

ASSESSMENT OF AMBIENT AIR QUALITY INDEX OF SURAT

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Abstract - Clean air is the essential necessity of every single living being. As of late, because of populace development, endless suburbia, mechanical turn of events, and vehicular blast, the nature of air is breaking down and being dirtied. Contaminations of significant general wellbeing concerns incorporate particulate matter, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide, which present genuine dangers to human wellbeing and cleanliness. In the current examination, prime particulate toxins (PM10, PM2.5), and vaporous contaminations (SO2, and NO2) were assessed at two stations limbayat and varachha in Surat, Gujarat, India. The examination zone was taken fundamental zone of surat city i.e.varachha and limbayat are which is come in focal zone of surat city and related with various industrial and business exercises. The degree of PM10 at all examining areas, and that of PM2.5 were discovered minimal higher than recommended admissible constraints of CPCB principles, while SO2 and NO2 levels were inside the adequate reach. The Air Quality Index (AQI) score was discovered to be gone from 71 to 120, which is at palatable level according to CPCB norms. The outcomes demonstrated that air quality in the city is characterized from good to satisfactory, with a slight variety brought about by the meteorological conditions, the segment development, and the modern progress.

Key Words:- Air Pollution, Mortality, Morbidity, Human health, Ambient air quality, Respiratory diseases, SO2, NO2, PM

1. INTRODUCTION

Air pollution is a worldwide environmental concern that the health of the urban population is primarily affected. Over the Over Due to higher atmospheric levels of air pollution, epidemiological studies have indicated adverse health effects over the past few decades. Studies have shown that prolonged exposure over a long period of time to indoor air contaminants raises the likelihood of vulnerability to airborne diseases such as cardiovascular disease, respiratory disease, and lung cancer (WHO, 2009). Air pollution has been routinely related to Significant pressures of ill-health in the growth and development of The Nations. (Gorai et al., 2014; Bruce et al., 2000; Smith et al., 2000; WHO, 1999; Schwartz, 1994).

Scientists maintain that effect on the climate of global warming is widespread. Warme temperatures are melting ice in the Arctic and Antarctica, contributing to rising sea levels

and altering the composition of the surrounding sea water. Growing sea levels have both economic and recreational impacts on cities, agriculture and fisheries. Air pollution, however is a serious environmental issue, closely linked to global warming. It is a by-product of growing urbanisation and industrialization that in line with economic, technological and political changes, has a long and changing history of fascinating transitions. It can also occur in indoor environments and in outdoor environments. The release of toxic substances to the atmosphere can be described as air pollution. Therefore this broad concept encapsulates a large number of contaminants, including: sulphur dioxide (SO2), oxides of nitrogen (NOx), ozone (O3), particulate matter (PM2.5 and PM10), carbon monoxide (CO) and volatile organic compounds (VOCs). When describing 'air pollution,' we have to consider natural pollutants, although they can be very dangerous, such as volcanic eruption gases and particles, forest fire smoke, and anthropogenic emissions.

In the recent industrial period, population growth, urban development, and vehicular boom have degraded the quality of ambient air. Particulate and gaseous emissions with major public health issues pose a significant danger to human health if they surpass the regulatory authorities' allowable limits (WHO, 2000; USEPA. 2008). The consequences of urban (outdoor/indoor) air pollution, primarily caused by the combustion of solid unburned fuels, are due to more than two million premature deaths per year (WHO, 2005). The population of developing countries is responsible for more than half of the diseases caused by air pollution (WHO, 2005). The association between respiratory and cardiovascular disease incidence and cardiopulmonary mortality with air pollutant exposure is well established in previous published literature (Dockery et al., 1994; Koken et al., 2003).

The CPCB has set the National Ambient Air Quality Standards (NAAQS) for criteria pollutants in India, as summarized in Table 1.

Pollutant	Time Weighted Average	Concentration in Ambient Air		
		Industrial Areas	Residential, rural and	Sensitive Areas

			other areas	
Sulfur dioxide (SO ₂) µg/m ³	Annual	80	60	15
	24 h	120	80	30
Oxides of Nitrogen (NO ₂) µg/m ³	Annual	80	60	15
	24 h	120	80	30
Suspended Particulate Matter (SPM) µg/m ³	Annual	360	140	70
	24 h	500	200	100
Respirable Suspended Particulate Matter (RSPM) µg/m ³	Annual	120	60	50
	24 h	150	100	75
Lead (Pb) mg/m ³	Annual	1.0	0.75	0.50
	24 h	1.5	1.00	0.75
Ammonia (NH ₄) mg/m ³	Annual	0.1	0.1	0.1
	24 h	0.4	0.4	0.4
Carbon Monoxide (CO) mg/m ³	8 h	5.0	2.0	1.0
	1 h	10.0	4.0	2.0

2. MATERIALS AND METHODS

➤ Description of Study Area

Fig. 1 shows the study area Surat (21°10'12.864"N 72°49'51.819"E), of Gujarat state is covered with various industrial and commercial activities because of the availability of raw materials in the close proximity.

In view of the current air pollution scenario, two numbers of ambient air quality monitoring stations were selected based upon CPCB, Government of India guideline based on nearby emission sources, information about meteorological conditions and past air quality report. The authors have already studied on the ambient air quality modeling at the current study area taking the common sampling locations. In addition, in the current study, an attempt has been made to calculate the Air Quality Index (AQI) of the study area in order to categories it on the basis of its pollution potential as per the norms of government of India.

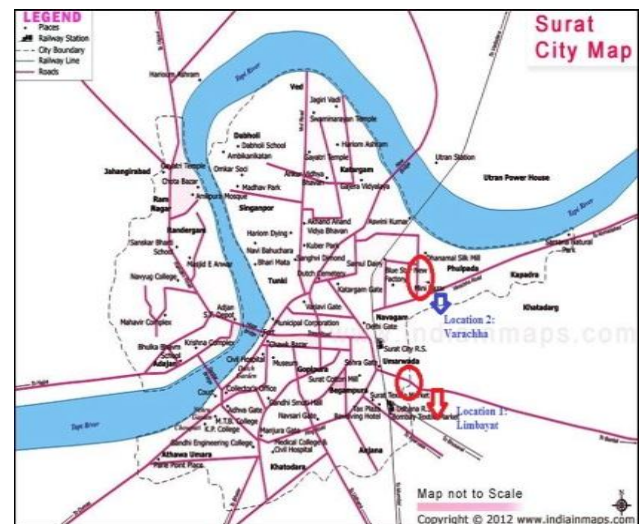


Fig -1: Area of Surat city showing location of AQI analysis

3. METHODOLOGY

Ambient air pollutants were monitored for a period of 6 months as per the standard methods prescribed by CPCB as given. Then AQI was calculated with the help of monitored results during the study period to find out the status of ambient air quality.

The sampling of the above pollutants was recorded continuously for 24-hourly average for 51 days. The reading was done at two different locations which are Varachha (Location 1), Limbayat (Location 2). The reading and analysis of the readings was done as per Ambient Air Quality Analysis using Air Quality Index. The particulate matter (PM₁₀ and PM_{2.5}) were determined by gravimetric method i.e air is drawn through a pre weighed glass fibre filter paper on 8 hourly basis for 24 hours.). The concentrations of these methods were expressed in µg/m³. The AQI method involves

formation of subindices for each pollutant and aggregation of sub-indices.

Table -2: Break Points of Various Pollutants (National Air Quality Index, CPCB, October 2014) (Units: µg/m³)

AQI Category Range	PM10 (24hr)	PM2.5 (24hr)	SO2 (24hr)	NO2 (24hr)
Good (0-50)	00-50	0-30	0-40	0-40
Satisfactory (51-100)	51-100	31-60	41-80	41-80
Moderately Polluted (101-200)	101-250	61-90	81-380	81-180
Poor (201-300)	251-350	91-120	381-800	181-280
Very Poor (301-400)	351-430	121-250	801-1600	281-400
Severe (401-500)	>430	>250	>1600	>400

The mathematical equations for calculating sub-indices is as follows

Method I:

Air quality Index (AQI) is calculated based on arithmetic mean of the ratio of concentration pollutants to the standard value of that pollutant such as PM10 PM2.5 NO2, and SO2, The average is then multiplied by 100 to get the AQI index. AQI was then compared with rating scale (Kaushik et al., 2006). individual pollutant AQI was calculated by the following formula

$$AQI = (C/CS) * 100$$

Where,

AQI = Air Quality Index

C = the observed value of air quality parameter pollutant (PM10 PM2.5 NO2, and SO2)

CS= CPCB standard for residential Area (CPCB, 2009)

Method II:

Air Quality Index was done for combining qualitative measures with qualitative concept of the environment. The individual air quality index here is calculated as follow:

$$AQI = (W * C / Cs)$$

Where,

AQI = Air Quality Index

C = the observed value of air quality parameter pollutant (PM10 PM2.5 NO2, and SO2)

CS= CPCB standard for residential Area (CPCB,2009)

4. DATA COLLECTION AND ANALYSIS

SURAT: Residents in the Diamond City run the risk of serious health problems from the high levels of particulate matter (PM) in the atmosphere thanks to industrial emissions and noxious fumes of vehicles, particularly in the last two years.

Gujarat Pollution Control Board's (GPCB) annual PM10 data of 2017-18 shows that the particle pollution recorded from 10 locations in the city was much higher than national average.

Table -3: Pollution Level in surat

Pollutants	Surat
PM10	97
PM2.5	52
PM10 Pollution Level	HIGH

4.1 Ambient air quality monitoring programme (AAQM)

Gujarat Pollution Control Board is monitoring ambient air quality at 62 strategic locations in the state of the Gujarat under the Ambient Air Quality Monitoring programme (AAQM) including Ahmedabad, Ankleshwar, Bharuch, Bhavnagar, Bhuj, Gandhinagar, Jamnagar, Rajkot, Surat, Vadodra, Vapi, Morbi, Sanand, Sarigam total 14 cities.

The ambient air quality samples are collected as per the standard norms for ambient air quality monitoring. The parameters determined during analysis include SO2, NOx, O3, NH3, CO, PM10, PM2.5, LEAD, ARSENIC, NICKEL, BENZENE and BENZO-A-PYRENE.

4.2 Data Collection

Table -4: Ambient Air Quality monitoring data

Time	Area	AQI	Air pollution level	Major Pollutants	Concentration	Temperature	
Average 24-hour	Limbayat	88	Satisfactory	PM2.5	25.2µg/m ³	37°C	
				PM10	46.53µg/m ³		
				SO2	70.27µg/m ³		
				CO2	415.17µg/m ³		
				NO2	0µg/m ³		
				CO	1.01µg/m ³		
	Varachha	89	Satisfactory	PM2.5	19.08µg/m ³	35°C	
				PM10	63.28µg/m ³		
				SO2	71.37µg/m ³		
				CO2	425.48µg/m ³		
				NO2	0µg/m ³		
				CO	1.06µg/m ³		
	Suratcity overall average	97	36	Moderate	PM2.5	34.2µg/m ³	31°C
				Good	PM10	31.00µg/m ³	
				Good	O3	38.00µg/m ³ -	

Table -5: Ambient Air Quality monitoring data

Time	Area	AQI	Air pollution level	Major Pollutants	Concentration	Temperature	
Average 24-hour	Limbayat	57	Satisfactory	PM2.5	24.83µg/m ³	36°C	
				PM10	36.8µg/m ³		
				SO2	45.67µg/m ³		
				CO2	418.37µg/m ³		
				NO2	0µg/m ³		
				CO	0.77µg/m ³		
	Varachha	97	Satisfactory	PM2.5	25.43µg/m ³	37°C	
				PM10	43.2µg/m ³		
				SO2	78.13µg/m ³		
				CO2	431.17µg/m ³		
				NO2	0µg/m ³		
				CO	0.92µg/m ³		
	Suratcity overall average	91	04	Moderate	PM2.5	31.2µg/m ³	33°C
				Satisfactory	PM10	130.86µg/m ³	
				Good	O3	4.52µg/m ³	

Table -6: Ambient Air Quality monitoring data

Time	Area	AQI	Air pollution level	Major Pollutants	Concentration	Temperature	
Average 24-hour	Limbayat	101	Moderately Polluted	PM2.5	56.17µg/m ³	40°C	
				PM10	75.97µg/m ³		
				SO2	80.67µg/m ³		
				CO2	401.47µg/m ³		
				NO2	0µg/m ³		
				CO	1.94µg/m ³		
	Varachha	106	Moderately Polluted	PM2.5	61.63µg/m ³	38°C	
				PM10	90.03µg/m ³		
				SO2	72.97µg/m ³		
				CO2	431.63µg/m ³		
				NO2	0µg/m ³		
				CO	1.71µg/m ³		
	Suratcity overall average	103	39	Unhealthy	PM2.5	47.2µg/m ³	33°C
				Satisfactory	PM10	188.87µg/m ³	
				Good	O3	39.62µg/m ³	

5. RESULT AND DISCUSSIONS

Chart -1: Ambient Air Quality Index graph of September-2020

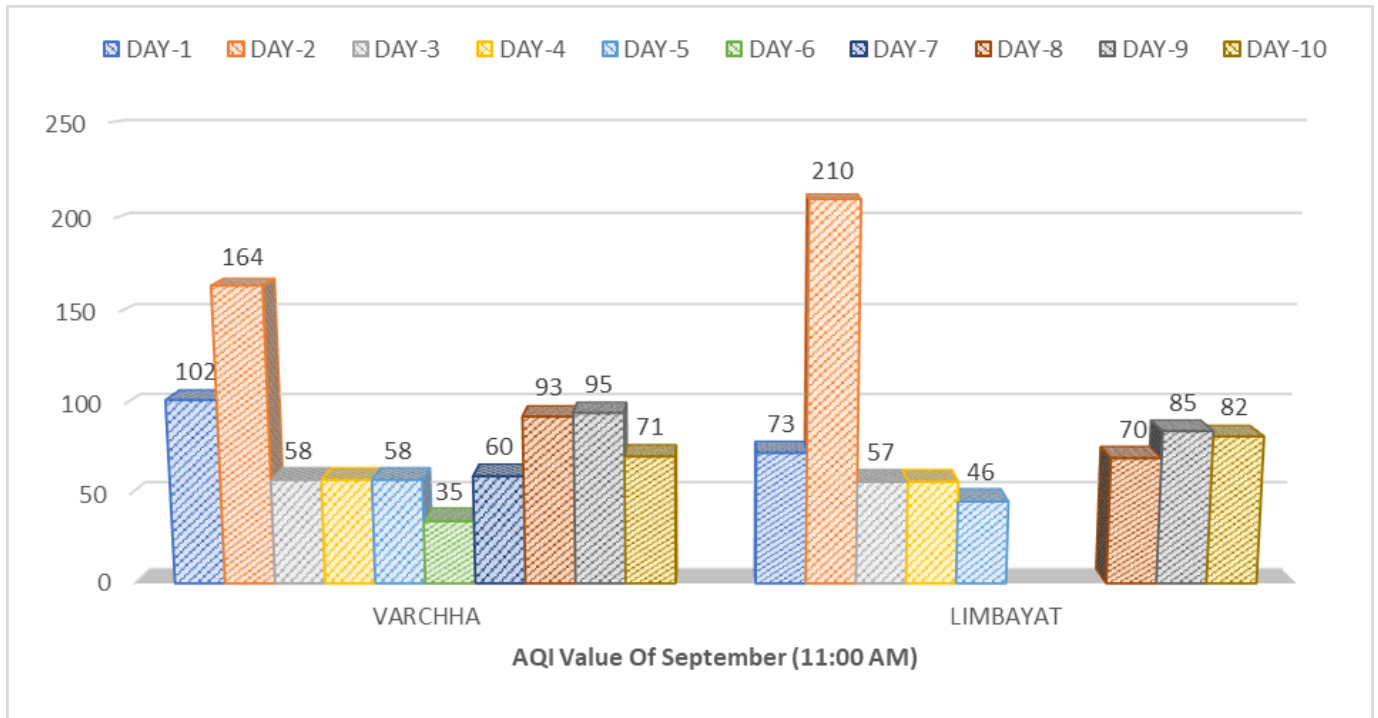
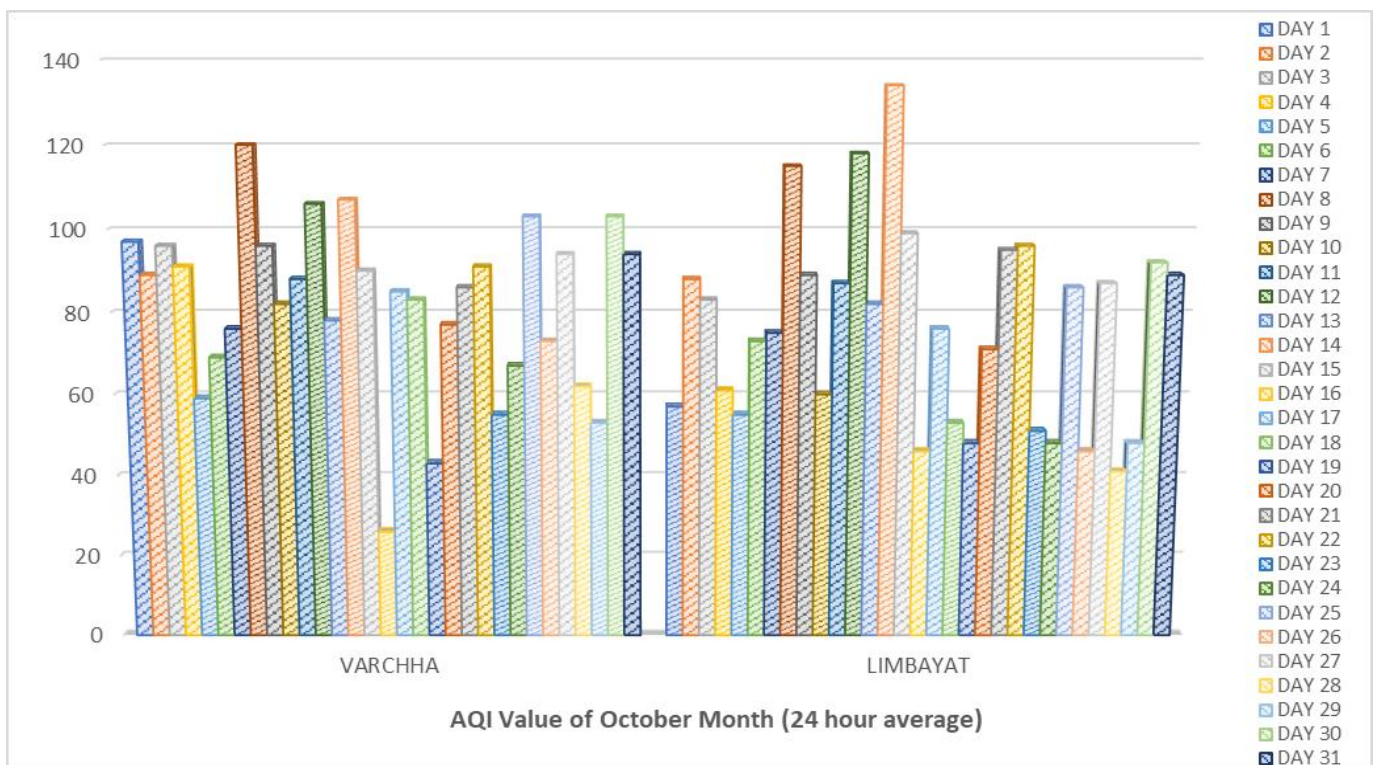


Chart -2: Ambient Air Quality Index graph of October-2020



6. CONCLUSIONS

Health risks have been estimated for various zones of surat using risk morality/mrbidity due to air pollution (Ri-Map)model.about 132.77 and 107 morbidity as per the given area by limbayat and varachha in year 2020.This morbidity increase in 2024 nd it is853 and 874we observed that udhna zone has the large excess number of cases of morbidity because of industrial area and the large density of population so that the emissions of the fuel from the vehicle and the chimney of the industrial area are in large numbers so that morbidity is at high level compare to other zones.other zone has the least access number of morbidity compare to Pandeshra. it is found that higher ambient concentration of SPM and NOx are responsible for excess number of mortality and morbidity in various area of surat. The daily average concentrations were calculated. The corresponding graphs of concentration of each pollutant with time were plotted. The study show that the minimum and maximum concentration of PM 2.5 is $68.0 \mu\text{g}/\text{m}^3$ PM 10 is $137.0 \mu\text{g}/\text{m}^3$ at limbayat and PM 2.5 is $42.0 \mu\text{g}/\text{m}^3$ PM 10 is $113.0 \mu\text{g}/\text{m}^3$ at varachha The daily average concentrations were calculated. The corresponding graphs of concentration of each pollutant with time were plotted. The study show that the minimum and maximum concentration of PM 2.5 is $68.0 \mu\text{g}/\text{m}^3$ PM 10 is $137.0 \mu\text{g}/\text{m}^3$ at limbayat and PM 2.5 is $42.0 \mu\text{g}/\text{m}^3$ PM 10 is $113.0 \mu\text{g}/\text{m}^3$ at varachha

REFERENCES

- 1) Brunekreef, B., Holgate, S., 2002. Air pollution and health *Lancet* 360 (9341),1233e1242.
- 2) Burret, R.T., Doles, R.E., 1997. Association between ambient carbon monoxide levels and hospitalization for congestive heart failure in the elderly in 10 Canadian cities. *Epidemiology* 8, 162e167.
- 3) Butler, T.M., Lawrence, M.G., Gurjar, B.R., van Aardenne, J., Schultz, M., Lelieveld, J., 2008. The representation of emissions from megacities in global emission inventories.
- 4) Dockery, D.W., Pope III, C.A., Xu, X., Spengler, J.D., Ware, J.H., Fay, M.E., Ferris Jr., B.G., Speizer, F.E., 1993. An association between air pollution and mortality in six U.S. Cities. *N. Engl. J. Med.* 329, 1753e1759
- 5) Douwes, J., Gibson, P., Pekkanen, J., Pearce, N., 2002. Non-eosinophilic asthma: importance and possible mechanisms. *Thorax* 57, 643e648.
- 6) ESD, 2008. Chapter 8: Environmental Concerns (Tables 8.1e8.3). In: *Economic Survey of Delhi (ESD) 2007e2008*. Planning Department, Government of National Capital Territory of Delhi (GNCTD), New Delhi URL. <http://delhiplanning.nic.in/Economic%20Survey/ES2007-08/C8.PDF>.

- 7) Kanchan, A. K. Gorai, and P. Goyal, "A review on air quality indexing system," *Asian Journal of Atmospheric Environment*, vol. 9, no. 2, pp. 101-113, 2015.
- 8) D. Mishra and P. Goyal, "Neuro-Fuzzy approach to forecasting Ozone Episodes over the urban area of Delhi, India," *Environmental Technology Innovation*, vol. Volume 5, pp. 83-94, April 2016.
- 9) E. Y. Bezuglaya, A. B. Shchutskaya, and I. V. Smirnova, "Air pollution index and interpretation of measurements of toxic pollutant concentrations," *Atmospheric Environment Part A, General Topics*, vol. 27, no. 5, pp. 773-779, 1993.
- 10) G. Cannistraro and L. Ponterio, "Analysis of Air Quality in the Outdoor Environment of the City of Messina by an Application of the Pollution Index Method," in *Proceedings of the International Journal of Civil and Environment Engineering* 1, vol. 1, p. 4, 2009.
- 11) T. Mandal, A. K. Gorai, and G. Pathak, "Development of fuzzy air quality index using soft computing approach," *Environmental Monitoring and Assessment*, vol. 184, no. 10, pp. 6187-6196, 2012.
- 12) B. Cyganek, B. Krawczyk, and M. Woźniak, "Multidimensional data classification with chordal distance based kernel and Support Vector Machines," *Engineering Applications of Artificial Intelligence*, vol. 46, pp. 10-22, 2015.
- 13) S. Mirjalili, "How effective is the Grey Wolf Optimizer in training multi-layer perceptrons," *Applied Intelligence*, vol. 43, no. 1, pp. 150-161, 2015.
- 14) E. Gupta and A. Saxena, "Robust generation control strategy based on grey wolf optimizer," *Journal of Electrical Systems*, vol. 11, no. 2, pp. 174-188, 2015.