INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES
Volume-4, Issue-1, Jan-Mar-2014
ISSN 2231-4490
Coden : IJPAES www.ijpaes.com
Received: 01st Dec-2013 *Revised: 23rd Dec-2013* *Accepted: 27th Dec-2013*
Research article

MODELING AND ENVIRONMENTAL IMPACT ASSESSMENT IMPLEMENTATION BY NOISE AND AIR POLLUTION REDUCTION OF INDIAN HEAVY DIESEL TRUCKS ON HIGHWAYS

Dr. Parag Dalal
Prof. Ujjain Engineering College, Ujjain

ABSTRACT: Recent technology advances in automotive engineering have resulted in new type engine development with straight exhaust emissions and engine noise reductions. A systematic approach to evaluate these environmental problems should be taken as soon as possible. The highway development is among the activities essential for successful urban development. The transportation segment in India is the most important energy consuming segment. The key dispute in front of India is bottlenecks in power which contribute the limitation of financial development. The rise in amount of automobiles would absolutely add to air pollution which will result in many troubles of health by air and noise pollution. The reduction in visibility during chest hours will raise highway accidents to a large extent and will also increase various security problems. This paper attempts to investigate noise and air problems through an environment friendly model and V.A.P.I.S. to make a policy for most advantageous transportation and its ecological strategy. In noise different equations are used to determine L_{10} and L_{50} with special reference to highway diesel trucks. The vehicle emits contaminants generally on a height at which children of age infant to 5 live. This increases their health problems and they have less immunity for many diseases. Similarly the height at which horns are fixed is similar which increase deafness in kids.
Key Words: V.A.P.I.S., L_{10}, L_{50}, Noise Pollution, Air Pollution, Trucks, highways

Abbreviations

AAS – Atomic Absorption Spectroscope
C.P.C.B. – Central Pollution Control Board
CC – Cubic Centimeter
CO – Carbon Monoxide
E.I.A. – Environmental Impact Assessment
FPM – Fluid Partial Mechanics
G.C. – Gas Chromatography
G.V.W. – Gross Vehicle Weight
HC – Hydrocarbons
I.S.I. – Indian Standards Institution
L_{10} – Sound Pressure Level Exceeding 10% of monitoring Time
L_{50} – Sound Pressure Level Exceeding 50% of monitoring Time
NDIR – Non-Dispersive Infrared
NO_X – Nitrogen Oxides
PM – Particulate Matter
R.I.T.E.S. – Rail India Technical and Economic Services
SO_X – Sulphur Oxides
UV – Ultraviolet
V.A.P.I.S. – Vehicular Air Pollution Information System
W.H.O. – World Health Organization

INTRODUCTION

The transportation is a significant infrastructure for socioeconomic growth of our country. The environment noise pollution and air pollution in recent years are recognized as the most important in most of industrialized nations. The traffic is been increasing at a substantial rate over the past three decades although there is still well after the urbanized countries in per capita transportation concentration [12].

The total concentration of registered motor vehicles in overall countries rises vertically. This amount is raised from 213.75 Lakh in 1991 to 372.81 Lakh in 1997 to 1593.6 Lakh in 2011 in India [22]. The table 1 gives World Diesel fuel consumption for transportation in 1991 to 2020.

Table 1 – World Diesel Fuel Consumption (1991-2020) in million barrels of oil per day [10].

Region/ Country	History				Projections	
	1991	1999	2005	2010	2015	2020
North America	2.1	2.8	3.5	4.1	4.5	5.0
West Europe	2.1	2.9	3.2	3.4	3.5	3.8
Russia	1.1	0.6	0.8	1.0	1.1	1.25
China	0.1	0.4	0.6	1.0	1.4	1.8
India	0.4	0.7	1.1	1.6	2.4	2.8
Korea	0.2	0.3	0.4	0.6	0.6	0.8
Other Asia	0.6	1.0	1.3	1.5	1.7	1.9
Africa	0.3	0.4	0.6	0.8	1.0	1.2
South America	0.6	1.0	1.1	1.2	1.3	1.6

According to RITES the probable quantity of vehicles by the year 2020 can attain 2474.32 Lakh [14]. This is extremely alarming that much enlargement in present size of two wheelers, cars, jeeps and trucks. The philosophy of highway planning and design do not take into consideration of the environmental factors resulting in problems like air pollution, noise pollution, and ecological male effects etc. which are created in the vicinity of the highway systems. In order to achieve the environmental harmony between the roads and its surroundings it is necessary to make an E.I.A. of highway, roadway and railway development proposals.

The Effect of Noise on People – The heavy noise is generally harmful and causes physical and psychological effects on humans (16&13).. Some of important effects of noise pollution on humans are –

i. It causes muscles to contract leading to tension and even nervous breakdown.
ii. It alters comfort and efficiency of humans permanently.
iii. Ultrasonic sound effect digestive, respiratory, cardiovascular systems to a large extent and can damage canals of ears permanently.
iv. Noise pollution changes hormones containing blood altering the effect of blood carriers.
v. It causes dilution of eye pupil.
vi. Non-living things as buildings, glasses, doors etc cause's physical damages due to noise pollution.

Standards of Pollution in India – In India the main standards [5] are given by Air prevention control act 1981 following the provision acts given by CPCB.

The Central Pollution Control Board hereby notifies the National Ambient Air Quality Standards with immediate effect, namely:-

The WHO safe limits of hearing is 45 dB (A) compared to which our city areas are much more noisy. This paper attempts to predict the vehicular development based on time data and estimate pollution generated by them mainly the contribution of heavy diesel trucks [7]. The Vehicular Air Pollution Information System [3, 8], model is developed by Harvard University to analyze the vehicular emission and their fuel efficiency. Vehicular Air Pollution Information System is a user friendly spreadsheet based tool designed to quickly analyze emission trends for a single vehicular category for a pollutant. This tool allows us to start with the basic information on vehicular numbers, growth rates, age splits, kilometers travelled per day, average retirement age and emission factors and establish the vehicular number and emission trends over a period of 30 years by age groups.

Table 2 - National Ambient Air Quality Standards [21]

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential. Rural and Other Area	Ecologically Sensitive Area	Methods of Measurement
P)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m^3	Annual* 24 hours* •	50 80	20 80	• Improved West and Gaekc • Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m^3	Annual* 24 hours'*	40 80	30 80	• Modified Jacob & Hoc heifer (Na- • Arsenate) • Chemiluminesccnce
3	Particulate Matter PM_{10} µg/m^3	Annual* 24 hours-	60 100	60 100	• Gravimetric • TO EM • Beta attenuation
4	Particulate Matter $PM_{2.5}$ µg/m^3	Annual* 24 hours'*	40 60	40 60	• Gravimetric • TOEM • Beta attenuation
s	Ozone (O_3) µg/m^3	8 hours* * 1 hour"	100 180	100 180	• Chcmilmrnesccnce • UV photometric • Chemical Method
6	Lead (Pb) µg/m^3	Annual* 24 hours *	0.50 1.0	0.50 1.0	• AAS 1CP method after sampling on EPM 2000 or equivalent filter paper • ED-XRF using Teflon filter
7	Carbon Monoxide (CO) mg/m^3	8 hours* * 1 hour**	02 04	02 04	• Non Dispersive Infra Red (NDIR) spectroscopy
8	Ammonia (NH_3) µg/m^3	Annual* 24 hours* *	100 400	100 400	• Chemi luminescence Indophenol blue method
9	Benzene (C_6H_6) µg/m^3	Annual*	05	05	• Gas chromatography based continuous analyzer • Adsorption and Desorption followed by GC analysis
10	Benzolal Pyrene (BaP) panic late phase only, µg/m'	Annual*	01	01	• Solvent extraction followed by HPL-GC analysis
11	Arsenic (As), ng/m^3	Annual*	06	06	• AAS /1CP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel ng/m^3	Annual*	20	20	• AAS/1CP method after sampling on F.PM 2000 or equivalent filter paper

• Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

•• 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. *2%* of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note. — Whenever and whoever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

The following standards are for Noise limits for vehicles at manufacturing stage as –

Table 3 – Noise limits for vehicles applicable at manufacturing stage applicable from 1st April, 2005 [20]

S. No.	Type of vehicle	Noise Limits dB(A)
1.0	Two wheeler	
1.1	Displacement up to 80 cc	75
1.2	Displacement more than 80 cc but up to 175 cc	77
1.3	Displacement more than 175 cc	80
2.0	Three wheeler	
2.1	Displacement up to 175 cc	77
2.2	Displacement more than 175 cc	80
3.0	Vehicles used for carriage of passengers and capable of having not more than nine seats, including the driver's seat	74
4.0	Vehicles used for carriage of passengers having more than nine seats, including the driver's seat, and a maximum gross Vehicle Weight(GVW) of more than 3.5 tonnes	
4.1	With an engine power less than 150 KW	78
4.2	With an engine power of 150 KW or above	80
5.0	Vehicles used for carriage of passengers having more than nine seats, including the driver's seat: Vehicles used for carriage goods.	
5.1	With maximum GVW not exceeding 2 tonnes	76
5.2	With maximum GVW greater than 3 tonnes but not exceeding 3.5 tonnes	77
6.0	Vehicles used for transport of goods with a maximum GVW exceeding 3.5 tonnes.	
6.1	With an engine power less than 75 KW	77
6.2	With an engine power of 75 KW or above but less than 150 KW	78
6.3	With an engine power of 150 KW or above,	80

Table 4 – Standards of noise level in air area wise

Area Code	Category of area	Noise Limits dB(A)	
		Day (6:00AM to 9:00 PM)	Night (9:00 PM to 6:00 AM)
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Area	50	40

Silence Zone is area around 100 meters from hospitals, schools, collages, court etc. the use of horns, loudspeakers, crackers are all banned in that areas [1]. The ISI has given more straight standards of outdoor ambient noise levels as –

Table – 5 – ISI standards

Location	Noise Limits dB(A)	
	Minimum	Maximum
Rural	20	35
Sub-urban	30	40
Urban (Residential)	35	45
Residential and commercial	40	45
Urban (City Traffic)	45	66
Industrial	50	60

MATERIAL AND METHODS

The transport segment consumes about 32% of the total business done in India. The utilization of power in transport section is 69.45 million tons in 1996 which go up to 125 million tons in 2005. The transport section account to about 79% of use of diesel fuel consumed in India by mainly trucks.

This increases the utilization of crude oil in India which increases from 3.5 million metric tons in 1950 to 4520 thousand barrels per year in 2013 out of which 78% is been imported. The increase in use of last decade of crude oil is about 2X which increase the air pollution to a level of three times more in India [11].

Automobile pollution in India – Air pollution generally in a common term means the unexpected levels of pollutants emitted from vehicles as CO, HC, NO_X, SO_X, SO_2 and PM in air. The pollution in big metropolitan cities is getting hazardous. According to W.H.O. nearly 52000 people died in 1995-1996 because of lung diseases and cardiovascular attacks of the Big 36 cities of India after which there are taken various steps with new standards applied in those 36 cities [9].

The increase in large amount of vehicles have congested the traffic, leading to ballooning of the air pollution and noise pollution problem of which the two wheelers, the cars and the trucks are principal contributors of about 80% to the air pollution emission loads and 95% of total noise pollution out of which the diesel trucks contributes more than 50% of each [15]. At present the pollution caused by vehicle emission account for a number of diseases in human beings and is now considered to be the most potential source of various diseases. The air quality in urban areas reached an all time low due to large increase of all types of vehicles in cities which tends to liberate more pronounced pollutants in ambient air.

The vehicle emits contaminants generally on a height at which children of age Infant to 5 live. This increases their health problems and decrease immunity for many diseases. Similarly the height at which horns are fixed is similar which increase deafness in kids.

Procedure of predicting highway noise – To estimate a highway noise pollution it is not that easy and also require a model with its implementation as soon as possible. The noise generated from a free flowing traffic is required to be separated from noise of diesel trucks [19]. These two results are been added to obtain the combined results. The procedure to calculate L_{50} and L_{10} levels in highway traffic along a straight long roadway n is given below [18].

1. **Calculation of L_{50} Level** – The calculation of L_{50} is done in Five different steps given below –
    a. Establish a volume flow V for vehicles/ hour and volume flow of heavy trucks in Vehicles/ hour.
    b. Establish an average speed S of each vehicle class in miles per hour.
    c. Find the reference L_{50} value for each vehicle class respectively.
    d. Correct the Levels in step C to account for the roadway width (i.e. no of lanes on road and width of each lane) and observation distance from observation centerline D_N in feets.
    e. Add the standard deviation to the results and correct them to obtain the final L_{50} values.

2. **Calculation of L_{10} level** – The calculation is based after calculation of L_{50} and is done in three steps [16]
    a. Compute the single Lane equivalent distance D_E where

$$D_E = \sqrt{D_N \times D_F}$$

Where D_N = nearest distance and
D_F = Farthermost distance from centerline

    b. For each Vehicle Class calculate –

$\frac{V_{DF}}{S}$ And find out the value of $L_{10} - L_{50}$ in which L_{50} is the raw data found in the above procedures. This will establish the L_{10} value for each vehicle class.

    c. Find the standard deviation of these results and add the errors to them getting best suited L_{10} values.

Adjustments to L_{10} and L_{50} levels should be done for curves, gradients, cross-sectional changes, non level terrains and stoppages. Hence there is a need to estimate and forecast the emission levels with a model on past and present data. In this paper an attempt is been made to study emission levels of heavy trucks in our and nearby city areas.

RESULTS AND DISCUSSIONS

The vehicular emissions are in table below –

Table 6 – Past, Present and future levels of emissions in Tonnes /Day for trucks

Year	CO	NO_X	SO_2	HC	TSP	PM_{10}	dB (A)
2001	4	1.5	0.05	0.4	0.25	0.2	75
2010	13	2.1	0.42	0.7	0.45	0.43	85
2020*	14	3.3	1.004	1.02	1.05	1.03	90
2030*	16	5.2	2.001	2.01	2.005	2.01	90

(* - Assumptions made according to Model)

In 2001 the highest CO emission came from cars amounting about 60 Tonnes/day and till 2010 the emissions of two wheelers are at 80.04 Tonnes/day and will continue to increase to about 250 Tonnes/day till 2030.

By 2020 the cars will be on second place with about 225 Tonnes/day and this is going to increase till new ways of transport is been found out and adopted by local public as soon as possible. The NO_X shows about the domination of trucks in 2001 but with the use of more diesel cars it's now lesser from trucks the same is case with other pollutants. But as far as noise pollution goes its about 75 dB (A) per truck in 2001 which increase to 85 dB (A) per truck in 2010 because of the use of pressure breaks and pressure horns increases which will increase this data in 2020 and will be about constant till 2030 till when its estimated to have a ban on pressure horns permanently to reduce the pollution steeply.

CONCLUSION

This projected development in vehicular pollution will result in more utilization of fossil fuels which will lead to a point where they will extinct. Various models present should be used to lower the level of pollution and increase the efficiency of the system so that the trucks do not reveal much pollution. A seamless flow of traffic should be provided so that less congestions and bottlenecks are there leading to less consumption of fuel and less use of horns. The use of pressure horns, fancy horns, double horns and loudspeakers should be banned permanently and the local public should also realize their responsibility and blow them as low as they can. Also the modifications in truck machinery should be done with modifications in their bodies to reduce noise pollution. Finally Every Indian should realize his responsibility and should not drive their vehicle for any one day of the weak to reduce pollution.

REFERENCES

[1] Central Motor Vehicle Rules 1989. Government of India
[2] Cunniff, P.F. 1977. "Environpmental Noise Pollution" John Wiley and Sons NY.
[3] Harsha Deep N.R. Vehicular Air Pollution System (VAPIS) for Delhi. SASEN. World Bank, 1998.
[4] I.J.Palmer, N.Chilton & R.A. Earnshaw, Web Programming Environments: Towards a Virtual API. http://www.cs.vu.nl/~eliens/WWW5/papers/VAPIS/index.html
[5] Indian Standards Institution
[6] Jena, R, Pal, A.K.,Saxena, N.C. 1996. "Noise Impact Assessment -An Approach' Energy Environment Monitor 12(2).
[7] Katiyar, S.C., Khathing, D.T. and Dwivedi, K.K. 2003. Characterisation of Exhaust Emissions from Gasoline and Diesel Powered Vehicles.Quarterly International Journal Pollution Research, ISSN 0257-8050,pp I -14.
[8] Kokaz, K. Vehicular Air Pollution System (VAPIS) for Delhi (modified). DEAS. Harvard University, 2000
[9] Perspective planning for Transport Development, Report of Steering Committee, Energy Policy Division, Planning Commission, 1994
[10] Peter, G.B.,Vedamuthu, Dr. 2004.Jatropha curcas oil-A bio-diesel for commercial & industrial applications, proceedings of the seminar on entrepreneurship awareness camp for rural women, entrepreneurship development cell (EDC)(Sponsored by department of science and technology, Government of India) Kumaraguru College of Technology, Coimbatore pp 28-36.
[11] Rail India Technical and Economic Services
[12] Rao, P.R.1992."The prediction of annoyance due to heavy vehicular traffic noise" Energy Environment Monitor 8(1)
[13] Rao, P R., Rao, M.G.S. 1992. "The Prediction of Annoyance due to Heavy Vehicular Traffic Noise" Energy Environment Monitor 8(1).
[14] Ray, Amit. 2001. Control of Vehicular Pollution through Regulation and Technology. Indian Journal of Transport 131 — 146.
[15] Saravanan, S.V., Manivel, R. and Dhandapani, S. 2002. Investigation of Emission Monitoring and its Control for the Indian Two Stroke Two Wheeler Applications to meet WTO Regulations, Proceedings of the UGC Sponsored National Seminar on Automobile Emissions Monitoring and Control. (Edited by Prof.AR. Ramanathan), pp 24-28.
[16] Seshagiri Rao Hoskote, Elmo "ED" Koehn. Impact on the Economy due to Transportation in Developing Regions, Lanmar University.
[17] Swing, J.W., Inman, D.J. 1974. "Noise Level in railroad Operation", A. S.M.E. rail Transportation Divison, No.74-WA/RT-8.
[18] Swing, J.W. 1975. "Simplified Procedure for Developing railroad Noise Exposure Contours", Sound and Vibration.
[19] Swing, J.W., Pies, DB, 1973. "Assessment of Noise Environments around Railroad Operations", Wyle Laboratories, Report WCR 73-5.
[20] Traffic and Transportation Policies and Strategies in Urban Areas in India. Final Report. Ministry of Urban Development, Government of India, New Delhi. March 1998
[21] Urban Statistics, Central Pollution Control Board. Town and Country Planning
[22] World Health Organization: WHO