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Environmental Noise Pollution in the City of Khoramabad, Iran

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Abstract: This study was carried out to assess the environmental noise pollution in the city of Khoramabad, Iran. On the basis of the resultant acoustic zoning 30 sites were selected for an experimental study. The main indices for noise pollution (Leq, L_1, L_{10}, L_{50} and L_{90}) were measured. Results indicated that main streets of Khoramabad are overloaded during day-time. In all the sites average daily sound levels was 14 dB higher than environmental standards due to street traffic and peculiar geo-morphological structure of the town.

Key words: Noise pollution, environmental impact, Khoramabad

INTRODUCTION

Noise pollution is by now globally recognized as a major problem which affects the quality of life in urban areas. Noise effects include impacts on mental and physical health as well as interfere with indices of human comfort and emotions such as effects on sleep, conversation, frequency of induced state of annoyance, hearing loss, cardiovascular problems, as well as steady mind-set to support tasks performance (Ouis, 2001). Then, assessing the problem and programming actions for controlling its adverse effects have become issues of immediate concern for community as evidenced by the large number of anti-noise laws, ordinances and regulations decreed by many governments (Implementation Responsibilities and Standards, Washington, DC, 20410; Environmental Protection Agency, 1978). The problem of noise is become an inevitable environmental pollution and many surveys have been carried out to assess the noise pollution in many cities of the world and urban noise has not been received much attention in Iran and hence this study is carried out (Arana and Garcia, 1998; Sadan *et al*., 1998; Kurra *et al*., 1999; Abdel-Razia *et al*., 2000; Passchier-Kerneer and Paschier, 2000; Moehler *et al*., 2000; Zeid *et al*., 2000; Morillas *et al*., 2002; Korfali and Massoud, 2003; Zannin *et al*., 2003; Diniz and Zannin, 2004; Lacerda *et al*., 2005). The primary goal of the present study was to evaluate the environmental noise pollution in the urban part of the city of Khoramabad. In this city, due to the peculiar topographic structure and crowded structure and jammed traffic of vehicles, was presented as a case study. The objective of this study was to measure different levels of sound in different urban zones of the city. As the first step, an acoustic classification of the territory was made. Five acoustically homogeneous areas were selected according to Iranian legislation. Subsequently, 30 measuring sites were selected. A comparison was then performed between measured noise levels and permissible limits of Iranian noise standards.

MATERIALS AND METHODS

Khoramabad is a medium-sized ancient city of Lorestan (Iran), with about 350,000 inhabitants. Figure 1 shows the distribution of selected sites.

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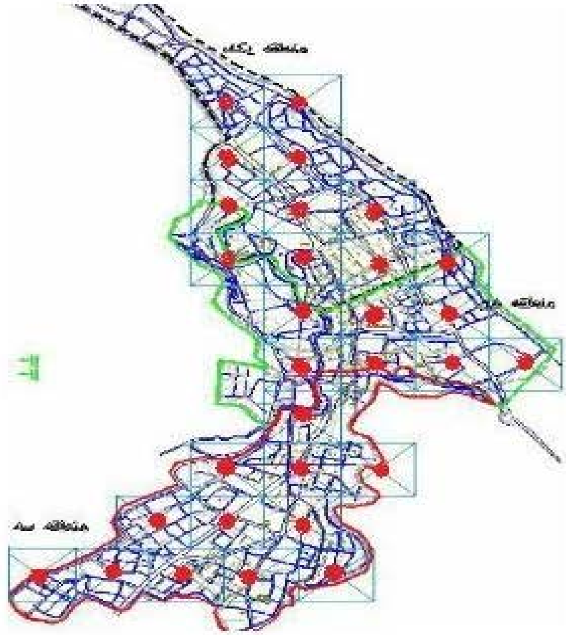

Fig. 1: Zone distribution throughout the city of Khoramabad

Table 1: Noise exposure limits set by Iranian legislation

	Permissible limit for the equivalent continuous sound level-Leq dB(A)	
Type of area	Day (07:00 am- 10:00 pm)	Night (10:00 pm-07:00 am)
Residential	55	45
Commercial-residential	60	50
Commercial	65	55
Industrial-residential	70	60
Industrial	75	65

Measuring points (red points in Fig. 1) were selected along the streets of the city in a way that cover all the five acoustically homogeneous areas (Table 1). Noise was measured 1 m away from the facades of buildings and 1.5 m above ground using a Class 1 2238 B and K integrating sound level meter together with a 4230 B and K calibrator.

All measurements were carried out during working days in 2007 and under ideal meteorological conditions: no wind and no rain. Measurements were taken for all the sites in the daytime period which runs from 07:00 am to 22:00 pm. The duration of each measurement in each site was 15 min in each hour. At each location and for each interval-time the A-weighted continuous equivalent sound level Leq and the statistical levels L_1, L_{10}, L_{50} and L_{90} were measured.

RESULTS

Noise Levels Time Variation

An example of the measured acoustic data is shown in Fig. 2 where the time variation of the A-weighted sound level Leq and of the statistical levels L_1, L_{10}, L_{50} and L_{90} is plotted for the case of site 6. In Table 2, the daily average values for all the investigated sites are also listed.

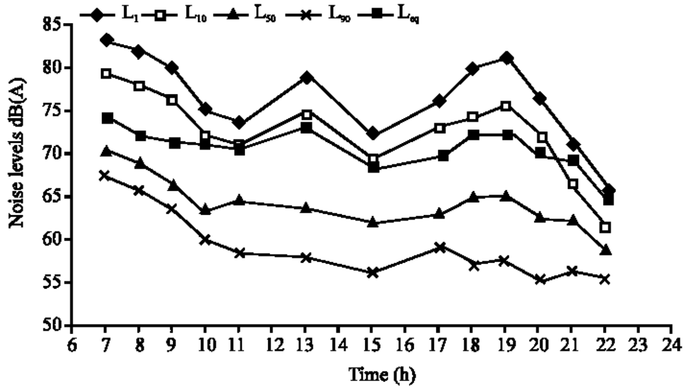

Fig. 2: Hourly noise levels relative to sampling location 6

Table 2: Average values for noise levels

Site	L_1dB(A)	L_{10}dB(A)	L_{50}dB(A)	L_{90}dB(A)	L_ddB(A)
1	80.5	76.4	69.5	66.2	75.5
2	79.8	74.2	64.8	60.3	75.0
3	82.4	76.7	69.3	64.7	78.2
4	80.1	74.3	65.5	62.3	75.4
5	81.8	74.2	67.1	65.7	75.3
6	80.6	74.8	67.6	65.1	76.3
7	79.9	75.6	66.0	65.9	75.0
8	78.8	73.5	63.8	61.3	73.7
9	80.3	71.4	64.6	59.4	73.5
10	78.3	75.1	65.0	62.4	71.8
11	82.7	79.8	71.9	70.1	80.1
12	81.5	76.5	69.2	67.0	77.3
13	80.7	75.4	67.2	65.3	77.8
14	81.3	77.2	66.5	61.2	76.6
15	83.8	79.2	75.9	69.8	80.0
16	84.3	78.7	70.4	68.5	80.2
17	81.2	75.5	70.0	66.9	77.6
18	82.5	80.1	74.6	67.8	79.8
19	78.7	76.8	70.2	64.1	72.2
20	80.6	77.7	75.4	66.9	75.6
21	81.7	78.1	75.9	67.2	76.3
22	82.4	79.3	76.2	68.7	78.5
23	79.8	75.4	73.8	65.8	73.7
24	80.6	76.2	74.6	66.7	76.3
25	81.3	77.8	75.5	67.3	78.4
26	80.9	76.6	73.8	67.1	76.5
27	79.4	73.8	69.7	65.4	73.6
28	82.2	79.1	76.2	68.2	79.8
29	81.7	78.2	75.8	67.9	78.7
30	79.8	74.2	70.0	66.3	74.4

Mean Noise

In all sampling locations the daytime average sound level, L_d, exceeds the maximum permissible limit set by legislation. The overall mean value of L_d is 75 dB (A) with a standard deviation of 2.4 dB (A) while the overall mean value of the exceeding difference is 15 dB (A) with a standard deviation of 3.2 dB (A). In Table 3 the average L_d values per acoustic zone are shown together with the exceeding extent.

Peak Noise

Statistical levels L_1 and L_{10} are obviously very high being determined by the transit of single vehicles which behaves as simple point sources. In daytime the mean values of L_1 and L_{10} for area A

Table 3: Average L_d values per acoustic zone and the exceeding extent over the permissible limits

Zone	Mean L_d dB(A)	Exceeding extent over the permissible limits dB (A)
Residential	74.0	19.0
Commercial-residential	71.2	11.2
Commercial	77.0	12.0
Industrial-residential	81.4	11.4
Industrial	83.0	8.0

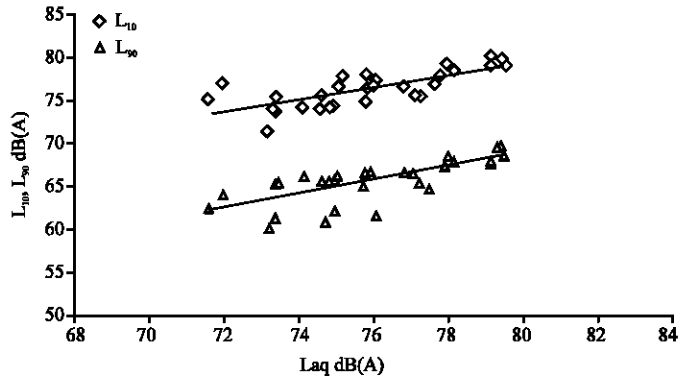

Fig. 3: Linear relationships between measured percentile levels L_{10}, L_{90} and Leq

are, respectively 80.5 and 75 dB (A). In Fig. 3 the correlation between the percentile level L_{10} and Leq is illustrated. All the 30 sites measurement results are included. As found in reference (Commission of European Communities (2000) 468 final) a linear relationship between L_{10} and Leq is observed: experimental points are fitted by the linear law $L_{10} = 0.93Leq+2.9$ with a correlation coefficient $R^2 = 0.96$. This result suggests that reliable prediction of L_{10} can be made once Leq is known.

Background Noise

Statistical levels L_{90} are very close and can be considered as the background noise levels. In this case noise is due to the whole stream of cars which behaves as a line source of sound. The mean values of L_{90} for area A is 63.4 dB (A). The correlation between L_{90} and Leq is not as good as than that found between L_{10} and Leq as shown in Fig. 3 where the linear law $L_{90} = 0.8$ Leq+1.6 fits measured data with a correlation coefficient $R^2 = 0.64$. It has been pointed out (Commission of European Communities (2000) 468 final) that the increased data scattering observed at low percentile levels would reflect the high randomness of noise level fluctuations in the outdoor environment or the scattering of the noise climates. On the other hand, data at the lower noise levels are expected to inherently contain high degree of scatter as a result of the sensitivity of Leq levels to noise from other sources and from short duration noisy events.

CONCLUSIONS

This study has demonstrated that in Khoramabad city, environmental noise levels due to road traffic are notably higher than the limits set by Iranian noise standards and policy to protect public health. In the overall monitoring sites noise daily average sound levels L_d resulted higher than 74 dB (A) and clearly correlated with traffic flow conditions which are nearly saturated in most of the urban roads. Obviously, the identification of the worst affected areas requires the employment of noise mapping that cause the relatively small number of measurement points, has not been possible to draw up in the present study. Anyway, available data have allowed pointing out that an unsuitable and acoustically incompatible location of important facilities can give rise to marked spatial variations in the city noise, with the existence of areas characterized by sound level distributions obeying to different statistics. Since the most penalized areas cannot be easily redeveloped by the introduction of facility pertinent zones suitable to the urban characteristics of the specific areas, it is necessary to think of recovery plans. This phase should come after the drafting of a noise map, actually in progress. At this point we can only affirm that, as the heavy traffic constitutes the main source of noise pollution, a desirable mitigation action would be that to find a new location for the landing-places far from residential areas to decongest the urban centre from the heavy traffic. This action would give rise to the double benefit effect to reduce the number of vehicles and to reduce the maximum noise levels being prohibited the noisy vehicles.

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