

Occupational noise problems in developing countries

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1. Introduction

Noise, usually defined as an unwanted sound is an almost ubiquitous form of nuisance affecting more people more widely than perhaps any other disamenity. In industries, it is one of the most undesired and unavoidable by-products of modern mechanized operations and a potentially serious health problem. High level noise not only hinders communication, but depending upon level, quality and exposure time, it may result in feelings of annoyance and irritation, sleep disturbance, tensions, headache, efficiency with which tasks are performed, accidents at work place, etc. The other noise induced effects on human health are hearing losses, vasoconstriction, changes in heart rate, heart diseases, blood pressure, muscular activity, metabolic rate, slow deep breathing, an increase in gastrointestinal mobility, diastolic pressure, respiratory rates, blood glucose, and urinary 17-Ketosteroid, and decrease in salivary and gastric secretion, slowing of digestive functions, hearing losses, heart diseases, electrolytic imbalances (potassium, sodium, calcium, magnesium), an increased secretion of catecholamines in noise exposed subjects followed by an increased urinary excretion of venillyl mandelic acid.

Noise conditions in four industrial plants in some developing countries are discussed, concerning the maximum permissible occupational noise exposure limits of 90 dB(A) L_{Aeq} for plants working for 40 hrs a week [1], and proposed limit of 88 dB(A) L_{Aeq} for plants working for 48h/week [2], and percentage of overexposure evaluated. The reasons for high level noise in industrial plants and measures to control high level occupational noise are also discussed.

2. Noise conditions in some industrial plants in the developing countries

Much work is being done all over the world to limit high level environmental and occupational noise levels, but in developing countries, like Pakistan very little attention is being paid to this. Existing occupational noise levels in four industrial plants, in some developing countries, namely (i) Polyester Fibre Plant in Pakistan [3] working for 8h/day and 6 days a week (i.e., 48h/week), and (ii) a Liquid Packing Plant in Pakistan [4], a Pharmaceutical and Drug Firm in India [5] and a Textile Factory in Vietnam [5], all with a working schedule of 8h/day and 5 days a week (i.e., 40h/week) are summarized in Table 1. The Table shows that in the different sections of the Polyester Fibre Plant, Liquid Packing Plant, Pharmaceutical and Drug Firm and Textile Factory, the workers are exposed to occupational noise levels about 93.2 – 99.5, 91.5 – 94.3, 96-109 and 92 – 99 dB(A) respectively. These would conceivably reflect the generally prevalent conditions in other more noisy plants in Pakistan and in other developing countries.

3. Maximum permissible occupational noise exposure limits:

In order to protect workers health and safety against high level occupational noise, maximum permissible occupational noise exposure limits have been recommended by the International Standards Organization, International Institute of Noise Control

Table 1 Occupational Noise Levels in four industrial plants in the developing countries [3-6] and percentage of overexposure per day.

Plants	Noise Level dB(A)	Working schedule h/week	Permissible exposure time (h/day) hrs min sec-hrs min sec	percentage of overexposure per day	
Polyester Fibre Plant (Pakistan)					
Filament Take-up Section	93.2	48	2 30 00	220	
Texturizing Section	94.8	48	1 30 00	433	
Compressor House	99.5	48	0 37 30	1180	
Liquid Packing Plant (Pakistan)					
Decartoning Section	94.3	40	3 00 00	167	
Bottle Washing Section	91.3	40	6 00 00	33	
Packing Section	92.4	40	5 00 00	60	
Pharm. and Drug Firm (India)					
Fermentation Plant	(evening)	100-105	40	0 45 00 – 0 15 00	967-3100
	(night)	102-108		0 30 00 – 0 07 30	1500-6215
Air Compressor	(evening)	95-102	40	2 30 00 – 0 30 00	220-1500
	(night)	98-103		1 15 00 – 0 22 30	540-2023
Ammonia Compressor	(evening)	93-97	40	4 00 00 – 1 30 00	100-433
	(night)	94-98		3 00 00 – 1 15 00	167540
Primary Air Filter	(evening)	104-106	40	0 18 45 – 0 11 15	2453-4186
	(night)	104-109		0 18 45 – 0 05 38	2453-8471
Textile Factory (Vietnam)					
Waving Sections fitted with					
100 Shuttleloomsa	98	40	1 15 00	540	
400 Shuttleloomsb	99	40	1 00 00	700	
30 Shuttleloomsa	94	40	3 00 00	167	
20 Small shuttlelooms	92	40	5 00 00	60	

Engineering (I-INCE), USA, and are followed by the European Economic Community and other individual countries. According to these limits, ISO has recommended a limit of 85-90 dB(A) L_{Aeq} , with exchange rate of 3 dB(A) per doubling or halving exposure time [1] and I-INCE has recommended a limit of 85 dB(A) L_{Aeq} , with exchange rate of 3 dB(A) [7]. Other individual countries such as (i) United Kingdom [8], Argentina [7], China [9], allow 90 dB(A) L_{Aeq} , with exchange rate of 3 dB(A), (ii) Australia [10,11], Germany [12], Sweden [7], allow 85 dB(A) L_{Aeq} , with exchange rate of 3 dB(A), (iii) Canada allows 85 – 90 dB(A) L_{Aeq} , with exchange rate of 3-5 dB(A) [7, 13], (iv) Korea [14], Vietnam [15], allow 90 dB(A) L_{Aeq} , with exchange rate of 5 dB(A), and (v) USA [16], Chile [17] allow 85 dB(A) L_{Aeq} , with exchange rate of 5 dB(A). All these limits have been allowed for working schedules of 8h/day and 5 days a week, i.e., 40h/week. India has set up a limit of 90 dB(A) L_{Aeq} [7], but exchange rate and permissible exposure time are not specified. Vietnam is setting a new limit of 85 dB(A) L_{Aeq} , with exchange rate of 5 dB(A) [17], by the end of this year.

In developing countries like Pakistan, the main reasons for high level occupational noise are the absence of regulatory laws, to limit high level occupational noise and the unawareness of the workers about the ill-effects of high level noise. Also the owners of the industrial plants pay negligible attention to safety measures for their workers.

For the health and safety of workers exposed to high level noise, the lower limit of 85 dB(A) L_{Aeq} is quite safe, but its implementation would not be feasible in the developing countries, for effective control measures for reducing noise in

industries, as these affect the cost-effectiveness of the manufacturing plant. Therefore, in industrial plants working for 8h/day and 5 days a week (i.e., 40h/week), the highest limit of 90 dB(A) L_{Aeq} with exchange rate of 3 dB(A), may be set-up. But in developing countries like Pakistan, most of the industrial plants work for 8h/day and 6 days a week (i.e., 48h/week). In such plants, the total working hours are about 20% more than that in industrial plants with a working schedule of 40 h/week. For such plants, a limit for steady noise of 88 dB(A) L_{Aeq} , for 48h/week, with exchange rate of 3 dB(A), per doubling or halving exposure time and overriding limit of 115 dB(A) has been proposed by Shaikh [2]. This limit is closely consistent with the highest limit of 90 dB(A) L_{Aeq} , with exchange rate of 3 dB(A). The occupational noise exposure limits of 90, 88 and 85 dB(A) L_{Aeq} , with exchange rate of 3 dB(A), had been analyzed for permissible exposure time per week for each dB(A) value [2]. The proposed limit of 88 dB(A) L_{Aeq} with exchange rate of 3 dB(A), is 25% safer than that of 90 dB(A) L_{Aeq} with exchange rate of 3 dB(A). These limits have been further analyzed for permissible exposure time per day for each dB(A) value and are presented in Table 2.

Noise Level dB(A) L_{Aeq}	Occupational noise exposure time per day								
	90 dB(A)			85 dB(A)			88 dB(A)		
	hrs	min	sec	hrs	min	sec	hrs	min	sec
85				8	00	00			
86				6	00	00			
87				5	00	00			
88				4	00	00	8	00	00
89				3	00	00	6	00	00
90	8	00	00	2	30	00	5	00	00
91	6	00	00	2	00	00	4	00	00
92	5	00	00	1	30	00	3	00	00
93	4	00	00	1	15	00	2	30	00
94	3	00	00	1	00	00	2	00	00
95	2	30	00	0	45	00	1	30	00
96	2	00	00	0	37	30	1	15	00
97	1	30	00	0	30	00	1	00	00
98	1	15	00	0	22	30	0	45	00
99	1	00	00	0	18	45	0	37	30
100	0	45	00	0	15	00	0	30	00
101	0	37	30	0	11	15	0	22	30
102	0	30	00	0	9	23	0	18	45
103	0	22	30	0	7	30	0	15	00
104	0	18	45	0	5	38	0	11	15
105	0	15	00	0	4	42	0	9	23
106	0	11	15	0	3	45	0	7	30
107	0	9	23	0	2	49	0	5	38
108	0	7	30	0	2	21	0	4	42
109	0	5	38	0	1	53	0	3	45
110	0	4	42	0	1	25	0	2	49
111	0	3	45	0	1	10	0	2	21
112	0	2	49	0	0	56	0	1	53
113	0	2	21	0	0	42	0	1	25
114	0	1	53	0	0	35	0	1	10
115	0	1	25	0	0	28	0	0	56

Table 2.
Permissible occupational noise exposure time per day allowed under the limits of 85, 88 and 90 dB(A) L_{Aeq} with exchange rate of 3 dB(A).

neighbour's dog

A widower vowed to save his dog when a court condemned it to death after an elderly neighbour complained about its barking. William Shaw, 56, said that his West Highland terrier, Sam, had kept him company since his wife died seven years ago. Mr Shaw lodged an appeal after Aberdeen district court said the dog would have to be destroyed because it had continued to bark despite an earlier civil court order to keep it quiet. "He's a very affectionate dog but if someone comes to the door he'll bark, then sit and be nice. He's a dog, they bark. We have tried everything humanly possible to stop him barking, leaving the television on for instance when he's on his own."

4. Overexposure of occupational noise in developing countries

The permissible occupational noise exposure time per day for the different sections of the Polyester Fibre Plant working for 48h/week and (ii) Liquid Packing Plant, Pharmaceutical and Drug Firm, and Textile Firm, all with working schedule of 40h/week are given in Table 1. The Table shows that depending upon the existing noise levels in the different sections of the Polyester Fibre Plant, Liquid Packing Plant, Pharmaceutical and Drug Firm and Textile Factory, the workers may be permitted to work from 3h 30 min to 37 min 30 sec, 6h to 3h, 4h to 5 min. 38 sec, and 5h to 1h 15 min per day respectively.

Percentage of overexposure per day of the workers with reference to the maximum permissible limits of 90 and 88 dB(A) L_{Aeq} for 8h/day, both with exchange rate of 3 dB(A), in these plants has been evaluated by using the formula:

$$\text{Overexposure (\%)} = \left(\frac{\text{Working schedule in h/day}}{\text{Permissible exposure time in h/day}} \times 100 \right) - 100$$

Working schedule is 8h/day and permissible exposure time (h/day) for the existing dB(A) values in a plant for the limits of 90 and 88 dB(A) L_{Aeq} may be obtained from Table 2.

For example, the working schedule of Filament Take-up hall is 8h/day (48h/week) and existing value of noise level is 93.2 dB(A). From Table 2, for the limit of 88 dB(A) L_{Aeq} , permissible exposure time for 93 dB(A) L_{Aeq} is 2 hrs and 30 min per day. Percentage of overexposure of the workers at 93 dB(A) L_{Aeq} value may be evaluated as follows:

$$\begin{aligned} \text{Overexposure (\%)} &= (8/2h\ 30\ min \times 100) - 100 \\ &= (3.2 \times 100) - 100 \\ &= 320 - 100 = 220\% \end{aligned}$$

Percentage of overexposure evaluated for the different sections of the four plants are given in Table 1. The Table shows that (excluding the overtime of the workers), for working schedule of 8h/day, the workers in the different sections of the Polyester Fibre Plant, Liquid Packing Plant, Pharmaceutical and Drug Firm and Textile Factory, they are overexposed by about 220 – 1180, 33 – 167, 100 = 8471 and 60 – 700 percent respectively of the permissible time, provided that the workers work for 8h/day. Similarly, the condition in more noisy plants may be more serious. Long term exposure of the workers to such a high level noise will not only result in noise induced deafness, but may also result in other type of ill-effects on the workers.

5. Measures to control high level occupational noise:

In order to provide a healthy and safe environment for the workers in the industrial plants in the developing countries, it is recommended that:

- Occupational noise exposure limit of (i) 90 dB(A) L_{Aeq} in plants with working schedule of 40h/week and 88 dB(A) L_{Aeq} in plants with working schedule of 48h/week, both with exchange rate of 3 dB(A), and overriding limit of 115 dB(A) L_{Aeq} , should be set-up, legislated and implemented forcefully,
- the working schedule per day of the workers should be set up in the light of existing occupational noise levels, as given in Table 2,

- c) the management and health and safety engineers of the plants should be made responsible for the achievement of these limits,
- d) in industrial plants, where noise level exceeds 85 dB(A) L_{Aeq} , no one may be allowed to work without ear protectors,
- e) audiometric tests of the workers should be carried out periodically,
- f) the workers should be paid compensation for noise induced health injuries,
- g) to limit emission of high level noise from an individual machine, vibration isolators should be used in the foundation of machines,
- h) the closed spaces of the plants should be installed with sound absorbing materials,
- i) awareness about noise induced ill-effects on human health should be created among the workers through press, electronic media, lectures, posters, etc.,
- j) the owner of the plants providing health and safety measures to their workers, should be encouraged and duly benefited,
- k) Penalty should be imposed on owners of the plants not observing the occupational noise exposure limits.

To some extent, high level noise may be controlled by proper maintenance of the plant, but the ultimate solution to limit high level occupational noise, is the acoustical treatment of the plant.

6. References

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yes, airports are noisy

Airport noise arguments are commonplace, with residents and local authorities complaining about noise from airports. But this time, in Arizona, Phoenix's aviation director is perhaps trying to pre-empt complaints. He is writing to developers building alongside the Tempe lake, reminding them that it is right under the flight path and urging them to warn prospective buyers that living there is going to be noisy. It is thought that this move might be being made because property where the development is taking place has deed restrictions giving residents the right to file legal claims over aircraft noise.

logan airport

Boston's Logan Airport will shortly start assessing fees to airlines, rental car companies and bus lines to fund emissions reduction programs, becoming the nation's first airport to impose such a measure and leading the way for others around the country. The airport cannot ask airlines to reduce their nitrogen oxides because of Logan's notorious noise problems; less noisy airplanes emit higher rates of nitrogen oxide.

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16. *US Department of Labour, Occupational Safety and Health Standards, Vol. 39, No. 125, Part-II, 1974, USA.*
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parliament

19th November 2001, In answer to a written question on guidelines for the maximum level of background noise in school classrooms,

Mr Timms replied,

'The Education (School Premises) Regulations 1999 state that

Each room or other space in a school building shall have the acoustic conditions and the insulation against disturbance by noise appropriate to its

normal use.'

For new school buildings, the Department has published Building Bulletin 87 "Guidelines for Environmental Design in Schools" in which

(a) Table 1a gives the recommended maximum background noise levels, from adjacent areas, ventilation and traffic noise, for various types of spaces found in schools. The figure quoted for

general teaching, seminar and tutorial rooms and classbases is 40 dB LA;eq, 1hr.

(b) In specialist accommodation for pupils with hearing impairments, in special schools and in special units in mainstream schools, the maximum background noise level should be at least 10 dB lower than the figures given in Table 1a.'

parliament

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