

Noise Pollution Control—A Need of the Day

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There is an increasing public awareness of the danger posed by noise as environmental pollutant. Ever since the Industrial revolution and ever since the dawn of technology, the lives of people have been affected daily, and more so in urban environments, because of such pollution. Noise is an undesirable product of technological civilisation. At one time the people had generally accepted in silence the noise of traffic but today the traffic noise is so intolerable that there is serious thinking to stem this disturbing environmental pollutant. From the commercial point of view, there is universal adoption of diesel engine for commercial use of vehicles which is a patent source of pollution. In most of the countries the urban noise-level has increased with the introduction of the turbojet engine into commercial aviation. The advent of the supersonic transport is creating a global dimension to an already major national noise problem. In 1969 in the United States of America there was an annual increase of 11.5 million cars and trucks. Background noise was increasing at a rate of one decibel a year on the 'A' scale (a scale devised to give greater weight to high-pitched sounds, which are more annoying to the human ear than low-pitched sounds). It is stated that if this increase persists at the same rate for another 20 or 30 years, it could become lethal. The intensity of sounds doubles with every six decibels and in six years it can double the loudness of city noise. The strength of the general noise background in some of the communities in 1970 was four times what it was in 1956 and 32 times what it was in 1938. In urban areas of our country the use of motor vehicles is increasing and the noise irritant is gathering momentum, though comparatively on a lesser scale than in the western countries. But the problem remains the same.

One of the major irritants responsible for environmental noise pollution is the noise of traffic. It is a common experience of the urban population that noise poses a threat to their health and nerves. The biggest violators and destroyers of tranquility are the motor-cycles, sports cars, buses, trucks and passenger cars auto-rickshaws with loud or defective silencers. The possible preventive remedy is, adequate shielding and noise-insulation on all engine compartments and exhaust systems.

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The traffic noise could be controlled through technology in several ways. One of the solutions is to place major thoroughfares in "ditches"—that is, constructing the roads in troughs which are normally 15 to 20 feet below the ordinary land surface. This is particularly necessary where the high-speed roads are extended into the heart of major cities. Some architects who look to the future have predicted the use of covered tunnels for all vehicular traffic of cities. Even lining the streets and highways with trees, fences, earth banks *etc.*, help to insulate and to protect the surrounding area from noise.

The automobile manufacturers could go a step further in devising engines which could produce less noise. In America an engine has been developed called the Wankel Engine which employs a rotor in a casing rather than the more common piston in a cylinder, while retaining an internal combustion engine. A gas-turbine-powered bus is under production in New York city but the General Motors has indicated that a production model of the bus would take some time. "The Gas-turbine vehicles are known for their low noise-levels. The Engine lets off a subdued canine whine instead of the familiar feline purr which turns into a roar when the diesel engine accelerates". The most commendable possibility for the reduction of noise is some kind of electric engine. A dual-mode transit system has been devised by Dwight M. Baumann, a Professor at the Massachusetts Institute of Technology, U.S.A. which uses special buses and cars equipped with both internal combustion engine and electric motors. It is reported (*The Hindu* dated 2-5-1977) that the General Motors Corporation has made it official that barring unforeseen developments, the rotary engine has no place in its future plan. The world's biggest auto-maker announced that it had discontinued research and development work on the rotary or Wankel Engine that began seven years ago. The corporation added that though it had improved the engine in some respects, it did not "demonstrate the potential for low emission levels and fuel economy equal to those of current reciprocating piston engines". In the meantime, Mazda, the Japanese Automaker was successfully selling rotary engine cars in America. For some time, its sales soared because it appears to have achieved better emission control than American models. A spokesman for the Curtiss-Wright Corporation said that according to U.S. Government data, Toyokogyo's rotary engine-powered Mazda Automobiles being sold in America have equivalent fuel consumption comparable to cars using conventional engines while at the same time, meeting all emission requirements.

There is a third remedy available which recommends a shift from individual automobile transportation to mass transportation. Perhaps this would end the long romance with the automobile. It is reported that in New York, it is virtually impossible to cross Manhattan in the peak-hour either with a

car or without one. The suffocation and immobilisation of the cities by the automobiles has been encouraged greatly by the federal Government since the Eisenhower administration. At that time, the powerful lobbying interests of the oil and automobile industries prevailed upon the congress to set up a huge self-perpetuating highway trust fund which is financed from a tax imposed on all sales of gasoline. The money can be used only for building new inter-state highways. In an unsuccessful effort to abate city congestion, large multistorey car parks have been built in the midst of Metropolitan areas and the effect of their presence has been to encourage more motorists to drive into town.

If transportation by automobile is to be discouraged there should be a viable alternative in the form of fast, efficient and quiet mass transportation. The conversion to swift, silent and exhaust-free, mass transport systems will not be an easy task. It requires not only a tremendous capital investment in sophisticated new equipment but also the sacrifice of the already existing investments in conventional methods of transportation. It is not advisable to shift the costs of pollution-control on Industry and on the public in general in the same way that costs for other safety measures are accepted.

A number of states in the western countries have introduced motor vehicle statutes prescribing mufflers on automobiles, trucks and buses to prevent excessive or unusual noise. But most of these statutes do not lay down maximum decibel levels and therefore are extremely difficult to enforce. In New York and Connecticut and in several foreign countries positive measures have been taken to restrict the noise of traffic through comprehensive anti-noise legislation stipulating maximum decibel noise-levels for motor vehicles. For instance in New York State, vehicles on toll ways and public high-ways are limited by law to a decibel count of 88. The state police use portable decibel meters at toll-booths, to enforce the law and it is reported that truck and automobile noise has substantially diminished. The State of California has adopted a comprehensive anti-highway noise legislation which prohibits noise levels exceeding 82 decibels for passenger cars and 92 decibels for trucks and buses at posted highway speeds. As an additional measure, California is restricting the sale of new motor vehicles which exceed the prescribed noise level. A new electronic system is being employed by the State Police in Connecticut, to record the noise-level of passing vehicles and to photograph each car or truck exceeding the prescribed decibel level. Microphones, record each vehicle as it passes. If the noise emitted from the passing vehicle reaches a certain level, the system trips a Camera which photograph a noise-level gauge in a corner of the photograph of the offending vehicle. In the process, a signal is automatically relayed to the State Police Patrol so that, an immediate warning or arrest could be effected.

This system could be utilised in adducing evidence in court cases for the prosecution of the offenders. 85 decibels is the maximum noise-level prescribed in Connecticut. In a six months study which recorded the noise level of 2900 vehicles on the Connecticut Turn Pike, 11 % of the vehicles had 94 decibels or more.

One of the British Regulations envisages that all passenger-cars and trucks constructed after April 1, 1970 shall not produce more than 85 decibels. Motor cycles and other mechanically propelled two-wheelers are confined to noise-levels below 90 decibels. Maximum permissible noise-level in France is 83 decibels for passenger-cars and small trucks, 86 decibels for motor-cycles and a maximum of 90 decibels for large trucks and buses. In Switzerland the maximum permissible noise-level measured laterally in an open field at a distance of 7 meters with full engine power is 80 decibels for passenger cars, 85 decibels for two-stroke motor-cycles, large trucks and buses. The 'maximum noise level' scale established by the Swiss Anti-Noise Commission have been of great value in providing points of departure for the antinoise legislation of other countries. It is necessary to have a uniform legislation throughout our country in order to make the measures effective and useful to the public.

By this time, it is fairly conceded that the damaging effects of noise as an environmental pollutant is a harm for which there ought to be a suitable legal remedy. The physical damage to the nerve receptors caused by excessive noise is similar to the damage caused by a series of physical blows and it is worth-while and rational to classify excessive and deliberate noise as a form of battery as understood under the Law of Torts. The developing law of the right of privacy which is described as the right to sanity should also cover infringement by excessive noise. These are areas of new developments and theories, which deserve a study in depth in the light of developing psychological and sociological studies of the adverse effects of undesirable noise. Public remedy in the nature of a central enactment for abatement of noise is an immediate necessity. Tax incentives could be offered by the State to encourage noise abatement programme. A corporate body could be extended the concession for treating expenditure incurred in the abatement of noise-pollution as a business expense in order to be entitled to an immediate tax write-off without having to show depreciation over several years of such expenditure. The state could also consider the grant of low-interest loans to companies which are unable to secure funds from the traditional sources. Such loans could be granted only to companies in existence which are presently causing noise-pollution without the capacity of abating it. In laws relating to anti-noise efforts the basic concept is decibel limit and the other considerations are: standard-setting, enforcement and constitutionality. It

is possible that the traditional and stereo-typed anti-noise ordinances which merely limit noise which is excessive or unusual may be challenged in courts as unconstitutional on grounds of arbitrariness and vagueness. The new decibel-limit laws while creating an objective standard will avoid the vagueness problem but create fresh problems of enforcement. Experience has demonstrated in countries which are employing these methods that it is almost impossible to conduct measurement tests on crowded highways because of noises emanating from other vehicles and outside sources. More research is required to decide the maximum noise level for our local urban environment and the legal problems must be tackled before the decibel-limiting laws could become viable in practice.

It would not be unreasonable to observe that the state has an obligation to protect its citizens against all forms of violence including assault by noise. In spite of the consciousness of what is happening in countries which are confronting similar danger, there seems to be complacency and lethargy in taking timely action to surmount this subtle danger.

The main reason for the present situation is the same as in other areas of environmental pollution in as much as social and legal measures were not taken to prevent it and there was a failure on the part of the public authority in taking timely action. It is apparent that law, justice and public authorities had compromised with technology that increase in noise is a natural process and a price to be paid for technological progress. There are two views about noise pollution. One of the views is that technology has become an end in itself, that it subjects man to its demands rather than serve human needs, that it is inherently destructive of personal freedom and that it will make the world totally uninhabitable or at least deprive it of all hope and beauty. The other view is that technology is a universal solution which has not only liberated western man from the bondage of poverty and disease but will assure global prosperity and universal happiness for generations to come if only vigorously applied. However, a balanced approach finds an expression in the following terms :

The choice, rather, is between technological advance that proceeds without adequate consideration of its consequences and technological change that is influenced by a deeper concern for the interaction between man's tools and the human environment in which they do their work.

In our country, legislation has been enacted for the control of water pollution and smoke pollution. The crying need of today is adequate legislation and social measures to contain noise pollution which is gradually assuming alarming proportions.

Noise impairs the health of the people in various ways—psychologically, physiologically and behaviourally. Dr. Samuel Rosen, a Clinical Professor of Otology of New-York city observed that an unexpected or unwanted noise can cause the pupils dilate, paling of the skin, dryness of mucous membranes, intestinal spasms and adrenal secretion. In other words, it disturbs biological organism. It is also medically confirmed that noise causes a loss of nervous energy to the detriment of the health and well-being of the individual. Noise pollution could be a major factor in creating individual cognitive dissonance as well as mass societal neuroses. With the increase of the noise level, the human being like other animals becomes more irritable and more susceptible to neurotic and irrational behaviour. The relationship between increasing urban noise level and the nations increasing rate of crime cannot be brushed aside. It is interesting to note that the noise pollution has adverse economic implications. The World Health Organisation has estimated that lowered efficiency and increased errors caused by noisy working condition result in a loss of four billion dollars per year to American Industry. In 1961 a TIME Magazine estimate placed the cost of noise to American Industry at 2 million dollars a day in the form of compensation, lost hours and diminished efficiency.

The ordinary legal remedies are absolutely inadequate to meet the growing needs for effective control of noise pollution. Tort remedies under the law of Nuisance and out dated Municipal Laws are insufficient safeguards to protect individual rights, public health and safety against the inroads of noise pollution. In the advanced countries or what are known as the developed countries, recent legislation based on modern scientific audiometric concepts has achieved only limited success. Even the quieting process cannot break a new ground unless the individual outlook changes by conviction. Once the individual is fully informed and realises that unwanted noise is a serious threat to health like air or water pollution, effective steps could be taken to control environmental pollution caused by noise. The individual has to be educated that noise is not just an unpleasant irritant to be tolerated as an inevitable part of the price of progress. The psychology of the individual needs to be changed. This conditioning requires educative efforts both by governmental and private agencies. Sustained efforts are required to keep noise within reasonable limits. Market pressure should be brought on manufacturers of noise-producing items. Public pressure could be a very effective catalyst for securing special legal regulation of specific noise-producing sources. The continuing deterioration of man's habitat demands a re-evaluation of the present approach to ecomanagement.

Exposure to excessive noise causes loss of hearing though it may be difficult to show the subjective effect of noise on individual and collective

mental well-being. The adverse effects of noise pollution on the human organism are manifested through physiological indications such as loss of hearing, occupational deafness and noise-induced diseases. The psychological and behavioral effects created by excessive noise includes annoyance, speech interference, fatigue, psychosomatic disorders, tension-related diseases, sleep interference, mental illness and emotional distress. The effects of infrasound and ultra-sound and the effects of noise pollution on other animals and on the nation wilderness areas cannot be ruled out.

At a meeting of the American Association for the advancement of science, it was asserted by Dr. Lester W. Sontag that the human fetus may be damaged by noise pollution either directly by such violent noise as sonic-booms, or indirectly by the mother's psychoso-psychological reaction to excessive noise. A report by the Federal Council for Science and Technology of U.S.A. has stated that increasing numbers of competent investigators believe that prolonged exposure to intense noise may adversely affect other organic, sensory and physiologic functions of the human body. Dr. Vern O. Knudsen, a Physicist, a founder of the Acoustical Society of America and a former Chancellor of the University of California characteristically remarked, "Noise is a slow agent of death". At one time it was estimated that in the United States alone, 11 million adults and 3 million children suffer some form of hearing loss on account of exposure to unreasonable noise. It is also stated that airborne sound is a variation in normal atmospheric pressure and the response of the ear is proportional to such pressure.

Noise has been defined as one or a group of loud, harsh, non-harmonious sounds or vibrations that are unpleasant and irritating to the ear. In determining whether a sound is a noise, mental attitude and environment are of major importance and it is interesting to note that groups of people with different backgrounds of work-experience have differing annoyance thresholds. It is also said that what makes a sound a noise is a matter of psychology rather than acoustics. The degree of annoyance is not necessarily related to the intensity of the sound. It may often be influenced by subjective factors such as familiarity and personal attitude. For example loud music may still be considered melodious by an appreciative listener whereas, even extremely weak sounds and screeches can be a disturbing noise to some persons. In this area of psychological and behavioral reaction, there is no objective method of measuring annoyance. Perhaps the standards of a reasonable and prudent person have to be applied. Another behavioral effect of noise is its interference with speech communication. This is the best example of the non-auditory effects of noise. This aspect of noise pollution is of far reaching consequence in industry where the ability to communicate by speech is indispensable and its interference may cause disruption of work,

inefficiency, accidents and inconvenience. Psychiatrists and psychologists have recently noted the connection between excessive undesired noise and mental disorders. These noises to which most of us are exposed day and night are recognised as a major factor in the so called tensions of modern living. They contribute and aggravate all of the tension-related diseases ranging from stomach ulcers to neuroses, mental illness, allergies and cardiovascular and circulatory diseases.

Dr. Knudsen calls the total effect of the background roar of modern life "Decibel fatigue", and says that millions of Americans suffer from it.

Dr. Rosen believes that medical science will one day recognise an entire "noise syndrome"—a family of symptoms related to unwanted or unexpected noises. He and others already cite dilation of the pupils, dry mucous membrane, skin paleness, intestinal spasms and glandular secretions as candidates for membership in the full "noise-syndrome" when it is recognised.

Dr. Fabian Rouke reported to the New York Committee for a Quiet City:

One of the incidious aspects of excessive noise is the fact that an individual may be unconsciously building up nervous tension due to noise exposures. This may cause a person thus exposed to noise suddenly to be catapulted into an act of violence, or mental collapse, by some seemingly minor sounds which drive him beyond the point of endurance. Many persons who are using tranquilisers may be treating the symptoms rather than the disease.

It is medically confirmed that persons exposed to unwanted noise easily become irritable and unsociable. One of the most disruptive effects of noise pollution both physically and mentally is loss of sleep.

According to Lehmann :

Studies show that workers in noisy jobs tend to be more quarrelsome at work and away from it (at home, for example) than those doing equivalent jobs, but who are not subjected to similar noise stresses.

There is increasing evidence of the adverse impact of noise on the efficiency, performance and concentration of workers in factories and employees in offices. Reports confirm that Astronauts subjected to a reproduction of 145 decibel sound of a jet engine at full thrust, find difficulty in carrying out simple arithmetical operations and they were inclined to put down any answer in order to end the experiment. In many instances people

engaged in work in a noisy environment make more mistakes and their thinking becomes slow and fuzzy.

Scientific research has revealed that sound may damage body and mind even though it cannot be heard. Studies made by the French National Centre for Scientific Research in Marseilles concerning infra-sound which has a pitch or frequency of below 30 cycles per second and is thus inaudible to the human ear, is still capable of impairing the human organism. Industrial cities abound in Infra-sound, generated by many varieties of machines and motors which turn at a slow rate. Even infra-sound of weak intensity can penetrate houses and become the unsuspected cause of such ills as fatigue and dizziness. Persons affected by infra-sound, experienced physiological effect similar to those caused by low frequency mechanical vibration. Vertigo and Nausea are attributed to the excitation of the semi-circular canals, and infra-sound may also cause resonances of internal organs producing intense irritation, visual disturbances and interference with intellectual activity.

Ultra-sounds are also inaudible to the human ear but they cause serious effects on the human organisms. In an extensive survey of the auditory and subjective methods of industrial ultra-sonic sources made in 1967 in USA, it was found that unpleasant subjective effect including headache, nausea, tinnitus and fatigue were experienced by some persons and that temporary threshold-shift occurred.

Animals are susceptible to the effect of intense noise. Mink farmers can lose a majority of their animals in the killing frenzy which the female minks undergo after being startled by a sonic-boom. Laboratory exposure of animals to short loud sounds can cause diverse effects such as temporary rise in breathing and heart rates, a rise of blood pressure or a lessened flow of gastric juice. These responses quickly subside when the noise ceases. Laboratory experiments have proved that sound with an intensity of 150 to 160 decibels is fatal to certain animals. The animals suffered from burns, spasms and paralysis before dying. Sport fish are believed to be hyper-sensitive to sound. Guinea pigs exposed to short periods of above-normal but supposedly tolerable noise have developed swollen inside-the-ear membranes and vital auditory ear hair cells have been destroyed. Prolonged exposure to excessive noise has made rats lose their fertility and eat their young. If loud enough (150 decibels) the noise eventually kills them through heart failures.

In USA it is feared that wilderness areas and national parks would be subject to a new menace—sonic booms from super-sonic transport planes flying overhead. Serious damage connected with sonic-booms has been observed and reported in the Canyon de Chelly National Monument in

Arizona, Bryce Canyon in Utah, Mesa Verde National Park in Colorado and elsewhere.

Three approaches are available for achieving an acceptable noise environment consistent with operational and economic consideration. One of the solutions is to minimise the noise-level at the source. The second is to insulate the places where we live and work. The third is to drown or mask unwanted noises with pleasing sound. The commonly existing sources are household appliances or gadgets, industry and construction, traffic and aircraft noise and the sonic boom.

The remedial measures require detailed examination. One of the urgent steps is to hold discussions under a comprehensive educational programme on noise with the participation of doctors, manufacturers, industrialists, machine designers, architects, engineers, health organisation representatives, factory inspectors, trade union officials, insurance executives, politicians and the lawyers. The polycentric effects of noise pollution need to be tackled by all forces from various angles.

Lack of understanding of both the problem and its possible solutions may be the reason for the failure of the legislative bodies in grappling with this serious problem. There is ample scope for elaborate anti-noise regulations on city, state and national levels. A study in comparative law will help evaluation of various statutory solutions to noise control. Familiarity with the scientific intricacies of noise pollution and the legal technique of statutory control is absolutely essential for both the legislators and the law officers of the legislative bodies. The following actions are commended for legislative consideration :

- (a) General survey of the problem on methods, standards, local conditions and instrumentation.
- (b) Definition of injurious noise-levels in terms of the decibel concept, frequency and duration of exposure.
- (c) Specification in terms of persons, place and circumstance for the application of noise-control law.
- (d) Description of the enforcement agencies.
- (e) Sanctions against violations.
- (f) Standards and methods for medical test and the action contemplated against loss of hearing due to noise induction.

- (g) Principles and practise of Engineering noise control.
- (h) Qualifications for engineering control and the medical staff.
- (i) Types of ear-protectors and directions for their use.

The laws relating to private and public remedies require reappraisal in the light of the Decibel Limit concept. The efficacy of the "Quieting Process" needs to be further explored. Education and communication go together.

Environmental pollution transcends all frontiers whether international or economic or political. Its solution calls for global effort, international co-operation and trans-national action. It is hardly necessary to emphasise that on the capacity of the human being to surmount the calamity of pollution that the survival of mankind as a species depends. Exposing the vast population of our Country to know hazards of un-predictable dimensions is unpardonable.