ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

ASSESSMENT OF NOISE POLLUTION AND MITIGATION MEASURES IN BODHJUNGNAGAR INDUSTRIAL GROWTH CENTRE – A CASE STUDY

Sukanta Chakraborty[1], Amarendra Jamatia[2], Sumanta Chakrabarti[3].

1 MTech Scholar, Department of Civil Engineering, National Institute of Technology Agartala, India.
2 Assistant Environmental Engineer, Tripura State Pollution Control Board, India.
3 Registrar (I/C), National Institute of Technology Agartala, India.

Manuscript Info

Manuscript History:

Received: 15 June 2014
Final Accepted: 29 July 2014
Published Online: August 2014

Key words:
Noise, Equivalent sound pressure level, Mitigation, Bodhjungnagar Industrial Growth Centre, Green belt.

Corresponding Author

Sukanta Chakraborty

Abstract

According to the report of World Health Organisation noise pollution is one of the three most hazardous types of environmental pollution. With the rapid growth in the industrial activities the noise pollution level is also increasing with an alarming rate. The impact of noise pollution on human health and other biological creatures is a matter of serious concern in the present day's world. The results of analysis of noise pollution levels measured in different parts of Bodhjungnagar Industrial Growth Centre situated in the proximity of Agartala, the capital town of Tripura are recorded. The Equivalent sound pressure level within the industrial area ranges between 43.7 dB(A) to 68.9 dB(A) in the day time and 36.5 dB(A) to 48.9 dB(A) in the night time. Sound pressure level data of some commercial and residential areas are also included in the literature. Further some mitigation measures are also incorporated in the study report and a brief discussion regarding the green belt development to minimize the noise pollution impact is added in the study. Thus this study may act as a useful literature in predicting the Environmental Impact of the Bodhjungnagar Industrial Growth Centre and development of Environmental management plan in future.

Introduction

Physically noise pollution is one of the complex sounds with little and no periodicity. Psychologically, the noise may be defined as the sound that is very unpleasant and unwanted by the listener due to its bothersome nature, interference with the perception of wanted sound and also its harmful physiological and psychological effects. The unpleasantness and harmful effects of noise mainly depend upon the factors such as intensity of sound waves, frequency and duration of exposure and intermittence of sound. It is therefore considered that noise pollution is one of the biggest environmental problems. The noise pollution problem seems to be very acute in the case of industrial sectors. Uses of heavy machineries for producing final products often generated considerable noises and create noise pollution in and around the adjoining area of industries. The problems may be more critical in the case of industrial estate or industrial growth centre. Occupational health and environment are the serious concern.

Noise is generally defined as the unpleasant sounds which disturb the human being physically and psychologically and cause environmental pollution by destroying environmental properties (Melnick, 1979). Noise pollution is one of the biggest problems that the modern world is facing. Various human activities, especially the urbanization and the development of transport and industry are responsible for the increasing rate of noise pollution. The noise pollution problem is said to exist when the sound level in the air interfere normal human activities like disturbance in sleep, work etc. The perception of noise level by individual varies depending upon level of exposure, hearing ability, socio economic activities etc. The impact of noise pollution on the community varies in a very wide range and has a very important effect on the health and social condition of the society. Although the noise pollution has not created much public concern but some sort of study in this field has already been done.

Noise affects human health adversely and may cause health problems like hypertension, disrupt sleep and/or hinder cognitive development in children. Excessive noise may cause permanent loss of memory or psychiatric disorder. Noise exposure can also lead to acute stress responses and can even results in cardio-vascular and mental health disturbances.

The Noise Pollution resulting from industrial activities is becoming a nuisance. It is hampering the physical and mental health of the workers and is alienating them from society. In India the level of noise pollution is also at an alarming stage. Several studies have already been carried out which indicate that the level of noise pollution in different cities and towns alongwith various industrial complexes are beyond the specified limit (Bhabananda, 2013). Assessment of noise impacts and their effects depend upon a number of factors like the ambient noise level in the vicinity of project site, the types of industrials operation etc.

STUDY AREA

The Bodhjungnagar Industrial Growth Centre is the largest industrial estate of the Tripura State, India. It spreads over an area of approximately 238.53 acres. Various types of industries such as Rubber processing industries, Cement industries, Rolling Mills, Food processing industry, Electronics and Electrical appliances manufacturing industries, Brick kilns, Tobacco industries, stone crushing industries etc. have been grown up in the Bodhjungnagar Industrial Growth Centre. The geographical data obtained from different sources indicates that the latitude of the growth centre area is N $23^{O}51^{/}30^{//}$ and the longitude between E$91^{o}20^{/}$ to E $91^{o}\ 25^{/}$. The topographical map of the industrial complex collected from the official website of TIDC is illustrated in fig 1.

METHODOLOGY

An inventory was conducted in the Bodhjungnagar Industrial Growth Centre to identify the major noisy area and also noise generating industries. Noise level was measured at nine identified locations of the Bodhjungnagar Industrial Growth Centre and also close proximity of the complex using Sound level meter. The noise monitoring was conducted for day time during 6 am to 10 pm and night time data were measured during 10 pm to 6 am. The equivalent sound pressure levels at day and night time are evaluated from the measured data. The recorded noise data are interpreted to the equivalent sound pressure levels using the following equation:

$$L_{eq} = 10 \log (\sum t_i \times 10^{Li/10})$$

Where, L_{eq}= Equivalent sound pressure level,
L_i = The noise level of any i^{th} sample,
n=Total number of sound samples,
t_i = Time duration of i^{th} sample expressed as fraction of total sample time.

Apart from the Equivalent sound pressure level (L_{eq}), some other parameters such as L_{10}, L_{90} and L_{max} are also considered in the present study. The equivalent sound pressure levels at day and night time are compared with the standards prescribed by CPCB and the Noise Pollution (Regulation and Control) Rules, 2000. Ultimate goal is to evaluate present status of noise levels within the impact zone and identification of impacts due to any anticipated rise in noise levels on the surrounding environment.

OBSERVATIONS:

The ambient noise level was measured at 9 identified stations within the vicinity of Bodhjungnagar Industrial Growth Centre. Out of nine stations, six stations are identified as industrial zones. 2 stations are taken in residential areas, which are located outside the boundary of growth centre mainly for assessing of noise pollution load due to industrial activities. One station has taken in the commercial area. The measured ambient noise levels in respect of various categories of zones during day and night time are presented in the Table-No-1. The equivalent sound pressure level (L_{eq}), L_{10}, L_{90} and L_{max} as calculated in respect of noise stations during day and night time are presented in the Table No-2 and Table No-3 respectively.

Analysis of recent noise data reveals that the equivalent sound level pressures at all the stations are within the prescribed noise limit in day time. The maximum equivalent sound level pressure of 69.9 dB (A) is observed at the Devendrachandranagar in day time. However, the values of equivalent sound level pressure found considerable declined at two stations during night time. Equivalent sound level pressure of 70.4 dB (A) observed at NEEPCO Complex during night time. The noise is coming out mainly from the gas turbine of thermal power plant. As Khayerpur station is located within the commercial area, therefore noise level is slightly above from the prescribed noise limit. The reason for declining of noise level in khayerpur is due to vehicular movement during the night time. The equivalent noise pressure level in other stations are found within the prescribe standards of CPCB (Central Pollution Control Board, India). The calculated noise level parameters are graphically illustrated in Fig 2 to Fig. 4.

NOISE POLLUTION MITIGATION MEASURES

Numerous studies have already been conducted to investigate about the impact of noise pollution on human beings and other living creatures along with possible methods of mitigation of adverse impact on the biological community (Arana and Garcia, 1998, Morillas et.al, 2002). The development of green belt around the noise polluting area is a useful measure in order to reduce noise pollution level (Aylor, 1972, Tyagi, 2006). Different researchers have already studied the efficiency of green belt in the mitigation of noise pollution (Rao et al., 2004, Krag, 1979, Cook, 1977). The main mechanism associated in the mitigation of noise level by the plants includes the absorption of acoustic energy by its leaves which reduces the kinetic energy of the vibrating air molecules (Pathak, 2011). Another useful mechanism adopted by the plants in reducing sound pressure level is the barrier effect of green plants which causes greater reflection, refraction, scattering and absorption of noise resulting in higher amount of attenuation of sound (Fang and Ling, 2003). Some important design parameters considered in the development of green belt to reduce noise pollution level includes trees height, width of green belt, distance of green belt from the source, visibility etc. The vegetation species selected for such function are required to have fast growth rate for quick development of a canopy, large leaf size for enhanced retention of pollutants and absorption of noise. These plants are also required to have comparatively good tolerance to insects, diseases and other pollution loads. Longer life span is also an essential requirement to ensure the longevity of the developed green belt (Shannigrahi, 2004). As per the study made by some researchers for highway noise management through green belt development, it indicates that an effective highway noise absorption and deflection can be done if the border planting are lower towards the noise and higher towards the hearer (Pathak, 2011, Rao, 2004). The same principle can also be employed in the case of industrial noise pollution control. In the Bodhjungnagar Industrial Growth Centre a green belt can be developed with such types of vegetations which have a higher elevation than the noise generating points and the adjoining locality, thus forming a shadow zone behind the barrier (Pathak, 2008). The arrangement of trees in the green belt is another important factor required to be considered during the development of the green belt. The arrangement of trees in periodic lattice is proved to be an effective means of sound attenuation by green belt (Martinez-Sala, 2006). Thus it is clear from the literature studied that depending upon the agro-climatic condition of Bodhjungnagar Industrial Growth Centre, some plant species like Caesalpinea pulcherima, Bambusa sp., Azadirecta indica, Ficus benghalensis, Ficus religiosa, Acacia auriculiformis etc that can be used for development green belt in the growth centre area. These plants are also effective in prevention and control of air pollutants from any industrial sources. As the noise poses significant occupational health hazard among the workers, therefore installation of acoustic enclosure is very much necessary for reduction of noise at the sources. Depending upon the size of the unit, acoustic enclosure or acoustic treatment of the room shall be used and designed for minimum of 25 dB(A) insertion loss or for meeting the ambient noise standard. Besides, installation of low noise producing equipments is also reducing noise pollution problems some extent.

CONCLUSION

From the present study the current status of the noise pollution level in Bodhjungnagar Industrial Complex is assessed. The results of noise level in the area indicate a less intensity of noise pollution. However there exists a strong chance of enhanced noise pollution in the near future with gradual expansion of the industrial complex. The study also pointed out some measures to cope with the noise pollution in the area. The development of green belt around the study area is one of such effective tools to mitigate noise pollution not only in the current situation but also in future. A brief discussion on the probable mechanism of green belt design is also presented in the paper.

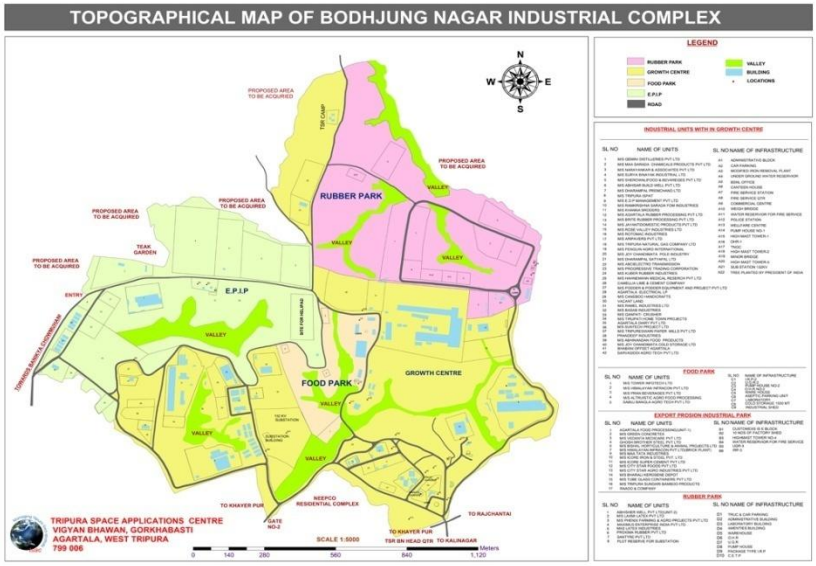

FIG.1. Topographical map of Bodhjungnagar Industrial Growth Centre (SOURCE: TIDC)

Table. 1. Ambient noise levels in the study area

Station Code	Name of the location	Type of Zone	DAY (dB)	NIGHT (dB)
NS-1	Near Avishar Buildwell Pvt. Ltd.	Industrial	51.3 – 71.2	43.2 - 51.3
NS-2	Near Dharmapal Premchand Ltd.	Industrial	53.7 - 70.3	40.0 - 49.2
NS-3	Near Proxima Rubber industry	Industrial	44.6 – 56.1	39.9 - 49.0
NS-4	Near Tripura Ispat	Industrial	55.1 – 68.3	41.0 – 46.0
NS-5	Near Power Plant (NEEPCO)	Industrial	40.0 – 48.9	33.1 - 46.9
NS-6	Khayerpur	Commercial	53.1 – 73.7	34.6 - 55.2
NS-7	Banikya Chowmuhani	Residential	47.5 – 58.6	35.8 - 52.5
NS-8	Devendra Chandra Nagar (MSW dumping yard)	Industrial	39.0 - 62.4	33.5 - 47.4
NS-9	R K Nagar	Residential	38.6 – 49.6	33.1 - 42.5

Table. 2. Day time noise level parameters in the study area

Station Code	Name of the location	L_{eq}	L_{max}	L_{10}	L_{90}
NS-1	Near Avishar Buildwell Pvt. Ltd.	66.1	71.2	68.7	53.4
NS-2	Near Dharmapal Premchand Ltd.	63.5	70.3	67.1	55.9
NS-3	Near Proxima Rubber industry	51.5	56.1	54.6	45.2
NS-4	Near Tripura Ispat	50.1	68.3	67.7	50.2
NS-5	Near Power Plant (NEEPCO)	43.7	48.9	45.9	41.8
NS-6	Khayerpur	68.9	73.7	70.0	60.6
NS-7	Banikya Chowmuhani	53.0	58.6	55.2	47.5
NS-8	Devendra Chandra Nagar (MSW dumping yard)	47.9	62.4	63.2	45.8
NS-9	R K Nagar	44.2	49.6	45.2	42.0

Table. 3. Night time noise level parameters in the study area

Station Code	Name of the location	L_{eq}	L_{max}	L_{10}	L_{90}
NS-1	Near Avishar Buildwell Pvt. Ltd.	48.1	51.3	49.9	44.4
NS-2	Near Dharmapal Premchand Ltd.	44.2	49.2	44.6	42.4
NS-3	Near Proxima Rubber industry	42.9	49.0	48.1	41.2
NS-4	Near Tripura Ispat	42.1	46.0	46.8	42.1
NS-5	Near Power Plant (NEEPCO)	38.4	46.9	51.4	35.5
NS-6	Khayerpur	50.7	55.2	55.8	39.6
NS-7	Banikya Chowmuhani	46.6	52.5	50.0	37.0
NS-8	Devendra Chandra Nagar (MSW dumping yard)	42.5	47.4	44.5	34.2
NS-9	R K Nagar	36.5	42.5	49.9	35.2

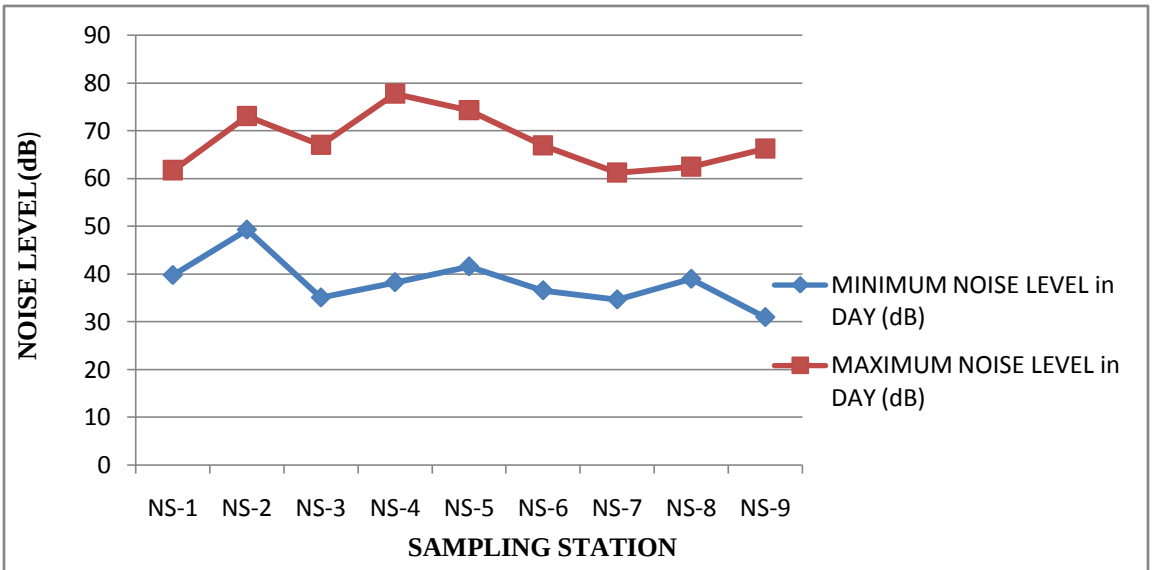

Fig. 2. Variation of Noise Level

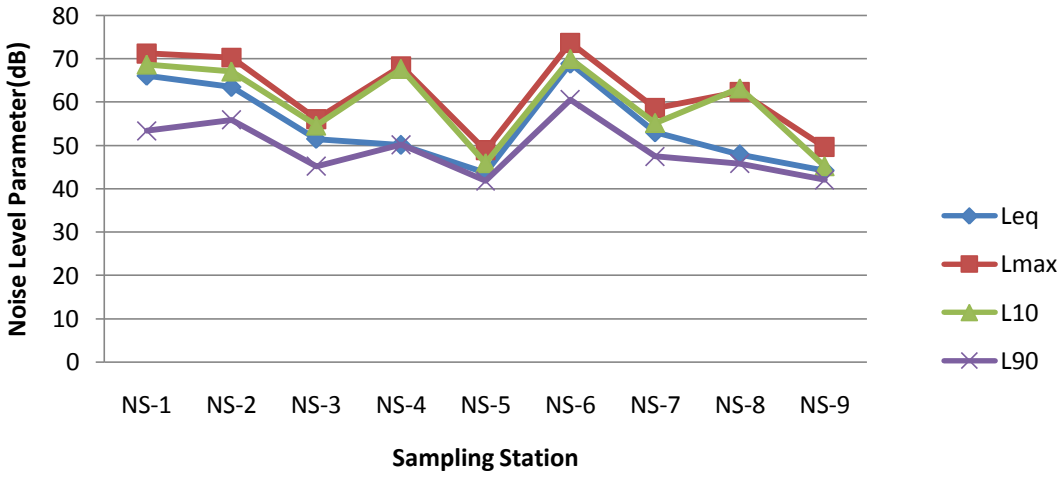

Fig. 3. Variation of Noise level Parameters in Day time

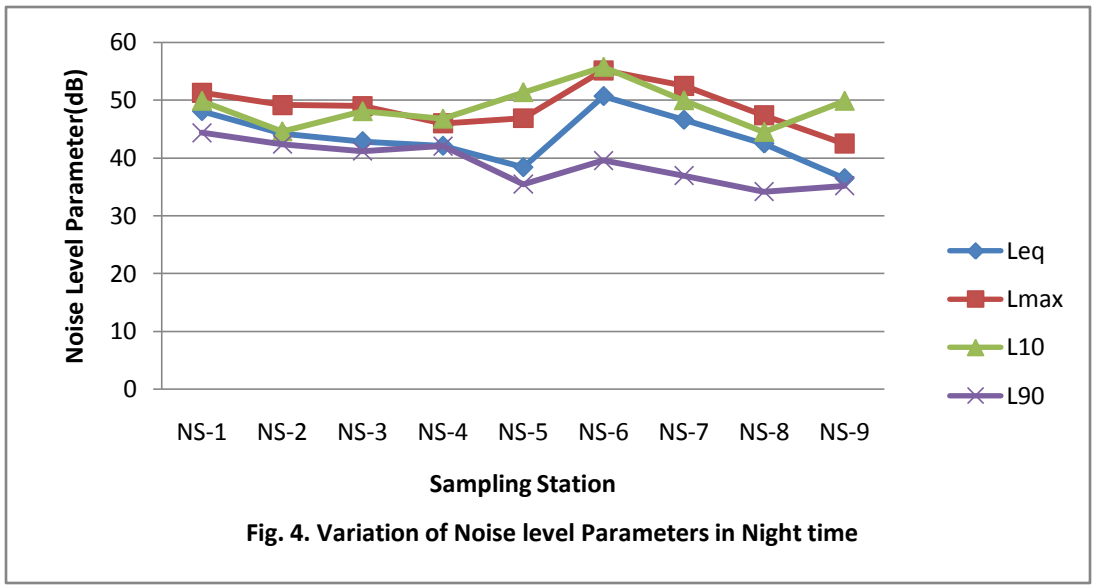

Fig. 4. Variation of Noise level Parameters in Night time

REFERENCES

[1] Arana, M. and Garcia, A., 1998. A social survey on the effects on environmental noise pollution in the city of Curitiba, Brazil. Applied Acoustics, 53, 245–253.
[2] Aylor DE, (1972). Noise reduction by vegetation and ground. J. Acoust. Soc. Am. 51, 197–205.
[3] Bhabananda, P., Kalyan. K., (2013), An experimental study of noise pollution in Gauhati University campus, Guwahati, Assam, India, International Journal of Environmental Sciences, 3(5).
[4] Cook, DI. and Haverbeke, DF., (1977), Suburbon noise control with planting and solid barrier combinations, Research bulletin, 100.
[5] Fang, C.F., and Ling, D.L. (2003). Investigation of the noise reduction provided by tree belts. Landscape and Urban Planning, 63: 187-195.
[6] Krag, J., (1979). Pilot study on railway noise attenuation by belts of trees. Journal of Sound and Vibration, 66(3), 407–415.
[7] Martinez-Sala, R., Rubio, C., Garcia-Raffi, L.M., Sanchez-Perez, J.V., Sanchez-Perez, E.A.S., and Llinares, J. (2006). Control of noise by trees arranged like sonic crystals. Journal of Sound and Vibration, 291: 100-106.
[8] Melnick, W. (1979), Hearing loss from noise exposure, Handbook of Noise Control, Harris, C. M (Ed.). Mc. Grow Hill, New York,15, 1.
[9] Morillas, JMB., Escobar, VG., Sierra, JAM., Gómez, RV. and Carmona, JT., (2002). An environmental noise study in the city of Cáceres, Spain. Applied Acoustics, 63 (10), 1061–1070.
[10] Pathak, V., Tripathi, B.D., and Mishra, V.K. (2011). Evaluation of anticipated performance index of some tree species for green belt. Urban Forestry and Urban Greening, **10**: 61-66.
[11] Pathak, V., Tripathi, B.D., and Mishra, V.K. (2008). Dynamics of traffic noise in a tropical city Varanasi and its abatement through vegetation. Environ Monit Assess, 146: 67-75.
[12] Rao, PS., Gavane, AG., Ankam, SS., Ansari, MF., Pandit, IV., and Nema, P., (2004). Performance evaluation of a green belt in a petroleum refinery: A case study. Ecological Engineering, 23(2), 77–84.
[13] Shannigrahi, A.S., Fukushima, T., and Sharma, R.C. (2004). Anticipated air pollution tolerance of some plant species considered for green belt development in and around an industrial/urban area in India: an overview. Intern. J. Environ. Studies, 61: 125-137.
[14] Tyagi V., Kumar K. and Jain V., (2006). A study of the spectral characteristics of traffic noise attenuation by vegetation belts in Delhi, Applied Acoustics, 67, 926–935.