ARTICLES

Noise Levels in Kuwait City

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Abstract:

This paper mainly aims to measure noise level using a portable sound level meter. To meet different spatial and temporal requirements for noise level pollution assessment, monthly measurements, for a period of one year (March 2011 - February 2012), were conducted at 25 locations geographically distributed in Kuwait City. A distance of at least 15 meters was maintained from traffic noise sources during the noise measurements. The results of the average ambient noise level measurements in Kuwait City are found to be as follows: (1) during working days: day time- 7:00 to 14:00 (57.1-73.7dB); evening time- 14:00 to 22:00 (61.5-72.5dB), and night time- 22:00 to 7:00 (54.9-68.2dB), and (2) during weekend days: day time (61.3-70.8dB); evening time (61.1-72.2 dB); and night time (54-66.2dB). The measured ambient noise levels are in excess of the established Kuwait EPA standards; (65dB)- under Category Traffic- Urban Residential with Commercial.

Intoduction

Noise can be traditionally defined as an unwanted or undesired sound whereas environmental noise is any unwanted or harmful outdoor sound created by human activities that is detrimental to the quality of life of individuals (Chauhan, 2008). It can be considered as a part of the physical environment since it is a vibration phenomenon physically transmitted through a medium such as air. Since the range of sound pressure varies greatly, a logarithmic scale is used to relate sound pressures to a common reference level and is represented as the decibel (dB) (Al-Mutairi et al., 2009). In a way that is analogous to second-hand smoke, second-hand noise is an unwanted airborne pollutant produced by others; it is imposed on us without our consent,

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often against our wills, and at times, places, and volumes over which we have no control.

Noise effect includes various impacts on mental and physical health and disturbance of daily activities which may affect sleep, conversation, lead to perception of annoyance, cause hearing loss, instigate cardiovascular problems as well as affect human judgment and performance. The impact of noise may cause permanent hearing loss due to the exposure to noise levels exceeding 90 dB. The other adverse effects of noise pollution includeHearing Impairment, interference with spoken communication, sleep disturbances, cardiovascular disturbances, and disturbances in mental health, impaired task performance, negative social behavior and annoyance reaction effect. (Lisa and Louise, 2007). Along with other types of pollution, noise pollution has become a hazard to the quality of life (Singh and Davar, 2004).

The level of noise pollution in Kuwaits urban areas is high enough to adversely affect the human health and well-being of the residents (Al-Mutairi et. al, 2011). Also, due to the exponential growth of the population in Kuwait, the number of private vehicles owned by individual citizens has increased and hence this adds up to the noise pollution in the roads. With the rapid expansion of the infrastructures in metropolitan Kuwait, it is virtually definite that traffic noise will shortly assume a dangerous dimension, and will be a ground of escalating fear for both the public and liable policy makers. No work, to our knowledge, has been undertaken to investigate the noise pollution in Kuwait city. Therefore, the present work is an earnest effort to provide a widespread picture on the current status of noise levels in one of the rapidly growing urban areas in the Arab Gulf countries.

Materials and Methods

Comprehensive noise measurements were conducted during 12 months period, started from March 2011 to February 2012, at different times in a day in Kuwait city at 25 locations. The measurements were taken at the peak traffic hours until the end of the day, where the traffic

rush would come to a standstill. At each location, measurements were performed for a period of 60 minutes at three different times; i.e., during morning (day) (7 -14), afternoon (evening) (14-22), and night (22-7) hours. Measurements were taken at weekdays and weekends.

A Sound Level Meter, Casella CEL-490, was utilized to measure the noise level. The Sound Level Meter (SLM) used for noise assessment, consists of microphone, amplifier, electronic filter and digital readout. SLM shows the Sound Pressure Level (SPL), measured in decibel (dB), instant-by-instant using standard specified time constant responses designated Fast and Slow. The dB (A) LAeq (Equivalent continuous level) denotes the time weighted average of the sound pressure level in decibels on scale A which is relatable to human hearing. The Sound Level Meter was calibrated before and after each measurement. The microphone was set-up on tripods at a height of approximately 1.5m above the grounds and included full environmental protection against adverse weather conditions. All noise sources (e.g., traffic, human voices, pumps and other machinery, wind) were included in the analysis and a distance of at least five meters was maintained from traffic noise sources during the measurements. Table 1 and Figure 1 show the coordinates and the locations of the main preselected sites, to carry out the noise measurements, in Kuwait City.

Based on the average noise values measured an interpolation method, Surface Mapping Software (SURFER 10) has been utilized to map the noise pollution in Kuwait City.

Table 1
Coordinates of sampling locations for noise measurements in Kuwait City

Station	ID	Longitude	Latitude	Station	ID	Longitude	Latitude
Al-Qebla	ST01	47.963714º	29.365125º	Ministers	ST13	47.982158º	29.365947º
Naief	ST02	47.973833º	29.364º	Al-Mothana	ST14	47.967233º	29.366597º
Al-Ahly	ST03	47.9761º	29.372456º	Mosqu	ST15	47.97625º	29.378797º
Al-Awqaf	ST04	47.988881º	29.371983º	Towersy	ST16	48.002308º	29.387867º

Cont| Table 1
Coordinates of sampling locations for noise measurements in Kuwait City

Station	ID	Longitude	Latitude	Station	ID	Longitude	Latitude
Engineers	ST05	48.000958º	29.381786º	B. Embassy	ST17	47.994697º	29.388822º
Al-Amiry	ST06	47.987656º	29.386411º	MacDonalds	ST18	47.996269º	29.382786º
Al-Baladiya	ST07	47.970756º	29.372692º	Old Stores	ST19	47.993628º	29.372603º
Sharq	ST08	47.981867º	29.382064º	Al-Meqab	ST20	47.981067º	29.368036º
Al-Sawaber	ST09	47.984964º	29.3753º	Al-Salheiya	ST21	47.967017º	29.362911º
Behbehani	ST10	47.992392º	29.379942º	B. Hospital	ST22	47.965258º	29.366678º
Dasman	ST11	47.993411º	29.386219º	Al-Adl	ST23	47.967775º	29.369044º
Khalijiya	ST12	47.992561º	29.375292º	Bubyan Bank	ST24	47.969767º	29.372169º
				Waha Hotel	ST25	47.977917º	29.376183º

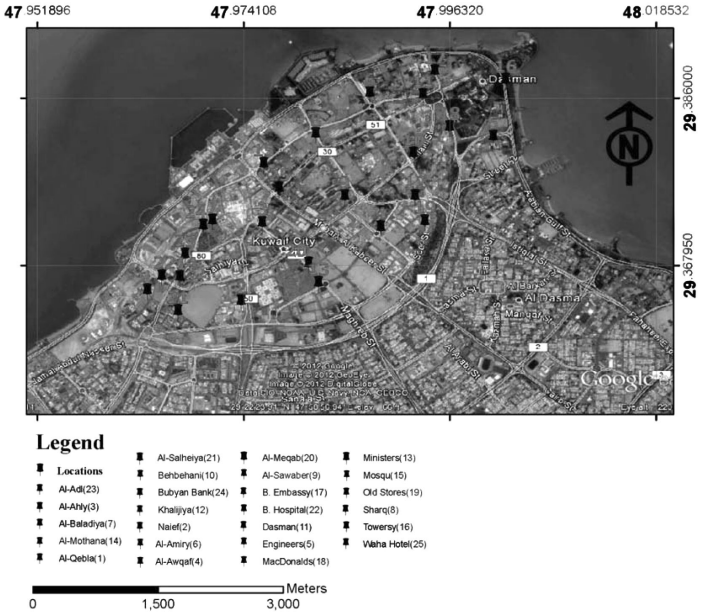


Figure 1 - Sampling locations in Kuwait City.

Results and Discussion

Figure 2 shows the monthly average maximum and minimum noise levels measured during weekends and weekdays. The minimum and maximum values of noise measurement were found to be between 40.4 to 91.5dB on weekdays, and 41.1 to 95.3 dB on weekends. This may indicate that on weekends, due to increasing shopping activities, Kuwait City can be characterized by heavier traffic contributing a considerable noise source.

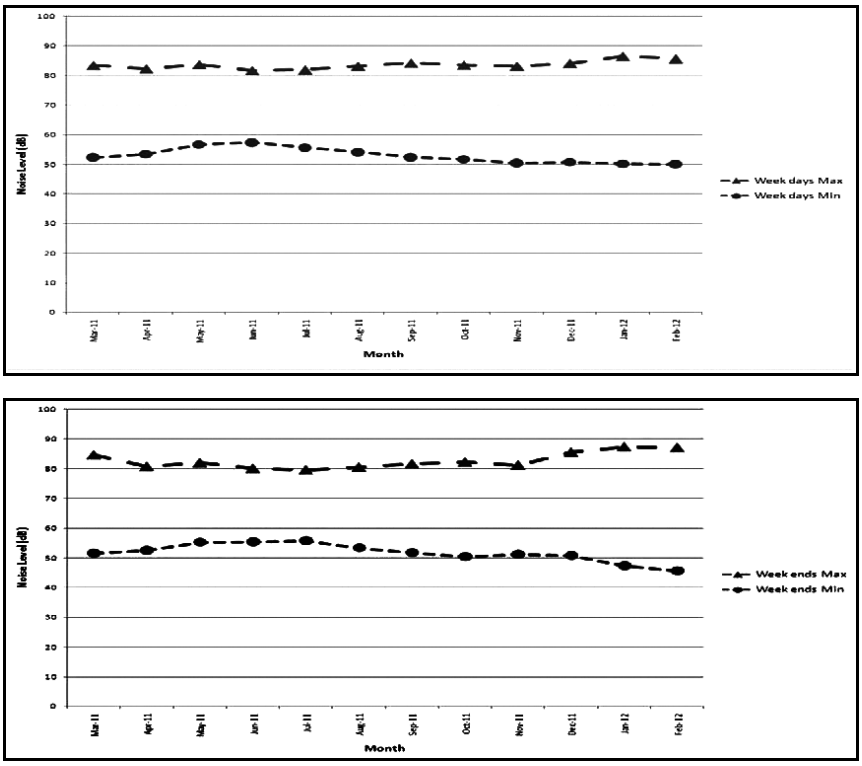


Figure 2 - Comparison of average maximum and minimum noise levels (dB) in the weekdays and weekends during March 2011 to February 2012.

The spatial equivalent noise pollution level (Leq) resulting contour maps for Kuwait City during working days and weekends and during day and evening times are illustrated in Figure 3. The distribution patterns of noise levels in morning and evening periods are generally similar during weekends, with elevated noise level during evening time. This may confirm that a significant portion of the noise is generated from vehicles in the city, mostly due to increase of traffic movement for shopping purposes in the weekends evenings. However, distribution patterns of noise levels in morning and evening period differ during working days; with obvious elevated noise level during the morning time in the downtown area where many governmental offices, headquarters of most Kuwaiti corporations and banks are located, while the distribution patterns of noise levels in the vicinity of the area covering the southwestern entrance to the city remain similar.

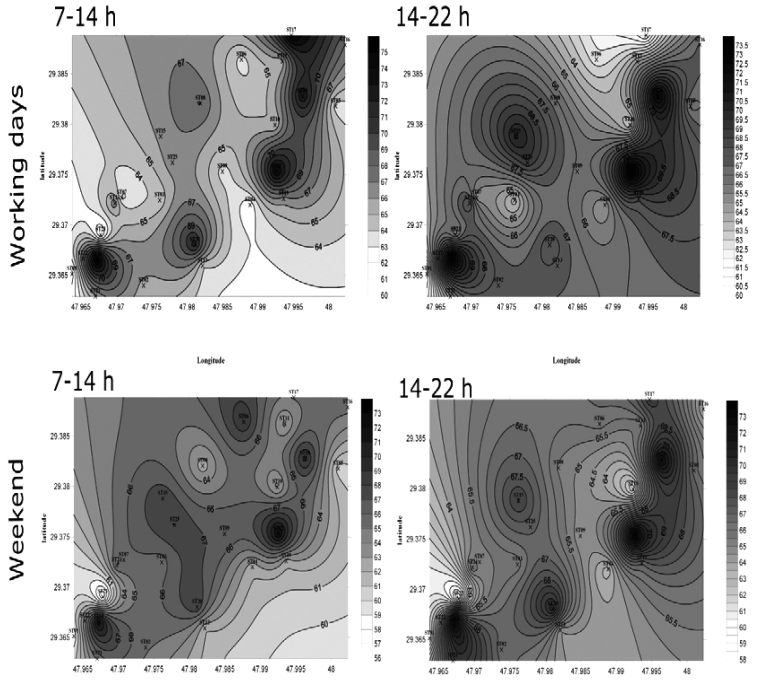


Figure 3 - Contour plots for the averaged Leq (A) noise level (dB) during day time and evening time.

In order to get a better consequence of monthly spreading noise levels over Kuwait city, the city was divided into 3 different zones (Fig. 4) based on the distance of the measuring points to the center point of the area (47º58'45.08"E and 29º22'10.37"N). Figure 5 shows the monthly distribution of average equivalent noise level for each zone during the morning, evening and night times.

The monthly average noise level ranged from 60.2 to 69.2dB with average noise level of 64.6dB. Higher noise level was observed in January at the three zones in Kuwait city. The lower average noise level in summer at the three zones might be due to less impact of traffic volume. A factor, which could account for the elevated noise level in winter season, is the higher traffic volume due to the seasonal influx of visitors to the city during this period. On the other hand, a factor contributing to the lower levels of noise pollution in the summer season could be associated with the fact that the majority of the population in Kuwait, especially the non-Kuwaiti professionals, leaves the State for summer vacation.

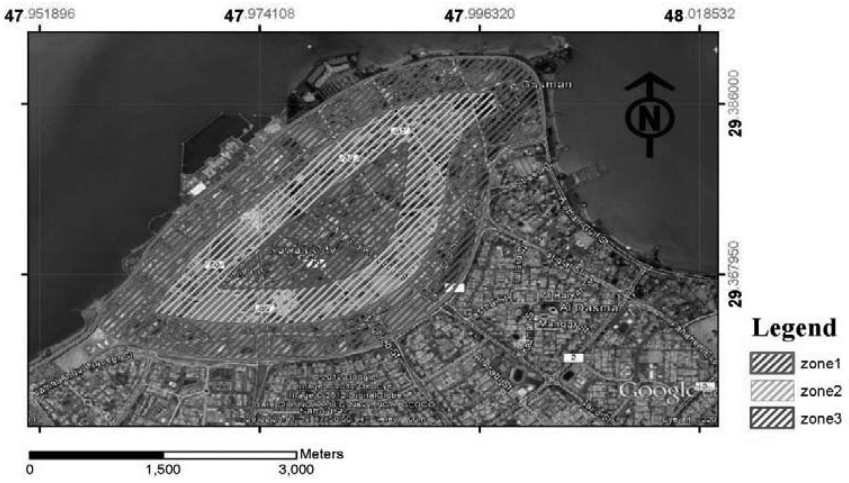
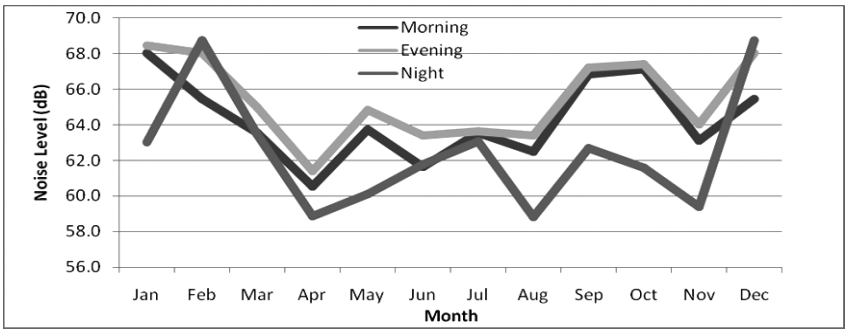
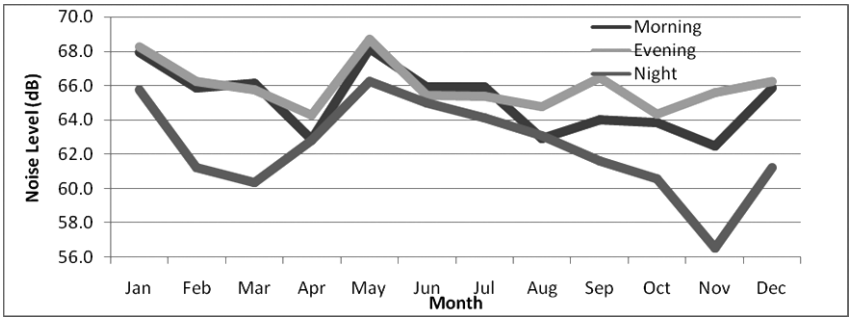


Figure 4 - Zones selection for noise level comparison.

a- Zone 1



b- Zone 2



c- Zone 3

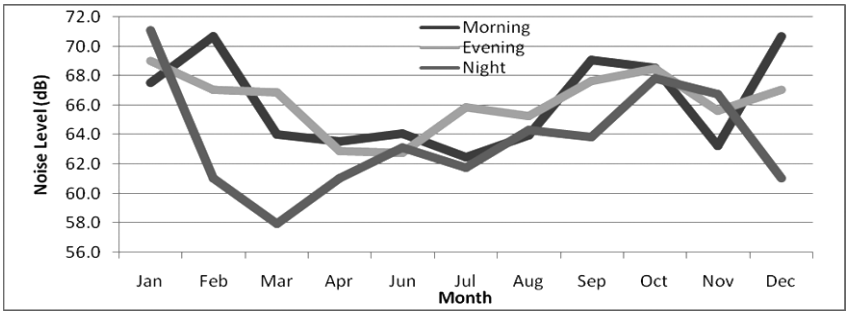


Figure 5 - Monthly average LAeq at three zones during the morning, evening and night times.

The significance of the contribution of urban traffic to levels of noise in Kuwait City is highlighted in Figure 6. Zone 1 with its central location in the city is characterized by low traffic volumes and daily congestions, while zone 3 on the other hand, located near the 1st ring road (highway) is characterized by high traffic volumes and daily congestions. The average increase in noise levels in zone 3, compared to those in zone 1 is about 2%.

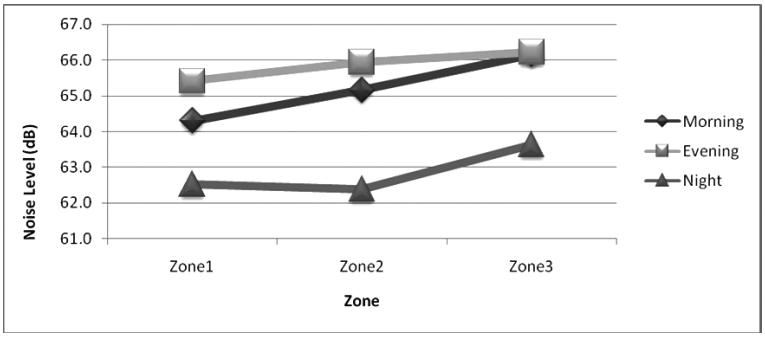


Figure 6 - Mean noise levels by zones.

On comparing the measured noise levels (Table 2) with the Kuwait Environment Public Authority (K-EPA) standards (Table 3), the values of the noise levels that are higher than the standard levels are highlighted. In general, the LAeq level for Kuwait City during the morning and afternoon of working days is 66.7dB while in evening is 64dB, which is higher than the EPA limit. For eekends the LAeq values in the morning, afternoon and evening are 65dB, 66.4dB and 61.8dB, respectively.

Table 2
Ambient noise levels at selected sites in Kuwait city

	Leq (dB)				Leq (dB)		
	Day	Ebening	Night		Da	Evening	Night
	07:00 to 14:00	14:00 to 22:00	22:00 to 07:00		07:00 to 14:00	14:00 to 22:00	22:00 to 07:00
ST01	60.2	60.2	60.9	ST01	58.9	61.4	59.8
St02	65.6	67.3	63.3	ST02	65.2	66.7	62.6
ST03	64.2	63.7	64.3	ST03	65.5	65.7	62.7
ST04	62.3	65	59.7	ST04	62.3	63.2	57.3
ST05	63.5	66.3	60.2	ST05	60.5	66.7	62
ST06	63.6	62.7	62.1	ST06	69.1	66.3	59.6
ST07	62.8	65.2	62.3	ST07	65.6	65	58.7
ST08	68.1	66.7	63	ST08	62.3	65.4	60
ST09	63.6	66.4	61.4	ST09	66.9	64.6	61.4
ST10	65	63.4	62.9	ST10	62.6	61.4	59.8
ST11	65.3	65	64.1	ST11	62.6	65.6	60.5
ST12	74.4	73.7	71.5	ST12	72.4	73.5	64.4
ST13	64.1	67.4	63.6	ST13	62.1	64.5	62.7
ST14	75.9	73.3	71.1	ST14	72	72.8	71.6
ST15	66.3	70.2	68.7	ST15	67.9	68.6	66.7
ST16	68	67.1	64.9	ST16	65.4	63.9	60.2
ST17	75.5	60.9	64	SY17	65.1	69	57.4
ST18	73.1	72.5	68.6	ST18	69.6	72.4	65.1
ST19	66.6	68.1	55.1	ST19	62.5	67.2	58.7
ST20	71.7	68	65.6	ST20	68.1	70.5	63.6
ST21	65.7	65.3	69.8	ST21	65.2	69.4	65.9
ST22	68.3	67.4	60.7	ST22	64.6	65.1	55.1
ST23	60.6	65.7	60.5	ST23	55.6	57.9	55.2
ST24	66.9	68.3	63.5	ST24	66.2	66.3	65.1
ST25	66.6	68.9	67.7	ST25	68.1	67.2	68.8

NOTE:
Indicates noise lebels in excess of standards

Table 3
Kuwait ambient noise standards

Type of area exposed to external noise	Leq (dB) over different time periods		
	Day	Evening	Night
	07:00 to 14:00	14:00 to 22:00	22:00 to 07:00
Urban residential areas with some commercial activities and workshops	65	65	60

Source: Kuwait Environment Public Authority, Decision 210/2001, Appendices 18-1 to 18-5, pp. 332-336.

Due to rapid urbanization in Kuwait City and the corresponding increase in the number of vehicles on roads the noise pollution is increasing at an alarming rate. The noise levels are showing an alarming rise and in fact the levels exceed the standard levels in most of the sites.

CONCLUSION

The present study explicitly reveals that the noise levels in Kuwait City are more than the permissible limit in most of the investigated locations. High traffic generates a high noise level, and added to it is the amount of noise created at construction sites. Therefore, a strict enforcement of law and regulation is well needed in this regard. Creating diversions and allotting peak hour time slots for heavy vehicles outside the city, planting of more trees on roadsides for sound cushioning, constructing noise barriers wherever necessary and broadening the roads are some remedial and preventive measures which can be considered for improving the noise environment of Kuwait City.

ACKNOWLEDGMENTS

This work was supported by Kuwait University Research Grant No. [SE03/08]. The author gratefully acknowledges the assistance, co-operation and logistical support provided by Mr. Ahmed El-Tabei and Mrs. Jaya Jacob at the Department of Earth and Environmental Sciences, and Ms Shahrzad Gashasi from Solutions for Environmental Consultancy Office.

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