INVESTIGATION OF NOISE POLLUTION OF ELECTRICAL DIESEL GENERATORS IN DUHOK CITY/ KURDISTAN OF IRAQ

MANAF A. MAHAMMED[1], FARIS A. KOCHERY[1], MOHAMMED S. ABDULKHALIQ[2]
[1]Dept. of Physics, Faculty of Science, University of Duhok, Kurdistan Region-Iraq
[2]School of Planning, Faculty of Engineering, University of Duhok, Kurdistan Region-Iraq
(Accepted for publication: June 9, 2013)

ABSTRACT

The City of Duhok, Kurdistan region of Iraq, whilst has been subjected to persistent fast development and urbanization and expansion of economy, travel and tourism, it is still suffering from the shortage of public electricity supply since 1990. This leads to widely depending on diesel electricity generators. This study investigates diesel generators noise pollution in Duhok city. An empirical correlation formula was deduced for the mean noise level of 30 diesel generator sites as a function of distance for the 50 meters range, and then this correlation is extrapolated up to 80 m from the sites. The results showed that the measured mean noise level at 50 m from the generator sites was 74.86 dB(A) which is higher than the permissible noise level for residential and commercial areas that are 55 dB(A) and 65 dB(A) respectively, while it is near the industrial areas which equals 75 dB(A). On making the extrapolation to the empirical formula to compare distance up to 80 m from the sites, the extrapolated mean noise level reduced to 71.1 dB(A) which is still beyond the permissible noise level for residential and commercial areas.

KEYWORDS: Noise level, pollution, diesel generators, dB(A), permissible noise

INTRODUCTION

Noise, is defined as unwanted sound that causes various health effects (Paul, 1993). People prefer to live in places far from noisy urban areas (Yılmaz and Özer, 1998). Existing evidence indicating that noise pollution may have negative impacts on human health has justified researches in order to provide better understanding of noise pollution problems and control (Georgiadou*et al.*, 2004**).** Noise pollution has been stated as a serious health hazard (Bies and Hansen, 1996).After 1991, the electricity in Iraq in general and in Kurdistan region in particular have faced many problems that caused the national electricity hours available to be reduced especially in cold winter and hot summer months. The local government was forced to depend on other sources of electricity. Private Diesel generators were one of these choices that have covered the basic needs of the people. On the other hand, these generators have many negative effects and impacts like environmental pollution, visual pollution, noise pollution, etc.The majorityof existing diesel generators are assembled by connecting old technology diesel engines of vehicles like (Man, Volvo, Mercrdes, Scania, Albe, etc) with high KVA dynamos without taking into account the noise pollution that may cause a great challenge to the environment in Duhok city. So it is expected that these generators will be noisy and they may cause many harmful effects on habitants living nearby the generating sites. One of the main sources of noise pollution in Duhok city is due to using huge numbers of generators (Yousif, 2010). Karim (Karim, 2011) measured the noise caused by 27 diesel generator sites in Duhok city and suggested to replace them with solar system.The expected various harmful effects of noise on human beings may be:Reduces work efficiency, affects the speech communication, may cause induces loss of hearing ability, causes psychological strain and mental fatigue, may damage the heart, increases the cholesterol level in the blood, dilates the blood vessels of the brain, upsets the chemical balance of the body, causes headache, nausea and general feeling of uneasiness, induces errors in 'motor' performance, induces psychosis and acute mental agony (Zakhmi, 2009).

MATERIALS AND METHODS

Thirty of those generator sites were selected covering Duhok city center. The noise level was measured for those 30 diesel generators sites for the period of (20) days, beginning from 22 /2 /2012 until 14/3/2012. After this date, the electric power supplied by the public network was almost continuous with little intermittences. The noise level generated by these diesel generators was measured as a function of distance from the generators. Measurements

were done at selected distances ranging from five meters (5 m) up to fifty meters (50 m) in steps of five meters (5 m). All distances were measured using ordinary fifty meters (50 m) tape meter. The noise level was measured using LYBOLDHand-held Sound Level Meter (Phonmeter) with measuring range: 20 ... 135 dB and audible-weighted (dB(A)). Theaudible-weighted (dB(A)).

Table(1): Generating sites and number of diesel units

Site Name	No. of Diesel units
SagvanRekani, Maher Qomri, Al-Nejjar 1, Adeeb, RezgarBetkary	one
Bekhal company 1, Abdulkhaliq, Media, Gree base 1, K.R.O 2, Gree base 3,Gree base 4, Nizarki village	two
Matin, Bekhal company 3, Shiva shorki, Ahmed Gulli,Jameia 1,Shakhke, Takhe Reza	three
TakhePeshasazi 1, Gree base 2, BazareeHavcharkh	four
Solav, Jameia 2, Bekhal company 2	five
Takhe Raze Site	six
BekhalCompany 4, K.R.O 1, BekhalCompany 5	seven

Noise measurements were executed at different times of the day or night depending on the time of the stopping of the supply of electric power from the public network. Each generating power site may contain many diesel generating units. For each power site, the number of generator units that were simultaneously in service was between one and seven diesel units. Table 1 shows the names of generating sites and number of diesel generator units that each site includes.

RESULTS AND DISCUSSION

In this section, results and discussion of study of noise carried out for (30) electrical diesel generator sites in Duhok city were introduced. Figure (1) shows the map of Duhok city on which the locations of the sites of these generators are shown. Location coordinates of these sites were measured as part of this study by using the GPS device. It can be seen from this map that the majority of these sites are situated in residential restricts. Some of these diesel generating sites are established between houses, near schools and kindergartens, near clinics, near mosques, near green parks, etc. From the coordinates of the selected sites it is clear that the testing's had been done around city and center of Duhok in different times of day and night. It should also be observing that since these sites are located inside residential regions, they cause noise to those regions and surrounding these sites to some certain distances.

In order to compare the mean noise level in dB(A) for thirty of the diesel generator sites that are measured throughout this work with the permissible noise level, the mean noise level in dB(A) has been drawn as a function of distance in figure (2). On the same figure, the permissible noise levels for the residential area, commercial area and industrial area were drawn. The permissible noise values are 55 dB(A) for the residential area, 65 dB(A) for commercial area, and 75 dB(A) or industrial area (Vijayalakshmi, 2003). It can be seen from figure (2), that the mean measured noise value with the distance from 5m up to 50m is higher than the permissible noise value for the residential, commercial, and industrial areas. At distance 50m from, the generators the mean value of noise level becomes almost equal to the permissible noise level for the industrial area as can be seen from the intersection of the mean noise level curve with the straight line for the permissible noise level for industrial area. Figure (2) is plotted using Microsoft Excel 2007 Program. Also and by using the same program, the following power empirical formula with R^2 value of 0.990 is deduced,

$$\mathbf{I\ (dBA) = 122.4[\ d\ (m)\ ]^{-0.12}}$$

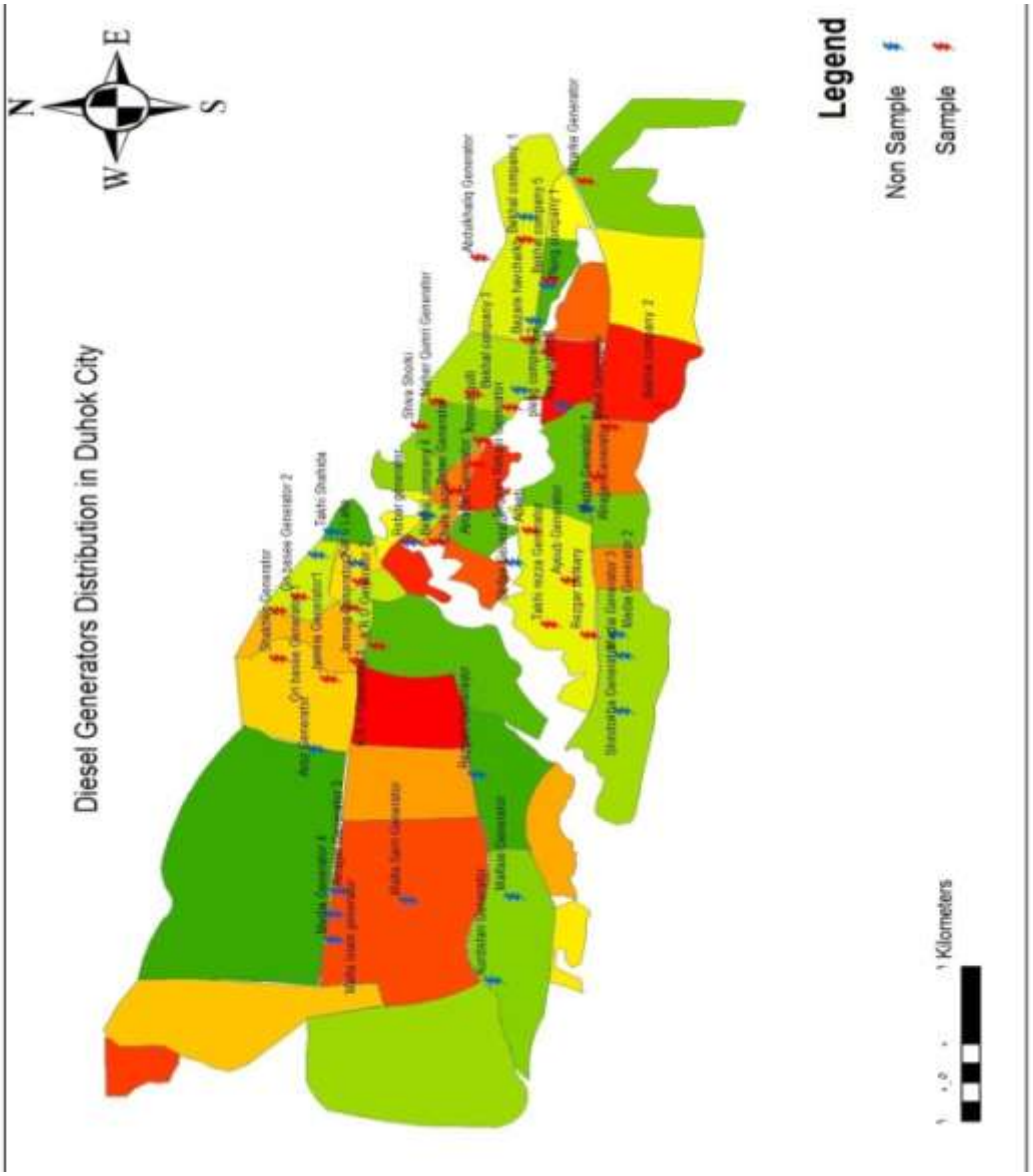

Figure (1): Map of Duhok city on which the locations of the sites of diesel generators are shown

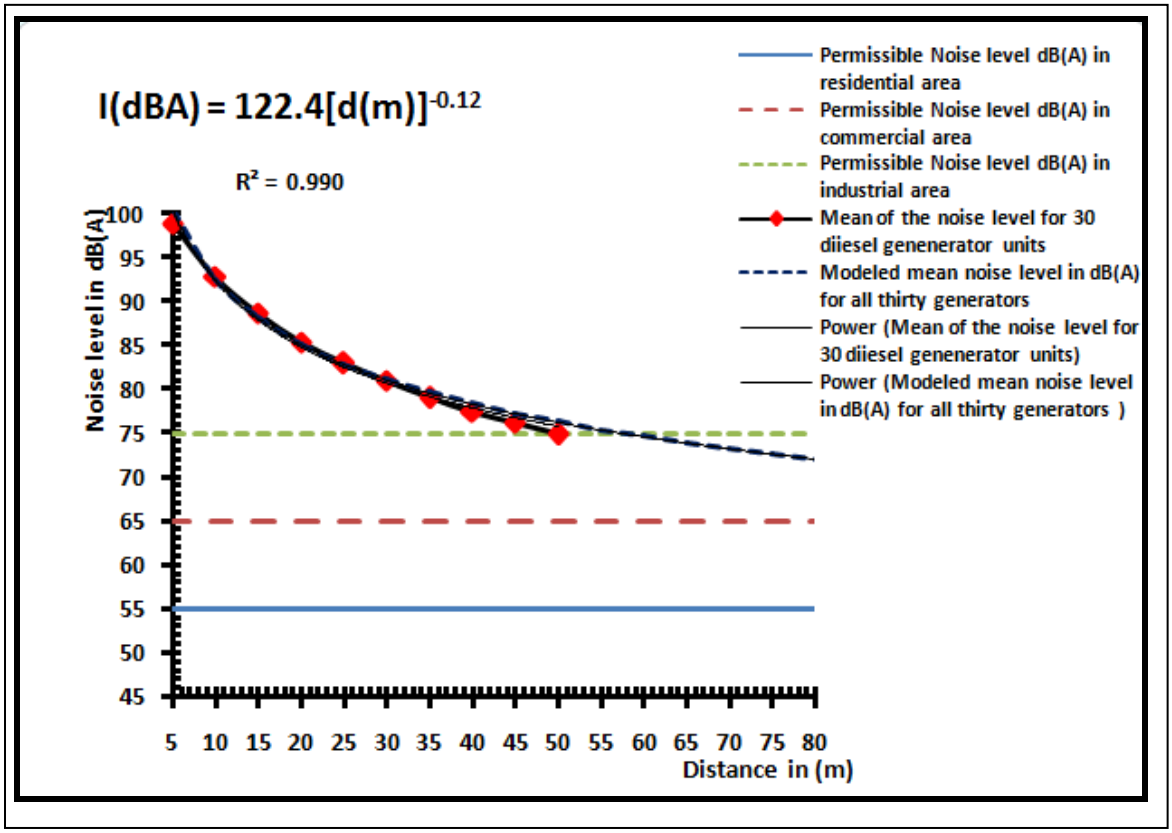

Fig. (2): Comparing of the mean noise level in dB(A) for all thirty generator sites as a function of distance with the permissible noise level s in dB(A) for residential, commercial, and industrial areas.

In the above equation, I is the mean noise pressure level in dB(A) for all the thirty diesel electrical generator sites, d (m) is the distance in meters from these sites. This empirical formula can be used to predict the mean noise pressure level of all the thirty diesel electrical generator sites for the distances from 5 m up to 50 m. As can be seen from figure (2), the noise pressure level is higher than the permissible noise pressure levels for the residential, commercial, as well as industrial areas. So, inhabitants, living within these distances from generating sites, will suffer from harmful effects of noise.This correlation is extrapolated to comprise distances up to 80 m from generating sites. The extrapolated correlation is also plotted on the same figure. It can be seen as an extrapolation, that for the distance range (5 – 50) m, the agreement between the measured and correlated curves is excellent. From the distance range from 50m up to 80m, the curve belongs to the correlation decreases from 75 dB(A) to 72 dB(A), i.e. a decrease of only 3 dB(A) which is still above the permissible noise level for the commercial and residential area, but below the permissible noises for the industrial area.The extrapolation is made for 30 m from 50m to 80 m, which is more than half of the measured distances. This distance, 80 m is sometimes within the buildings. It is worth mentioning that the values of the permissible noise level in the figure (2) are for the day hours from 7 am until 10 pm and that for the night hours, 10 pm until 7 am, the permissible noise value is lower by 5 dB(A) area (Vijayalakshmi, 2003). This implies that the correlated mean noise value of generator sites is greater thanthe permissible noise level for residential, commercial and industrial areas as can be observed from the figure.

CONCLUSION

On plotting the mean noise level with distance as shown in figure (2), it can be concluded that the mean noise level in dB(A) for all the selected sites shown on the map of Duhok city are higher than the permissible noise

levels for residential, commercial and industrial regions. Thecalculated mean noise level at distance of 5m is 98.91 dB(A) while at distance of 50m it is 74.86 dB(A) which represents the almost the peak value of the permissible noise level in industrial regions at day hours.An empirical power formula was deduced from figure (2) for the mean noise level in dB(A) as a function of distance d in meters. On making extrapolation to this formula to extend the distance to 80m, the mean noise was dropped to 71.1dB (A) which is within the permissible noise level of industrial regions. Thus it is concluded that the mean noise level in dB(A) for all 30 diesel generating sites up to 80m distance from the sites is higher than the permissible noise levels for both residential and commercial regions.Accordingly, peoples living near these generating sites are subjected to the harmful effects of noise pollution caused by these generators.

References

Bies, D. A. and Hansen, C. H.: 1996,Engineering Noise Control: Theory and Practice, 2nd ed., E and FN SPON, London]

Georgiadou, E., Kourtidis, K. and Ziomas, I.: 2004, 'Exploratory traffic noise measurements at five main streets of Thessaloniki, Greece', Global Nest International Journal 6(1), 53–61.

Karim, P. M., (2011).Feasibility of Using Photovoltaic (PV) for Protecting the Environment at Duhok City, MSc Thesis, Department of Physics, College of Education, University of Duhok.

Paul, M. (1993). Occupational and Environmental. Reproductive Hazard Clinicians, *NEngl J Med* 329,1588-1589.

Vijayalakshmi, K.S.,(2003). Noise Pollution, Proceeding of the third conference on environment and health, p. 597-603, Chenna, India.

Yılmaz H, Ozer S (1998). Evaluation of Noise Pollution in The Respectof Landscape Planning and Solution Proposals. Atatürk Univ. Agric.Faculty J. 28(3): 515-530.

Yousif, K. M., (2010). Feasibility of Using Renewable Energy for Protection the Environment at Duhok Region on North of Iraq. World Renewable Energy Congress Xi, 25-30 September, Abu Dhabi, UAE.

Zakhmi, S. M, (2009). Study of Noise Generated by Single Cylinder Two Stroke Petrol Engine. Msc. Thesis, Thapar University of Patiala, Mechanical Engineering Department, Patiala, India.

پوختە

باژێرێ دهوکێ د هەرێما کوردستانێ دا توشێ پێشکەفتنەکا ب لەز و بەرفرەه بویە ژ لا ئافاکرنێ، ئابوریێ و گەشت وگوزارێ فە، دگەل فێ چەندێ هندەك کێماسی ژ لایێ هەبونا کارەبێ فە یێن هەین، هەر ژ سالا 1990. و ئەڤ چەندە دبیتە ئەگەرێ هەبونا موەلیدێن کارەبێ ئەوێن ب گازوایلێ(دیزل) کاردکەن بشێوەیەکێ بەرفرەه.

ئەف فەکولینە ژاوەژاوا موەلیدێن (دیزل)ی بخوڤەدگریت ئەوێن بەربەلاڤ ل جهێن جودا جودا یێن باژێرێ دهوکێ. و گرنگی یێ دایە خواندنا 30 جهێن موەلیدا کو هەر جهەك نزیکی 1 هەتا 7 موەلیدا یێن هەین و ئەف جهێن هە یێن هاتینە دیارکرن ل سەر نەخشێ باژێرێ دهوکێ.و بهاریکاریا سیستەمێن پێزانینێت جوگرافی ئاستێ ژاوەژاوا 30 جهێن موەلیدین (دیزل)ی ژ دیراتیا 5مەتر هەتا 50 مەتران هاتیە دیارکرن.

ژ ڤێ فەکولینێ دیاربو گریدان و نزیکبوونا ئاستێ ژاوەژاوێ یێ 30 جهێن موەلیدێن(دیزل)ێ بەرامبەر دویراتیێ ئەڤا هاتیە دیارکرن ل پێشیێ و ئەف پێگڤەگرێدانە هەتا 80 مەترا هاتە دەستنیشانکرن بو هەر جهەکی. ژ ڤێ جەندێ ئەنجام دیاربون کو تێکرایێ ئاستێ ژاوەژاوێ ئەڤێ هاتیە پیڤان ژ دیراتیا 50 مەترا ژ جهێن موەلیدا د بیتە 74,86 دیسیبیلە و ئەف رێژە دهێتە هژمارتن بلندتر ژ ئاستێ ژاوەژاوا ئاسایی ل جهێن ئاکنجیبونێ و یێن بازرگانی کو پێدڤیە نە گەهیتە 55 دیسیبێلا و 65 دیسیبێلا بو خهێن دیارکری، بەلێ ل جهێن پیشەسازی ئاستێ ئاسایی پێدڤیە ژ 75 دیسیبێلا بلندتر نەبیت.

كو دا بزانين ئەف تێستە هاتە كرن بەرامبەر ديراتيا 80 مەترا ژ جهێن موەليدا، دياربو تێكرايێ ئاستێ ژاوەژاوێ هاتە خارێ بو 71,1 ديسيبێل ديسان هەر پترە ژ ئاستێ ژاوەژاوێ ل جهێن ئاكنجيبونێ و يێن بازرگانى.

ديسان ئەف ڤەكولينە چەند تێستەكێن پرەكتيكى بخوڤە دگريت بو زانينا كومكرنا ئاستێ ژاوەژاوێ ئەوێ ژ چەند موەليدا دەردكەڤيت ژ ئاستێن جودا جودا ژ ژاوەژاوێ و دا بزانين كانێ هندەك رێگر هەنە ژاوەژاوێ كێمبكەن.

داكو بزانين ئەف ژاوەژاوا ژ موليدا چێدبيتّ چەند نەخوشى ژێ چێدبن ڤێ ڤەكولينێ

خلاصة البحث

تعرضت مدينة دهوك في اقليم كردستان للتطور السريع والمستمر والتوسع العمراني والتوسع في السفر،والاقتصاد والسياحة، ولكن لا يزال يعاني من نقص في امدادات الكهرباء منذ عام 1990. وهذا يؤدي الى الاعتماد بنطاق واسع على مولدات الكهربائية التي تعمل بالديزل.

يتضمن البحث دراسة الضجيج الناتج عن مولدات الديزل الموزعة في مختلف المناطق السكنية في مدينة دهوك. حيث يهتم البحث بدراسة 30 موقعا للمولدات و كل موقع يحتوي على عدد من المولدات من مولدة واحدة الى سبعة مولدات. تم تحديد احداثيات هذه المواقع على خارطة دهوك الادارية. و قد تم قياس مستوى الضجيج لثلاثين موقعا لمولدات الديزل بواسطة استعمال نظام المعلومات الجغرافية لمسافة تتراوح بين 5 امتار الى 50 مترا.

استنتجت في هذا البحث صيغة لارتباط لمعدل مستوى الضجيج لثلاثين موقعا لمولدات الديزل كدالة للبعد للمسافات المذكورة سابقا و هذا الارتباط قد قدر الى 80 مترا لكل موقع. بينت النتائج بان معدل مستوى الضجيج المقاس في بعد 50 مترا عن مواقع المولدات كان 74.86 دسيبيل و هذه النسبة تعتبر اكبر من مستوى الضجيج المسموح للاماكن السكنية و التجارية و التي لايجوز ان تتجاوز ال55 دسيبيل و 65 دسيبيل على التوالي، بينما في المناطق الصناعية فان المستوى المسموح يجب ان لا يتجاوز ال75 دسيبيل.

لمعرفة الاستنباط من الصيغة التجريبية لمقارنة المسافة الى 80 مترا من المواقع، فان معدل مستوى الضجيج المقدر قد انخفض الى 71.1 دسيبيل و التي لاتزال اكثر من مستوى الضجيج المسموح للمناطق السكنية و التجارية.

تم اجراء تجارب تطبيقية لمعرفة جمع مستويات الضجيج الناتج عن عدد من المولدات لمستويات مختلفة من الضوضاء و ايضا لمعرفة قابلية بعض الحواجز للتقليل من مستويات الضجيج.