Running Condition Noise Dose to Auto drivers in Kolkata Metropolitan City of India in Different Seasons

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Abstract— This paper studies work exposure for drivers of auto rickshaws in Kolkata, India in a running condition to noise. Since the most negative effects caused by noise exposure are related to the hearing system and it may produce professional deafness or even permanent deafness. It is necessary to assess the noise exposure and to develop mechanisms for studying and proposing preventive solutions for minimizing environmental pollution. Equivalent noise exposures of drivers at work and in-auto noise are evaluated using a precision dosimeter in different areas or locations of various times like summer and rainy seasons etc. Readings were taken in different routes in north Kolkata, India and the noise doses are analyzed. The A-weighted values of L_{eq} (12), L_{10} , L_{90} , TWA (Time weighted Average) and TNI (Traffic Noise Index) are determined. It shows significant effect of noise exposure from auto-rickshaws in Kolkata city of India.

Index Terms— precision dosimeter, vehicle flow, traffic composition, noise exposure

I. INTRODUCTION

Kolkata in India is the most populous metropolitan cities of the world with significant commuter flows according to Census of India, 200. There are about 75 thousand auto-rickshaws out of which 35 thousands are having license. Work exposure for the drivers involves heat, noise, diesel exhaust, the body vibration etc, causing noise and environmental pollution.

Maximum routes of this city are congested and roads are not properly designed. It has a large public transportation system involving significant environment pollution. Work-exposures for the drivers, conductor and commuters in an

auto are mostly heat, noise, diesel exhaust, whole body vibration etc. The noise emitted from the engine, gear, clutch, accelerator, brake, etc. during operation of the auto are the main noise source within and outside the auto. Noise intensity varies with operating conditions and with the overall state of the autos. There are also other factors—striking of metal body structures, horn, voice of the passengers etc. Moreover, while crossing different traffic zones, autos pass through the crowded areas and the outside noise contributes to the in-auto noise. The report of this study looks at exposures of the auto drivers in Kolkata metropolitan city of India.

II. METHODOLOGY OF THE STUDY

For studying the characteristics of noise dose at different sites, simultaneous measurement of sound-pressure levels (SPL) at different routes in North Kolkata are taken in running condition in winter, summer season. Also Time Weighted sound-pressure level (TWA), threshold level, criterion levels were also made. A history of discomfort in running condition, regarding noise pollution, if any, experienced while driving the auto previously is obtained through questionnaire to different auto drivers in different routes of the city.

A. Instrument Used

Type 4444, Noise dose meter a lightweight and instrument has been used for recording assessment and of noise levels associated with auto drivers in Kolkata city. This meter type 4444 comes with different seven built in setups, which includes OSHA, MSHA, DOD, ACGIH (USA Standards) and ISO 85A, ISO 90A (International Standard) which corresponds to today's most widely used standard. There are two sound level meter setups: SLM which gives on-screen results only and cannot store data to memory. METER which can store data to memory.

Fig.1. Noise Dose Meter 4444 used for this study

B. Method of measurement

Each route was studied at least 2 times during the to-

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and-fro journey. The noise, monitoring a weighted noise, Leq, is recorded for the driver by connecting the mouthpiece to the drivers collar (10cm approx. from the driver ear). It is estimated by recording the dB(A) value in Leq mode. The noise exposure of auto drivers is taken during January to end of July, 2010 over a period of 32 weeks, which cover winter, summer seasons. An area of north Kolkata is selected and measurement is taken in different routes in morning, noon and afternoon times.

The noise dose (ND) for drivers on each trip can be calculated from:

$N.D = T/8X \text{ antilog } \{0.1 (L-90)\}$, Where T is the duration in hours over a specified noise level reaches ear and L is level of noise reaching the ear in dB (A).

The Leq is calculated over a particular route from ND.

$$Leq = 10 \log(ND) + 90 \text{ dB (A)}. \quad [1] \quad (1)$$

$$Leq = 10 \log \left[\left(\frac{1}{T} \int_0^T P^2_A(t) dt \right) / P^2_{ref} \right] \text{ dB (A)} \quad (2)$$

The recordings are taken when the auto rickshaws in motion. When the driver takes break for lunch, usually for half an hour i.e. 1pm to 1.30pm, intervals are taken while an auto is idle in the stand.

TABLE 1. ROUTE CHART

Route No	Name of Route	Location
1.	Sithirmore to Shyambazar	North Kolkata
2.	Shyambazar to Sithirmore	North Kolkata
3.	Sithirmore to Bally	North Kolkata
4.	Bally to Sithirmore	North Kolkata
5.	Shyambazar to Ahiritola	North Kolkata
6.	Ahiritola to Shyambazar	North Kolkata
7.	Ahiritola to Baghbazar	North Kolkata
8.	Baghbazar to Ahiritola	North Kolkata
9.	Ahiritola to Sovabazar	North Kolkata
10.	Sovabazar to Ahititola	North Kolkata
11.	Baghbazar to Sovabazar	North Kolkata
12.	Sovabazar to Baghbazar	North Kolkata

C. Data Computation

Data recorded from 10 A.M. to 6 P.M. (8 Hrs) at each route to compute the hourly equivalent continuous noise level Leq (8), traffic noise index (TNI), and the noise exceedance level L10, L90 are done.

The different formulas used for computation of these parameters are written down below:-

$$TNI = 4(L_{10} - L_{90}) + L_{90} - 30 \quad [1] \quad (3)$$

$$Leq(12) = 10 \log \frac{1}{12} \sum_{i=1}^{12} 10^{\frac{L_i}{10}} \quad (5)$$

Results obtained from computation and from 4444 Noise Dose Meter are as follows:

TABLE 2. TRAFFIC NOISE INDEX & EQUIVALENT NOISE POLLUTION IN WINTER

No of runs	Leq(dBA)	L ₁₀ dBA	L ₉₀ dBA	TNI(Traffic Noise Index)
1	82.2	91.2	73.84	113.28
2	80.5	90.7	70.44	121.48
3	87.0	99.2	72.94	147.98
4	84.3	96.2	77.64	121.88
5	81.3	97.5	71.14	146.58
6	82.0	91.2	75.04	107.88
7	89.1	93.0	75.64	115.08
8	87.3	95.3	73.54	130.58
9	84.1	98.02	72.74	113.86
10	86.7	92.7	71.44	126.48
11	86.7	91.1	74.14	111.98
12	89.7	94.6	74.74	124.18

Mean TNI is 123.43

Range for TNI = Maximum value - Minimum value = 147.98-107.88 = 40.1

Fig. 2. Leq Vs No. of Runs (winter)

Fig. 3. TNI Vs No. of Runs (winter)

TABLE 3. TRAFFIC NOISE INDEX & EQUIVALENT NOISE POLLUTION IN SUMMER

No of runs	Leq dBA	L ₁₀ dBA	L ₉₀ dBA	TNI (Traffic Noise Index)
1	84.2	90.2	75.64	103.88
2	87.3	99.1	73.54	145.78
3	85.4	96.7	72.74	138.78
4	83.3	99.3	71.44	152.88
5	85.4	93.0	74.14	119.58
6	83.1	95.3	74.74	126.98

7	87.4	98.02	72.62	144.22
8	88.01	91.2	75.11	109.47
9	82.5	90.7	71.45	118.45
10	87.4	99.2	75.34	140.98
11	84.7	96.2	73.14	135.38
12	82.2	97.5	72.04	143.88

10.	100	16.96	6.60	0.15	0.00	0.00	63.1
11.	97.79	18.81	2.62	0.08	0.00	0.00	61.7
12.	92.61	17.61	3.22	0.10	0.00	0.00	67.7

Mean TNI is 131.67
Range for TNI = Maximum value-Minimum value
=152.88-103.88 = 49.00

Fig. 4. Leq Vs No. of Runs (summer)

Fig. 5. TNI Vs No. of Runs (summer)

Time weighted Average (TWA) and Exceedance times (for % of runs from 70dB-140dB) are taken by Noise Dose Meter as follows: -

TABLE 4. TIME WEIGHTED AVERAGE (TWA) VERSUS EXCEEDANCE TIMES FOR PERCENTAGE OF RUNS FROM 70dB TO 140dB

No. of Run s	70dB	85dB	90dB	100dB	115dB	140dB	TWA (dB)
1.	95.18	17.99	4.62	0.21	0.00	0.00	39.7
2.	96.22	37.01	13.30	0.02	0.00	0.00	64.5
3.	91.01	58.31	5.99	0.52	0.00	0.00	66.6
4.	96.80	57.14	26.31	0.16	0.00	0.00	52.8
5.	100.1	56.65	3.74	0.04	0.00	0.00	42.6
6.	100.7	29.26	4.69	0.06	0.00	0.00	64.0
7.	99.74	35.50	5.79	0.03	0.00	0.00	51.6
8.	100	38.60	6.60	0.27	0.00	0.00	48.2
9.	91.19	52.37	18.38	0.10	0.00	0.00	61.0

Fig. 6. Percentage runs from 70dB-140dB

Fig. 7. TNI in summer & winter

TABLE 5. INTERMEDIATE NOISE DOSE IN PERCENTAGE

No. of Run s	70dB-85dB	85dB-90dB	90dB-100dB	100dB-115dB	115dB-140dB
1.	17.19	13.37	4.41	0.21	0.00
2.	59.21	23.71	13.28	0.02	0.00
3.	32.7	52.32	5.47	0.52	0.00
4.	39.66	30.83	26.15	0.16	0.00
5.	43.46	52.91	3.7	0.04	0.00
6.	71.44	24.57	4.63	0.06	0.00
7.	64.24	29.71	5.76	0.03	0.00
8.	61.4	32.00	6.33	0.27	0.00
9.	38.82	33.99	18.28	0.10	0.00
10.	83.04	10.36	6.45	0.15	0.00
11.	78.98	16.19	2.54	0.08	0.00
12.	75	14.39	3.12	0.10	0.00

Fig. 8. Intermediate Noise Dose from 70dB to 140dB

III. RESULTS AND DISCUSSION

Table 2 and Table 3 represents the equivalent continuous noise exposure in dB (A) as well as Traffic Noise Index (TNI) in twelve different runs in running condition in summer and winter seasons. Criterion level and threshold level are always kept in 90dB and 80dB respectively. The different values of the noise variables recorded on different runs in the dose meter are shown above in the above tables, line and bar diagram.

IV. CONCLUSIONS

From above it has been found that Traffic Noise Index is Maximum in summer and it is 152.88 and Mean Time Weighted Average (TWA) is 56.95. It was observed that the proportions of drivers by category of sensitivity of hearing are an important factor in running condition and the proportion of drivers with a hearing loss increases significantly. In summer Mean TNI is 131.67 and in winter 123.43. So the difference of Mean TNI in these two seasons is 08.24. Drivers undertaking four consecutive trips within Kolkata city traffic routes have higher noise exposure than the recommended standard. This study suggests that noise exposure and noise induced hearing loss and occupational noise exposure both interfere with the safety of driver as well as passenger's daily life. It is found that working in such places where daily noise dose exceed 89dBA is more dangerous, even for those suffering from mild noise related hearing loss. If noise exposure can be reduced, then it will decrease the tendency of drivers to cause accident and injury, because inability to hear auditory warning signals, or too uncertain about their presence. Thus appropriate action cannot be taken in time from the part of the auto drivers. Apart from this, long exposure to this level of noise, it is sure to produce short term and long term hearing disorders causing serious type of environmental pollution. Though this study is carried out only with auto-rickshaws i.e. small vehicle in Kolkata metropolitan city of India, similar study can be easily extended to other mode of vehicles i.e. light and heavy vehicles in all around the world. The results indicate how much the auto-drivers, passengers and road commuters of Kolkata in India are exposed to high intensity of noise pollution.

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