2.0

Air Quality Assessment

2.1 National Air Quality Monitoring Programme (NAQMP)

The CPCB is executing nationwide monitoring network under NAQMP, which consists of 341 stations covering 126 cities/towns in 25 States and 4 Union Territories. Sulphur Dioxide (SO_2), Oxides of Nitrogen (as NO_2), Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM10), are regularly monitored at all locations in addition to the monitoring of meteorological parameters such as wind speed and direction, relative humidity and temperature. The air quality monitoring is undertaken continuously for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to have about 104 observations in a year. The monitoring is being carried out by CPCB in association with SPCBs, PCCs, National Environmental Engineering Research Institute (NEERI), Nagpur. The CPCB coordinates and supervises the uniformity and consistency of air quality data also and provides technical and financial support.

NAMP consists of 341 stations covering 126 cities/towns in 25 States and 4 UTs

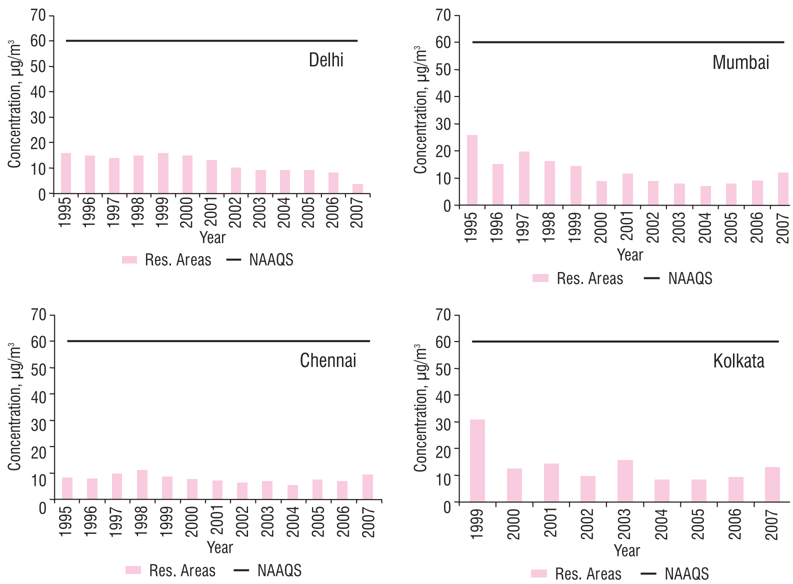
2.2 Air Quality Trends in Metro Cities

Based on Air Quality Monitoring Data generated from Air Quality Monitoring Stations under NAMP, the trends in annual average concentration of Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Respirable Suspended Particulate Matter (RSPM) in Delhi, Mumbai, Chennai and Kolkata have been derived and presented below.

The Air Quality Trend information in metro cities generated following information :

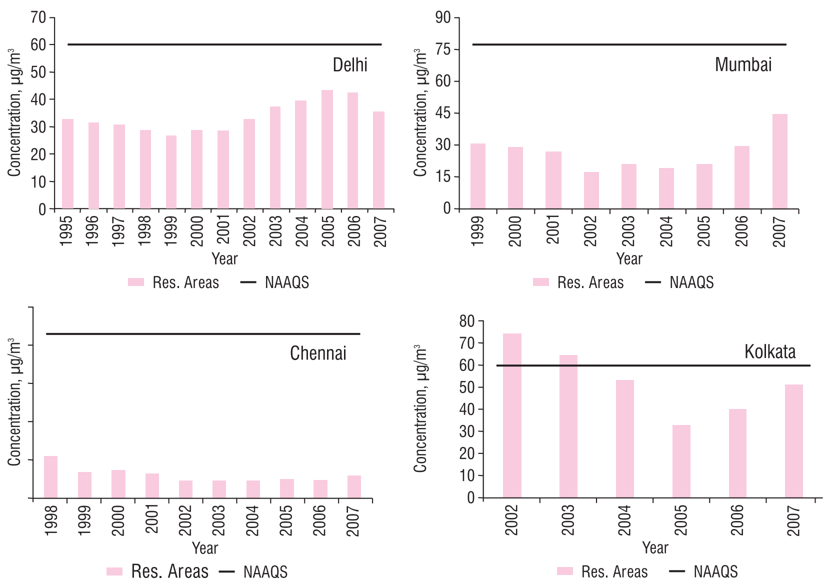
- Sulphur dioxide levels are within the National Ambient Air Quality Standards (NAAQS). A decreasing trend has been observed in ambient sulphur dioxide levels in Delhi, may be due to various interventions such as reduction of sulphur in diesel, use of cleaner fuel such as CNG etc.
- Nitrogen dioxide levels have also been observed within the NAAQS in most cities. While the levels of Respirable Suspended Particulate Matter (RSPM) exceed prescribed NAAQS, no definite trends have been observed in ambient nitrogen dioxide and RSPM. In some metro cities, the ambient NO_2 and RSPM levels are decreasing whereas in some it is fluctuating.

Figure 2.2a Trends in Annual Average Concentration of SO2 in Residential areas of Delhi, Mumbai, Chennai and Kolkata.



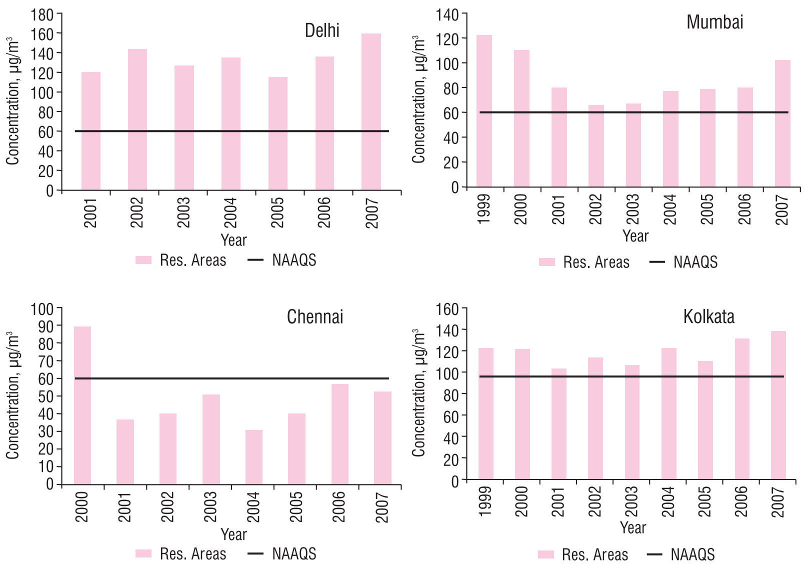
Remark: Data for 2007 for Chennai, Kolkata and Mumbai is the average of data available as on date

Figure 2.2b Trends in Annual Average Concentration of Nitrogen Dioxide (NO_2 in residential areas of Delhi, Mumbai, Chennai and Kolkata.



Remark: Data for 2007 for Chennai, Kolkata and Mumbai is the average of data available as on date

Figure 2.2c Trends in Annual Average Concentration of RSPM in Residential areas of Delhi, Mumbai, Chennai and Kolkata.



Remark: Data for 2007 for Chennai, Kolkata and Mumbai is the average of data available as on date

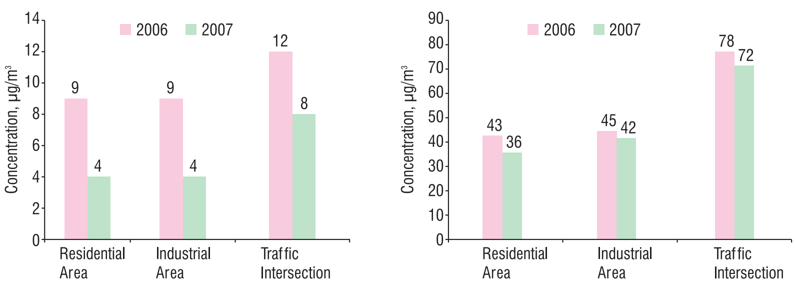
Vehicles have been found as one of the major sources of NO_2 and RSPM

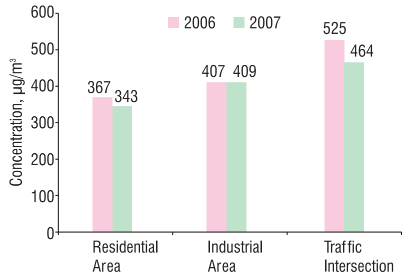
- Although various interventions have taken place to mitigate ambient NO_2 and RSPM levels but the increasing numbers of vehicles exponentially releasing these air pollutants in ambient air. The vehicles have been found as one of the major sources of NO_2 and RSPM.

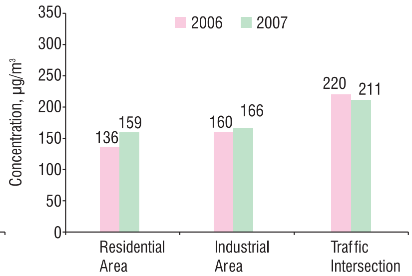
2.3 Ambient Air Quality in Delhi

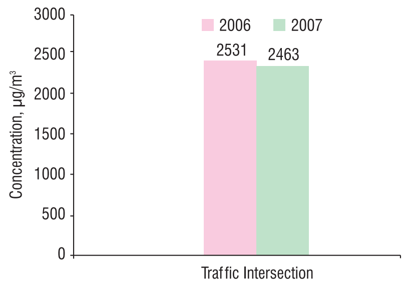
The monitoring of ambient air quality being undertaken at seven locations in Delhi for the past many years. The monitoring data from various land use monitoring stations viz. residential, industrial and traffic intersection are presented below.

Figure 2.3 Comparison of Ambient Air Quality in Delhi during year 2006 and 2007





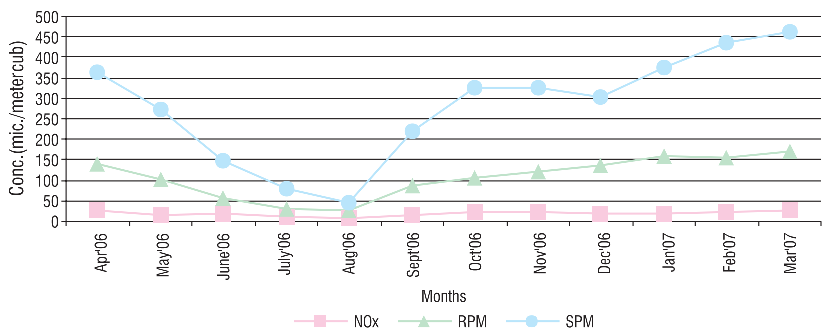




2.4 Ambient Air Quality at Bhopal

At Bhopal, the ambient air quality is undertaken at the CPCB Zonal Office Building. The ambient air quality monitoring data is uploaded regularly to the Environment Data Bank. The annual data of three primary pollutants viz. SPM, RSPM, and NO_2 are presented.

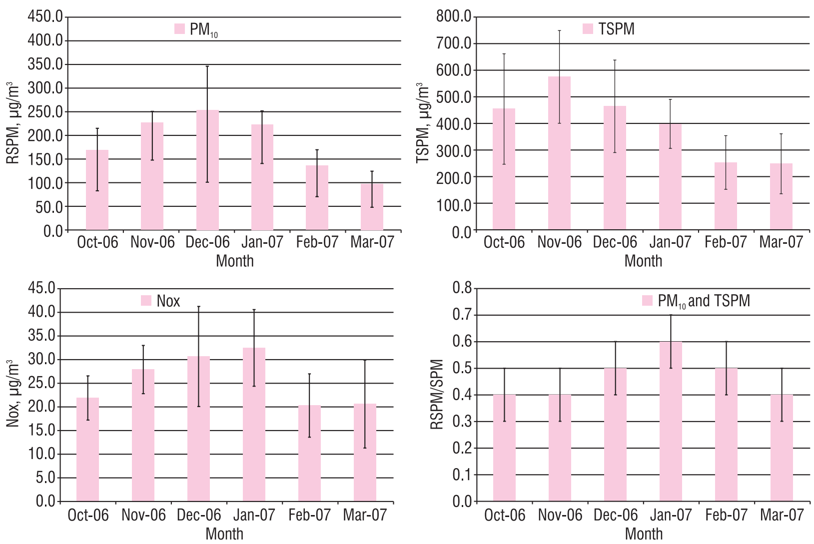
Figure 2.4 Annual Status (Nox,RPM & SPM) of Ambient Air Quality, Bhopal (Stn.436)



2.5 Ambient Air Quality at Kanpur

Ambient Air Quality Monitoring is undertaken at Vikas Nagar, Kanpur in association with IIT Kanpur. The monitoring includes air quality sampling and analysis of PM10 (particles of size less than 10 µm aerodynamic diameter), SO_2 and NO_2 five days in a week (Monday to Friday). The monthly variations in air quality and information generated based on air quality data are presented ahead.

Figure 2.5 Monthly variations over 24-hour average for PM10, TSPM, NOx levels and PM10/TSPM ratio at Kanpur



Air quality has been found deteriorated with respect to PM10 and NO2 during winter at Kanpur

The air quality data indicate following information :

- The weak correlation behind PM10 and NOx levels suggests that PM10 may not be originating from the combustion sources alone.
- TSPM and PM10 correlate well and originate from the same pollution sources, which is also evident from high PM_{10} to TSPM ratio (range 0.6 – 0.8) during post-monsoon and winter periods and around 0.4 in summer and monsoon period.
- As expected, NOx levels are found higher in December and January months compared to post monsoon and February / March months.
- The air quality has been found deteriorated with respect to PM_{10} and NO_2 during December which improves during January.
- July month showed best air quality both for PM_{10} and NO_2.

2.6 Ambient Air Quality at Lucknow

Ambient Air Quality is monitored at Vikas Khand, a residential area at Lucknow. This monitoring station is located in the eastern end of the city and is at least 500 metres away from any busy road. Monitoring at the station has been initiated in December 2007. The air quality data is presented below:-

Table 2.6 Ambient Air Quality at Lucknow

Period	SO_2 (µg/m3)	NO_2 (µg/m3)	RSPM (µg/m3)	SPM (µg/m3)
December 2007	11.6	43.4	274	856

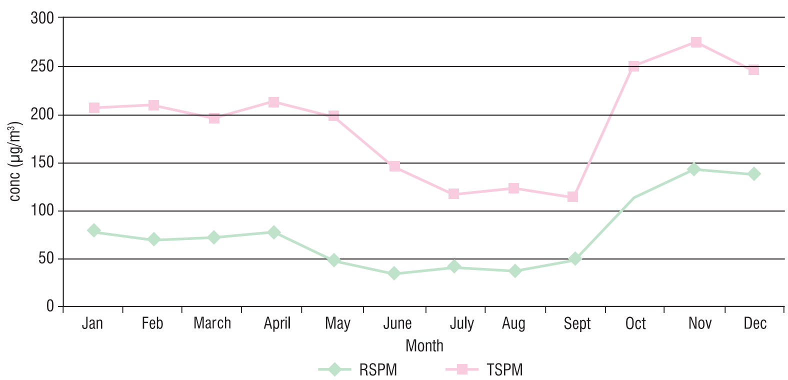
The high values of RSPM and SPM may be attributed due to constructional activities in the area and meteorological conditions.

2.7 Ambient Air Quality Monitoring in Vadodara

The CPCB West Zone Office, has undertaken Ambient Air quality Monitoring at Vadodara for 5 days in a week for the parameters RSPM, SO_2, NOx. The results reveal that the particulate matter in ambient air in Vadodara is high due to the vehicular movement and the background dust.

The air quality data generated indicate that the monthly average SPM values ranged between 119 µg/Nm3 to 275 µg/Nm3. The monthly average NOx value ranged between 3.6 µg/Nm3 to 51.3 µg/Nm3 respectively. The monthly average SO_2 values were found below detection limit during May to September, the highest value observed was 39.2 µg/Nm3.

Figure 2.7 Trend of Monthly Average RSPM and TSPM at Vadodara (2007)



2.8 Ambient Air Quality Monitoring at Agra

With reference to the Writ Petition (C) No. 13381/1984 M.C. Mehta Vs Union of India and directives by Hon'ble Supreme Court of India in 2000, the Central Pollution Control Board has been undertaking Ambient Air Quality assessment at four identified locations at Agra for last six years. During the calendar year, four affidavits have been submitted on quarterly basis along with monitoring data for information to the Hon'ble Court. The data on quarterly basis are also being submitted to the Taj-Trapezium Zone Authority as compliance to the directives. Annual average concentration of various parameter, standard deviation with reference to applicable ambient air quality goal and percentile violation are presented below.

Table 2.8.1	Ambient Air Quality Monitoring Status of Agra City: January to December 2007				
Location	Parameters	Annual Average	Standard Deviation	Total valid monitoring days*	Percent Violation
TajMahal	SO2	06	2.0		00
	NO2	23	10	261	25
	RSPM	167	117	262	65
	SPM	296	148	259	83
Itmad ud daulah	SO2	05	1.5	115	00
	NO2	27	09	113	36
	RSPM	203	118	111	81
	SPM	377	178	111	95
Rambagh	SO2	05	1.1	109	00
	NO2	25	06	109	30
	RSPM	203	126	105	80
	SPM	439	153	110	93
Nunhai	SO2	05	1.2	109	00
	NO2	37	11	109	61
	RSPM	274	134	106	86
	SPM	584	210	105	100

* Valid monitoring day: Sampling time 16 hours or more in a day
• All the values are in mg/m3 of Ambient Air
• % Violation: Percentage violation with respect to National Ambient Air Quality Standards (24 Hourly Average)

With the increase in the use of CNG in recent times in Agra, it has been observed that the NOx formation in the ambient air is also increasing

Aerosol Profile at Agra

Characterization of the PM10 samples collected at all locations with special focus for particulate matter samples at Tajmahal was attempted during the year. Particulate Aerosol Profile (SPM, RSPM and FPM) at Tajmahal and "Spearman Rank Correlations' of these particulate fractions and the relative humidity are graphically presented below.

It is noted that SPM is mostly dependant on RSPM (+0.8248), while FPM is largely dependant on RSPM (+0.7774). It is also noted that correlation of relative humidity (RH) was highest with SPM (-0.6350), followed by RSPM (-0.4632) and lowest with FPM (-0.1552), thus, FPM has been observed as least influenced by RH.

Figure 2.8a Particulate Aerosol Profile (SPM, RSPM and FPM) at Tajmahal

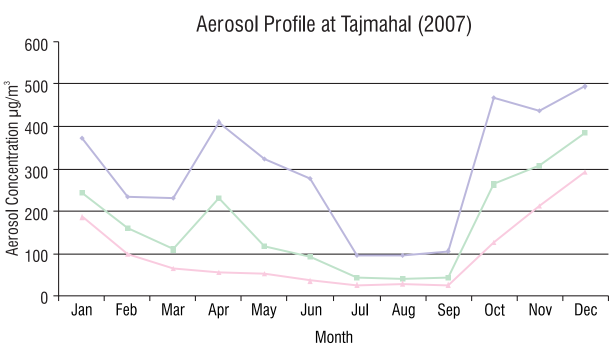


Table 2.8.2	Spearman Rank Correlations on Particulate Aerosol Profile at Tajmahal					
Parameters	PM100	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temp.(C) ($\mu g/m^3$)	RH(%)	WS(m/s)
PM100 ($\mu g/m^3$)	1.0000	0.8248	0.5883	0.1259	-0.6350	-0.2380
PM10 ($\mu g/m^3$)		1.0000	0.7774	-0.2447	-0.4632	-0.2603
PM2.5 ($\mu g/m^3$)			1.0000	-0.4708	-0.1552	-0.3005
Temp (^oC)				1.0000	-0.5483	0.3075
RH %					1.0000	-0.1100
WS (m/s)						1.0000

Ionic Profile of Ambient Air RSPM at Agra

Central Pollution Control Board Project Office – Agra carried out the study on fate of cations and anions in RSPM (PM10) samples and estimation of factor Q (= total equivalent cations / total equivalent anions), as a part of the aerosol profile study of particulates at four monitoring locations at Agra,. The ionic profile and factor Q of some PM10 samples is presented below. It may be seen that among four locations Tajmahal has the highest range of Q. The least Q range is found at Nunhai industrial area site.

Ambient Air Quality in Taj-Trapezium Zone

Taj-Trapezium Zone is one of the air pollution sensitive zones in the country. In order to gather Ambient Air Quality data for the entire Trapezium area, CPCB Project Office, Agra, has carried out the Ambient Air Quality at four districts viz. Agra, Mathura, Firozabad (all in UP) and Bharatpur (Rajasthan). The monitoring has been carried out in winter months for 3 most primary criteria pollutants (viz. SPM, SO_2 and NO_2). In addition, Toluene Soluble Organic Fraction in SPM at above locations were also measured to assess the anthropogenic origin of organic fraction particulates in the SPM. The data for these locations are tabulated below:

The data on organic fraction in ambient air reveal that anthropogenic sources are maximum at Agra Nunhai Industrial Area, Agra, followed by Firozabad (maximum industrial contribution coal use area). The Ambient Air at Mathura city had the least concentration of organic fraction.

Table 2.8.3 Ionic profile and Q for Ambient Air PM10 Samples at Agra

Location	F-	Cl-	NO2-	NO3-	PO4---	SO4--	Na+	NH4+	K+	Ca++	Mg++	NF
Tajmahal	0.00	2.90	0.00	1.16	0.00	7.21	9.90	0.10	2.94	5.65	0.78	3.42
	0.00	6.47	0.00	9.33	0.00	13.30	9.48	0.47	4.32	12.96	2.40	2.29
	0.00	3.03	0.00	1.11	0.00	6.44	9.95	0.64	3.19	4.37	0.52	3.42
Itmad ud daulah	0.40	4.87	0.17	7.71	0.04	10.30	9.13	0.55	3.20	9.56	2.02	2.30
	0.45	7.62	0.05	6.22	0.00	14.08	4.16	0.29	2.94	12.62	3.19	1.84
	0.38	4.27	0.17	7.63	0.00	12.28	9.70	0.86	4.17	10.32	2.35	2.46
Rambagh	0.33	6.13	0.12	9.41	0.05	12.33	11.42	0.82	4.52	11.14	2.45	2.35
	0.26	3.92	0.07	4.43	0.00	9.62	10.70	0.62	3.10	9.45	2.57	3.18
	0.27	6.91	0.13	8.14	0.04	11.02	14.09	0.80	5.25	8.09	1.96	2.36
Nunhai	0.31	4.19	0.08	5.47	0.00	11.76	6.94	1.18	3.87	8.24	1.19	2.08
	1.05	8.24	0.11	7.01	0.00	13.66	9.63	1.00	5.56	13.05	2.08	2.09
	0.00	6.21	0.07	5.86	19.29	17.31	7.55	1.82	4.73	5.17	0.79	0.70

All the values of concentration are in μg/m3 NF: Neutralization

Table 2.8.4 Ambient Air Quality in Taj-Trapezium Zone

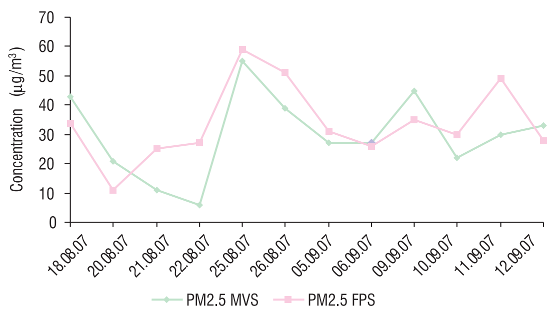
City		Mathura			Agra				Firozabad	
Parameters	Krishna Nagar (R)	Industrial Area, Site-A (I)	Janam Sthan (S)	Itmad-ud-Daulah (S)	Nunhai (I)	Tajmahal (S)	Rambagh (O)	Mahavir Nagar (R)	Industrial Area (I)	Coal Sites (I)
SPM	720	862	510	514	814	463	597	971	936	776
SO2	26	51	13	17	BDL	34	8	10	29	83
NO2	44	35	34	46	51	51	25	47	81	56
TSOF in SPM	18	9	27	31	70	24	27	23	36	68

All the values are in mg/m3 of Ambient Air, R: Residential, S: Sensitive, I: Industrial

Comparative Study of PM2.5 at Tajmahal

The comparative study has been carried out between two methods of sampling/measurement of fine particulate matter (PM2.5) namely by gravimetric measurement using Indigenous Fine Particulate Matter Sampler (FPM) at a flow rate 1.0 m3/hr and by Leckel-German make Low Volume Sampler (MVS) at a flow rate 2.3 m3/hr. Results are graphically presented below. Significant correlation (0.66) between two methods has been observed. Seasonal trends of PM2.5 are also presented. Maximum value was observed during December (246 $\mu g/m^3$) and minimum during July (25 $\mu g/m^3$) i.e. during monsoon.

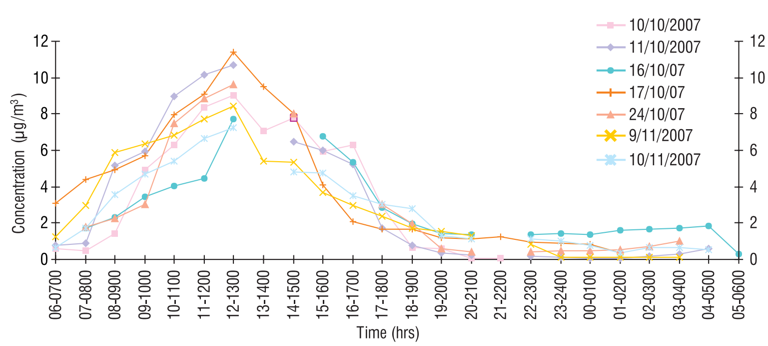
Figure 2.8b Comparison of $PM_{2.5}$ concentrations using MVS & FPS



Ambient Air Ozone Profile at Tajmahal

With the increase in the use of compressed natural gas (CNG) in recent times in metro cities including Agra, it has been observed that the NOx formation in the ambient air is also increasing. NOx in the presence of sunlight triggers formation of ozone in ambient air. The diurnal variations in ozone concentration at Tajmahal for the month of October 2007 are graphically presented. The maximum concentration (11$\mu g/m^3$) was noted between 1200-1300 hours while least during night hours.

Figure 2.8c Representation of hourly ozone concentration at Tajmahal, Agra



2.9 Ambient Noise and Air Pollution Status during Deepawali

Deepawali a festival of light is also celebrated as a festival of fire crackers, which generates lot of noise, toxic gases, dust and solid waste affecting adversely the public in general and asthmatic patients in particular. In view of this, CPCB has undertaken studies on status of ambient noise and air pollution status at various important cities of country. The findings reported ahead.

No significant change observed in the RSPM levels on pre-Deepavali and Deepavali in Vadodara

• Lucknow:

Ambient air and noise pollution monitoring was undertaken before, during and after the Deepawali festival at Lucknow. The Ambient Noise level (Leq) varied between 50.7 dB (A) - 92.5 dB (A). Location-wise, highest Leq value was recorded at Indira Nagar [92.5 dB (A)] followed by Nishatganj [90.1 dB (A)], Mahanagar [82.25 dB (A)], Aliganj [80.8 dB (A)] and Gomti Nagar [79.6 dB (A)]. The noise level increase was recorded between 9 and 12 PM.

Average SO_2, NOx and RSPM concentration observed on the festival day ranged between 7 - 8.8 µg/m^3; 42 -64.8 µg/m^3 and 261 - 264 µg/m^3 respectively.

Figure 2.9a Graphical Presentation of Noise level at Gomti Nagar, Lucknow

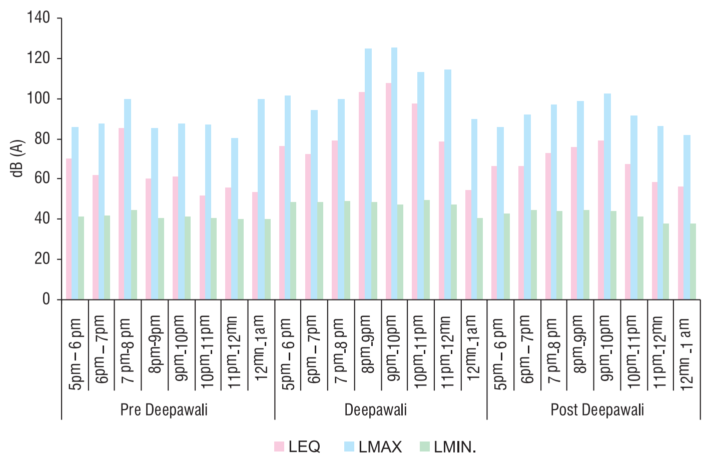
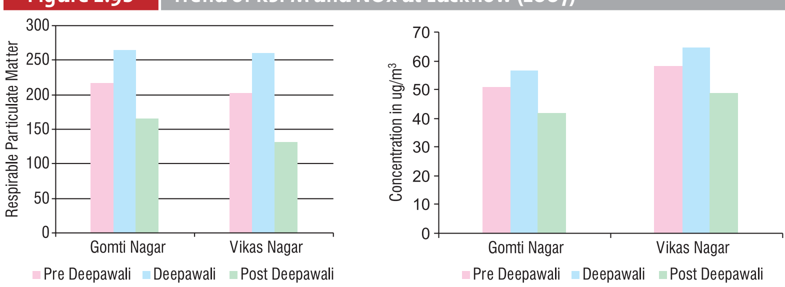


Figure 2.9b Trend of RSPM and NOx at Lucknow (2007)



• Bangalore

The CPCB Zonal Office, Bangalore carried out ambient noise and ambient air quality monitoring at various locations at Bangalore city during 6-10 November 2007. The data obtained during monitoring revealed that the average Leq noise level were exceeding the day time standard limit. The RSPM was also exceeding the standard limit of 100 µg/m³. However, the level of SO_2 was well within the standard while the NOx was found exceeding at few places

Figure 2.9c Ambient Air Quality Status at Bangalore during Deepawali 2007

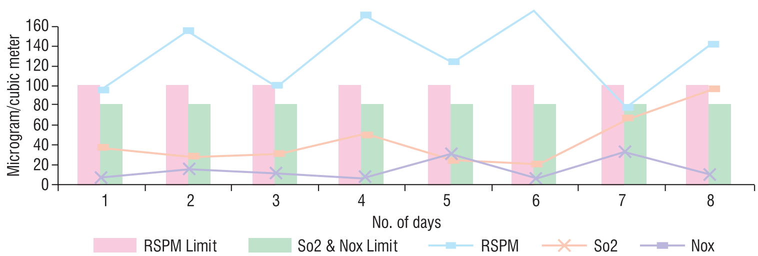
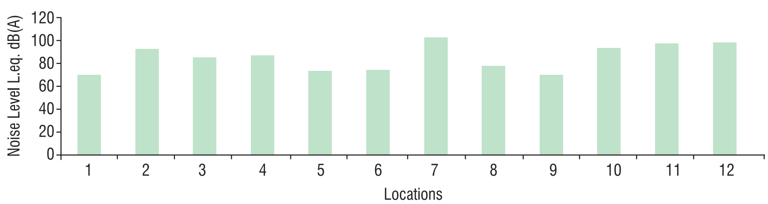


Figure 2.9d Area wise Average Ambient Noise Level Status at all monitored places in Bangalore during Deepawali festival-2007



• Vadodara

The ambient air quality monitoring was undertaken at two locations at Vadodara during Deepawali festival. The results reveal that the SPM values found have exceeded the prescribed ambient air quality standards some time during the monitoring. The range of SO_2 values measured during Deepawali festival was 2.1 µg/m³ to 52.6 µg/m³. The NOx values ranged between 11.7 – 53.6 µg/m³ and 8.4 – 39.4 µg/m³ during pre-Deepawali and Deepawali festival, respectively.

Following inferences may be drawn from the monitoring results during pre-Deepavali and Deepavali festival:

- The rise in concentration of SO_2 has been observed during Deepawali festival. However, the concentrations values were well within the Ambient Air Quality Standard (AAQS) i.e. 80 µg/m³.
- Decrease in concentration of TSPM and NOx was observed, which may be due to less vehicular movement because of holiday. However, the TSPM results were found higher than the AAQSi. e. 200 µg/m³.
- No significant change was observed in the RSPM levels on pre-Deepavali and on Deepavali except at Harinagar monitoring location where 480 µg/m³ between 2 AM and 6 AM on Deepawali.

Figure 2.9e Ambient Air Quality at Vadodara during Pre - Deepawali Festival

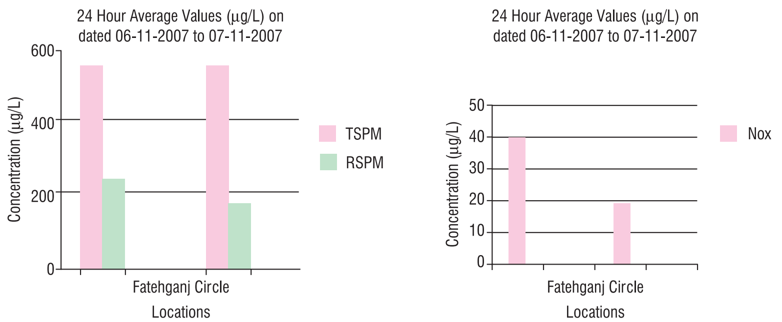
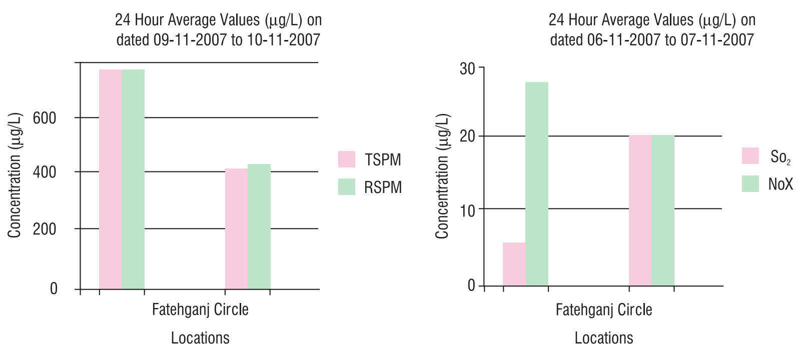


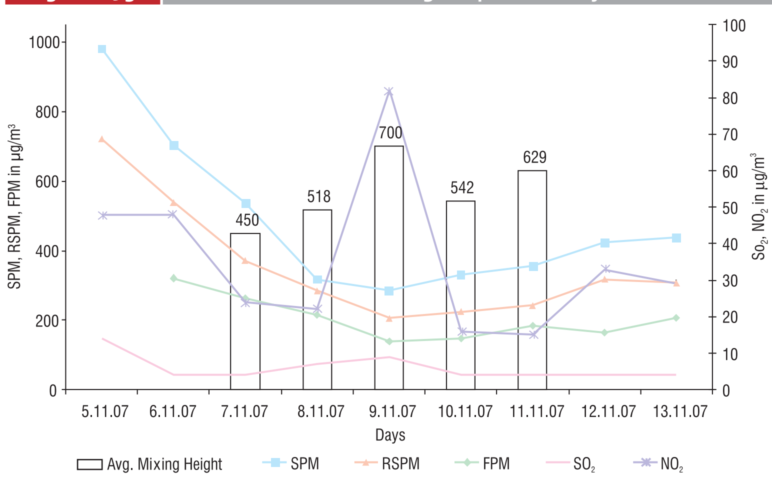
Figure 2.9f Ambient Air Quality at Vadodara during Deepawali Festival



• Agra

Monitoring of ambient air quality during Deepawali Festival during November 2007 at Agra (Tajmahal) was carried out. The general profile of SPM, RSPM, FPM, NO_2 and SO_2 and the average mixing and inversion height (m) during pre-Deepawali (November 7-8), Deepawali (November 09) and post Deepawali (November 10-11) are presented below.

Figure 2.9g Particulate Matters During Deepawali at Tajmahal



• Delhi

Ambient air quality has been measured during Deepawali for the past many years. Ambient air quality data during Deepawali in years 2006 and 2007 is presented in table ahead.

Sulphur dioxide and nitrogen dioxide levels at most of the locations were found within the prescribed AAQS whereas SPM and RSPM exceeded the AAQS.

Table 2.9 **Ambient Air Quality in Delhi during Deepawali during 2006-2007 (All Values are in microgram per cubic metre)**

Parameter Year	SO_2		NO_2		SPM		RSPM	
	2006	2007	2006	2007	2006	2007	2006	2007
B.S.Z Marg (ITO)	10	27	51	83	489	842	304	670
Pitampura (R)	27	72	42	64	687	1463	388	1294
Sirifort (R)	16	8	41	45	519	1314	440	1139
Janakpuri (R)	31	113	45	91	704	1198	426	1068
Nizamuddin (R)	19	30	54	61	485	1236	265	1012
Shahazada Bagh (I)	26	46	53	64	586	1324	300	966
Shahdara (I)	45	45	37	53	625	904	395	610

Monitoring of VOCs in Ambient Air during Deepawali Festival in Delhi

The CPCB has carried out a monitoring of Volatile Organic Compounds (VOCs) in the Deepawali period including Pre & Post during November 8-10, 2007. VOC monitoring was conducted at three selected locations from 16.00 to 24.00 hrs on Pre and Post Deepawali day and two rounds of 4 hourly sampling have been done on the Deepawali day.

Toluene concentrations were observed moderately high on the day of Deepawali at all the three locations at East Arjun Nagar (East Delhi), Pitampura (North-West Delhi) & ITO (B.S. Z. Marg, Central Delhi) i.e. 140.44 µg/m3 143.40 µg/m3 and 165.98 µg/m3 respectively between 20.00 to 24.00 hrs whereas Benzene was found only moderately high on the Deepawali day at Pitampura & ITO in the range of 70 µg/m3 during normal days.

• Bhopal

The CPCB Zonal Office, Bhopal has undertaken ambient air quality and noise monitoring at Bhopal on the occasion of Diwali festival, 2007. Ambient air quality was monitored on October 04-05, 2007 as pre-Diwali observations during normal days at six locations, four in residential and other two commercial. The same locations and one more industrial location were again monitored on the festival day i.e. November 08-10, 2007 for SPM, RSPM, SO2 and NOx parameters.

The Ambient noise level monitoring was carried out for short duration at 18 locations in Bhopal during Pre-Diwali period in October and on the festival day in November 2007. The ambient air quality and the noise levels are presented ahead.

Figure 2.9h Ambient Air Quality at Bhopal during Deepawali festival

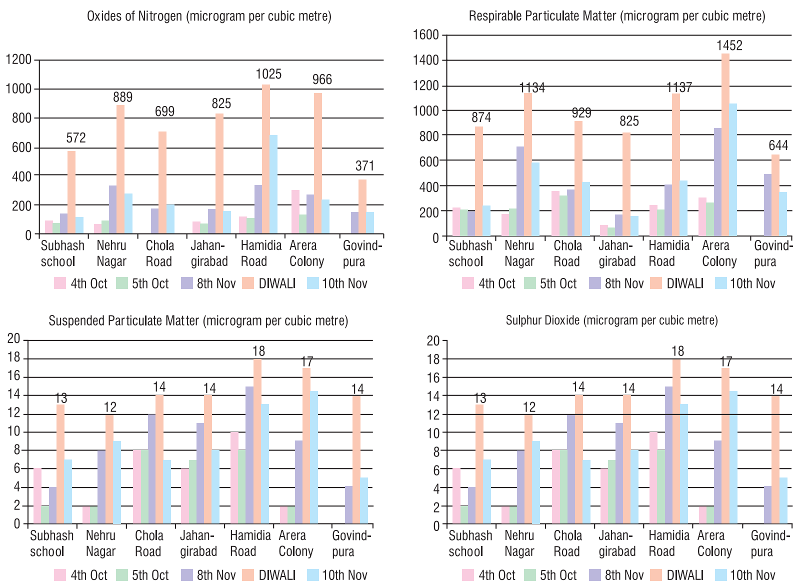
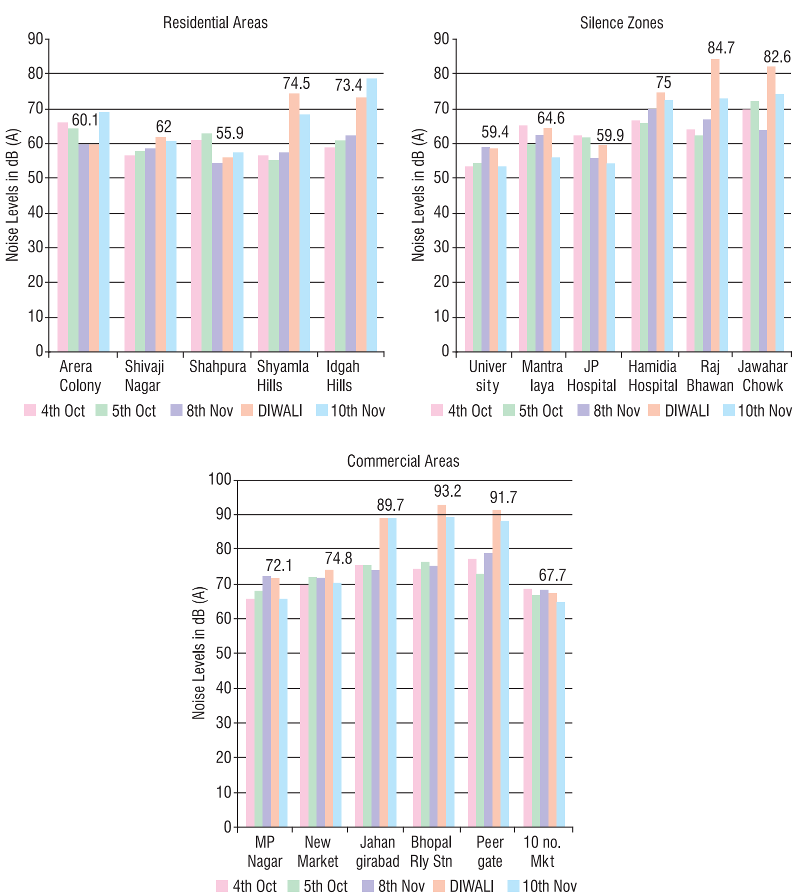


Figure 2.9i Noise Levels in Bhopal City



2.10 Ambient Air Quality Monitoring during Navaratri Festival at Vadodara

Navaratri festival is being celebrated traditionally during all 9 nights of the Navaratri (Dussera) festival. These celebrations attracts huge public gathering at the venues, which in turn contributes noise as well as ambient air pollution. In order to assess the pollution load with respect to ambient

Figure 2.10a Ambient Air Quality during pre - Navaratri Festival

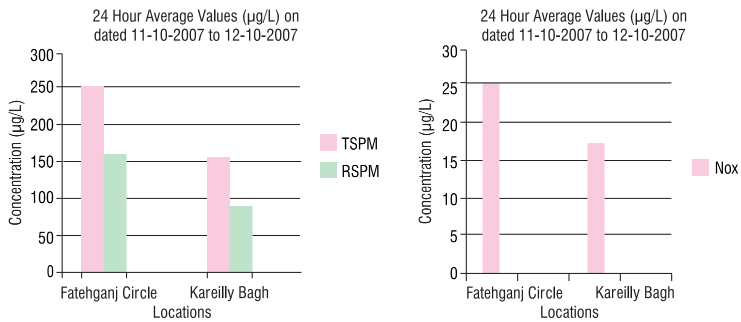
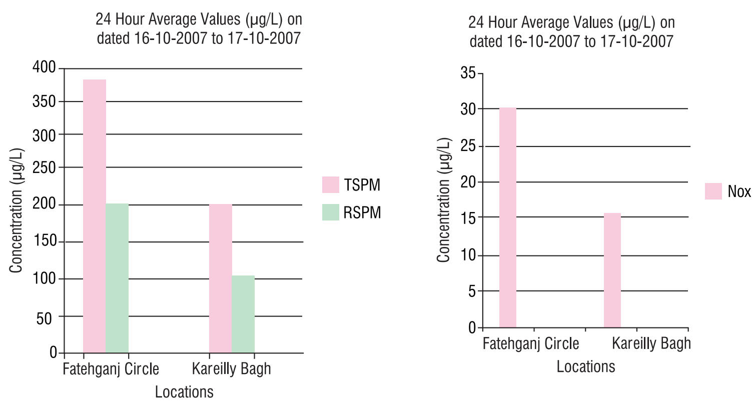


Figure 2.10b Ambient Air Quality on Navaratri Festival



air and noise. CPCB has carried out monitoring for ambient air quality and noise pollution survey at 7 prominent Navaratri garba locations at Vadodara. The results of ambient air and noise levels are exceeding the prescribed limits due to heavy vehicular movement and noise due to public audio systems used at Garba Venues.

The ambient air quality monitoring has been undertaken by CPCB during Navaratri festival at Vadodara. The results reveal that the RSPM, SPM values found exceeding the prescribed ambient air quality standards occasionally during the monitoring. The SO_2 values were measured BDL most of the time. The NOx values have ranged between 7 – 36 µg/m^3.

2.11 Surveillance of Air Quality Monitoring Stations and associated Laboratory Facilities under NAMP

West Zone: There are 19 air quality stations under NAMP located in various cities/towns of Gujarat for the monitoring of ambient air quality. The monitoring is being undertaken by NETEL on behalf of Gujarat Environmental Management Institute (GEMI) / GPCB. The West Zone Office has visited 16 Nos. of NAMP stations in Gujarat. In Maharashtra, 42 NAMP stations are located, out of which 07 stations have been inspected during the year. In Maharashtra, the NAMP stations are being operated by various institutes, universities and MSPCB offices.

It was observed during the inspections that the operating agencies were following the method of sampling, analysis and the data reporting is as per guidelines prescribed by CPCB

Central Zone: The Central Zonal Office visited 21 NAMP stations and the related laboratory facilities at SPCB's regional offices of Jaipur, Bhopal, Indore, Nagda and Korba during the year. The SPCBs have been informed about the observations for necessary compliance.

2.12 Atmospheric Mixing Depth Observations in Delhi through SODAR System

A Sound Detection and Ranging (SODAR) system is in continuous operation to collect mixing height data at CPCB premises. Most occurring period of free convection, average mixing height in the period of free convection, average mixing height in period of without free convection, monthly average mixing height, maximum mixing height and minimum mixing height of different months during the year 2007 are presented ahead.

Monthly average mixing height was observed minimum in the month of November. The diurnal variation of mean mixing height of the month, diurnal variation of mixing height on days November 17 and 21 which are having higher daily averages and diurnal variation of mixing height on days November 6 and November 23 which are having lower daily averages are graphically presented.

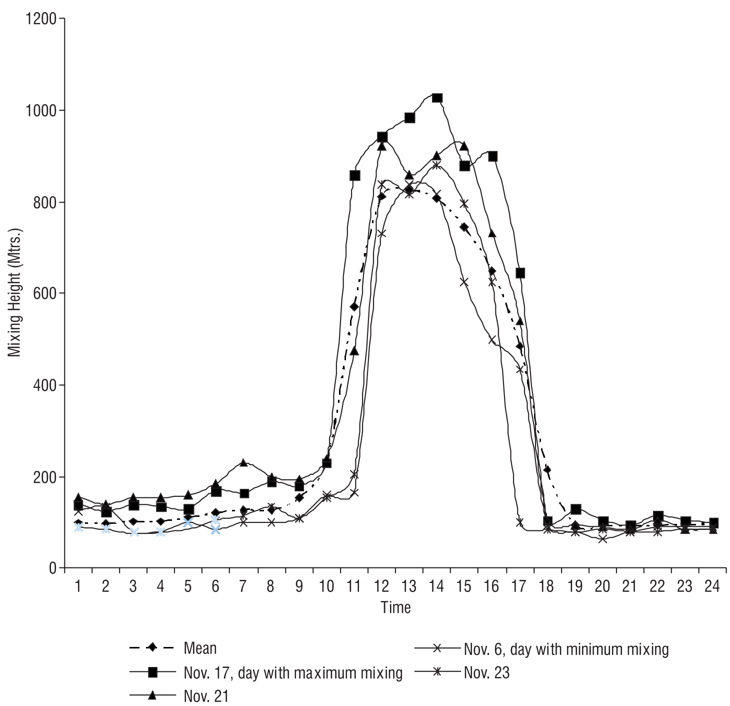
2.13 Continuous Ambient Air Quality in Delhi

Ambient air quality monitoring using automatic analysers is being conducted continuously at three fixed stations in Delhi in addition to six other monitoring stations that are operated manually. The air quality data of these three fixed automatic stations is updated at 15 minutes interval at CPCB website for public awareness. A summary of monitoring results at the three automatic stations of 2007 is presented ahead.

Table 2.12	Period of free convection, Average of Mixing Heights, Maximum and Minimum Mixing Heights (in Metres) in Delhi in 2007					
Month	Mostly occurring period of free convection during the month	Minimum Mixing Height*	Maximum Mixing Height*	Monthly Average Mixing	Average Mixing Height in the period of free Height convection	Average Mixing Height in the period without free convection
Jan, 07	10 am to 04 pm or 05 p.m.	80	1070	310	741	137
Feb, 07	Between 08 am and 11 am to 06 pm	80	1240	377	791	138
Mar, 07	08 am or 09 am to 06 pm	80	1007	352	699	152
Apr, 07	09 am to 06 pm	85	1028	396	776	177
May, 07	08 am to 06 pm	90	943	413	753	162
Jun, 07	07 am or 08 am to 06 pm or 07 pm	90	1282	431	759	160
Jul, 07	07 am or 09 am to 06 pm or 07 pm	80	1282	**	761	117
Aug, 07	Between 07 am and 09 am to 06 pm or 07 pm	80	1113	416	752	118
Sep, 07	07 am or 08 am to 06 pm or 07 pm	65	1007	390	722	107
Oct, 07	08 am or 09 am to 05 pm or 06 pm	70	1007	336	701	122
Nov, 07	10 am to 05 pm	65	1028	289	717	111
Dec, 07	10 a.m to 05 pm	65	964	309	727	142

* hourly averages ; **Due to inadequate no. of daily averages monthly average for July, 2007 is not given.

Figure 2.12 Time based mixing height during November 2007



2.14 Portable Air Quality Monitoring Station

CPCB has procured a portable ambient air quality monitoring station from Germany through GTZ–ASEM during January 2007. The station has been designed keeping in view the Indian climatic condition. The station has been kept on trailer that can be transported to any place with the help of light vehicle. The station has the facility to monitor the parameters - dust (PM_{10}, $PM_{2.5}$ and PM_1), ozone (O_3), sulphur dioxide (SO_2), oxides of nitrogen (NOx), carbon monoxide (CO) and temperature. The station has been kept on testing and the problems faced during the initial period have been rectified. The station is in working condition and proposed to be used for field monitorings.

Average concentration of Sulphur Dioxide was found within prescribed limit at all the locations in Delhi

2.15 Ambient Air and Noise Monitoring under W.P. (C) 17855/2005 of Hon'ble Delhi High Court

The CPCB has been monitoring the ambient air quality of Delhi at Nizamuddin, Janakpuri, Shahdara, Shahzada Bagh, Pitam Pura, Town Hall, Sarojini Nagar and Mayapuri under NAMP. Additionally, continuous monitoring is being conducted at three locations, namely Sirifort, B. S. Z. Marg (ITO Intersection) and Delhi College of Engineering (DCE) using automatic analysers. Hon'ble Delhi High court after hearing the Writ Petition (C) 17855 / 2005 on January 15, 2007 directed CPCB to conduct ambient air quality and noise monitoring at ISBT, Connaught Place, Karol Bagh, Dwarka, South Extention and other areas of Delhi and submit the report. Therefore, CPCB conducted ambient air quality monitoring at the desired locations between January 19 and 25, 2007. The following findings have been reported :

Findings

- 24 Hours average concentration of Sulphur Dioxide (SO_2) was found within prescribed limit at all the locations.
- 24 Hours average concentration of Nitrogen Dioxide (NO_2) was found within prescribed limit at all the locations except at South Extension.
- 8 Hours average concentration of Carbon Monoxide (CO) was exceeding the limit only in evening (2nd shift) at Connaught Place and South Extension due to high movement of vehicular traffic.
- 24 Hours average concentration of Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (PM10) was found above the prescribed limits at all the locations.
- The daytime and nighttime Leq values of ambient noise were found above the prescribed limits at all the locations.

Table 2.13.1 Monthly Averages of NO, NO2, NOX, SO2, CO, O3 and RSPM at ITO, Sir Fort and DCE during 2007

Parameter	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann. Avg
NO_2	ITO	161	146	126	132	167	74	77	53	77	177	208	123	126
(µg/m³)	SIRI	121	87	84	110	61	44	39	38	51	175	265	126	98
	DCE	39	39	43	55	50	20	18	20	21	31	39	21	33
SO_2	ITO	28	26	27	37	32	18	9	8	13	22	31	27	23
(µg/m3)	SIRI	16	10	8	15	14	5	7	6	8	16	15	11	11
	DCE	3	2	4	9	9	13	15	14	15	41	21	7	13
CO	ITO	3099	2729	1907	2310	2330	1688	1834	1773	1750	2719	4531	2767	2469
(µg/m³)	SIRI	1776	1879	1000	1581	1265	1045	956	946	995	1934	2945	1770	1475
	DCE	1646	1386	1267	1285	1443	1347	1200	1344	669	912	1548	1013	1250
O_3	ITO	21	27	62	40	39	26	28	26	24	35	26	19	31
(µg/m³)	SIRI	26	79	49	53	57	54	39	47	44	36	24	45	46
	DCE	62	59	49	64	128	105	57	62	59	81	52	79	71
$PM_{2.5}$ (µg/m³)	ITO	222	138	80	102	73	63	45	34	47	158	-	189	102
PM_{10} (µg/m³)	DCE	-	230	-	344	225	164	102	99	106	284	385	372	231

Table 2.13.2 Annual Averages of SO2, NO2 CO, Ozone and Particulate Matter at DCE, ITO and Siri Fort during year 2006 and 2007

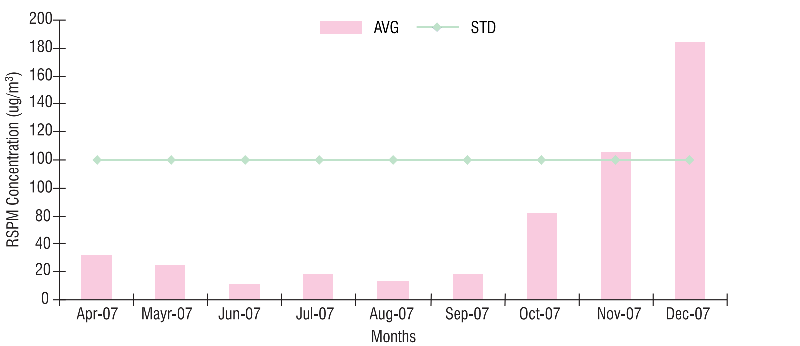
Parameter	DCE 2006	2007	ITO 2006	2007	SIRIFORT 2006	2007
SO_2 µg/m³	22	13	42	23	09	11
NO_2 µg/m³	40	33	143	126	49	98
CO µg/m³	1800	1250	2542	2469	-	1475
O3 µg/m3	132	71	23	31	37	46

2.16 Ambient Air Quality Monitoring at Port Canning (Male Declaration)

The CPCB has been operating an ambient air quality-monitoring station at Port Canning, West Bengal bordering Bangladesh for the study of transboundary movement of pollutants. Besides, water quality of the adjacent water bodies such as ponds and rivers, as well the quality of sediment and soil were also monitored. Ambient air sampling was undertaken at eight hourly intervals in a day for at least ten days in a month. Water and sediment samples were collected once in a year.

RSPM concentration was observed highest in November (106 µg/m^3) and December (184 µg/m^3), which exceeds the permissible limit of 100 µg/m^3. RSPM has been found within permissible limits during April to September, while it exceeded the permissible limits by 27.3% to 92.8% during October to December with highest frequency in December. Concentrations of SO_2 and NO_2 level were always below the permissible limit. But slight variation among the values of NO_2 of different months with slight increase in level during winter was observed. Apart from the Ambient Air Monitoring, analysis of the rainwater is a routine practice. Rainwater pH has been observed ranging between 5.2 and 6.2.

Figure 2.16 Monthly Average RSPM at Canning



2.17 Project to Set-up Continuous Air Quality Monitoring (CAAQM) Stations in 16 Cities

Hon'ble Supreme Court of India has identified the following sixteen cities, where air pollution is high and asked respective State Govts. / SPCBs to prepare action plan to control air pollution.

In view of the above, CPCB had resolved to set up Continuous Air Quality Monitoring Stations (one each) in 16 cities to see the impact of implementation of Action Plan on Air Quality.

In the above 16 proposed stations, parameters like Carbon Monoxide, Sulphur Dioxide, Oxides of Nitrogen, Benzene, Toluene & Xylene, Ozone, Particulate Matters (TSP & PM10) and Meteorological Parameters will be monitored continuously.

The Capital cost of each station (i.e. Rs. 80.00 Lacs) will be borne between CPCB and the concerned SPCB on 50:50 basis. The annual Operation & Maintenance cost of each station (Rs. 10.00 Lacs) will be

The Capital cost of each Continuous Air Quality Monitoring Station (i.e. Rs. 80.00 Lacs) will be borne between CPCB and the concerned SPCB on 50:50 basis

borne by the respective SPCBs and the networking cost of all the 16 stations will be borne by CPCB. A sum of Rs. 40.00 Lacs per station was released towards CPCB share for Mumbai, Hyderabad, Faridabad and Bangalore during the financial year 2003–04, for Chennai and Ahmedabad during 2004–05, for Jodhpur, Patna, Pune, Solapur, Kanpur and Varanasi during 2005–06, for Agra and Rs. 27.5 Lacs for Kolkata during 2006–07 and for Jharia during 2007-08.

2.18 New Continuous Air Quality Monitoring Stations in Delhi, Bangalore, Chennai, and Lucknow

CPCB, is operating four continuous automatic ambient air quality-monitoring stations in Delhi (three fixed at Siri Fort, Campus of Delhi College of Engineering (DCE) and ITO and one mobile at East Arjun Nagar). The live data of these stations are automatically uploaded on CPCB's website at the frequency of fifteen minutes. The stations are regularly visited for routine maintenance and calibration. The reviews related to the quality of the data of continuous automatic ambient air quality monitoring stations are done twice a week.

Three more stations are being set up in Delhi under operational contract. The supply order for these stations (and also for three each in Bangalore, Chennai, and Lucknow) has already been placed and the sites for the three stations to be installed in Delhi have been selected.

2.19 Continuous Ambient Air Quality Monitoring in South Zone

There are 43 Continuous Ambient Air Quality Monitoring Stations (CAAQMS) identified in southern zone which are established by State/ Central PCBs and industries. Most of the monitoring stations are equipped with NO, NO2, NOx, SO2, CO, PM10/SPM and at few monitoring stations O3, Total HC, and meteorological parameters also.

To ensure the consistency in monitoring and to evaluate positive and negative features of the available alternate technologies in continuous monitoring, South Zonal Office has taken up the project for assessment of the CAAQMS. Accordingly, 19 CAAQMS were inspected throughout the region in 2007. The observations are :

- The monitoring stations are not having full-fledged calibration facility
- Many operators expressed the difficulties to get the spare parts in time
- The operators need to be trained and require to be educated regarding air quality importance and its compliance standards
- The management needs to pay direct supervision to ensure operation and improve the quality of data generated.
- The monitoring station operated by APPCB at Hyderabad and Vizak steel plant are well maintained
- The three monitoring stations operated by M/s. HPCL Vizak needs improvement in providing proper maintenance and facility for calibration
- The monitoring stations operated by M/s. FACT need proper uploading of data and storage

2.20 Air Quality Assessment, Emission Inventory & Source Apportionment Studies

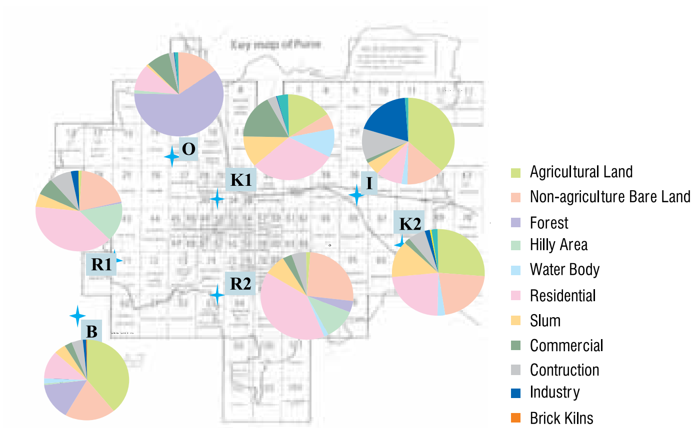
Air quality assessment, emission inventory and source apportionment studies are being carried out in six major cities viz. Delhi, Mumbai, Chennai, Bangalore, Pune and Kanpur. Outcome of the study would result in formulation of a cost-effective approach and action plan for improving air quality in these cities. Besides, this would also provide a better scientific approach for dealing with the air quality management issues in other cities.

Study comprises of following five major components viz. (i) air quality measurements including detailed chemical characterization of fine particulates (PM10 & PM2.5), (ii) emission inventory (based on primary data collection), (iii) application of CMB 8 receptor model (to assess contribution of different sources in ambient air quality), (iv) application of dispersion model (to get air quality profile & evaluate impact of various control options and (v) formulation of action plans and control strategies based on findings of the study.

Documents on 'Conceptual guidelines and common methodology for air quality monitoring, emission inventory & source apportionment studies for Indian cities' and 'Model standard operating procedures (SOPs) for sampling and analysis' had already been finalized and posted on CPCB's website (http://www.cpcb.nic.in). Besides, emission factors for vehicular emissions have been finalized, which are also posted on CPCB's website.

Air quality monitoring is being carried out at 7 to 10 locations along with capturing spatial data. State of the art equipment like Speciation Samplers (for PM10) and FRM Samplers (for PM2.5) are being used. Primary surveys are done around monitoring locations to collect data on activity profiles/land use for preparing emission inventory. The land use for the city of Pune is presented below as an example.

Development of source emission profiles for vehicular as well as non-vehicular sources (about 50 source categories) and emission inventory are near completion



Air Quality Monitoring at Background location in Pune

Air Quality Monitoring at Residential location in Kanpur

Emission factors for vehicular and non-vehicular sources have been finalized. Development of source emission profiles for vehicular as well as non-vehicular sources (about 50 source categories) and emission inventory are at advance stage of completion. Air quality measurements for all the three seasons will be completed soon. Detailed chemical analysis is under progress. The monitoring data for the first season (summer) for the cities of Chennai, Bangalore and Kanpur are presented below:

Figure 2.20a Ambient Particulate matter concentration in Chennai

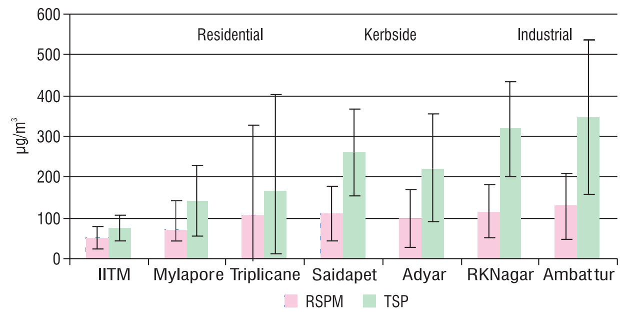


Figure 2.20b Ambient Air NO_2 concentration in Chennai

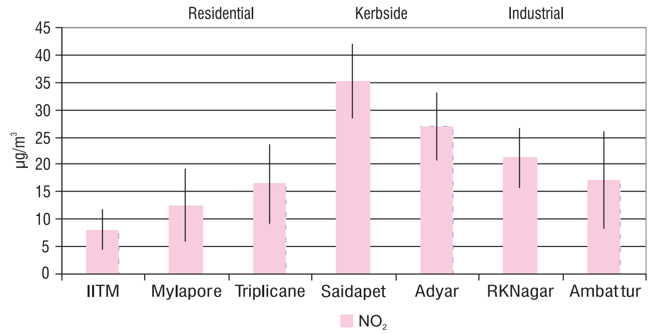


Figure 2.20c Ambient Air PM_{10} concentration in Kanpur

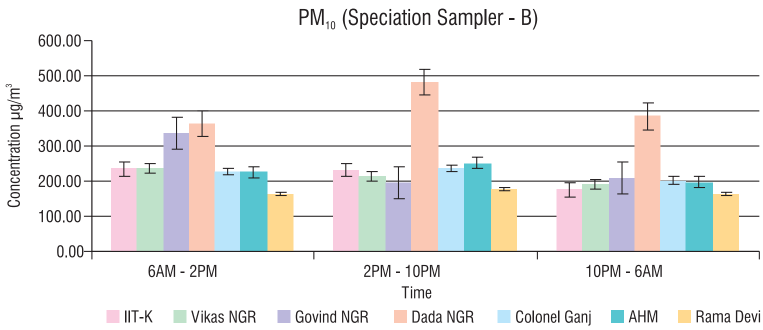


Figure 2.20d Ambient Air $PM_{2.5}$ concentration at Kanpur

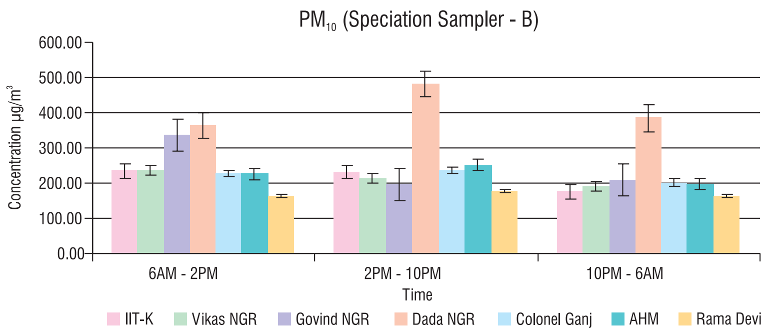


Figure 2.20e Ambient Air NO_2 concentration at Kanpur

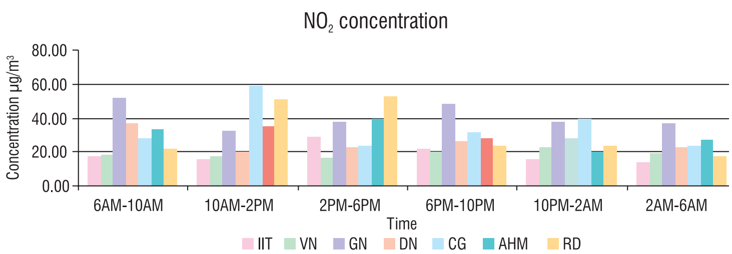


Figure 2.20f Ambient Air PM_{10} concentration at Bangalore

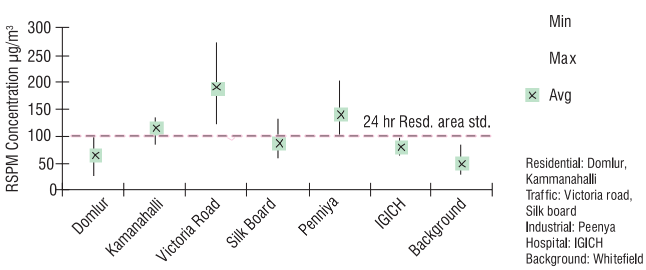
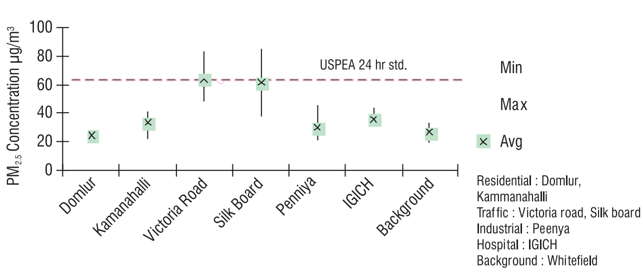


Figure 2.20g Ambient Air RSPM concentration at Bangalore



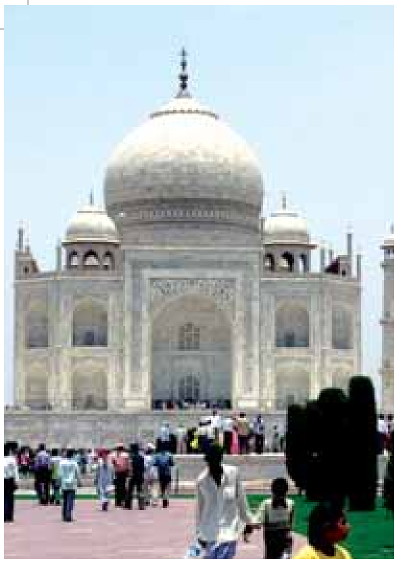
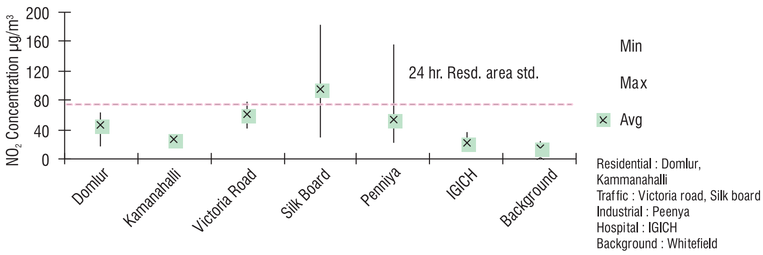


Figure 2.20h Ambient Air NO_2 concentration at Bangalore



Primary surveys are done around monitoring locations to collect data on activity profiles/land use for preparing emission inventory. The land use for the city of Pune is presented below as an example.

Emission factors for vehicular and non-vehicular sources have been finalized. Development of source emission profiles for vehicular as well as non-vehicular sources (about 50 source categories) and emission inventory are at advance stage of completion. Air quality measurements for all the three seasons will be completed soon. Detailed chemical analysis is under progress. The monitoring data for the first season (summer) for the cities of Chennai, Bangalore and Kanpur are presented below:

The study is being monitored by the Steering Committee and the Technical Committees, headed by the Secretary, MoEF and Chairman, CPCB respectively. It is expected that the studies would be completed by June 2008.

Toluene Soluble Organic Fraction in PM10 at Agra

Toluene Soluble Organic Fraction (largely corresponds to the organic content in the air, contributed mostly by anthropogenic activities) in the ambient air particulate matter at Agra was investigated. The quarterly data (carried out in January, April, July and October) is presented below. The highest concentration of PM10 in winter months and the least during rainy month.

Table 2.19	Toluene Soluble Organic Fraction in PM10, Agra (All values are in µg/m3)				
Location	Week	Taj-mahal	Itmad-ud-Daulah	Rambagh	Nunhai
January, 07	Week I	8	44	4	22
	Week II	32	20	16	11
	Week III	11	41	27	31
	Week IV	8	16	16	25
April, 07	Week I	9	-	20	4
	Week II	14	11	13	-
	Week III	5	12	-	16
	Week IV	10	13	10	16
July, 07	Week I	6	11	9	12
	Week II	3	3	11	12
	Week III	13	4	6	16
	Week IV	13	3	10	18
October, 07	Week I	15	16	20	39
	Week II	13	39	18	-
	Week III	10	15	12	42
	Week IV	21	48	40	47
Data Range	16 samples	3-32	3-48	4-40	4-47
Average	16 samples	11.9	19.7	15.5	22.2

2.21 Review of Ambient Air Quality Criteria/Standards

The CPCB recognizing the need to review the air quality criteria/ standards took up this task in technical collaboration with Indian Institute of Technology (IIT), Kanpur. A steering committee comprising members from renowned academicians and research institutes, MoEF, Govt. of India and CPCB was constituted to deliberate, discuss and devise the revised standards. The committee has been overseeing the progress of the project on a continual basis and had six meetings during last three years.

Various aspects are being considered including general description of the pollutant, dose-response based health risk evaluation, current levels of the pollutants in the country, current standards, and the basis for new standards.

The primary criterion for suggesting the standard is human health, therefore, dose-response relationship developed/published in Indian studies have been taken as the main basis for development of standards. Besides, knowledge from other studies, including WHO guidelines have been thoroughly examined and used.

Draft standards have been put up on the CPCB's website (http://www.cpcb.nic.in) and have also been circulated to industrial associations, some NGOs and SPCBs for inviting comments.

Table 2.21 Proposed Ambient Air Quality Standards

Parameter, units	Averaging Time 1-hr	8-hr	24-hr	Annual	Analysis Method
Benzene (C6H6), µg/m3	-	-	15	5	• Online gas chromatography • Activated carbon/tenex adsorption and GC analysis
Carbon Monoxide (CO), µg/m3	4000	2000	-	-	Non Dispersive Infra Red (NDIR), spectroscopy
Formaldehyde (HCHO), µg/m3	80	45	-	-	Absorption in MBTH and spectrophotometer analysis
Polyaromatic Hydrocarbons (BaP) (particulate phase only), ng/m3	-	-	5	1	Solvent extraction followed by analysis on GC/HPLC/GCMS
Arsenic, ng/m3	-	-	20	6	AAS/ICP Method after sampling on EPM or equivalent Filter paper
Lead, µg/m3	-	-	1	0.5	
Mercury(1) (total), ng/m3	-	-	15	-	Particulate : same as for lead above
Particulate phase, ng/m3	-	-	3	-	Vapour - Activated carbon or gold coated sand adsorption
Vapour phase¸ ng/m3	-	-	12	-	followed by analysis on AAS/ICP
Nickel, ng/m3	-	-	25	-	AAS/ICP Method after sampling on EPM or equivalent Filter paper
Vanadium, ng/m3	-	-	200	-	
Nitrogen dioxide (NO2) General Area, µg/m3	200	-	80	40	• Jacob & Hochheiser Modified Method
Nitrogen dioxide (NO2) Sensitive Area(2), µg/m3	-	-	-	30 (3-months Average)	• Chemiluminescence
Ozone (O3), µg/m3	180	90	-	-	• UV Photometric technology • Chemiluminescence
Particulate matter (PM10), µg/m3	-	-	100	60	• Approved Particle size cutoff sampler • Gravimetric analysis
Particulate matter (PM2.5), µg/m3	-	-	60	40	
BSF/TSF (benzene/toluene soluble fraction), µg/m3	-	-	20	-	ASTM D4600-87,1990
Sulphur dioxide (SO2) General Area, µg/m3	260	-	80	50	• Improved West and Gaeke • Ultraviolet Fluorescence
Sulphur dioxide (SO2) Sensitive Area (2), µg/m3				20 (3-months Average)	
Ammonia (NH3), µg/m3	-	-	400	100	• Chemiluminescence • Indophenol- blue method

(1) Whenever measurement of vapour mercury cannot be done, standard for particulate mercury only is applicable
(2) For sensitive area, more stringent standards will be applicable for NO2 and SO2; standards for other parameters remain unchanged

Notes:
(a) Annual Arithmetic mean of minimum 104 measurements taken twice a week 24 hourly at a uniform interval should not exceed the annual standard.
(b) 1-hour/24-hourl/8-hourl values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.