Assessment of Ambient air Quality in the surrounding area of an upcoming airport in India

Arun Kumar Mishra, Dr. Prabhat Srivastava

Abstract
This paper mainly deals with the measurements of air quality by observing the concentrations of pollutants in the atmosphere namely suspended particulate matter, NOx, SO2 and CO at ten different locations around the Navi Mumbai international airport. The location for the study have been selected on the basis of land use pattern. Air monitoring was carried out at all the locations at a frequency of twice a week for 24 hours and the results were analyzed. From the study it is found that air quality in the surrounding area of the airport is mix in nature.

Kew words: Airport, Air quality, Air Quality Index, International, Navi Munbai, India, Pollutants

1 Introduction

Air pollution can be defined as an imbalance in the quality of the air so as to cause adverse effects on the living organisms existing on the earth. The major source of air pollution is the release of particle into the air for burning the fuels for energy in aircrafts, automobiles, industries etc Although there has been a phased reduction in the number of vehicles above 15 years of age in India, the significant amount of new age is expected to contribute towards deterioration of ambient air quality. Recent evidence indicates that motorized vehicles are a major source of air pollution in urban areas, [1]. While transportation engineers aim at steps to reduce congestion and improve the flow condition in urban streets; the impact on environment is neglected and often ignored.

Exhaustive studies have been conducted on identifying the causes for excessive emissions from automobiles. Air quality standards have been evolved for the different land uses by organizations like Indian Ambient Air Quality Standards proposed by CPCB (1984), National Ambient Air Quality Standards proposed by US Environmental Protection Agency (1970) and Air Quality Standards proposed by WHO (1995). The emission factors have also been evolved by organizations like the Indian Institute of Petroleum (IIP) in 1985 and Automotive Research Association of India (ARAI).

Modeling of air pollution has been accomplished with the aid of Gaussian Dispersion Plume models that accounted for the dispersion characteristics of the pollutants. Vehicular emission is generally considered as a line source in air dispersion models. Line source models are used for assessing the effects of roadway emissions [2]. Many of the Air Quality models developed by research institutes are based on Gaussian plume diffusion equation to describe temporal and spatial distribution of vehicular exhaust emissions on roadways [3]. Mobile Emissions models have been evolved like the Mobile Source Emission Factor Model (MOBILE6) in 1992 by USEPA (United States Environmental Protection Agency), Emission Factor Model (EMFAC) in 2002 by CARB (California Air Resources Board). Some of the dispersion models developed include the California Line Source Dispersion Model (CALINE) 4 in 1989 , Indian Institute of Technology Line Source Model (IITLS) developed for traffic conditions in Delhi, [4]. General Finite Line Source Model developed by Luhar and Patil in 1989 and and Delhi Finite Line Source Model in 1996. Time series based zone wise regression models for each type of pollutant was also developed using the pollutant data collected [5]. Traffic Simulation and traffic induced air pollution was used to evolve the concentrations of Suspended particulate matter and carbon monoxide [6].Integrated land use and Transportation for Environmental Analysis Model was developed using CALINE 4 and spatial data analysis wherein a GIS framework was used to the identification of pollution hot-spots[7].

Micro scale dispersion model have been developed to estimate the concentration of pollutants from motor vehicle exhaust wherein the diffusion parameters of the pollutants and the eddy diffusivity resulting on buildings on either lane width etc were accounted for [9]. Regression models were developed to estimate the concentration of oxides of nitrogen based on the emission factor with due weightage given to the traffic speed and emission factor [10].

Considering the need to evolve models that could aid in predict the concentrations of pollutants in urban streets, it is imperative that relationships be developed to correlate the vehicle population, traffic parameters and emission factors. In this respect, considering the need to assess the air quality in Navi Mumbai, the following objectives have been identified for the study (i) To conduct air pollution surveys by observing the concentration of carbon monoxide (CO) at selected links in Navi Mumbai and comparing with the standards proposed by Central Pollution Control Board.(ii) To find the possible relationships between CO pollutant concentration and traffic parameters, (iii) Predicting the air quality levels in Navi Mumbai by appropriate model for different years

2 Air Quality Index

Air quality indices are used to compare air quality over different links. It is expressed as a percentage of the relevant standard of the pollutant. As lower the index, better is the air quality. Air quality index for each link is calculated. Based on the index, ambient air quality performance is estimated over each link.

side of the road have been dealt with in detail [8]. Studies on the pollutant concentration in intersections have been taken up wherein intersections variables like traffic volume,

3 Description of the Study Area

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 CBD of Mumbai/Santacruz airport. The airport is planned with two runways of 3700 M with parallel taxiways designed to suit the new generation large aircraft. The other facilities include the domestic terminal, international terminal, cargo terminal, airfield lighting, city side facilities etc. The phase wise development approach has been adopted to suit the air travel demand

The study area shown in Figure 1 covers the area around the airport falling within the radius of 10 kms. The study area is further divided in two parts namely core area and fringe area. The core area covers the area within the radius of 10 km, in which all the scooped environmental parameters have been studied to understand the magnitude of impact. In the remaining area i.e. fringe area places of historical importance, aesthetics, cultural including environmentally sensitive have been studied.

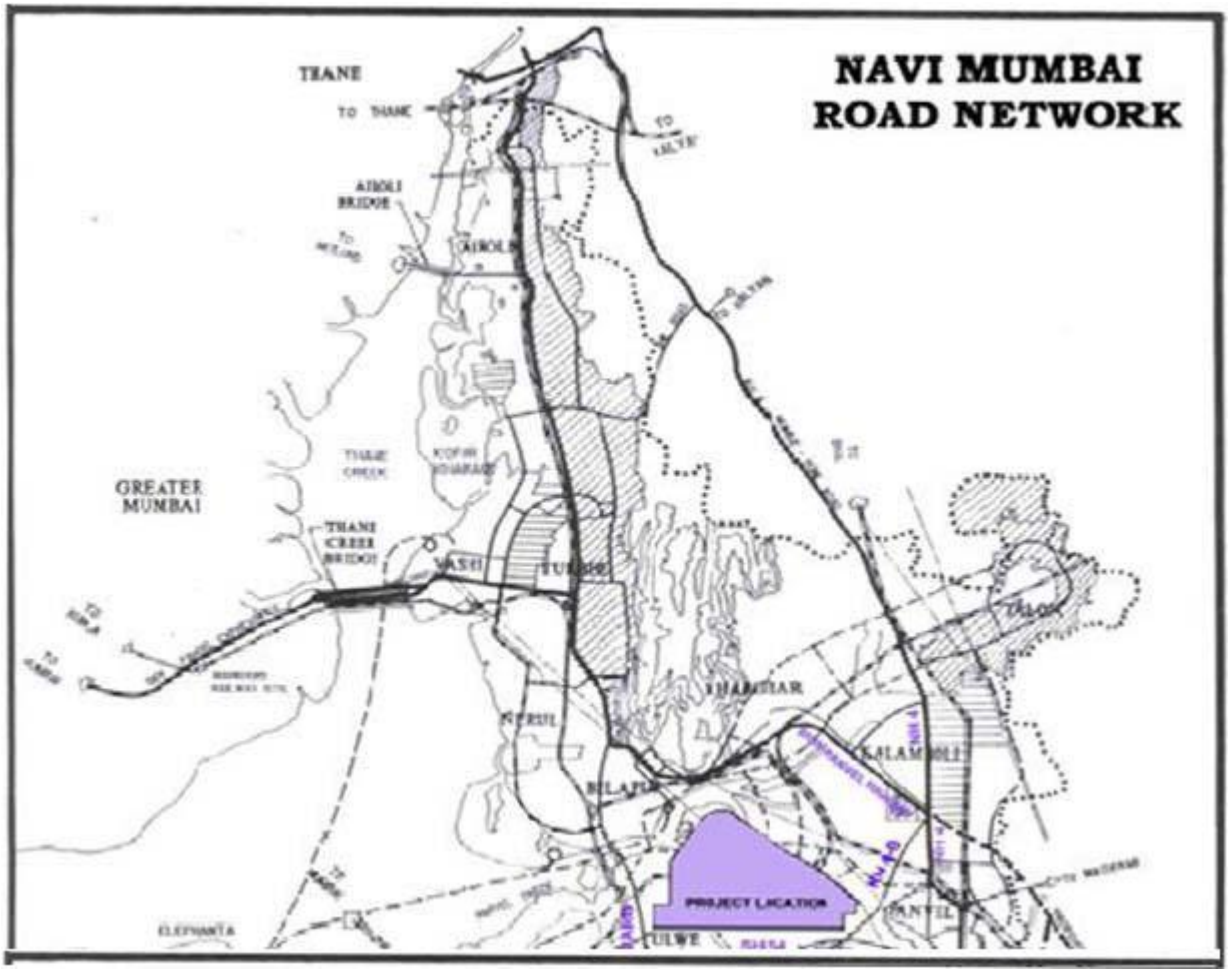

Fig 1: Study area of Navi Mumbai International Airport

4 Data Collection

Air quality of the project area was carried out by monitoring the pollutants namely, Total Suspended Particulate Matter (TSPM), Respirable Particulate Matter (RSPM or PM_{10}), Oxides of Nitrogen (NO_x), Sulphur dioxide (SO_2), Carbon Monoxide (CO), and Hydrocarbons (HC). The selections of stations were based on WHO (1981) guidelines. The monitoring was done during post monsoon, pre monsoon, monsoon and winter season at a frequency of twice a week at each station for 24 hours. Respirable Dust Sampler and High Volume Sampler were used for monitoring of RPM, TSPM and gaseous pollutants like SO_2 and NO_xTo monitor the traffic pollutant Carbon Monoxide, a portable multi gas monitor with digital display was used. CO pollutant was monitor at all the 10 locations at a frequency of twice a week at each station for 24 hrs. Anemometer was used to note the wind speed and direction. Digital thermometer was used to record the existing temperature. Horizontal and vertical dispersion parameters were taken based on the atmospheric stability class B and downwind distance.

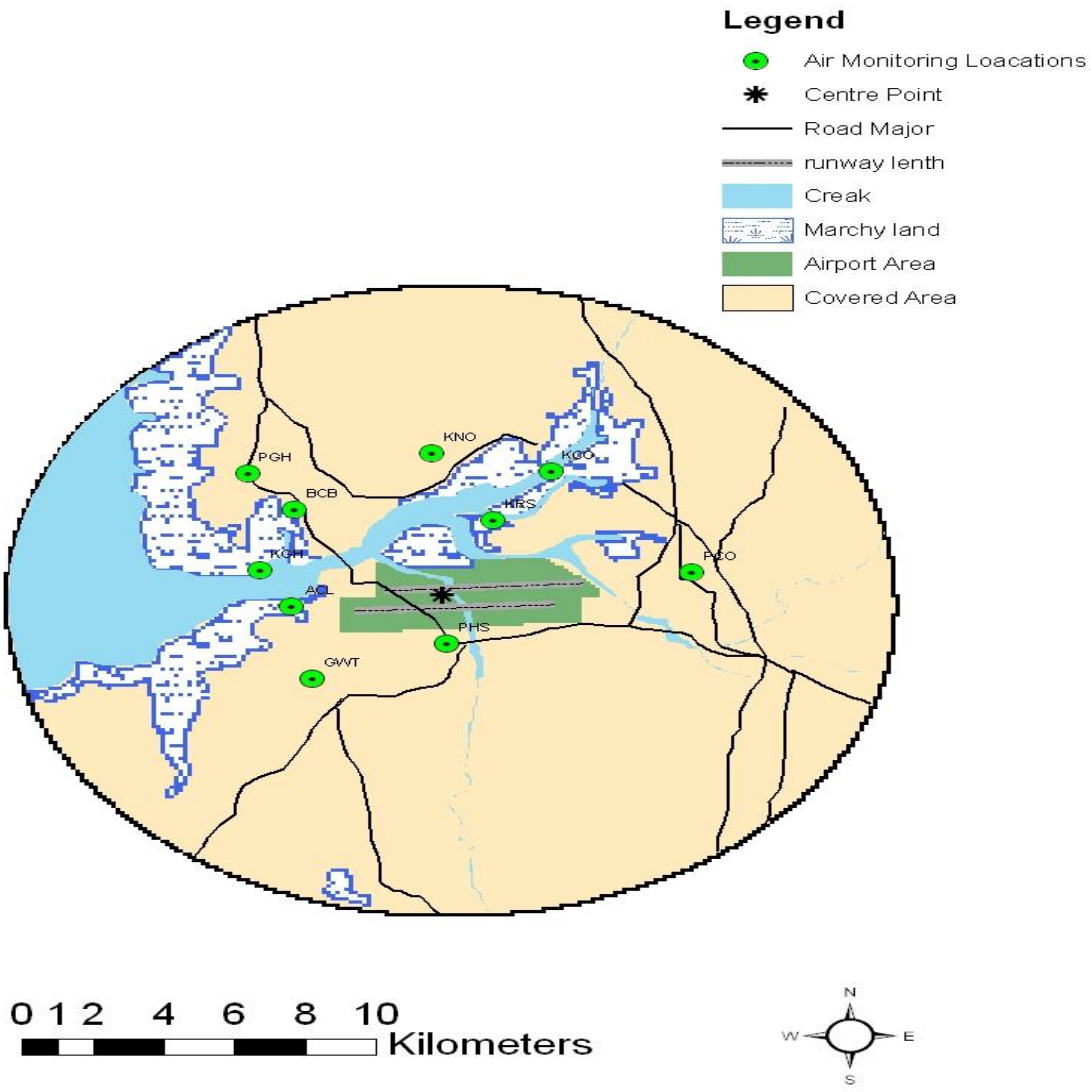

Fig 2: Location map of Air Monitoring Stations

4.1 Methodology Adopted

Air quality was carried out at 10 monitoring stations within the 10 km of the project area. Details about the monitoring stations are shown in the Table 1.Air quality Index at each station was calculated separately. The main pollutants which have major impact on the area like TSPM, SPM, SO2, NOx, HC were considered for calculation of Air Quality Index. Traffic volume, vehicles speed, meteorological data, and pollutant concentrations were collected and compiled according to requirements. Traffic volume on various link 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. Air Quality Index for a particular pollutant (Ri) has been carried out by using equation (Santhinathan ,2007)

R i=Concentration of the pollutant/Standard value of the pollutant----------(1)

The total Air Quality Index for I number of pollutant is given by the value obtained and defined as above. Air Quality Index is given by

AQI=(ΣR i) *100 ----------(2)

Table 1:

Location of the Air Monitoring Stations in the Project Area

Sr. -	Station Code -	Station	Remarks
1.	PCO	Panvel CIDCO Office	Location of meteorological station and in residential zone
2.	KRS	Khandeshwar railway station	Commercial activity centre
3.	KCO	Kalamboli CIDO Office	Receptor oriented as it is in residential zone
4.	KNO	Kharghar Nodal Office	Receptor oriented as it is in residential zone
5.	BCB	Belapur CIDCO Bhavan	Major commercial activity centre, heavy traffic movement
6.	PHS	Pargaon High School	Rural and mixed area
7.	GWT	Gavanphata Water Tank	Near to main Traffic Junction and hence heavy traffic movement
8.	ACL	Ambuja Cement Ltd.	Industrial activity centre
9.	KGH	Kille Gaothan Gueust House	Receptor oriented as it is in residential zone
10.	PGH	Panchsheel Guest House	Receptor oriented as it is in residential zone

5 Result and Discussion

Air Quality Index was calculated at all the monitoring stations during post Monsoon, Winter, Pre Monsoon and Monsoon season and the results are given in table 2.

Table 2

-Results of Air Quality Index

Station	Air Quality Monitoring Seasons							
	Post Monsoon		Winter		Pre Monsoon		Monsoon	
	AQI	Descriptor category	AQI	Descriptor category	AQI	Descriptor category	AQI	Descriptor category
Industrial and Mixed Areas								
KRS	0.46	Acceptable	0.64	Unacceptable	0.28	Acceptable	0.12	Acceptable
BCB	0.50	Acceptable	0.91	Unacceptable	0.73	Unacceptable	0.20	Acceptable
ACL	0.47	Acceptable	0.56	Unacceptable	0.27	Acceptable	0.13	Acceptable
GWT	0.73	Unacceptable	1.34	Alert	0.59	Unacceptable	0.16	Acceptable
Residential and Rural Areas								
PCO	0.90	Alert	1.25	Alert	0.78	Alert	0.33	Acceptable
KCO	1.15	Alert	1.52	Alert	0.90	Alert	0.31	Acceptable
KNO	0.76	Unacceptable	1.09	Alert	0.70	Unacceptable	0.26	Acceptable
PHS	0.80	Unacceptable	1.05	Alert	0.71	Unacceptable	0.30	Acceptable
KGH	0.73	Unacceptable	1.13	Alert	0.63	Unacceptable	0.22	Acceptable
PGH	0.65	Unacceptable	1.15	Alert	0.68	Unacceptable	0.24	Acceptable
Average AQI for the Project Area	0.72	Unacceptable	1.06	Alert	0.63	Unacceptable	0.23	Acceptable

6 Conclusions

- The Air quality index values showed significant variation during study period. The average value of air quality index observed for industrial and mixed areas was in range, 0.37 to 0.83, 0.51 to 1.37, 0.24 to 0.81 and 0.09 to 0.21 during post monsoon, winter, pre monsoon and monsoon season respectively.
- The average value of air quality index observed for residential and rural areas was in the range, 0.68 to1.4, 1.21 to 1.83, 0.71to 1.18 and 0.2 to 0.34 during post monsoon, winter, pre monsoon and monsoon season respectively.
- The average value of air quality index indicated that industrial and mixed areas falls in the *"Acceptable"* category during monsoon season, *"Unacceptable to Acceptable"* category during post monsoon season, *"Acceptable to Alert"* category in pre monsoon season and it was in *"Unacceptable to Alert"* category during winter
- Similarly the average value of air quality index indicated that the residential and rural areas fall in the *"Acceptable"* category during monsoon season, *"Acceptable to Alert"* category during pre monsoon and post monsoon season ,it was found to be in *"Unacceptable o Alert"* whereas during winter it was in *"Alert"* category.
- According to the average air quality index calculated for total project area, the air quality status of the study area was found to be in *"Unacceptable"* category during post monsoon and pre monsoon season, whereas during winter season it was in *"Alert"* category. During monsoon season the air quality status of the study area was found to be in *"Acceptable"* category.

ACKNOWLEDGEMENT

The authors are thankful to Dr Dhingra S. L. and Dr. A.K.Dixit , Professors, Civil Engineering Department, I.I.T. Bombay , India for their valuable guidance and suggestions.

References

[1] Ditty R, (1995), "Evaluation of Ambient Air Quality Levels due to road Traffic in Calicut City", M.Tech thesis, Department of Civil Engineering , Regional Engineering College, Calicut.

[2] Goyal, P. and Rama Krishnan, T.V.B.P.S (1999)," A line source model for Delhi" Transportation Research Part D, Vol.14, No.4, pp241-249.

[3] Hitoshi Kono, Shozo Ito, 1990, " A Micro Scale Dispersion for Motor Vehicle Exhaust Gas in Urban Areas", Journal of atmospheric Environment, Vol 24 B, No.2, pp243-251.

[4] Liping Xia and Yapang Shao(2005),' Modelling Of Traffic Flow and Air Pollution Emission with application to HongKong island', Journal of Environmental Modeling and Software 20,pp 1175-1188.

[5] Mrinal K. Ghose, R.Paul, S.K Banerjee (2004),' Assessments of Impacts of vehicular Emissions on urban air quality and its management in Indian context', Journal of Environment Science and Policy, 7, pp345-351.

[6] Nagendra, S.M.S. and Khare, M.(2002)," Line Source Emission modeling" Atmospheric Environment, No.36 pp2083-2098

[7] Potogolu, D.and Kanaragolu, P.S. (2004)," CO emissions from passenger vehicles"Canada CSPA.

[8] Shin'ichi O Komato, Keizo Kobayachi (1990),' Comparitive Study On Estimation Methods for NO_x Emissions for a Roadway, Journal of atmospheric Environment', Vol 24 A,No.6,pp1535-1544.

[9]Venkatram, A and Horst, T.w. (2005)." Approximating Dispersion from a finite line source" Atmospheric Environment, No.40, pp2401-2408.

[10] Yu Meng, DebbieA.Neimmer, (1998),' Project Level Carbon Monoxide Hot-Spot Analysis for Level of Service D Intersections', Transportation Research Record No.1641,pp73-80.

BIOGRAPHIES

1. Mr. Arun Kumar Mishra,is a Assistant Professor in Civil Engg. Department, Madan Mohan Malviya Govt. Engg. College Gorakhpur, U.P . India -273010
(e mail-arun_gmishra@yahoo.co.in)

2. Dr. Prabhat Srivastava, is a Professor & Head, Civil Engg. Department, S.P. Government College of Engg. Mumbai ,India-400058
(e-mail-srivasp@gmail.com)