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STATUS OF CARBON MONOXIDE (CO) CONCENTRATION AT KEY INTERSECTIONS AROUND AN UPCOMING AIRPORT-A CASE STUDY OF NAVI MUMBAI , INDIA

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ABSTRACT

Air pollution is a result of human and manmade activities including the road vehicle use. This paper deals with the measurement and analysis of Carbon Monoxide concentration at key intersections around an upcoming airport at Navi Mumbai. Traffic volume study indicates that cars and two wheelers are the major source of carbon monoxide , methane and hydrocarbons. Air monitoring was carried out at all the seven intersections around the airport and the results were analyzed. Location of the monitoring stations was decided according to WHO and CPCB guidelines. Modeling of the CO pollutants for future scenario have been done through a traffic simulation software called VISSIM .Predicted values of CO and NOx were compared with the standards prescribed by Central Pollution Control Board (CPCB) . It was found that concentration level of CO pollutants at some of the intersections are within the prescribed limit of the CPCB whereas at some of the intersections, it is exceeding the prescribed limit of CPCB during the study period.

Keywords: Air Pollution, VISSIM, Simulation, CO, Pollution.

I. INTRODUCTION

Air pollution due to transportationis the result of thedischarge of unburnt and partially unburnt engine fuels together with the bi-products of complete combustion. The main components of air pollution due to transportation are carbon monoxide, oxides of nitrogen, hydrocarbons, lead etc. It had been a general perception in the past that air pollution is mainly a problem of industrially developed countries; however recent studies have shown that air pollution is a problem of developing countries also and attention should be given to this problem before it is too late [1]. Transportation is the movement of people, animals and goods from one place to another. Man' s desire for rapid development in transportation include air, rail, road, water space etc. Transport is important since it enables trade between people, which in turn establishes civilizations [2]. Surface transportation is a large source of green house gas emissions, and therefore large contributors to global climate change [3]. Generally motor vehicles produce more air pollution than any other single human activity [4]. In most developing countries, vehicular growth has not been checked properly by environmental regulating authorities leading to increased level of pollution [5]. Traffic emissions contributes about 50-80% of NO2 and

CO concentration in developing countries [6]. Anthropogenic sources of air pollution include products of combustion such as nitrogen oxides (NOx), carbon oxides (COx)sulphur Oxides (SOx).Actually motor vehicles produce more air pollution than any other single human activity [7]. About 50% of global emissions from fossil combustion come from gasoline and diesel powered vehicles. In the city centres specially on highly congested roads , thaffic can be responsible for as much as 90-95% of the ambient CO levels and posing a significant threat to human health and natural resources [8]. The rapid growth of a city has a big impact on the air quality situation, which arises as a result of increased vehicular emissions. This is generally true in developing countries, mainly true due to high proportion of old, poorly maintained vehicles and poor fuel quality [9]. CO is a colourless, odourless gas which when released into the atmosphere plays an important role in global, regional and urban atmospheric chemistry by affecting the concentration of hydraoxyl radical andand the cycle of tropospheric ozone. CO is often found to be a toxic air pollutant in urban and indoor air .In some of the developing countries, because of the tropical nature of the climatic conditions, many activities are performed outdoors [10]. People stay along the busy roads every day either to do their work or to sell their wares. Therefore, the ill effect on health due to air pollution resulting from automobile exhaust is a very serious issue.

II. MATERIAL AND METHOD

Description of the Study Area

For the present research work, the upcoming of a new International Airport ar Navi Mumbai has been considered as a case study. Due to introduction of this airport there would be significant impact on the surrounding environment which may be both positive and negative.Navi Mumbai is being developed as counter magnet to the main city. This is the largest new town planning and development project undertaken in Asia. The Site of Navi Mumbai airport is selected near Panvel town in an area admeasuring 2347 acres of land which is situated about 45 km away from the Mumbai / Santacruz airport. The airport is planned with two runways 3700 m length with parallel taxiways designed to suit the new aircraft. The other facilities include the domestic terminal, international terminal, cargo terminal, aircraft lighting etc. Details about the monitoring stations are given in table 1.

Table 1: Location of the Air Monitoring Stations in the Study Area

Sr.No. -	Station Code -	Station
1.	SPD	Sanpada
2.	DYP	D. Y. Patil
3.	BLP	Belapur
4.	URN	Uran
5	PVL	Panvel
6	KLB	Kalamboli
7	TLJ	Taloja

III. DATA COLLECTION

For the assessment of concentration level of CO at different intersections around the upcoming airport, it have been considered in the study area for all seasons in the base year (2007-08). The traffic characteristics and the meteorological data were also collected along with the air pollutants. The ambient air quality analysis has been performed by comparing the concentrations of monitored air pollutants with the standards of Central Pollution Control Board (CPCB) . The monitoring was done during post monsoon, pre monsoon, winter and monsoon season at a frequency of twice a week at each station for 24 hours. Post monsoon season was considered during the month of November, 2007 to October, 2008, Winter season was considered from December, 2007 to February, 2008, pre monsoon season was considered from March, 2008 to May, 2008 and monsoon season was considered from June, 2008 to September, 2008.Location of air monitoring stations are shown in **fig. 1.**

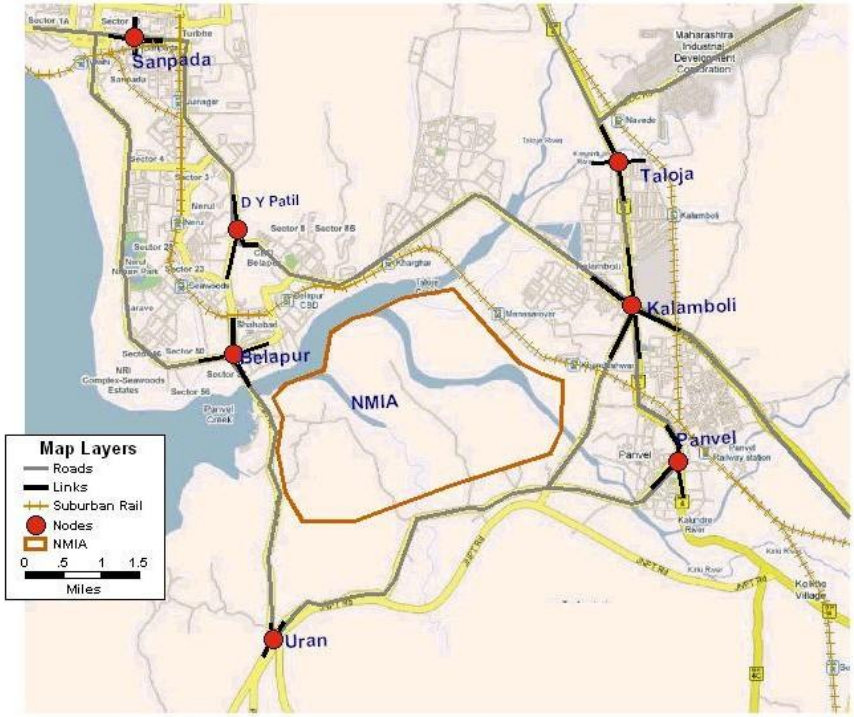

Fig.1 : Location of Air Monitoring Stations

IV. METHODOLOGY ADOPTED

Air quality assessment was carried out at 7 intersections within the radius of 10 km of the study area. Details about the monitoring stations are shown in the **table 1**. Traffic volume, vehicles speed, meteorological data, and CO pollutant concentration were collected and compiled according to model requirements. Traffic volume on various links was carried out and the same was used to forecasting the traffic on the road through which the airport traffic dispersal will take place. The main road through which airport traffic dispersal will take place are NH4, NH4B, SH4 and Amra Marg. The growth rate adopted for traffic forecasting on various links are based on the developments envisaged in the region and the same are given in **table 2**.The forecasted number of

vehicles are converted into passenger car units (PCU)for getting the average daily traffic and peak hour volume. Classified traffic volume was carried out at all the links for 14 hours (7.00 A.M TO 9.00 PM). The link characteristics of the various links such as the length and width of the link, type of operation (one way or two way) were also obtained by manual methods.

Prediction of the pollutant CO were done by simulation software VISSIM and results were compared with the standards prescribed by CPCB (CPCB 2009) as given in table 3

Table 2: Traffic growth rate for different links

Category	Car, Taxi, Van	2/3 Wheelers	Buses	Trucks
Upto 2008	4.5	10.0	5.0	7.5
2009-2015	4.5	10.0	5.0	6.0
2015-2030	4.0	10.0	5.0	3.0

V. APPLICATION OF THE VISSIM SOFTWARE

Simulation is basically a dynamic representation of some part of the real world achieved by building a computer model and moving it through time. The results obtained from simulation model are as good as the model replicates the specific real world characteristics of interest to the analyst. The successful utilization of the model depends on selecting the proper values of the parameters that describe the traffic performance and driving behavior characteristics. To facilitate the application of the VISSIM model to the local traffic conditions calibration and/or modification of the default values of the model have been considered.

VI. INPUT DATA REQUIRED FOR THE MODEL

The various input required for VISSIM software are data of network geometry, traffic volume data, turning movements, vehicle characteristics, travel demands, vehicle mix, stop signs, traffic control systems, etc. The coded VISSIM simulation network is further calibrated to replicate the local traffic conditions. The calibration involves comparing the simulation results against field observed data and adjusting model parameters until the model results fall within an acceptable range of convergence. Data collection for model calibration includes traffic volume data, travel time, maximum queue length, average queue length and average link speed.

Table 3; National Ambient Air Quality Standards effective from Nov.2009

Sl. No	Pollutant	Time-weighted average	Concentration in Ambient Air		
			Industrial Residential and other areas	Ecologically sensitive area as specified by central govt.	Method of measurement
1.	Sulphur Dioxide (SO_2)	Annual* 24 Hours**	50 80	20 80	Improved West and Gaeke method
2.	Oxide of Nitrogen (NOx) µg/m^3	Annual* 24 Hours**	40 80	30 80	Jacob and Hochheiser Modified (Na-Arsenite) (Method Gas Phase Chemihminescence
3.	Particulate Matter (PM) less than 10µm or PM10 (µg/m^3)	Annual* 24 Hours**	60 100	60 100	Gravimetric TOEM Beta attenuation
4.	Particulate Matter(PM) less than 2.5µm or PM2.5 (µg/m^3)	Annual* 24 Hours**	40 60	40 60	Gravimetric TOEM Beta attenuation
5.	Ozone(O_3)	8 Hours 1 Hour	100 180	100 180	UV photometric Chemical method Chemihminescence
6.	Lead (Pb)	Annual 24 Hours	0.5 1.0	0.5 1.0	AAS Method after sampling using EPM 2000 or equivalent Filter paper ED XRF using Teflon filter
7.	Carbon Monoxide (CO) (µg/m^3)	8 Hours 1 Hour	0.02 0.04	0.02 0.04	Non- dispersive infrared (NDIR) Spectroscopy
8.	AmoniaNH_3 (µg/m^3)	Annual 24 hrs.	100 400	100 400	Chemihminescence Indophenol blue method

(Source : CPCB, New Delhi)

VII. RESULT AND DISCUSSION

For air quality assessment at various intersections around the airport, CO baseline data were predicted by VISSIM simulation software and results have been given in table 4 .

Table 4: Emission CO near different intersections

	Emissions					
Intersections	**2008**	**2011**	**2016**	**2021**	**2026**	**2031**
Belapur	1.38	1.63	**2.12**	**2.57**	**2.63**	**2.91**
Kalamboli	1.09	1.20	1.34	1.43	1.60	1.65
Uran	0.71	1.06	1.24	1.3	1.50	1.52
Panvel	1.14	1.17	1.40	1.59	1.89	1.94
Sanpada	1.48	1.81	**2.32**	**2.31**	**2.43**	**2.40**
Dy Patil	0.82	1.00	1.27	1.51	1.65	1.74
Taloja	1.09	1.20	1.34	1.43	1.60	1.65

*permissible value – 2 mg/m^3

VIII. CONCLUSION

- The concentration level of CO at Belapur intersection is below the permissible limit upto the year 2011 but it is exceeding the prescribed limit in the year 2016 and it remains high during entire study period.
- The concentration level of CO at Kalamboli, Uran, Panvel, D. Y. Patil and Taloja intersection is well below the permissible limit during the entire study period.
- The concentration level of CO at Sanpada intersection is exceeding the permissible limit in the year 2016 itself and it remains high during the entire study period (upto 2031).

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