

## Environmental noise control

Environmental noise consists of the noise generated by railways, vehicular traffic, aeroplanes, industrial machinery, etc. Within a building, environmental noise comes from the heating, ventilation and air-conditioning (HVAC) systems. There can also be substantial noise from kitchen appliances, washing machines, exhaust fans, lift machinery, vacuum cleaners, hair dryers, etc.

Excessive noise exposure may lead to several physiological effects such as annoyance, headache, increase in blood pressure, loss of concentration, speech interference, loss of working efficiency, or even accidents in the workplace. Persistent exposure of a worker to loud noise in the workplace may raise his/her threshold of hearing. A workshop foreman, responsible for maintaining high levels of production day after day, is subjected to high levels of noise. His need to communicate with others in that noisy environment makes him raise his voice, often unknowingly. He develops a slight headache and high blood pressure that makes him irritable by the time he returns home. Often such people take to excessive coffee drinking, smoking and liquor – all in the name of unwinding.

Another important example is autorickshaw drivers. In trying to maximize his earnings during an eight hour shift before he returns the vehicle to the owner, an autorickshaw driver runs the vehicle with wide open throttle. This produces excessive environmental noise and makes the journey unpleasant for his passengers as well as the passers-by. More importantly, however, he subjects himself to more than 90 dBA (A-weighted decibels) of sound pressure level. Over the years, he becomes hard of hearing. Technically, his threshold of hearing rises permanently by several decibels in a few years.

Over the last 50 years, a great deal of research has been conducted in understanding the mechanisms of noise generation, propagation and control. For example, the periodic combustion pulses and reciprocating motion of the piston produce exhaust noise, intake noise and engine body vibration noise. Moreover, the sheet metal components like oil pan, valve covers and manifolds act as sounding boards.

Most of the environmental noise emanates from the road traffic. Buses and trucks radiate maximum noise because of their size as well as mechanical power. However, autorickshaws and motorbikes contribute more

because of their large number and penetration into residential areas. While the noise of new vehicles is controlled by legislation (gazette notifications), the in-use vehicles, particularly the older ones are a major source of noise. Dusty environment and poor maintenance make the older vehicles, particularly the commercial vehicles, much noisier. There is a general lack of the culture of preventive maintenance and regular (periodic) servicing of the vehicles. The worst aspect of traffic noise, of course, is excessive honking.

Appropriate noise control technologies are now readily available. What is required, however, is to make adequate use of these technologies. Globalization in India has brought in strong international forces for quietening our vehicles and machine tools in order to make them acceptable (saleable) in the international market. Moreover, the global competition within the Indian market is forcing the Indian manufacturers to quieten their products; otherwise, they would be elbowed out from the Indian market too. This has been the most important driving force for the design and fabrication of quieter vehicles as well as machine tools. There is an increasing use of acoustic enclosures and hoods for the captive diesel generator sets as well as portable gensets. Technology for design of efficient silencers is available for the high-pressure venting of steam and gases in the thermal power stations as well as fertilizer plants<sup>1</sup>. Tyre companies are now able to supply inherently quieter tyres with randomized tread patterns. Resilient mounts are now available for isolating unbalanced forces and moments of the reciprocating and rotating machines like automotive engines, compressors, turbines, etc. Vibration isolation helps in the reduction of the structure-borne sound which is a major source of noise in multistorey buildings as well as power plants and automobiles. Well-designed acoustic louvers and lined ducts can reduce the noise of the HVAC ducts in hotels, office spaces, etc.<sup>1</sup>.

It is most cost-effective, however, to control noise at the source. This can be done by selecting quieter machines, using lossy materials and quieter processes, and designing exposed surfaces with lower radiation efficiency. It is desirable and indeed possible to design flow machinery for quietness. This incidentally increases the overall efficiency of the system. In fact, one must understand that

noise is a symptom of wasted energy. The practices that reduce noise often make the energy conversion process more efficient by reducing the wastage of energy. This can be best illustrated by the example of the ubiquitous fan. The electrical power to run the motor and thence the fan is proportional to the product of the flow rate and the pressure drop against which the fan is pushing the air (or gas). By smoothening the flow passage we not only reduce the pressure drop (and thence the power requirement), but also the fan noise. Thus, the subject of engineering noise control is inherently coupled with designing the power plants for better efficiency<sup>2</sup>.

Legislative restrictions on environmental noise all over the world have been instrumental in substantial noise reduction. Recognizing this fact, the Central Pollution Control Board (CPCB), the executive wing of the Ministry of Environment and Forests (MoEF), Government of India (GoI), set up a National Committee for Noise Pollution Control (NCNPC) with the present author as its Chairman, way back in 1997. Over the last 18 years, based on this committee's recommendations, the MoEF has issued gazette notifications on zoning of urban areas into industrial area, commercial area, residential area and silence zone. It has specified permissible noise exposure for the industrial workers, and noise limits for the diesel generator sets, portable gensets, fire crackers and automobiles. Over the last couple of years, this committee has played a seminal role for monitoring and control of airport noise, starting with the Delhi airport. Currently, we are working on noise limits for off-road vehicles and different earth-moving equipment. We are also discussing how the railway noise could be mitigated. There again, the noise from whistles is a major source of nuisance.

In the colder advanced countries where windows and doors are kept closed all the time to conserve the warmth inside, they often use double-glaze fixed-framed windows, and doors with heavy duty door-closers. These measures of thermal insulation, incidentally, result in acoustic insulation too. Our living habits, coupled with high population density, make the Indian environment roughly 10 dB noisier than that in the colder developed countries. Accordingly, the typical speech of Indians is louder than that of the Westerners. Even our threshold of hearing is a little higher. One of the unfortunate consequences of this is that the pedestrians expect honking to give way to an approaching vehicle. This is worsening now with some of the pedestrians doing gay walking while talking on their mobile phones. Another equally important problem is the tendency of some drivers to use excessive honking in order to force their way through the traffic. All these habits of the drivers as well as the pedestrians make the Indian roads noisier, not so much because of the vehicle engine or tyre noise, but the honking noise. It has gone so deep in the Indian psyche that

every lorry or truck has a signboard at the back 'SOUND OK HORN'.

Fortunately, the Maharashtra Pollution Control Board has recently banned the 'SOUND OK HORN' signboard for all vehicles plying in the state. This would also apply to all vehicles entering Maharashtra. We are now going to make a recommendation through NCNPC and CPCB to the Ministry of Road Transport and Highways, GoI, to ban this slogan or signboard all over the country. Concurrently, pneumatic horns (which are much noisier) and musical horns which divert the attention of pedestrians rather than alerting them, have been officially banned from the cities, particularly at night<sup>3</sup>.

Indian society has developed over 5000 years. It has several religions and diverse culture. Each of the diverse religious groups has its own festivals which it likes to celebrate with pomp and show. Several musical instruments have been developed for the socio-religious ceremonies and celebrations. Thus, traditionally Indians are boisterous by nature. The availability of the public address systems has further increased the environmental sound pressure level. Prayers are often broadcast over loudspeakers. While this practice is accepted gratefully by the members of one particular community in the neighbourhood, it is often a nuisance for the others. A couple of years ago, the Supreme Court of India banned the use of loudspeakers outside religious places, particularly during night or early morning hours. But the Government has not had the political will to implement this ban.

Based on the recommendations of the NCNPC, MoEF has published a gazette notification<sup>3</sup>. This notification has had some salutary effect among the law-abiding citizens. Unfortunately, however, the public at large has not been deterred by it. Now, it is generally recognized that there has to be public campaign through the media. A successful example of starting at the grassroots level is the campaigning that has been going on in schools. Children are persuaded and convinced by the teachers that they should not use fire-crackers. This has reduced their use substantially in the country, making festivals like Diwali considerably quieter as well as safer.

1. Munjal, M. L., *Acoustics of Ducts and Mufflers*, Wiley, Chichester, UK, 2014, 2nd edn.
2. Munjal, M. L., *Noise and Vibration Control*, IISc Press in association with World Scientific Publishers, Singapore, 2013.
3. MoEF Notification G.S.R. 742 (E): Environment (Protection) Amendment Rules, 2000.

M. L. Munjal

Facility for Research in Technical Acoustics,  
Department of Mechanical Engineering,  
Indian Institute of Science,  
Bengaluru 560 012, India  
e-mail: munjal@mecheng.iisc.ernet.in