951, Air Act of 1981 and Environmental Protection Act of 1986 are some the legal measures taken in India for controlling noise pollution.

It is the people and technology which are responsible for this hazard. It is possible to reduce the noise through careful planning and co-ordinated mechanism. Consciousness is a primary aspect of this issue. The role of the human beings is a necessity in controlling noise. Noise pollution is a controllable hazard of the environment. Nobody likes a noisy environment.