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ISSN: 0193-4120 Page No. 2580 - 2584

Road Traffic Noise Measurement: A Review

Laxmi Deepak Bhatlu M*, Sukanya K, Neethu Jayan, Viswanathan T, Karthikayan S
Chemical Engineering Department,
Karpagam Academy of Higher education, Coimbatore-641021, India
*E-mail: laxmi818@gmail.com

Article Info
Volume 83
Page Number: 2580 - 2584
Publication Issue:
March - April 2020

Article History
Article Received*: 24 July 2019*
Revised*: 12 September 2019*
Accepted*: 15 February 2020*
Publication*: 19 March 2020*

Abstract:
Noise pollution ranks high on the list of citizens' concerns because it causes the widespread of community health problems, occupational consistently, among the environmental pollutants. Road traffic noise dominates many sources of noise pollution. Due to industrialization and urbanization, the impact of road traffic noise has reached far and wide-ranging effects which increase the noise pollution levels. Hence, road traffic noise has become a problem of immediate concern to several authorities. Ordinances, Anti-noise laws, major highway road laws and alternative governmental laws that concern environmental noise can not be abided while not a priori empirical concerns. Therefore, it's necessary to hold out in depth measurements to research road traffic noise levels and community response.

Keywords: *Environmental pollutants, Noise, Road traffic noise, Noise levels, Measurements.*

1. Introduction

Noise is Associate in Nursing accepted and ineluctable environmental problem that may cause a large vary of negative social impacts; it ends up in annoyance, reduces ecological normal, and may have an effect on vigour and perception. Noise may be outlined because the level of sound, that exceeds the appropriate level and creates inconvenience. the numerous sources of noise are Industrial noise, Traffic noise & Community noise. Traffic noise is one in every of the important sources of noise compared to different sources [1-4].

Unfortunately, In many countries, it has become a severe problem, and it is difficult to control and abide by its effects by physical means alone. Investigations in different countries in the past several decades have shown that noise affects various activities severely and cause sleep disturbances and poverty-stricken life quality. Because of less irregular fashion with the passage of individual vehicles and fluctuations of sounds from hour to hour, the road traffic noise has become the worst in this category of noise pollution worldwide. This necessitates stringent control of the noise caused by road traffic. Before taking action to reduce the noise, the measurement of noise is required [5-8].

2 DEFINITIONS

Terminologies used for measurement sound are

A Weighting: a typical coefficient of the audible frequencies developed to mirror the response of the human ear to noise.

Acoustic Calibrator: An instrument that has a reference noise source that is used to compute and study the performance of a Sound Level Meter.

Sound pressure level (SPL): It is a logarithmic measure of the adequate pressure level of a sound relative to a reference value. It's computed in decibels (dB) above SPL. The standard reference SPL in the air or alternative gases is twenty µPa, which is usually considered the threshold level of human hearing (at 1 kHz).

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Percentile Noise Levels: In every traffic noise survey, the instantaneous noise level is measured at a specified interval of time for a predetermined period. Phases of observations are made for obtaining the requisite field data which should be adequate, accurate and reliable. The traffic noise analysis attempts to describe and quantify the sporadic and random manner that transportation noises intrude on the acoustic environment. Road traffic noises are strongly time-dependent. Their distribution function is calculated by analyzing noise level data with some form of statistical analysis using the following parameters [9]:

L_{10}: 10 percentile time exceeding noise level; indicates the peak noise level which exceeds 10% of the total observation time

L_{50}: 50 percentile time exceeding noise level; indicates the average noise level which exceeds 50% of the total observation time;

L_{90}: 90 percentile time exceeding noise level; indicates the background noise level which exceeds 90% of the total observation time

Equivalent Continuous Sound Pressure Level or L_{eq}: It's the constant noise level that would result in the same entire sound energy being produced over a given period. It will be determined in either A, C or Z (Linear) modes. L_{eq} is not an 'average sound level', because it generally stated to. The equations used to calculate L_{eq} are not calculating a specific average level.

Equivalent sound pressure level (L_{eq}) is framed to explain the time-varying nature of transportation noise into equal steady-state noise level, which for a that for an outlined period of time contains an equivalent acoustic energy as the time-varying noise. The $L_{eq}$is energy summation integration [10].

$$L_{eq} = 10\log\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2}\frac{P^2(t)}{P_o{}^2}dt \quad \text{dB(A)} \qquad (1)$$

In terms of intensity,

$$L_{eq} = 10\log\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2}\frac{I(t)}{I_o}dt \quad \text{dB(A)} \quad (2)$$

$$L_{eq} = 10\log\frac{\sum_{i=1}^{n} f_i 10^{SPLi/10}}{\sum_{i=1}^{n} f_i} \qquad \text{dB(A)} \quad (3)$$

where, f_i is the or number of occurrence or frequency.

Robinson (1969), of the British National Physical Laboratory, carried out that for a Gaussian distribution of noise levels, the alternative expression for *Leq* may be given as:

$$Leq = L_{50} + \left[\frac{(L_{10} - L_{90})^2}{56}\right] \qquad \text{dB(A)} \quad (4)$$

Traffic Noise Index (TNI)

It is a traffic noise rating index acquired from incorporation of noise levels, which gives a bigger correlation with discontent. it's earned on the thought that, L_{10} as an average peak level intrudes into L_{90} as an avg. Surrounding noise level when A-weighted noise levels are evaluated outdoors [11]. It is mathematically stated as,

$$TNI = \left[4\times(L_{10} - L_{90}) + L_{90}\right] - 30 \quad \text{dB(A)} \quad (5)$$

The word $(L_{10} - L_{90})$ is called "noise climate" by some researchers, and the end arbitrary constant is included to yield more agreeable nos. *TNI* is derived on the assumption that extensive noise level variations over a period are the dominant consider traffic noise annoyance. Since unsteady noise is usually assumed to be more annoying, *TNI attempts to make an allowance for the noise variability.*

Noise Pollution Level (NPL)

L_{eq} in itself is an inadequate descriptor of annoyance caused by fluctuating noise, and, road traffic noise is a significantly fluctuating noise, according to Robinson (1969) of the British National Physical Laboratory. The index *NPL* was derived to estimate the dissatisfaction caused by road noise traffic comprising of 2 terms. The 1st is a measure of the equivalent continuous noise level (*Leq*), and the 2nd represents the more annoyance caused by fluctuations in that level [12-15]. For a Gaussian distribution of noise levels, *NPL* can be expressed as given below:

$$NPL = L_{eq} + (L_{10} - L_{90}) \quad \text{dB(A)} \qquad (6)$$

Sound Exposure Level – Ls: measures the sound's amendment from moment to moment when the sound varies. This completely different period measure combines the most sound level with the length of time throughout that the sound level is over a precise range of decibels below the maximum level.

Measurement time interval: The time interval within which the squared sound pressure is integrated and averaged.

Observation time interval: The overall time interval within which traffic noise is recorded, either continuously or by sampling.

Reference time interval: The time interval over which the squared sound pressure is averaged to determine the equivalent noise level for comparison with noise limits.

1. MEASUREMENT PROCEDURES

Measurements could also be performed unceasingly for a definite interval of time to characterize the traffic noise at intervals that specified time period, or they may be considered as samples representing the traffic noise during more prolonged periods.

Equivalent noise level measurement:
Continuous measurement: By measuring the traffic noise unceasingly for a specific time interval, the equivalent noise level for that time interval are often determined directly.

Maximum noise level measurement:
The maximum noise levels from road traffic during the day are often the same as during the night. If the maximum noise levels during the night differ from those during the day, the maximum noise levels shall be measured during the night, when they are measured to characterize potential sleep interference during the night. The average maximum noise levels differ between vehicle categories. Within each vehicle category, a particular spread of maximum noise levels around the average is encountered due to individual differences between vehicles and due to variation in speed or driving pattern.

Wind measurement: The average wind direction and average wind speed shall be recorded every 10 minutes of the measurement time interval, preferably at the height of 10 m above the ground.

Temperature measurement: The air temperature (as well as the road surface temperature, when recorded) shall be measured with an uncertainty of less than 1 °C

Vehicle speed measurement: The possibility of measured vehicle speed shall be less than 3%.

Humidity measurement: Humidity shall be measured with an uncertainty of less than 20%.

CONCLUSION

Noise is associate accepted and unavoidable environmental pollution which will cause a good vary of negative social impacts; it ends up in annoyance, reduces ecological normal, and would possibly have an effect on vigour and perception. The present study explains road traffic noise measure-mental procedures. There were several instruments to measure road traffic noise. This paper deals with the main parameters used in the measurement of road traffic noise.

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