

Lecture 11 Causes, effects and control of noise and thermal pollution.

Noise pollution

Noise is perhaps one of the most undesirable by products of modern mechanized lifestyle. It may not seem as insidious or harmful as the contamination of drinking water supplies from hazardous chemicals, but it is a problem that affects human health and well-being and that can also contribute to the general deterioration of environmental quality. It can affect people at home, in their community, or at their place of work.

Sound waves cause eardrums to vibrate, activating middle and inner organs and sending bioelectrical signals to the brain. The human ear can detect sounds in the frequency range of about 20 to 20,000 Hz, but for most people hearing is best in the range of 200 to 10,000 Hz. A sound of 50 Hz frequency, for example, is perceived to be very low-pitched, and a 15,000 - Hz sound is very high pitched.

Simply defined, noise is undesirable and unwanted sound. It takes energy to produce sound, so, in a manner of speaking, noise is a form of waste energy. It is not a substance that can accumulate in the environment, like most other pollutants, but it can be diluted with distance from a source. All sounds come from a sound source, whether it be a radio, a machine, a human voice, an airplane, or a musical instrument. Not all sound is noise. What may be considered music to one person may be nothing but noise to another. To a extent, noise pollution is a matter of opinion. Noise is measured in terms of Decibel units.

Sources of noise

Based on the type of noise include

- a) Industrial Noise
- b) Transport Noise
- C) Neighbourhood Noise

Industrial Noise

It is caused by machines used for the technological advancement. There exist a long list of sources of noise pollution including different machines of numerous factories, industries and mills.

Transport Noise:

Main source is transport. In addition to adversely impacting urban air quality, heavy automobile traffic creates seemingly unbearable noise pollution. Ever since industrial revolution doubling of noise for every 10 years



Pointed nose that angles downward during takeoff, the Anglo-French Concorde flies at more than twice the speed of sound. Supersonic plane is very noisy, and some believe its sonic booms harm the environment.



Animals such as whales use water to communicate with one another over great distances. Human-generated noises in the ocean, such as engine noises by boats, may interfere with animal communication.



Measurement of noise

The noise is usually measured either by i) Sound Pressure or ii) Sound Intensity. The Sound intensity is measured in Decibel (dB), which is tenth part of the longest unit “Bel” named after Alexander Graham Bell. Decibel (dB) is a ratio expressed as the logarithmic scale relative to a reference sound pressure level. The db is thus expressed as

$$\text{Sound Intensity Level} = 10 \log \frac{\text{Intensity Measured (I)}}{\text{Reference intensity (I}_0\text{)}}$$

or $\text{dB} = 10 \log I / I_0$

Intensity of Noise sources

Sources	Intensity(dB)
Breathing	10
Trickling clock	20-30
Normal conversation	35-60
Office noise	60 - 80
Traffic	50-90
Motor cycle	105
Jet fly	100 - 110

Effects of Noise Pollution

Auditory effects

- Auditory fatigue -- Whistling & buzzing in ears(noise level - 90dB)
- Deafness -- Permanent hearing loss (noise level- 100dB)

Tinnitus

- Persistent sound in one or both ears.
- Tinnitus is often experienced as a high-pitched hiss, ring, buzz, or roar.
- It is usually continuous, but it may pulsate, and the beats may coincide with the heartbeat.

Non auditory effects

- Interference with speech communication - 50dB
- Annoyance, ill temper, bickering
- loss in working efficiency - tiredness, deterioration or complete loss of ability to work

Physiological disorders

Neurosis, anxiety, hypertension, increased sweating, giddiness, nausea, fatigue, visual disturbance, reduces depth and quality of sleep , peptic ulcers, Increases cholesterol level resulting in constriction of blood vessel , Low weight children to mothers

Noise intensity	Health hazards
80	Annoyance
90	Hearing damage
95	Very annoying
110	Stimulation of reception in skin
120	Pain threshold
130	Nausea,vomiting
140	Pain in ear
150	Burning of skin
160	Rupture of tymphonic membrane
180	Permanent damage

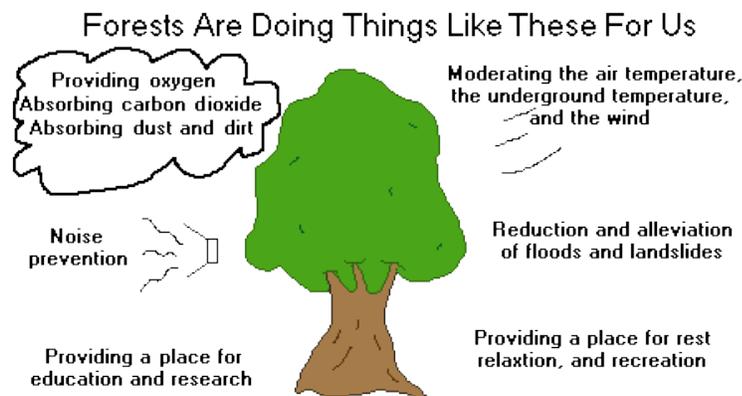
Even the nonliving things such as buildings undergo physical damage by cracks, breakage of windows, doors, and glasses etc. by sudden and explosive sounds.

Control of Noise Pollution

Noise definitely affects the quality of life. It is therefore important to ensure the mitigation or control of noise pollution. Noise pollution can be controlled

- At source level – Can be done by i) Designing and fabricating silencing devices in air craft engines, automobiles industrial machines and home appliances, ii) By segregating the noisy machines
- During Transmission – can be achieved by adding insulation and sound-proofing to doors, around industrial machinery. Zoning urban areas to maintain a separation between residential areas and zones of excessive noise. Sound
 - a) Acoustillite : made up of Compressed wood pulp, wood fibers and is available in the form of tiles
 - b) Acoustical blanket : Prepared from mineral wool or glass fibres
 - c) Hair Felt: Consists of wool fibres, Coarse Cotton Fibres.
 - d) Fibre Glass
 - e) Cork Carpet: Prepared out of pieces of corks treated with linseed oil and is used for covering floors.
 - f) Acoustic Plaster: Mainly consists of gypsum in the form of plaster.
- Protecting the exposed person
- By creating vegetation cover – Plants absorb and dissipate sound energy and thus act as Buffer Zone. Trees should be planted along highways, schools and other places.

Planting vegetation to absorb and screen out noise pollution – Trees can act as a noise barrier



- Through law
 - a) Silence Zones must be created near Schools, hospitals
 - b) Indiscriminate use of loudspeakers at public places should be banned/restricted by laws
 - c) Restriction on unnecessary use of horns and vehicles plying without silencers

d) Restrictions on aircraft flight at midnight

Permissible Ambient Noise Level in Different areas

Area	Code category	Noise level (dB)	
		Day Time (6 to 9 Am)	Night Time (9 to 6 PM)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

- a) The Air (prevention and control of pollution) Act, 1981
- b) The Motor Vehicles Act, 1988
- c) Indian Penal Code – Sections 268 & 290
- Through education - We Indians are Noisy people. Every occasion, it may be religious or family functions or elections; we used to celebrate with noise. Educating the people that noise is a pollutant, not a part of our routine life.

Thermal Pollution

The term thermal pollution has traditionally been used more often to refer to the heating of lakes, river, streams, and other water bodies usually by electric power generating plants or by factories

- The combustion of fossil fuels always produces heat, sometimes as a primary desired product, and sometimes as a secondary, less desired by-product i.e. noise
- Heat is also produced when fossil fuels are burned to generate electricity. In this case, heat is a by-product, not the main reason that fuels are burned.
- Electricity is also generated in nuclear power plants, when no combustion occurs.
- The decay of organic matter in landfills also releases heat to the atmosphere.

It is clear, therefore, that a vast array of human activities result in the release of heat to the environment. As those activities increase in number and extent, so does the amount of heat released. In many cases, heat added to the environment begins to cause problems for plants, humans, or other animals. This effect is then known as *thermal pollution*.

Sources of Thermal pollution

- Coal fired power plant effluents
- Domestic sewage
- Hydroelectric power effluent
- Industrial effluents
- Nuclear power plants

Effects of thermal Pollution

A one megawatt nuclear power plant may require 1.3 billion gallons (five million m³) of cooling water each day. The water used in such a plant has its temperature increased by about 63°F (17°C) during the cooling process. For this reason, such plants are usually built very close to an abundant water supply such as a lake, a large river, or the ocean.



When thermal pollution drives water temperatures up, most aquatic and marine wildlife cannot survive. Immobile organisms, such as plants and shellfish, simply die. One inevitable result of thermal pollution is a reduction in the amount dissolved oxygen in water. The amount of any gas that can be dissolved in water varies inversely with the temperature. As water is warmed, therefore, it is capable of dissolving less and less oxygen. Organisms that need oxygen to survive will, in such cases, cant be able to survive.

When heated water is released from a plant or factory, it does not readily mix with the cooler water around it. Instead, it forms a stream-like mass known as a thermal plume that spreads out from the outflow pipes. It is in this thermal plume that the most severe effects of thermal pollution are likely to occur. Only over an extended period of time does the plume gradually mix with surrounding water, producing a mass of homogenous temperature



Invasion of Destructive Organism

Water temperatures can have other, less expected effects also. As an example, trout can swim less rapidly in water above 66°F (19°C) making them less efficient predators. Organisms may become more subject to disease in warmer water too. The bacterium *Chondrococcus columnaris* is harmless to fish at temperatures of less than 50°F (10°C). Between temperatures of 50° - 70°F (10° - 21°C), however, it is able to invade through wounds in a fish's body and at temperatures above 70°F (21°C) it can even attack healthy tissue.

Urban Heat dome

Another example of thermal pollution is the development of urban heat islands. An urban heat island consists of a dome of warm air over an urban area caused by the release of heat in the region. Since more human activity occurs in an urban area than in the surrounding rural areas, the atmosphere over the urban area becomes warmer than it is over the rural areas.

It is not uncommon for urban heat islands to produce measurable climate changes. For example, the levels of pollutants trapped in an urban heat island can reach 5 to 25 percent greater than the levels over rural areas. Fog and clouds may reach twice the level of comparable rural areas, wind speeds may be produced by up to 30 per cent, and temperatures may be 32.9° - 35.6°F (0.5° - 2°C) higher than in surrounding rural areas. Such differences may cause both personal discomfort and, in some cases, actual health problems for those living within an urban heat island.

Thermal Air Pollution



Undesirable changes in Algal population: Excess Nutrients from the washout water from farm lands combined with thermal pollution cause an excessive algal growth with consequent changes. High Temperature promotes blue green algal blooms which disrupts the aquatic food chain.

Control of Thermal pollution

The water heated by thermal pollution also has a number of potential useful applications. For example, it may be possible to establish aquatic farms where commercially desirable fish and shellfish can be raised. The Japanese have been especially successful in pursuing this option. Some experts have also suggested using this water to heat buildings, to remove snow, to fill swimming pools, to use for irrigation, to de-ice canals, and to operate industrial processes that have modest heat requirements. Hot water is pumped into one end of the pond and cooler water is removed from the other end. The heat gets dissipated from the pond into the atmosphere. The main disadvantage is large amounts of water are lost due to evaporation

Here at Westport, Kentucky the Ohio River provides the large amount of water required by this coal-fired power plant. Thermal pollution is abated by the use of the large cooling tower which emits only steam into the atmosphere. The emission of the smokestack is largely steam but still contains pollutants.



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1.	Human Ear can detect sounds in the frequency range of about -----	
	a) 20 Hz	b) 20-20,000Hz
	c) 40,000Hz	d) 24,000 Hz
2.	Unit of measuring noise is -----	
	a) Dopson	b) Decimel
	c) Decibel	d) Dobson
3.	The permitted noise level in a silant zone during day time is -----	
	a)65	b)55
	c)50	d)70
4.	Human generated noise in the ocean may interfere with marine organisms	
	a) Communication	b) mobility
	c) food finds ability	d) migration
5.	When a person exposed to a voice level of 160 decibels for long time causes	
	a)Annoyance	b)Restlessness
	c)Tiredness	d)Rupture of tymphonic membrane
6.	For one megawatt energy generation, nuclear power plant requires colling water each day ----- Cooling water each day.	
	a) 1:3 million m ³	b) 0.3 million m ³
	c) 1 million m ³	d) 5 million m³
7.	Thermal pollution in a river -----	
	a) reduces the O₂ Dissolution	b) increases O ₂ solubility
	c) stabilizes O ₂ level	d) none of the above
8.	urban heat island is nothing but -----	
	a) a dome of cool air over the urban area	b) a dome of warm air over the urban area
	c) a dome of noise pollution over the urban area	d) reduced wind speed over the urban area
9.	<i>Chondrococcus columnaris</i> is harmless to fish at 10°C but causes diseases when the temperature of water is	
	a) more than 12°C	b) more than 21°C
	c) less than 10°C	d) at 10°C
10.	The thermal pollution of water in a industrial process can be	
	a) used for cogeneration	b) used to heat building to remove snow
	c) used to deice canals	d) all the above
11.	Tinnitus is due to	
	a)Water pollution	b) Noise Pollution
	c)Soil pollution	d)Xenobiotics
12.	The major effect of discharging heated water from power plants to aquatic ecosystems	
	a)Reduction in DO concentration	B0)Reduction in Biodiversity of the ecosystem

	c) Increase in metabolic rate of organism	d) All the above
13	The noise level during normal conversation is	
	a) 30 db	b) 35-60 db
	c) 20 db	d) 90 db
14	Persistent sound in one or both ears, often experienced as a high pitch ringing sound is	
	a) annoyance	b) all the above
	c) deafness	d) tinnitus
15	The amount of any gas that can be dissolved in water is	
	a) inverse with temperature	b) direct with temperature
	c) no relation with temperature	d) none of the above