ASSESSMENT OF AMBIENT AIR QUALITY INDEX OF SURAT CITY DURING EARLY MORNING HOURS

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ABSTRACT

The present study was done to take up the survey of an ambient air quality monitoring of Surat city, India during early morning hours. These monitoring was done during early morning hours (4.00 am to 8.00 am) each in winter season (December 2010 to March 2011). The parameters selected for the study were RSPM, SPM (PM-10), NOx, SO_2, and CO were measured according to BIS. The sampling of the pollutants was done by using High Volume Sampler (HVS). The AQI calculated was an effective tool to justify ambient air quality for better management of air quality. Looking to the AQI data, at APMC market N/R Railway Station the value of AQI was found to be 140 which is highest and according to EPA guidelines this value is unhealthy for sensitive groups. The pollution data shows that SO_2 is under limit at all the stations. Except Ambavadi, Dumas all stations are showing RSPM concentration above limit. SPM is exceeding at all station. Except Snehmilan Garden, Nanpura and Ambawadi-Dumas all stations are showing NO_x concentration above the permissible limit which is an alarming situation because normally morning hours are considered to be heavenly hours for people coming out to improve their health.

Key Words : Air pollution, Early morning hours, High Volume Sampler (HVS), AQI, Winter season

INTRODUCTION

These days are not suitable for people in urban areas who preferred going on jogging or for a brisk morning walk. Many researchers are of the opinion that walking in the morning especially in urban areas dominated by industrial activity is not only unsafe, it is harmful. It is harmful especially for the patients of asthma and other bronchial or respiratory disorders. As the night moves towards morning these pollutants tend to settle down and move horizontally with the blowing morning air in which we walk in the morning. Emission of air pollutants is caused by different anthropogenic processes which can be categorised into the source groups motor traffic, industry, power plants, trade and domestic fuel**.** An increasing concentration of people and economic activities as well as a growing vehicle fleet have contributed to high levels of air pollution in the large cities of developing countries**.**[1] Anthropogenic ambient air pollution can emanate from traffic, heavy industries, geological sources and domestic heating and cooking. However, of all the above mentioned sources, traffic related pollution is known to have far more detrimental health effects than non-combustion sources**.**[2] Changes in the composition of the urban atmosphere are caused largely by traffic-induced pollutants. These are mainly carbon monoxide (CO), nitrogen monoxide (NO), dust. Secondary trace gases which can be formed from these precursor substances in certain photochemical reaction conditions include nitrogen dioxide (NO_2), ozone (O_3) and other photo oxidants, e.g., peroxiacetyl nitrate (PAN).[3] The WHO/UNEP report reveals air pollution in metropolitan cities of the worlds. India has 23 major cities of over 1 million people and ambient air pollution levels exceed the WHO standards many of them.[4] Exposure to traffic-related air pollutants during early morning hour is associated with adverse health effects including cardiopulmonary disease, asthma and reduced lung function. In a

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year-long study of Polycyclic Aromatic Hydrocarbons (PAH) and other traffic related pollutants it was found that pollutant levels increased sharply after 05:00 a.m., peaked at around 06:00a.m–07:00 a.m. and then decreased sharply thereafter despite the relative constancy of traffic flow. This pattern was attributed to near-daily surface temperature inversions that are most pronounced just before sunrise.[5] The objective of the investigation was a worst-case analysis of the air pollution condition during early morning hours of urban areas. The investigation was carried out in Surat city, a city is hub of various industrial as well as commercial activity.

Importance of problem

The negative effects were observed due to higher concentration of Air Pollutants have inspired us to take up this study.[6]

Carbon monoxide (CO)

CO has a very high affinity for hemoglobin and on inhalation, combines selectively with hemoglobin of the blood (Hb) and forms carboxyhaemoglobin (COHb), thereby reducing the oxygen carrying capacity of the blood. This affects the central nervous system causing giddiness, laziness and exhaustion.CO impairs a person's time interval discrimination, reduces vision and causes cardiovascular disorders. High CO level is potentially deadly and fatal to human life as CO is a very dangerous asphyxiates.

Oxides of nitrogen

They include Nitrogen monoxide (NO) and Nitrogen dioxide (NO_2). NO is a colorless gas which is oxidized to NO_2 through secondary photochemical reactions. Being heavier then air, NO_2 is readily soluble in water and forms nitric acid, which falls out in the rain. NO is an inert gas but like CO, it can also combine with hemoglobin to reduce the oxygen carrying capacity of the blood. It is only moderately toxic as its concentration in the air is not high enough to become a health hazard. NO_2 is relatively more toxic as it irritates the alveoli of the lungs and high concentrations may even cause acute bronchitis.

Oxides of sulphur

These include Sulphur dioxide (SO_2) and Sulphur trioxide (SO_3). SO_2 is a colorless gas having a characteristic sharp, pungent and suffocating odour. It is photo chemically oxidized to SO_3. It is highly soluble in water and along with SO_3 forms sulphuric or sulphurous acid and is quickly washed out of the atmosphere by rain (acid rain).They are power pollutants and tend to irritate the mucous membranes of the respiratory tracts. Higher concentrations cause bronchitis. They readily attack building materials especially marble, limestone and mortar. Clothes, leather and paper are also affected. Plants are particularly sensitive to high concentrations of SO_2 and suffer from chlorosis (disappearance of chlorophyll), metabolic inhibition, plasmolysis and even death.

Particulate air pollutants

All atmospheric substances that are not gases but may be suspended droplets, solid particles or mixtures of the two are generally referred to as particulates. They differ widely in terms of particle density and particle size, with sizes varying from 0.1 µm to 100 µm. Particles larger than 50 µm can be seen with the unaided eye and those smaller than 0.005 µm can be seen only through an electron microscope. Larger particles like sand and water droplets quickly settle down in still air and smaller particles like dust remain in air for a long time whereas very fine particles like tobacco smoke do not settle down at all.

Particulate pollutants are categorized according to size, mode of formation (source) or physical state.

Aerosols

These include all air borne suspensions of solid or liquid particles smaller than 1 µm.

Dust

It consists of small solid particles (size 01 µm to 200 µm), which are formed by the breaking up of larger masses of rock and soil either by natural disintegration or by mechanical processes of crushing, grinding or blasting etc. They remain suspended in air temporarily but ultimately settle under the influence of gravity.

Smoke

It consists of fine solid particles (size 0.1 to 1 µm) resulting from the incomplete combustion of organic particles like coal, wood, tobacco or other chemical processes. Depending upon the nature of the material burnt, smoke may have different odors.

Fumes

These are fine solid particles (size 0.1 to 1 µm) formed by the condensation of vapors of solid materials. They are odorous vapors which may or may not be visible and are usually released from chemical or metallurgical processes.

Mist

It consists of liquid droplets (size smaller than 10 µm) formed by the condensation of vapors in the atmosphere or are released from industrial operations (such as formation of sulphuric acid mist).

Fog

If the mist is made up of water droplets whose concentration is high or dense enough to obscure vision, then the mist is called a fog.

Fly ash

This consists of finely divided non combustible particles present in the gases arising from fuel combustion. It contains inorganic metallic or mineral substance released when the organic part of coal is burnt.

Soot

Incomplete combustion of carbon containing materials release carbon particles impregnated with 'tar'. A collection of such particles is soot.

Natural particulates

Natural particulates are pollen grains spore, bacteria, viruses, protozoa, fungal spores and volcanic dust. Air pollutants have many acute as well as chronic effects on human health. Like: Irritation of the respiratory tract. Irritation of eye, nose and throat. Lead particulates (cause lead poisoning resulting in convulsions, delirium, coma and even death. Cadmium particulates (through cigarette smoking) cause cardiovascular diseases, kidney and liver damage and even death. Nickel particulates (in tobacco smoke) result in respiratory damage. Mercury (Combustion of fossil fuels, plants) results in nerve, brain and kidney damage. Radio-active fallout has somatic and genetic effects on future generations.

Effects on animals

When the animals feed upon the particulate coated plants (especially with Fluorine, Lead, Arsenic) they get affected with Arsenic poisoning (cattle and sheep) . Lead poisoning results in bronchitis and lack of appetite in pet animals.

Effects on plants

Spraying of pesticides and other agricultural practices has exposed the plants to a large number of air pollutants, adversely affecting their growth and metabolism by destroying chlorophyll and disrupting photosynthesis. SO_2 bleaches the leaf surface and causes chlorosis (i.e. loss of chlorophyll and yellowing of the leaf) especially in leafy vegetables. NO_2 causes premature leaf fall (abscission) and suppressed growth of plants resulting in reduced yields of crop plants. Ozone causes necrosis (dead areas on a leaf structure) and damages leaves. PAN (peroxyacylnitrate) damages leafy vegetables causing premature fall, discoloration and curling of sepals.

Effects on materials

Materials are affected by air pollutants in the following four ways-corrosion, abrasion, deposition and removal of materials, chemical attack. The damages cause to various materials by air pollutants are: SO_2, acid rains and aerosols damage the building materials. Paints are discolored by SO_2, H_2S and particulates. Metals undergo corrosion and tarnishing by SO_2 and acid gases. Paper becomes brittle and leather undergoes disintegration by SO_2 and acid gases. Ozone, SO_2, NO_2 and acid gases discolor, deteriorate and reduce the tensile strength of textile.

Effects on climate

This increase will change the climate of earth by changing the factors controlling the climate (e.g. composition of gases). This increase of CO_2 will increase the atmospheric temperature of earth, resulting in the melting of polar ice, glaciers etc. which will consequently cause the flooding of coastal towns (i.e. green house effect). Pattern of rainfall, if changed, will affect agricultural output. The thinning of the ozone layer in the stratosphere by the action of aerosols will increase the penetration of harmful ultraviolet rays to earth and this will cause blindness, sunburn, inactivation of proteins, RNA and DNA.

Effect on aesthetic beauty

The aesthetic beauty of nature is not visible Reduction in visibility results from scattering of light by air borne particulates (0.1 to 1 µm size). This also leads to safety hazards in the haze formed by dust and smoke in the air. Industries, automobiles, sewage and garbage heaps emit foul odors causing further loss of aesthetic beauty.[7, 8]

MATERIAL AND METHODS

Study area

12 sampling locations were selected across the Surat city to determine air quality as well as to determine air quality index for the study in **Fig. 1**. 12 sampling stations are given in **Table 1**. Surat is one of the most dynamic city of India with one of the fastest growth rate due to immigration from various part of the country. Surat is one of the cleanest city of India and is also known by several other names like the silk city, the diamond city, the green city etc. The city has seen an unprecedented growth in last four decades, recording one of the highest growth rates in the country and a 10-fold population rise over four decades. The city area has expanded with time (major expansion being in 2006) and presently covers 326.515 sq.km. The estimated population of the city in 2011 is about 4.5 million.[9]

Fig. 1 : Locations of sampling station, Surat, India

Due to explosion of population and rapid industrialization the transportation in the city is increased to un-imaginary heights but due to the want of efficient Mass Transit system, individual vehicular growth also touched the heights. As on 31-12-2010, the vehicles registered at R.T.O. is 15.00 lacks plus, which is equivalent to the highest growth rate of Delhi.[9] Thus the explosion of population, rapid industrialization and highest growth rate in vehicle population made the traffic problems complicated which cause the problem of air pollution.

Table 1 : Sampling stations

S-1	Gani Bhai Dahiwala Garden at Causway	**S-7**	Jogger's park , Citylight
S-2	N/r Dhaboli-Jahangirabad Bridge	**S-8**	Jawaharlal Nehru Garden, Athwagate
S-3	Gandhi Garden, Chowk Bazar	**S-9**	Snehmilan Garden-Nanpura
S-4	APMC market N/r Railway station	**S-10**	Amba wadi-Dumas
S-5	N/r Sardar Bridge, Adajan	**S-11**	Varacha Chopati Garden,Varacha
S-6	Siddhraj Jaisingh Park, Althan	**S-12**	Jyotindra Dave Garden, Althan

Sampling

The sampling of air pollutants was done using the instrument named high volume sampler (Polltech make HVS, Model: PEM- HVS 110). After the sampling was completed the analysis of the air pollutant sample were done and the conclusion and interpretation of it was taken out. The air quality was been observed at sampling stations from December 2010 to March 2011.

Experiment

The air quality parameters -RSPM, SPM (PM-10), NO_X, SO_2, CO were measured according to BIS guideline, shown in **Table 2**.

Air Quality Index

The Air Quality Index (AQI) is an index (that is, a numerical value or ratio derived from a series of observations) for reporting daily air quality. It tells you how clean or polluted air is, and what associated health effects might be a concern for living. The AQI focuses on health effects may experience within a few hours or days after breathing polluted air. The U.S. Environmental Protection Agency (EPA) calculates the AQI for five major air pollutants regulated by the Clean Air Act ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country.[9, 10]

Table 2 : Air quality parameters along with its analytical methods

Parameter	Method	Guideline
RSPM	Gravimetric	IS5182 (Part 23)
SPM	Gravimetric	IS 5182 (Part 4)
NOx	Spectrophotomatric	IS 5128 (Part 6)
SOx	Spectrophotomatric	IS 5128 (Part 2)
CO	Gas chromatographic	IS5182 (Part 10)

Determination of index

There are several methods and equations used for determining the air pollution index. The air quality index was calculated. If the five major pollutants in a city atmosphere are particulate matter (RSPM, SPM), sulphurdioxide (SO_2), oxides of nitrogen (NO_x) and carbon monoxide (CO), then

$$AQI = \frac{1}{5}\left[\frac{\text{RSPM}}{\text{S RSPM}} + \frac{\text{SPM}}{\text{S SPM}} + \frac{\text{NOx}}{\text{S NOx}} + \frac{\text{SO}_2}{\text{S SO}_2} + \frac{\text{CO}}{\text{S CO}}\right] \text{X } 100$$

Where, S RSPM, S SPM, S NO_X, S SO_2 and S CO represent the ambient air quality standards for Respirable Suspended Particulate Matter (RSPM), Suspended Particulate Matter (SPM), sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and carbon monoxides (CO) respectively.[10,11]

RESULTS AND DISCUSSION

The data obtained for air pollutants i.e. RSPM, SPM, NOX, SO_2 and CO at all sampling stations of the study is presented in **Fig. 2** to **Fig. 6** and **Table 3**.

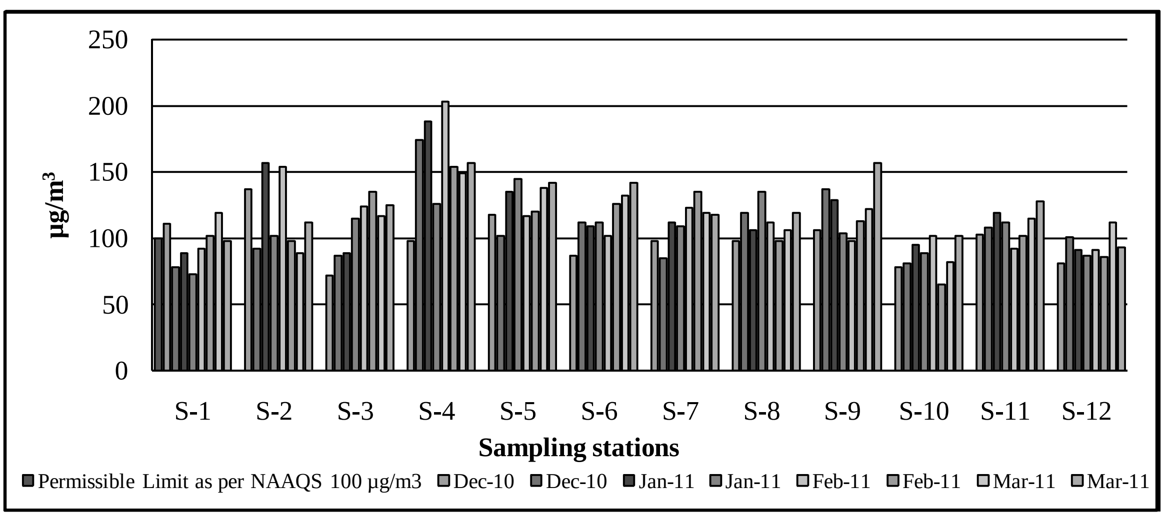

Fig. 2 : Respirable Suspended Particulate Matter (RSPM) in ambient air of Surat city during 2010-2011

The **Fig. 2** is showing the major exceeding limits of RSPM. Except Ambavadi, Dumas all stations are showing RSPM concentration above limit. The average value for RSPM was found to be 178.5 µg/m^3 at APMC Market near railway station which highly exceeds the permissible limits of 100µg/m^3. The exceeding amount of RSPM may be due to the commercial activities going on such as cement storage and transfer station is located in the area as well as due to vehicular movement which was observed during the early morning hours contribute to air pollution.

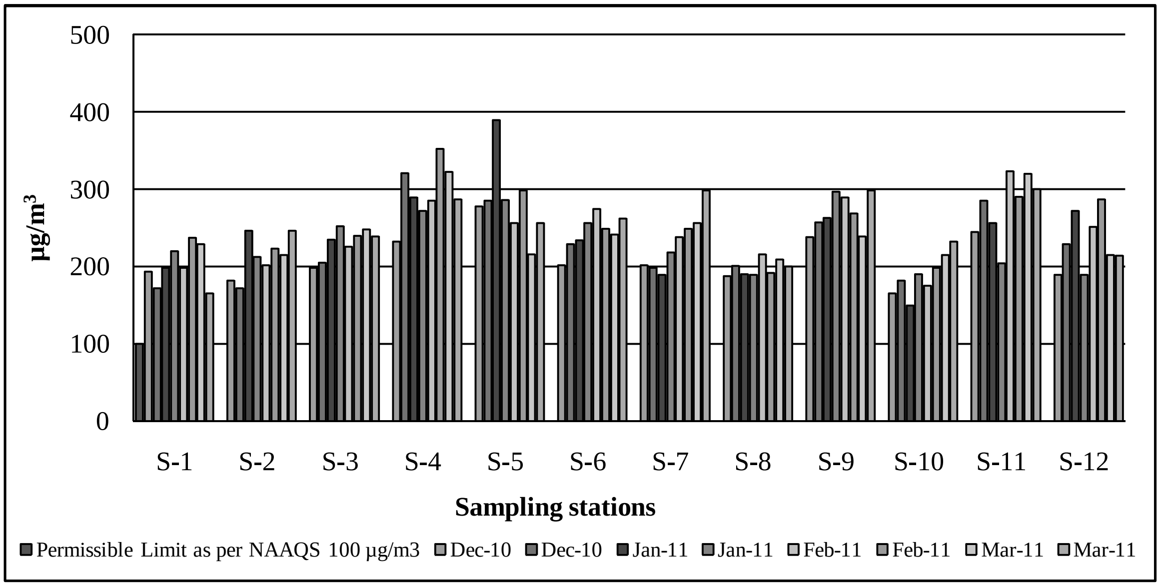

Fig 3 : Suspended Particulate Matter (RSPM) in ambient air of Surat city during 2010-2011

The **Fig. 3** is showing the exceeding limits of SPM at all the station throughout the study. The average value for SPM found to be 337.5 µg/m^3 at APMC market N/R Railway Station which highly exceeds the permissible limits of 100µg/m^3. The exceeding amount of SPM may be due to the vehicular traffic as well as the various industries situated nearby. Moreover various other commercial activities also contribute to SPM.

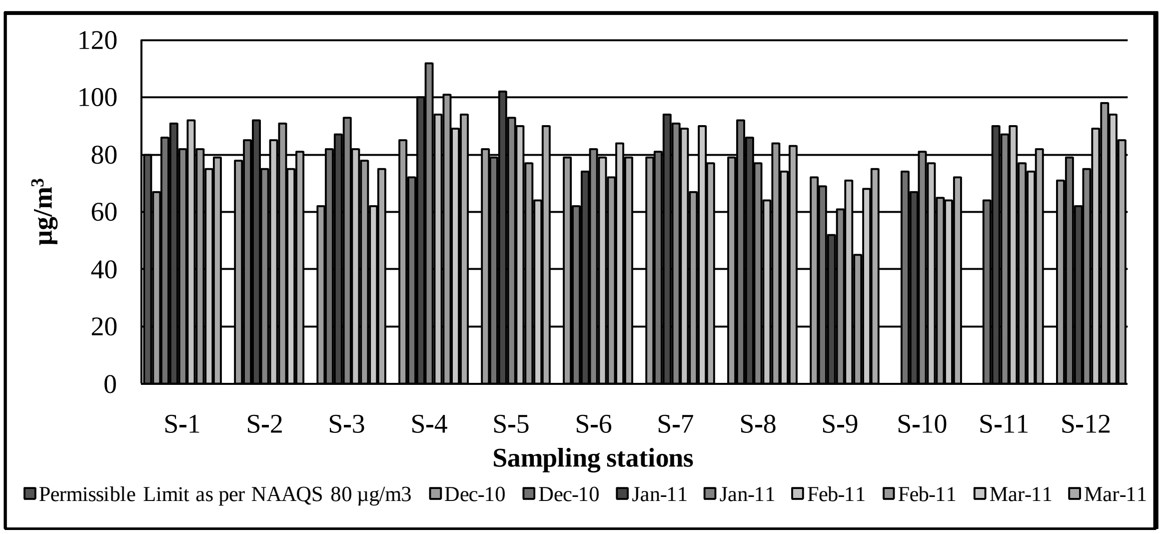

Fig. 4 : Nitrogen oxides (NO_x) in ambient air of Surat city during 2010-2011

The **Fig. 4** is showing the major exceeding limits of NO_x. Except Snehmilan Garden, Nanpura and Ambawadi- Dumas all stations are showing NO_x concentration above the permissible limit. The monthly average value for NO_x was found to be 106µg/m^3 -at APMC markt N/r. railway station which exceeds the permissible limits of 80µg/m^3 for NO_x. The exceeding concentration of air pollutants may be due to the commercial activities going on as well as due to vehicular movement observed during early morning hours. Moreover, N/r Sardar Bridge, Adajan, Jogger's park - Citylight, GaniBhai DahiWala Garden at Causway, N/r.Sardar bridge, value for NO_x was observed 97.5 µg/m^3, 92.5 µg/m^3, 86.5 µg/m^3 respectively which exceeds the permissible limit.

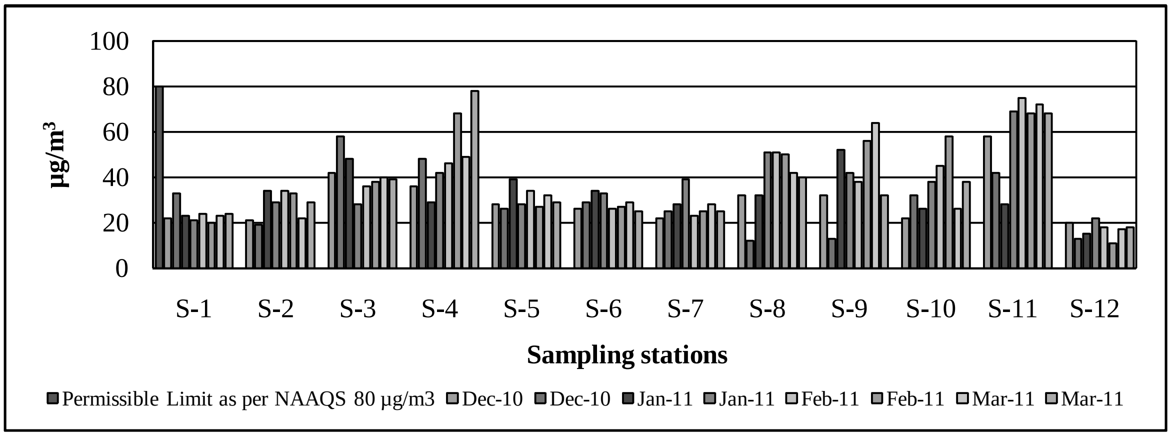

Fig. 5 : Sulphur dioxide (SO_2) in ambient air of Surat city during 2010-2011

The **Fig. 5** is showing the concentration of SO_2 at different sampling location. It is under limit at all stations which were studied. The average value for sulphudioxide (SO_2) was found to be 70 and 63.5 µg/m^3 respectively at Varacha chopati garden-Varacha, APMC Market N/r. Railway station which is high but within the permissible limits of 80µg/m^3. Moreover near the vicinity of sampling area coal based cottage industries are situated near APMC Market contributing to emission of particulates and SO_2. The **Fig. 6** is showing the concentration of CO at different sampling location.

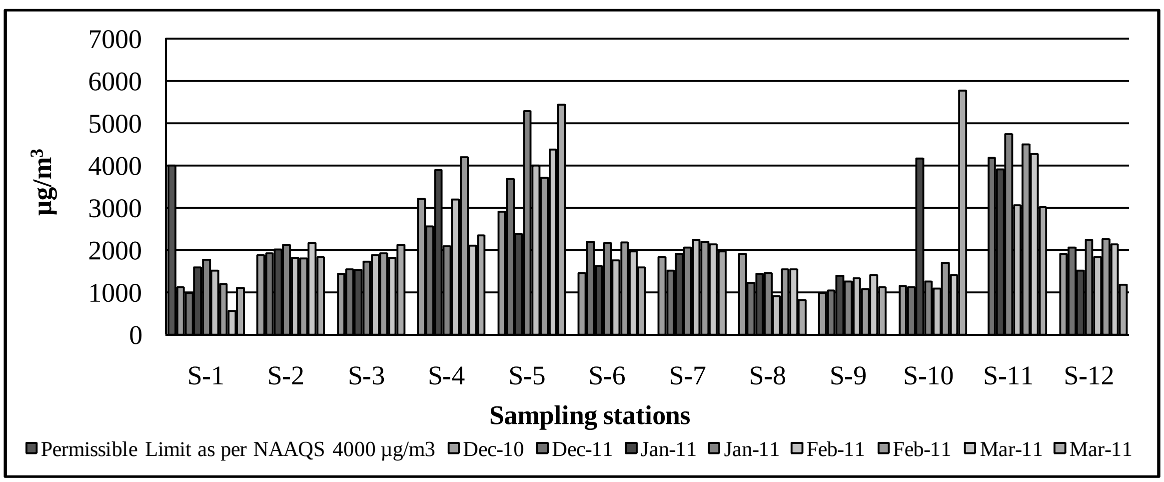

Fig 6 : Carbon monoxide (CO) in ambient air of Surat city during 2010-2011

It is observed above permissible limit at Sardar Bridge, Ambawadi-Dumas, Varacha Chopati Garden. The monthly average value for CO exceeds the permissible limit of 4000 µg/m^3 at N/r Sardar Bridge (4915.5 µg/m^3), Varacha Chopati Garden (5148 µg/m^3) respectively which exceeds the permissible limits. The exceeding concentration of air pollutants may be due to the commercial activities going on as well as due to heavy vehicular traffic near the sampling site as well the results were affected by the construction work of roads.

Table 3 : Air pollution data of various sampling locations in Surat city from December 2010 to March 2011

Pollutant	Month	Limit as per NAAQS	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12
RSPM	Dec'10	100 μg/m³	111 -78	92-137	72- 87	98 – 174	102-118	87- 112	85 -98	98 - 119	106 - 137	78 - 81	103-108	81-102
			94.5	**114.5**	**79.5**	**136**	**110**	**99.5**	**91.5**	**108.5**	**121.5**	**79.5**	**105.5**	**91**
	Jan'11		73-89	102-157	89 - 115	126-188	135-145	109-112	109-112	106-135	104-129	89-95	112-119	87-97
			81	**129.5**	**102**	**157**	**140**	**110.5**	**110.5**	**120.5**	**116.5**	**92**	**115.5**	**89**
	Feb'11		92-102	98-154	124-135	154-203	117-120	102-126	123-135	98-112	98-113	65-102	92-102	86-91
			97	**126**	**129.5**	**178.5**	**118.5**	**114**	**129**	**105**	**105.5**	**83.5**	**97**	**88.5**
	Mar'11		98-119	89-112	117-125	149-157	138-142	132-142	118-119	106-119	122-157	82-102	115-128	93-112
			108.5	**100.5**	**121**	**153**	**140**	**137**	**118.5**	**112.5**	**139.5**	**92**	**121.5**	**102.5**
SPM	Dec'10	100 μg/m³	172-193	172-182	198-205	232-321	278-285	202-229	198-202	188-201	238-257	165-182	245-285	189-229
			182.5	**177**	**201.5**	**276.5**	**281.5**	**215.5**	**200**	**194.5**	**247.5**	**173.5**	**265**	**209**
	Jan'11		198-220	212-246	235-252	272-289	286-389	234-256	189-218	189-190	263-297	150-190	204-256	189-272
			209	**229**	**243.5**	**280.5**	**337.5**	**245**	**203.5**	**189.5**	**280**	**170**	**230**	**230.5**
	Feb'11		198-237	202-223	226-240	285-352	256-298	249-274	238-249	192-216	269-289	175-198	290-323	251-287
			217.5	212.5	233	318.5	277	261.5	243.5	204	279	186.5	306.5	269
	Mar'11		165-229	215-246	239-248	287-322	216-256	241-262	256-298	200-209	239-298	215-232	300-320	215-214
			197	**230.5**	**243.5**	**304.5**	**236**	**251.5**	**277**	**204.5**	**268.5**	**223.5**	**310**	**214.5**
NOx	DEC'10	**80 μg/m³**	67-86	78-85	62-82	72-85	79-82	62-79	79-81	79-92	69-72	74	64	71-79
			76.5	**81.5**	**72**	**78.5**	**80.5**	**70.5**	**80**	**85.5**	**70.5**	**74**	**64**	**75**
	Jan'11		82-91	75-92	87-93	100-112	93-102	74-82	91-94	77-86	52-61	67-81	87-90	62-75

			86.5	**83.5**	**90**	**106**	**97.5**	**78**	**92.5**	**81.5**	**56.5**	**74**	**88.5**	**68.5**
	Feb'11		82-92	85-91	78-82	94-101	77-90	72-79	67-89	64-84	45-71	65-77	77-90	89-98
			87	**88**	**80**	**97.5**	**83.5**	**75.5**	**78**	**74**	**58**	**71**	**83.5**	**93.5**
	Mar'11		75-79	75-81	62-75	89-94	64-90	79-84	77-90	74-83	68-75	64-72	74-82	85-94
			77	**78**	**68.5**	**91.5**	**77**	**81.5**	**83.5**	**78.5**	**71.5**	**68**	**78**	**89.5**
SO_2	DEC'10	80 µg/m^3	22-33	19-21	42-58	36-48	26-28	26-29	22-25	12-32	32-13	22-32	42-58	13-20
			27.5	**20**	**50**	**42**	**27**	**27.5**	**23.5**	**22**	**22.5**	**27**	**50**	**16.5**
	Jan'11		21-23	29-34	28-48	29-42	28-39	33-34	28-39	32-51	52-42	26-38	28-69	15-22
			22	**31.5**	**38**	**35.5**	**33.5**	**33.5**	**33.5**	**41.5**	**47**	**32**	**48.5**	**18.5**
	Feb'11		20-24	34-33	36-38	46-68	27-34	26-27	23-25	50-51	38-56	45-58	68-75	11-18
			22	**33.5**	**37**	**57**	**30.5**	**26.5**	**24**	**50.5**	**47**	**51.5**	**71.5**	**14.5**
	Mar'11		23-24	22-29	40-39	49-78	29-32	25-29	25-28	40-42	32-64	26-38	68-72	17-18
			23.5	**25.5**	**39.5**	**63.5**	**30.5**	**27**	**26.5**	**41**	**48**	**32**	**70**	**17.5**
CO	DEC'10	4000 µg/m^3	982-1120	1886-1932	1447-1550	2560-2100	2917-3679	1452-2208	1514-1835	1907-1226	982-1054	1152-1120	2923-4191	1906-2057
			1051	**1909**	**1498.5**	**2885**	**3298**	**1830**	**1674.5**	**1566.5**	**1018**	**1136**	**4191**	**1981.5**
	Jan'11		1600-1780	2022-2119	1535-1726	2100-3905	2386-5292	1620-2176	1914-2057	1456-1438	1268-1394	1258-7170	3749-3909	1514-2246
			1690	**2070.5**	**1630.5**	**3002.5**	**3839**	**1898**	**1985.5**	**1447**	**1331**	**4214**	**3829**	**1880**
	Feb'11		1200-1520	1810-1825	1886-1932	3200-4200	3714-4000	1754-2192	2207-2246	918-1556	1072-1334	1097-1702	3061-4503	1835+2265
			1360	**1817.5**	**1909**	**3700**	**3857**	**1973**	**2226.5**	**1237**	**1203**	**1399.5**	**3782**	**2050**
	Mar'11		562-1110	1835-2176	1825-2119	2107-2351	4381-5450	1599-1969	1978-2139	816-1556	1120-1408	1411-5771	3025-7271	1178-2139
			836	**2005.5**	**1972**	**2229**	**4915.5**	**1784**	**2058.5**	**1186**	**1264**	**3591**	**5148**	**1658.5**

*Bold values are average values for the parameters

Moreover near the vicinity of sampling area coal based cottage industries are situated contributing to emission of CO. The Air Quality Index value for all the sampling stations is shown in **Fig. 7**. These data is compared with standard limit given by NAAQS 2010.[12,13]

Air Quality Index levels of health concern

Looking to the AQI data APMC market N/R railway station the value of AQI was found to be 140 for early morning hours which is highest and according to EPA guidelines this value is unhealthy for sensitive groups. Other stations AQI values are falling in the moderate range.

AQI colours

The U.S. EPA has assigned a specific colour to each AQI category to make it easier for people to understand quickly whether air pollution is reaching unhealthy levels in their communities. For example, the colour orange means that conditions are unhealthy for sensitive groups, while red means that conditions may be unhealthy for everyone, and so on **(Table 4)**.[13-16]

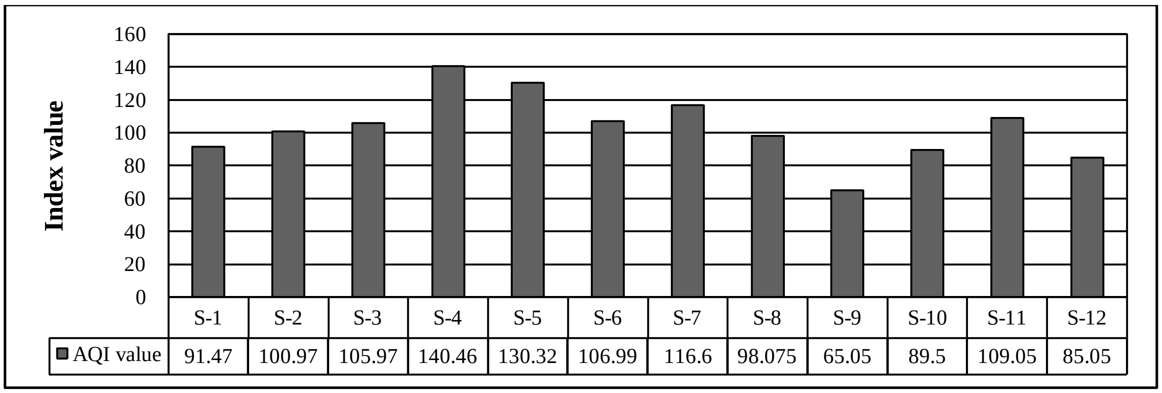

Fig. 7 : Air Quality Index (AQI) in ambient air of Surat city during 2010-2011

Table 4 : AQI Colours

Air Quality Index levels of health concern	Numerical value	Meaning
Good	0-50	Air quality is considered satisfactory, and air pollution posses little or no risk.
Moderate	51-100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for sensitive groups	101-150	Members of sensitive groups may experience health effect. The general public is not likely to be affected.
Unhealthy	151-200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effect.
Very unhealthy	201-300	Health alert: every one experience more serious health effects.
Hazardous	>300	Health warning of emergency condition. The entire population is more likely to be affected.

Source : US EPA (Environment Protection Agency) Guideline

CONCLUSION

From the experimental data and the graphical representation it has been concluded that, pollution occurred during the early morning hours and number of area going to be affected is also increasing. In the case where there was no change in the pollution sources, the weather conditions that reviled were suitable for diffusion, transmission and the removal of pollutants. From the graph, we can say that in early morning time concentration of RSPM, SPM & NOx are beyond the limit in various areas. The high concentrations of this parameter are observed near Gani Bhai Dahi Wala Garden at Causway and N/R Sardar Bridge. Causway is near to the industrial area of BhariMata and Katargam, so high concentration of air pollutants is observed. In monthly average analysis the concentration of all the parameters are above average values especially for RSPM, SPM and NOx, with maximum values at APMC Market N/r. Railway station and N/r.Sardar Bridge due to heavy traffic intersections and high emission of NOx. Looking to the AQI data APMC market N/R Railway Station the value of AQI was found to be 140 which is highest and according to EPA guidelines this value is unhealthy for sensitive groups. Looking to high values of pollutants strict emission standards need to be implemented by the control authorities. From the above graph studies it was observed that, when daily average values were taken, the air pollution level was exceeding the limits.

RECOMMENDATIONS

Adsorption, absorption, condensation and combustion are four basic technical control methods for air pollutants and use of these methods can control emissions. Control at the source point is suggested for more desirable than control by dilution in the ambient air.

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