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Urban Air Quality Management Plan - A Study of Greater Vadodara Area

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Abstract: Urban air quality is an issue of major concern across many cities and towns in developing counties, including India. High levels of particulate matter, oxides of Sulphur and Nitrogen are responsible for non-compliance of air quality standards. This study suggests various air quality management options that can be applicable to urban areas, which are at present affected by deteriorating air quality. The research aims to critically assess the current scenario of urban air quality and studying feasibility for technological alternatives based on Case study approach.
Keywords: Urban Air Quality Management

I. INTRODUCTION

The impacts of urbanization are generally well documented in terms of several issues. These include population overburden, air pollution, solid wastes, water pollution, and health and so on.

A population overburden in urban region translates in sharp increase of infrastructure demands, intensive energy and material flows, input as well as outputs and the subsequent release of wastes into environment. This often leads to depletion and degradation of resources, which in turn increases the economic cost of resource use and health care at the same time shrinking aesethic and recreational amenities and thus contributing to a poor quality of life.

The efforts at addressing such issues collectively spawn what is commonly referred to as today urban environmental management. Environmental Quality is rapidly becoming a major issue in urban India. Indian cities suffer from some of the worst air quality problems in world, which continue to be a major Health hazard.

The world health organization (WHO) estimates, India alone has estimated number of 15 to 20 million asthmatics and that worldwide economic costs estimated with asthma exceed those of tuberculosis and HIV / AIDS combined. It is supposed that costs to societies (part of which is direct productivity loss) due to urban air pollution are as high as nearly one tenths of income generated from all productive activities. Thus the urban cities in India are sufferers due to urban air pollution.

II. INDUSTRY AND DEVELOPMENT IN VADODARA

Lop-sided industrialization has led, paradoxically, to increase in unemployment. Vadodara like any other city of its kind continues to attract a large number of unskilled job seekers and daily-wagers besides skilled and educated workforce. The former has led to the growth of slums where poor working class people live.

The population of greater Vadodara (VUDA – Vadodara Urban Development Authority) area of 715 sq. km is 20, 68, 953 lakhs as per census data of 2011. Greater Vadodara area including Vadodara Municipal Corporation (VMC), its outgrowth areas as urban agglomeration, Petrochemicals Industrial area and Townships and nearby 108 villages including 85 of Vadodara Taluka, 9 villages of Padra Taluka and 14 villages of Waghodia Taluka.

At present there are more than 35000 BPL families, making up nearly 2, 00,000 persons (15-20%) of the total population of the city. There is, however, an uneven distribution of the slums. Naturally the old city area cannot afford any slums, as there is no patch available with already overcrowded dwellings.

Since late sixties and early seventies the city has seen a spurt of industrial growth with large refinery, petrochemicals and fertilizers units being developed along with other downstream chemical and petrochemical units. Several ancillary units have been set up through the city in several industrial estates, which dot the city landscape. This has definitely brought prosperity to the citizens of Vadodara but the city has environmentally degraded and is always in grave danger of any mishaps occurring in any of the petrochemicals units situated in the Northwest fringes of the city. The urban expansion has caused several areas which were previously the residential areas converted into the industrial zones, creating a serious air pollution risk to the citizens residing in those areas. Several units located in places such as Gorwa, Makarpura, Atladara and Ajwa are now located well within the residential areas of the city. This causes a very serious threat to environmental pollution in these areas.

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Further, there are no mechanisms in place in the town development plans, which address the problem. This case study makes an effort to understand the air pollution problems in the city of Vadodara, in such a fashion that town planners should make an air quality management study as a part of Urban Development Plans.

III. AIR QUALITY STATUS

The scenario analysis approach provides various options for air quality management under different circumstances. Analyzing the options a priority list of actions can be framed. In case of Vadodara, vehicular pollution and industrial pollution contribute to pollution loads.

The total PM, SO2, NOx, CO emissions should be studied carefully and a detailed source apportionment study could be carried out in the future.

However, different strategies could be framed for different sectors. This overall assessment of air quality issues for Vadodara provide useful inputs for framing strategies for air quality management in other cities of India and other developing countries. Town Planning Departments should incorporate such air quality assessment studies in their main development plans of any city or region.

IV. EMISSION INVENTERISATION

To understand the gravity of problem and address the casual factors of the first and the most important step i.e. emission inventerisation was carried out. Sectorial emission load were estimated for transport, industrial and domestic sectors, which provide an estimate of major pollutant, such as SPM, SO_2 and NO_X.

The approach towards emission Inventerisation was based on activity data, fuel consumption estimates, emission factors, estimation of pollution load from various point sources of major industries, and Line sources for various roads in greater Vadodara.

The detailed inventory of all the units which can cause air pollution was undertaken, and the stack / point source details were worked out with stack height, velocity, stack diameter, stack temperature, fuel used and results in mg/Nm^3 were obtained.

The data was converted in emission load in kg/hr, after using standard temperature and pressure corrections and ultimately converted in total load in kg/day.

V. MATHEMATICAL MODELING

Mathematical modeling was done at certain roads in Vadodara to understand the impact of carbon monoxide on various roads of Vadodara. The CALINE 4 model was run for 11 specific roads in Vadodara for PM, SO, NO_X, CO & HC impact on nearby receptors. ISCST, short-term model was used for point source modeling of various point sources and to determine the impact of those point sources and the distance at which GLCs (Ground Level Concentration) would be maximum.

A spatial study was done to in the city of Vadodara dividing the city in equal number of grids, of 500 m x 500 m, and critically polluted areas within the city were identified.

Traffic survey was carried out for major eleven roads in city of Vadodara. The pollution load for the parameters calculated on the basis of emission factors for various fuels.

VI. SCENARIO FOR VEHICULAR SECTOR

The following scenarios for vehicular sector were studied:

1) Use of CNG as fuel.
2) Use of bio-fuels
3) Reduction in vehicular pollution by introduction of efficient public transport system.
4) A futuristic scenario of vehicular pollution by business as usual scenario.
5) A futuristic scenario of vehicular pollution by change in fuels.

VII. SCENARIO FOR INDUSTRIAL SECTOR

The following scenario for industrial sector was studied:

1) Switch to cleaner fuels such as CNG or LPG
2) Improvement of air quality monitoring system
3) Augmentation of gas supply in all industrial estates
4) Framework for provision of air cess Act.

VIII. OVERVIEW OF DATA BASE

Ambient Air Quality Monitoring Stations in Greater Vadodara Area (for Oct-17 to Feb-18)

Ambient Air Quality Monitoring (Area Source)					
Stn. No	Area	Location	Justification	Frequency	Season
AQ01	Industrial	GIDC Makarpura,	Engineering	Twice a week	Oct-17 to Feb-18
AQ02		GIDC Nandesari,	Chemical		
AQ03		GIDC Ranoli	Mixed		
AQ04		BIDC Gorwa	Small scale		
AQ05		Patel Estate, Wadi	Small scale		
AQ06		Sardar Estate	Small scale		
AQ07		PCC	Petrochemicals		
AQ08	Residential	Old City	Densely populated area		
AQ09		Nizampura	Pure residential area		
AQ10		Waghodia Road	Residential area		
AQ11		Manjalpur	Residential area		
AQ12		Kishanwadi	Slum Area		
AQ13		Vasna-Gotri	Developing area		
AQ14		Maneja	Mixed area		
AQ15		Bajwa	Semi urban		
AQ16	Rural	Khatamba	East Region		
AQ17		Sindhrot	West Region		
AQ18		Sokhda	North region		
AQ19		Varnama	South region		
AQ20	Other	Padra Town	Mixed		

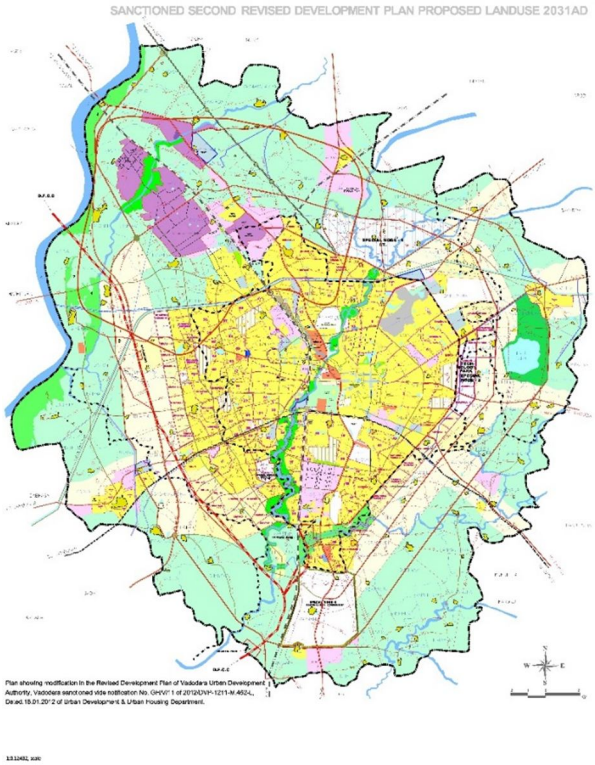
Stationery Source Monitoring Stations in Greater Vadodara Area (for Oct-17 to Feb-18)

Stack Emission Monitoring (Stationery Source)				
Stn. No	Area	Location	Justification	Frequency
I1	Industrial	GIDC Makarpura	To collect data for stationary source emissions like Boilers, DG & other process vents	Once during study
I2		GIDC Nandesari		
I3		BIDC Gorwa		
I4		PCC		

Traffic Survey Points

Line Source Monitoring (Mobile/ Traffic Sources)				
Point No.	Area	Location	Justification	Frequency
T1	Central	Mandvi Road	Major roads within city and industrial areas	Once during study period
T2		Station road		
T3	East	Ajwa Road		
T4		Dabhoi Road		
T5	West	Gotri Road		
T6		Padra Road		
T7	North	Chhani Road		
T8		Gorwa Road		
T9	North	Dhanora Road		
T10	South	GIDC Road		
T11		Makarpura Road		

Greater Vadodara Area (VUDA) Map



IX. CONCLUSION

A detailed air quality study was undertaken for city of Vadodara as discussed in chapter and various scenarios were studied for vehicular and industrial sectors.

Vehicular pollution is the having the largest magnitude of pollution in Vadodara. Various scenarios of vehicular pollution were studied using conventional fuels as well as using alternative fuels. Futuristic scenarios increasing number of vehicles, and up gradation in vehicular technology were also studied .However any reduction in vehicular pollution by changes in vehicular technology is nullified by the effect of increase in vehicles .The most effective solution it appears is improvement in public transport

system. A efficient public transport system shall create a substantial modal shift causing reduction in vehicular pollution by reducing the number of vehicles on road.

As far as industrial pollution is concerned the pollution caused by small scale industries is not critically polluting. However, certain industries in certain areas of Vadodara are located at locations which can be considered sensitive. Such industries should be relocated immediately and zoning bylaws strictly adhered to.

As far as residential pollution is concerned, the pollution caused in slums, the use of fuels other than gas is a serious cause of concern. The fuels such as coal, wood, and kerosene emit highly toxic gases apart from PM, SO2, NOX and HCs. Use of such fuels should be restricted.

The scenario analysis approach provides various options for air quality management under different circumstances. Analyzing the options a priority list of actions can be framed. In case of Vadodara, vehicular pollution and industrial pollution contribute to pollution loads.

The total PM, SO_2, NOx, CO emissions should be studied carefully and a detailed source apportionment study could be carried out in the future.

However, different strategies could be framed for different sectors. This overall assessment of air quality issues for Vadodara provide useful inputs for framing strategies for air quality management in other cities of India and other developing countries. Town Planning Departments should incorporate such air quality assessment studies in their main development plans of any city or region.

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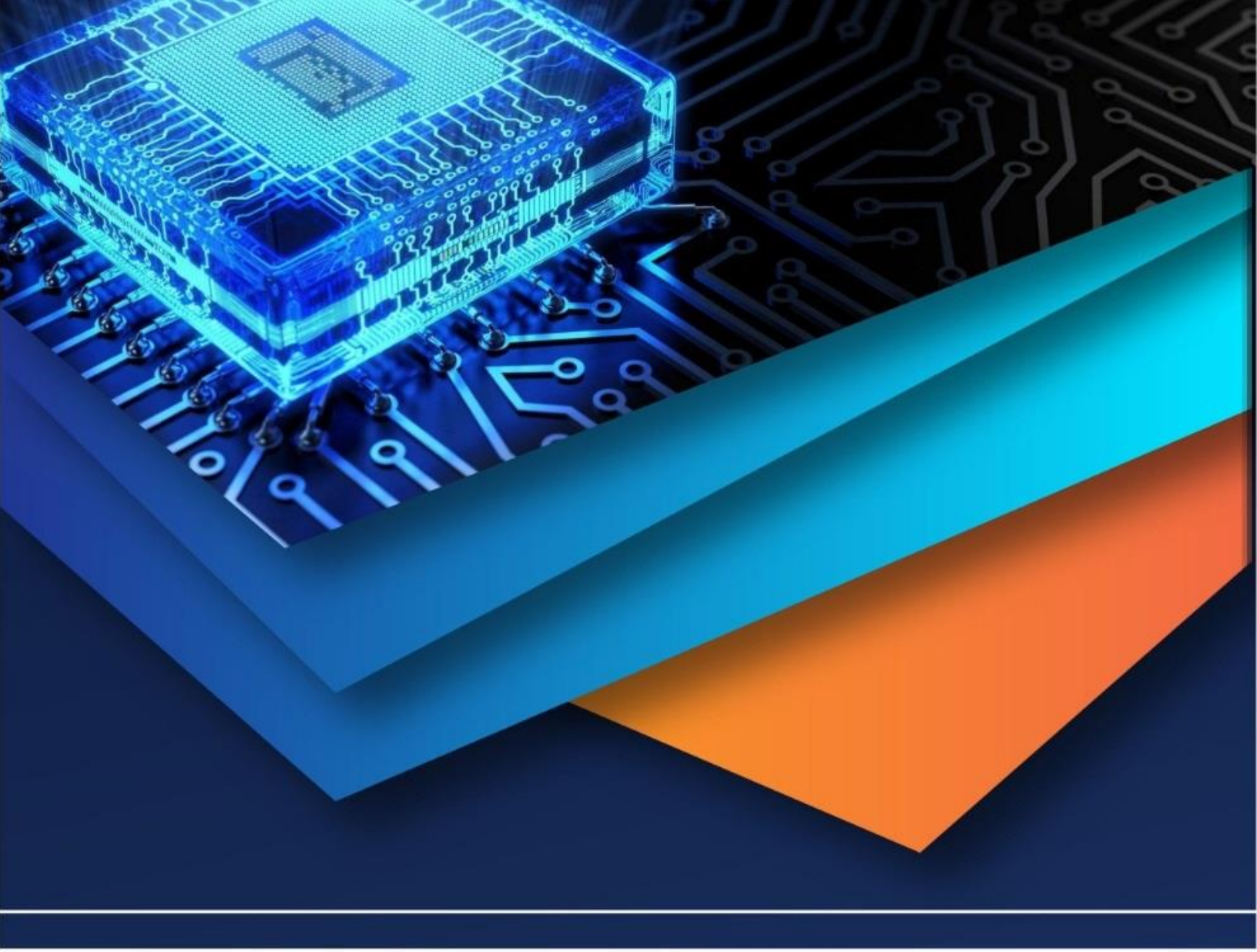
End of Report



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