AIR QUALITY ASSESSMENT

NATIONAL AIR QUALITY MONITORING PROGRAMME (NAMP)

Central Pollution Control Board initiated National Ambient Air Quality Monitoring (NAAQM) programme in the year 1984 with 7 stations at Agra and Anpara. Subsequently the programme was renamed as National Air Monitoring Programme (N.A.M.P.). The number of monitoring stations under N.A.M.P. has increased, steadily, to 313 by 2004-05 covering 113 cities/towns in 28 States and 4 Union Territories of the country.

Under N.A.M.P., four air pollutants *viz* ., Sulphur Dioxide (SO 2), Oxides of Nitrogen as NO 2 and Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM 10), have been identified for regular monitoring at all the locations. Besides this, additional parameters such as Respirable Lead and other toxic trace metals, Hydrogen Sulphide (H 2 S), Ammonia (NH 3) and Polycyclic Aromatic Hydrocarbons (PAHs) are also being monitored at selected locations. The monitoring of meteorological parameters such as wind speed and direction, relative humidity and temperature was also integrated with the monitoring of air quality. . The monitoring of pollutants is carried out 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 104 observations in a year. The monitoring is being carried out with the help of Central Pollution Control Board: ; State Pollution Control Boards :Pollution Control Committees:National Environmental Engineering Research Institute (NEERI), Nagpur: and other research institutions/universities etc. CPCB co-ordinates with these agencies to ensure the uniformity and consistency of air quality data and provides technical and financial support to them for operating the monitoring stations.

Air Quality Status and Trends

Sulphur dioxide (SO_2)

- Annual average concentration of SO 2 levels are within the prescribed National Ambient Air Quality Standards (NAAQS) at almost all the locations. A decreasing trend has been observed in sulphur dioxide levels in many cities
- There has been a change in domestic fuel use from coal to LPG. Also various measures have been taken such as reduction of sulphur in diesel that may have contributed to low levels of SO 2 .

Nitrogen dioxide (NO_2)

- Annual average concentration of NO 2 was also within NAAQS at most of the locations. Trend in annual average concentration of NO 2 is fluctuating in many cities
- The monitoring locations near traffic intersection show high levels of NO 2 . Vehicles are one of the major sources of NO 2 in the country.

Particulate Matter

- Annual average concentrations of RSPM and SPM exceeded the NAAQS in most of the cities. The trend in annual average concentration of RSPM is fluctuating in most of the cities.
- One of the major source of high RSPM levels is vehicles. The vehicle population is increasing exponentially in many cities. This is the single major factor responsible for high RSPM levels.
- The sources of SPM include, vehicles, natural dust, industries such as thermal power plants, sugar, cement etc., resuspension of dust, refuse burning etc.
- The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers and emission from power plants, resuspension of traffic dust, commercial and domestic use of fuels, etc.
- Lower levels of RSPM and SPM were observed during monsoon months possibly due to wet deposition. Higher levels of RSPM and SPM were observed during winter months possibly due to lower mixing heights and more calm conditions.
- One of the reason for low levels of pollution in coastal cities like Chennai is that it has excellent ventilation effects due to sea and land breezes which reduces pollution levels.

Non-attainment Cities

CPCB has identified list of polluted cities in which the prescribed National Ambient Air Quality Standards (NAAQS) are violated. These cities have been identified based on ambient air quality data obtained under National Air Quality Monitoring Programme (NAMP) for the period 1995 to 2003. The list of non-attainment cities state-wise is enclosed. Action plans are being formulated and implemented to control air pollution in non-attainment cities by respective states.

Strengthening of National Air Quality Monitoring Programme (NAMP)

Monitoring stations were sanctioned in cities like Khajuraho, Gwalior, Tirupati, Vijayawada, Asansol, Ranchi etc. State Pollution Control Boards were asked to monitor additional pollutants like carbon monoxide etc. near traffic intersections. Non-operational stations were made operational. Monitoring through automatic continuous analysers is also being initiated in many cities.

List of Non Attainment Cities in India

S. No.	State/Union Territory	City	Major Sources of Pollution	Air Pollutants of Concern
1	Andhra Pradesh	Hyderabad	Vehicles	RSPM, SPM
		Visakhapatnam	Vehicles, Industries	RSPM, SPM
2	Assam	Guwahati	Vehicles, Industries	RSPM, SPM
3	Bihar	Patna	Vehicles, Natural Dust	RSPM, SPM
4	Chandigarh	Chandigarh	Vehicles, Industries	RSPM, SPM
5	Chattisgarh	Bhilai	Industries	RSPM, SPM
		Korba	Industries	RSPM, SPM
		Raipur	Vehicles	RSPM, SPM
6	Delhi	Delhi	Vehicles	NO 2 , RSPM, SPM
7	Goa	Panaji	Industries, Vehicles	SPM
8	Gujarat	Ahemadabad	Vehicle, Industries	RSPM, SPM
		Ankleshwar	Industries	RSPM, SPM
		Jamnagar	Industries, Vehicles	RSPM, SPM
		Rajkot	Vehicles, Natural Dust	RSPM, SPM
		Surat	Industries, Vehicles	RSPM, SPM
		Vadodara	Vehicles, Industries	RSPM, SPM
		Vapi	Industries	RSPM, SPM
9	Haryana	Faridabad	Vehicles, Industries	SPM
		Yamuna Nagar	Industries, Vehicles	SPM
10	Himachal Pradesh	Damtal	Natural Dust	SPM
		Paonta Sahib	Natural Dust	SPM
		Parwanoo	Industries, Natural Dust	RSPM, SPM
		Shimla	Natural Dust	SPM
11	Jharkhand	Dhanbad	Industries	NO 2 , SPM
		Jamshedpur	Industries	NO 2 , SPM
		Jharia	Industries, Natural Dust	SPM
		Sindri	Industries, Natural Dust	SPM
12	Karnataka	Bangalore	Vehicle	RSPM, SPM
		Mysore	Vehicles	RSPM
13	Kerala	Kottayam	Vehicles	RSPM
		Kochi	Vehicles, Industries	RSPM, SPM
		Thiruvanan-thapuram	Vehicles	RSPM
		Kozhikode	Natural Dust	RSPM
14	Madhya Pradesh	Bhopal	Vehicle	RSPM, SPM

		Indore	Vehicles	RSPM, SPM
		Jabalpur	Vehicles	RSPM, SPM
		Nagda	Industries	SO 2 , RSPM, SPM
		Satna	Industries	RSPM, SPM
15	Maharashtra	Chandrapur	Industries	RSPM, SPM
		Mumbai	Vehicles, Industries	RSPM, SPM
		Pune	Vehicles,	NO 2 , RSPM, SPM
		Nagpur	Vehicles	RSPM, SPM
		Nashik	Vehicles	RSPM, SPM
		Solapur	Vehicles, Natural Dust	RSPM, SPM
16	Meghalaya	Shillong	Vehicles	RSPM
17	Orissa	Angul	Vehicles, Industries, Natural Dust	RSPM, SPM
		Rayagada	Industries	RSPM
		Rourkela	Industries	RSPM, SPM
		Talcher	Industries	RSPM
18	Punjab	Gobindgarh	Industries	RSPM, SPM
		Ludhiana	Vehicles, Industries	RSPM, SPM
		Jalandhar	Vehicles, Industries	RSPM, SPM
19	Rajasthan	Alwar	Vehicles, Natural Dust	NO 2 , RSPM, SPM
		Jaipur	Vehicles	RSPM, SPM
		Jodhpur	Natural Dust	RSPM, SPM
		Kota	Vehicles Industries	NO 2 , RSPM, SPM
		Udaipur	Vehicles, Natural Dust	NO 2 , RSPM, SPM
20	Tamil Nadu	Chennai	Vehicle, Industries	RSPM, SPM
		Madurai	Vehicles,	RSPM, SPM
		Coimbatore	Vehicles	RSPM, SPM
		Tuticorin	Vehicles	RSPM
21	Uttar Pradesh	Agra	Vehicle, Industries	RSPM, SPM
		Anpara	Industries	RSPM, SPM
		Kanpur	Vehicles, Industries	RSPM, SPM
		Lucknow	Vehicles,	RSPM, SPM
		Gajraula	Industries	RSPM, SPM
		Noida	Vehicles, Natural Dust, Industries	RSPM, SPM
		Varanasi	Vehicles, Natural Dust	RSPM, SPM
22	Uttaranchal	Dehradun	Vehicles, Natural Dust	RSPM, SPM
23	West Bengal	Kolkata	Vehicles, Industries	RSPM, SPM, NO 2
		Howrah	Vehicles, Industries	NO 2, RSPM, SPM
		Haldia	Industries, Vehicles	RSPM

AMBIENT AIR QUALITY IN DELHI DURING 2004

The Central Pollution Control Board has been monitoring ambient air quality at seven locations in Delhi for the past several years. The locations have been categorized on land use, i.e., residential, industrial and traffic intersection.

With the reduction of sulphur content in diesel, the sulphur dioxide concentrations have shown a declining trend at most of the locations in Delhi. Sulphur dioxide in residential areas during 2004 has shown no change with respect to 2003 (10 µg/m 3), the change observed at BSZ Marg traffic intersection was also found to be insignificant.

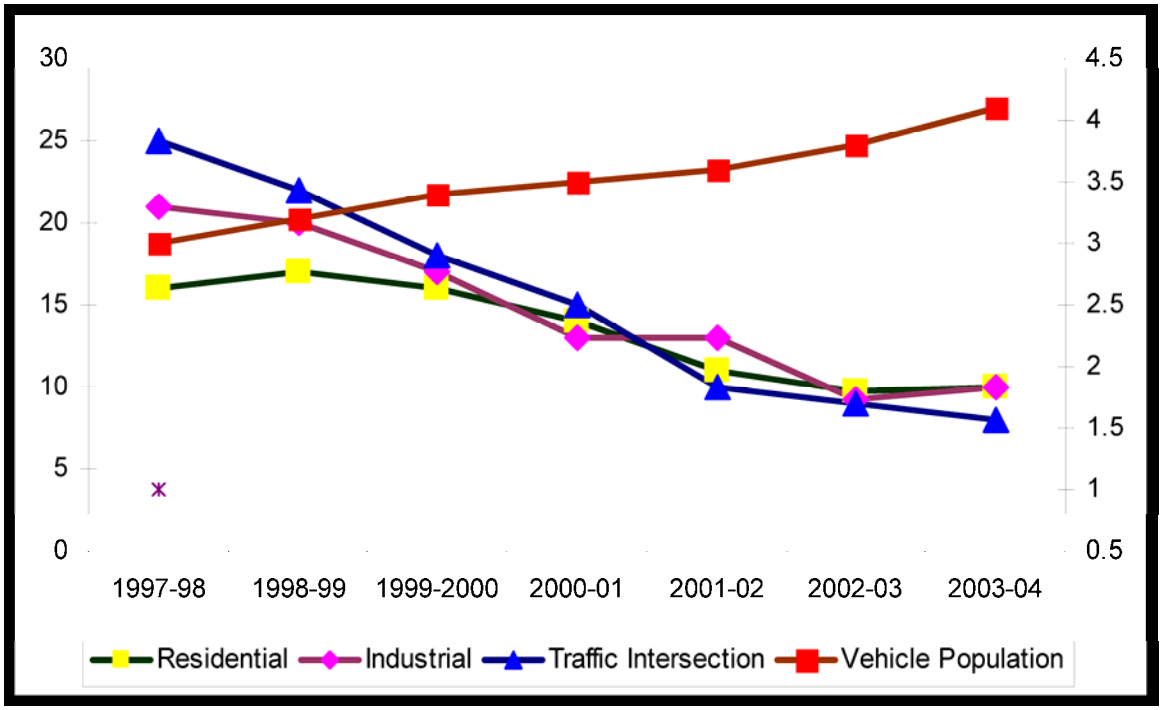
Nitrogen dioxide is the only parameter which shows an upward trend since 2001. During 2004, it increased in residential area (40 µg/m 3) and industrial area (42 µg/m 3) by 5 and 17 percent respectively, while in traffic intersection (89 µg/m 3) it decreased by 5 percent in comparison to 2003.

Annual average SPM concentration during 2004 registered a decrease of approximately 4 and 2 percent respectively in industrial areas (339 µg/m 3) and traffic intersection (500 µg/m 3). SPM concentration at residential areas (330 µg/m 3) registered an increase of 5 percent.

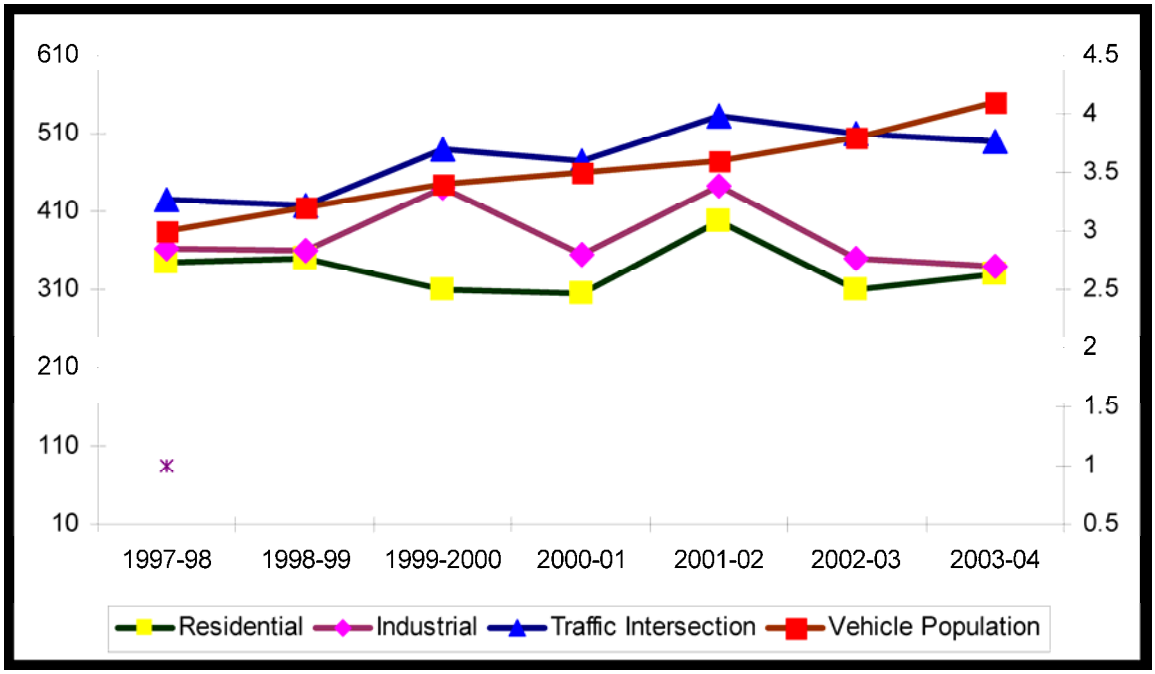
RSPM recorded 135 µg/m 3 in industrial areas and 228 µg/m 3 in traffic intersection during 2004. These are 4 and 7 percent respectively lower than the values recorded in 2003. RSPM at residential areas (131 µg/m 3) registered an increasing trend of only 3 percent.

CO levels measured at BSZ traffic intersection during 2004 was found to be 2581 µg/m 3 as against 2831 µg/m 3 recorded in 2003, thus indicating a decline of 9 percent.

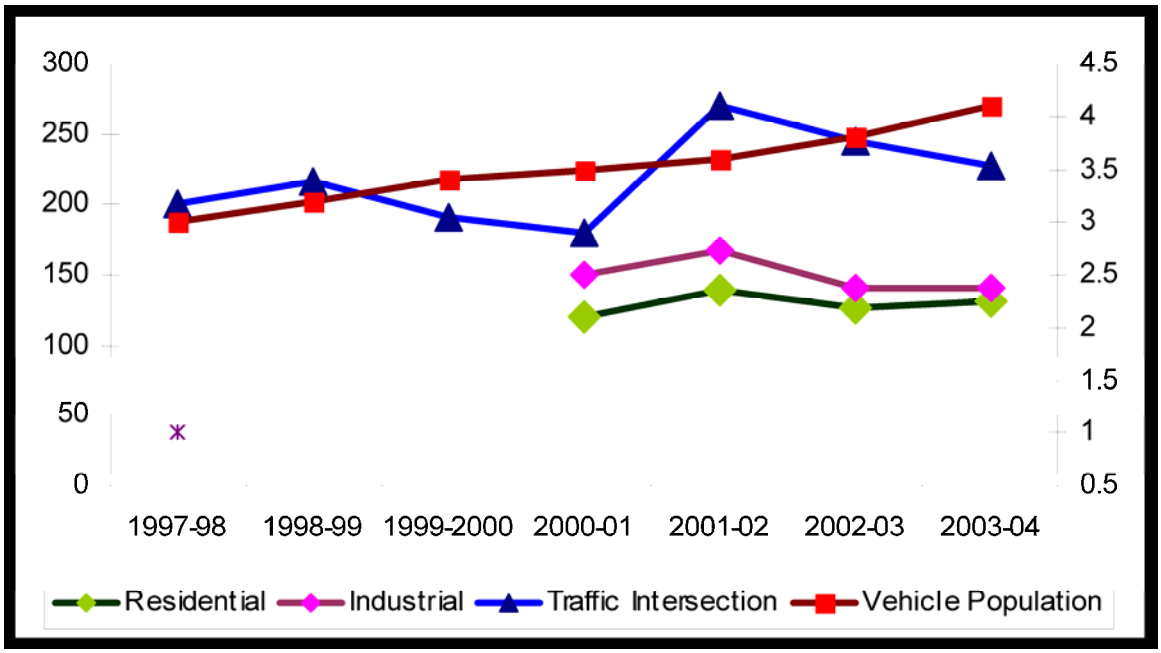
Sulphur Dioxide levels in Ambient Air of Delhi



Suspended Particulate Matter levels in Ambient Air of Delhi

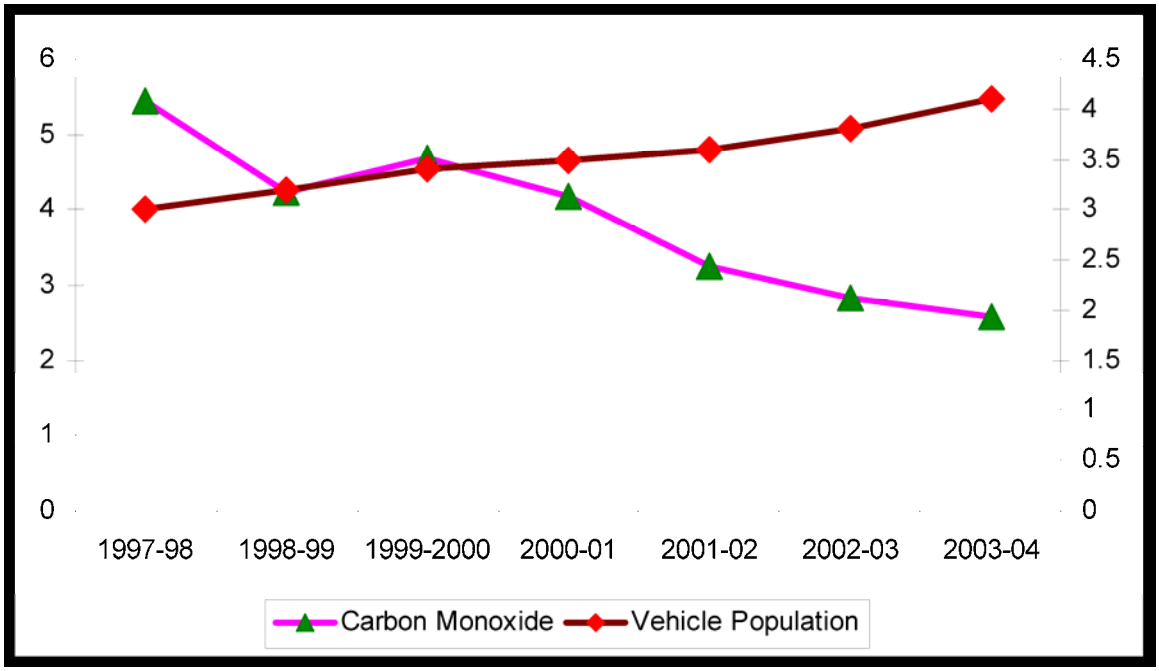


Respirable Suspended Particulate Matter levels in Ambient Air of Delhi



Oxides of Nitrogen levels in Ambient Air of Delhi

Carbon Monoxide levels in Ambient Air of Delhi



Vehicle Registration in Millions

Ambient Air Quality Trends in Delhi

Parameter	**Percent increase/decrease in 2004 with respect to 2003**	
	Area	**Increase/Decrease**
Sulphur dioxide (SO_2)	Residential	0%
	Industrial	(+) 11%
	Traffic Intersection	(-) 11%
Nitrogen dioxide (NO_2)	Residential	(+) 5%
	Industrial	(+) 17
	Traffic Intersection	(-) 5%
Suspended Particulate Matter (SPM)	Residential	(+) 5%
	Industrial	(-) 4%
	Traffic Intersection	(-) 2%
Respirable Suspended Particulate Matter (RSPM)	Residential	(+) 3%
	Industrial	(-) 4%
	Traffic Intersection	(-) 7%
Carbon monoxide (CO)	Traffic Intersection	(-) 9%

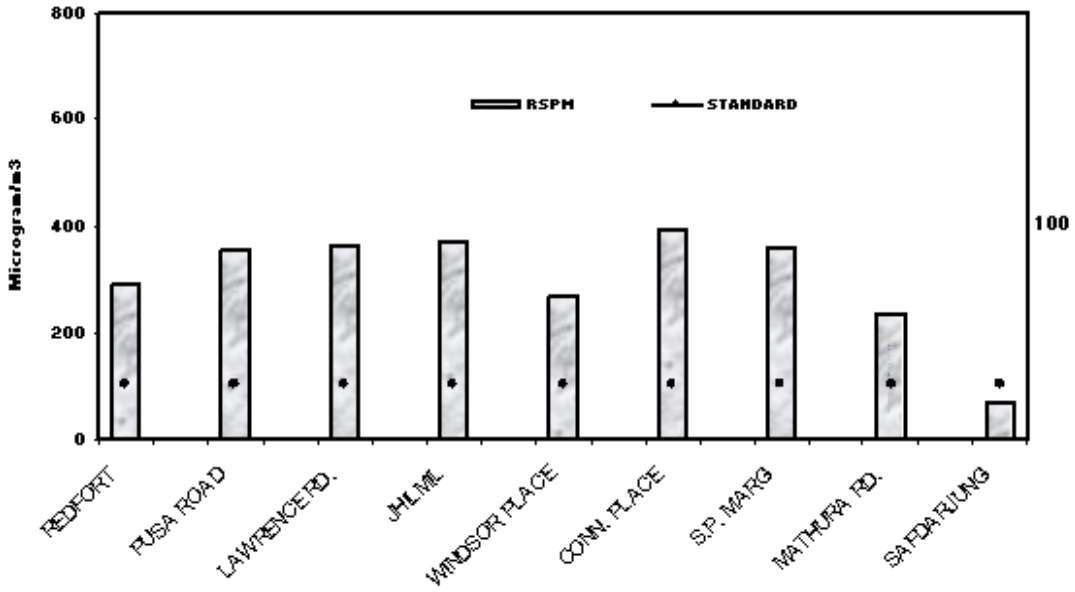
Ambient air quality monitoring in Delhi by Mobile van

The ambient air quality monitoring have been conducted at 10 (Ten) sites i.e. Red Fort, Pusa Road, Lawrence Road, Badli, Jhilmil, Windsor Place, Connaught Place S.P. Marg, Mathura Road and Safdarjung using ambient air quality monitoring van during May to July 2004. Results obtained from the monitoring are depicted below:

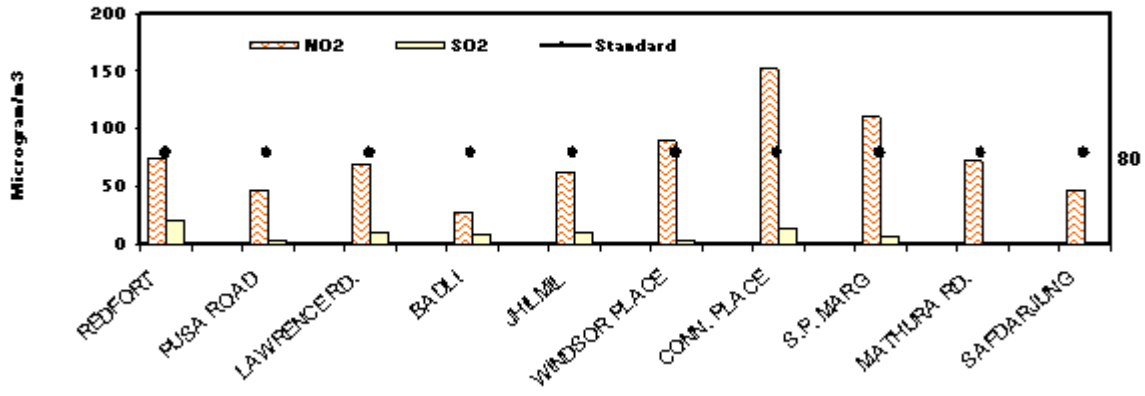
LOCATION	**DATE**	**NO 2**	**SO 2**	**CO**			**O 3**	**RSPM**
				(µg/m 3)				
		(µg/m 3)	**(µg/m 3)**	***06-14***	***14-22***	***22-06***	**(µg/m 3)**	**(µg/m 3)**
REDFORT	06/05/04	74	21	802	4630	3100	60	289

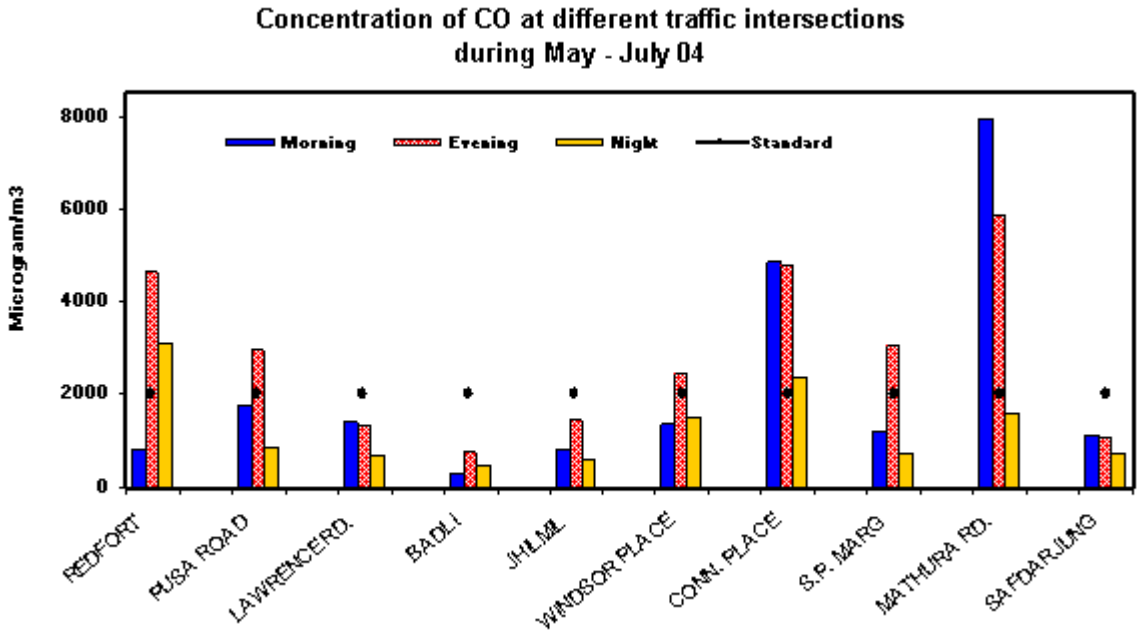
PUSA ROAD	12/05/04	46	04	1745	2970	846	15	353
LAWRENCE RD.	17/05/04	69	10	1425	1315	692	36	365
BADLI	19/05/04	28	08	300	767	455	30	-
JHILMIL	24/05/04	62	11	797	1475	615	33	370
WINDSOR PLACE	26/05/04	89	03	1375	2440	1495	18	267
CONN. PLACE	01/06/04	151	14	4865	4760	2355	14	395
S.P. MARG	03/06/04	111	07	1185	3035	719	30	359
MATHURA RD.	07/06/04	72	02	7950	5875	1581	13	231
SAFDARJUNG	06/07/04	46	-	1110	1060	734	22	67

Concentration of RSPM at different traffic intersections during May - July 04



Concentration of NO2 and SO2 at different traffic intersections during May - July 04





Ambient Air Quality during Deepawali, 2004

Ambient air quality is being measured during Deepawali days for the past several years. During Deepawali days, the air quality deteriorates alarmingly due to the bursting of crackers. In order of assess the air pollution caused due to bursting of crackers, ambient air quality was measured at selected locations in Delhi during 2004 also. The observations are as follows:

- Except for sulphur dioxide, the levels of all other pollutants at almost all the locations exceeded the air quality standards.
- RSPM and SPM levels during 2004 at all locations were found to be higher than that recorded during 2003.
- Gaseous pollutants namely Nitrogen dioxide and Sulphur dioxide recorded mixed trend in 2004 as compared to 2003. Four locations out of eight monitored in 2004 recorded higher concentration as compared to 2003.

Ambient Air Quality during Deepawali 2003 & 2004

(All Values are in microgram per cubic metre)

Parameter	**SO_2**		**NO_2**		**SPM**		**RSPM**	
Year	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**	**2003**	**2004**
B.S.Z Marg	15	13	99	107	676	1107	553	896
Ashok Vihar	8	9	63	43	1136	1826	877	1222
Janakpuri	28	8	92	42	1209	1435	468	607
Nizamuddin	4	10	71	100	787	1654	520	1161
Patel Nagar	7	8	115	124	-	-	788	1146
Sirifort	4	13	40	51	989	-	469	936
Shahazada Bagh	43	22	89	93	1177	1934	819	827
Shahdara	38	17	83	80	1516	2247	920	1797

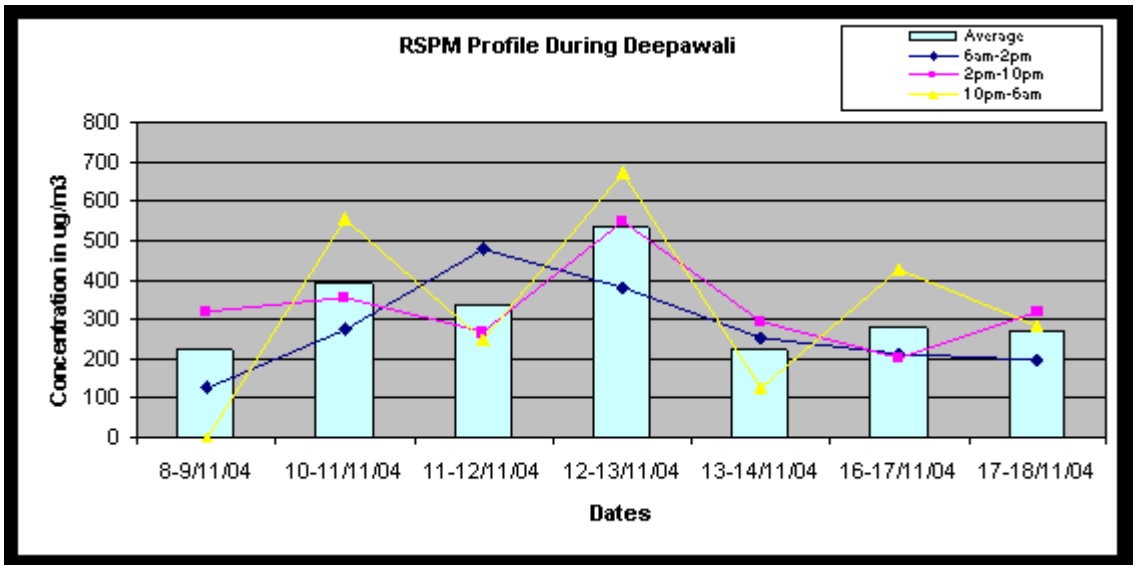
Ambient Noise Level in Delhi during Deepawali, 2004

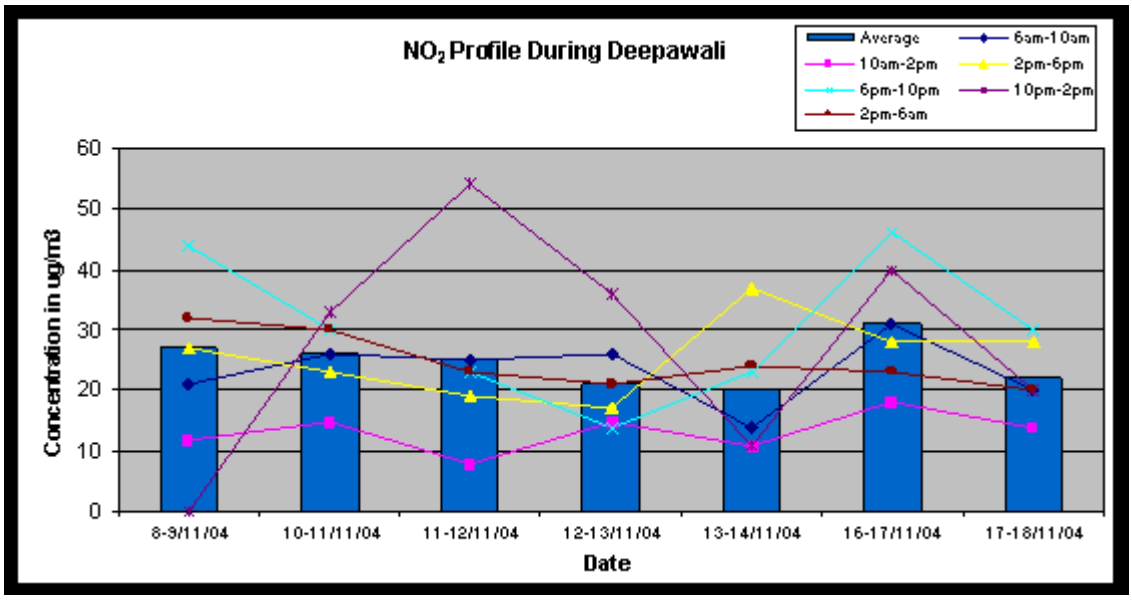
Ambient noise level monitoring was carried out at various locations in Delhi, i.e. All India Institute of Medical Sciences (AIIMS), Lajpat Nagar, New Friends Colony, East Arjun Nagar, Connaught Place, India Gate, Mayur Vihar Phase – II, Raja Garden, Pitam Pura, Model Town, Patel Nagar, Kamla Nagar, Dilshad Garden and ITO on the occasion of Deepawali festival. At Kamla Nagar, Patel Nagar and Dilshad Garden noise monitoring were conducted from 18.00 hrs. to 23.00 hrs. (long duration) while at other locations short duration (half hourly noise level monitoring were conducted between 18.00 hrs. & 23.00 hrs. This year, three new locations, i.e. Raja Garden , Model Town and Pitam Pura were selected for short duration monitoring. Normal day noise monitoring was conducted on November 5, 2004. The findings are as follows:

- Noise level on Deepawali day, 2004 decreased at six locations whereas it slightly increased at four locations and remained same at one location as compared to the Deepawali day, 2003 (Three locations, being new could not be compared.
- The Ambient noise level has increased on Deepawali day as compared to the normal day, i.e. November 5, 2004 at all the locations.
- The average ambient noise levels on normal day were ranging from 52 to 78 Leq dB(A) and 64 to 88 Leq dB(A) on Deepawali day.
- Average noise values on Deepawali were ranging from 64 to 88 Leq dB(A) against last year's average values of 69 to 90 Leq dB(A).
- Highest average value for noise level was observed at Model Town .

Impact of fire crackers on Ambient Air Quality during Deepawali at Kanpur

In order to assess the pollution generated by fire crackers, monitoring of Particulate Matter (PM 10), SO 2 and NO 2 was conducted during Deepawali week (Deepawali on 12 th) in year 2004 at Vikas Nagar, a typical residential colony of Kanpur . This study reflects the clear impact on air quality.





Rise in RSPM and NO 2 concentrations was observed during Deepawali . RSPM was increased two times to that of normal 8hours average values.

Impact of Fire Crackers on Ambient Air and Noise During Deepawali at Lucknow

Noise Impact in Lucknow

Noise Monitoring was conducted at Gomti Nagar (R), Indira Nagar (R), Aliganj (C), Vikas Nagar (R). Noise levels are depicted below:

Noise Impact in Lucknow

Observations

- At all the places day time, & night time Noise levels are exceeding the prescribed standards.
- The maximum increase from the prescribed standards was observed at Indira Nagar in the night time of +31.2 dB(A) due to firing of crackers.
- The Day time maximum deviation +25.8 dB(A) observed at Vikas Nagar.
- Out of all areas monitored, maximum noise pollution was observed at Indira Nagar area. The Peak value was observed at Vikas Nagar on the day of Deepawali. Aliganj commercial area is having values higher in the evening hours during commercial activities period.

Levels of Benzene Soluble Organic Fraction (BSOF) in PM 10

BSOF is being sporadically measured in RSPM at BSZ Marg Traffic Intersection Delhi since 2001. Benzene Soluble Organic Fraction (BSOF) mainly comprises of hundreds of particulate bound organic compounds present in ambient air. Some of the important BSOF compounds include Polycyclic Aromatic Hydrocarbons (PAHs), Dioxins and Furans, Oxidized Hydrocarbons (aldehydes, ketones, oxyacids etc.). Measurement of BSOF gives an idea about the anthropogenic emissions originating from the combustion of fossil fuels. The concentration of BSOF in PM 10 ranged between 16 – 70 µg/m 3 . Preliminary results indicate that BSOF during the winter months were higher ranging from 34 – 70 µg/m 3 , while the lowest values (16 µg/m 3) were observed in monsoon period. The percent BSOF in PM 10 ranged between 4 and 25. The highest percentage was observed in July 2003 when average RSPM was found to be only 67 µg/m 3 (perhaps due to wash out factor) but the BSOF even at such low levels of RSPM was found to be highest (25%) in comparison to other months.

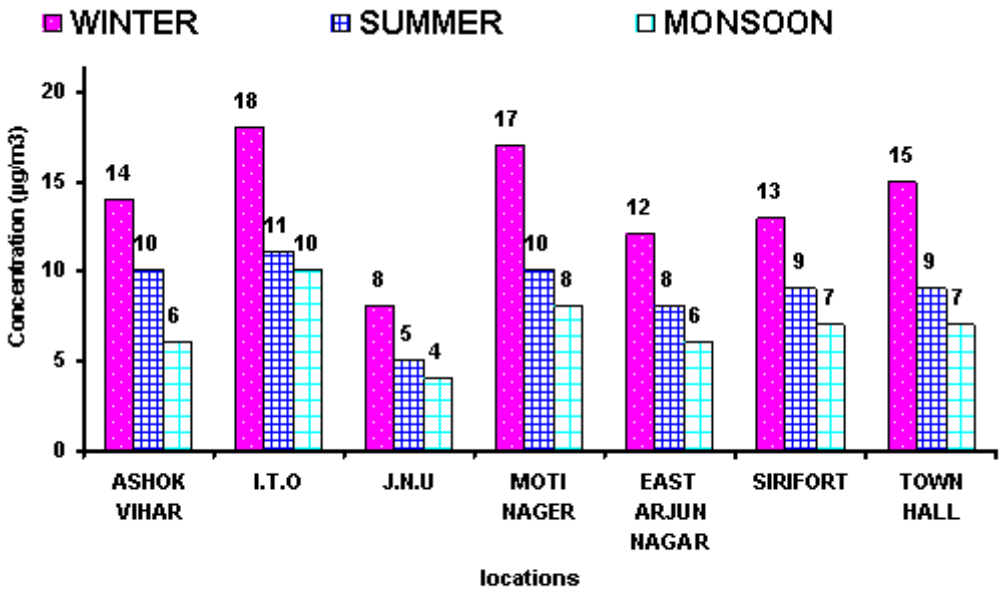
BSOF Levels in RSPM at B.S.Z Marg, Delhi

Period	BSOF µg/m 3	RSPM µg/m 3	Percent BSOF in RSPM
December-2001	34	327	11%
January-2002	70	387	20%
December-2002	67	361	17%
January-2003	44	285	12%
May-2003	34	834	4%
June-2003	30	944	3%
July-2003	16	67	25%
November-2004	52	266	20%
December-2004	33	353	9%

Seasonal Variation of Benzene Levels in Ambient Air of Delhi during 2003 - 2004

Central Pollution Control Board is monitoring benzene in Delhi using diffusive samplers (passive sampling method) at seven locations namely Ashok Vihar, I.T.O, J.N.U., Moti Nagar, East Arjun Nagar, Siri Fort, and Town Hall. Benzene is one of the volatile organic compounds (VOC). Benzene comes under aromatic category of volatile organic compounds. Benzene is a harmful pollutant causing exposure-related health affects in human beings. It is mainly released from anthropogenic activities such as transportation (from vehicle exhaust, filling and evaporative losses), industrial processes, combustion etc.

The maximum concentration of benzene was observed in winter season at all the location in comparison to summer and monsoon and ranged between 8 µg/m 3 (J.N.U) to 18 µg/m 3 (I.T.O). The benzene levels in summer season ranged between 5 µg/m 3 (J.N.U) to 11 µg/m 3 (I.T.O). Minimum concentration of benzene was observed during monsoon season at all the location and ranged between 4 µg/m 3 (J.N.U) to 10 µg/m 3 (I.T.O).

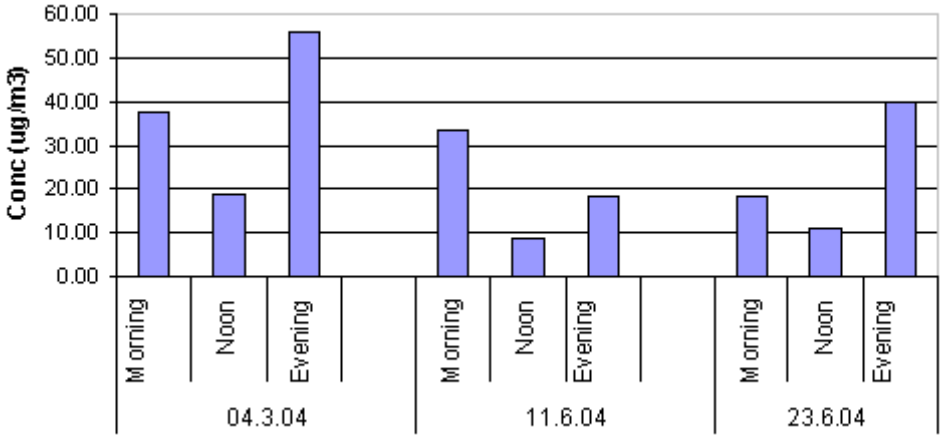


Seasonal variation of Benzene levels in Delhi during 2003 - 04

Active BTX Sampling Followed By ATD-GC Analysis

Samples were collected at selected locations near ITO Bride for shorter period (two-three hours) using low flow pump at different time intervals including peak and lean traffic periods. The exercise was

repeated thrice during March & June 2004. BTX samples collected were analysed using Automated Thermal Desorption - Gas Chromatography (ATD-GC). The observations are as follows:

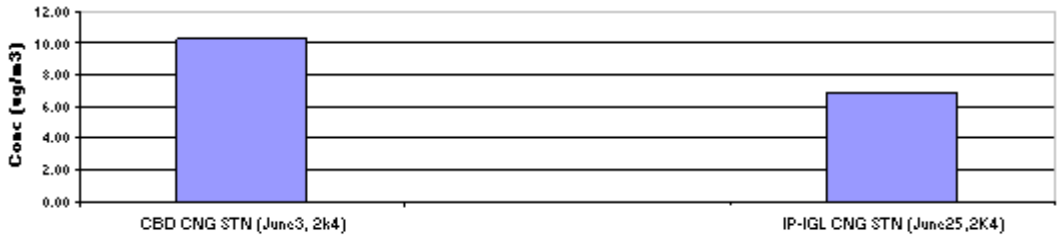


Benzene concentration during Peak & Lean hours along roadside near ITO Bridge

Traffic intersection (ITO) recorded short-term highest Benzene level (18.5 to 59.0 µg/m 3) during peak hours i.e. morning & evening due to high-traffic density as compared to lean period on the same day (9.0 to 19.0 µg/m 3).

Benzene Monitoring at CNG filling Stations

Benzene levels (7.0- 10.0 µg/m 3) monitored at two CNG filling stations at CBD Complex , East Arjun Nagar, Shahdra and Inder Prastha, Ring Road were recorded low as compared to traffic intersection and petrol pumps.

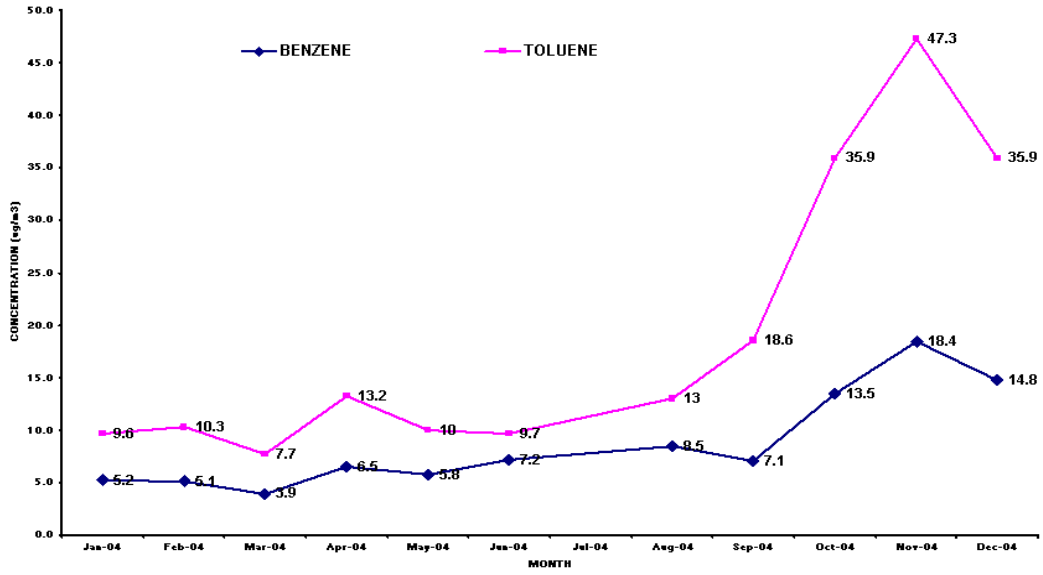


Benzene Monitoring at CNG Filling Stations in Delhi

On-line Volatile Organic Compounds (VOCs) Monitoring in Ambient Air of Delhi (2004)

Central Pollution Control Board is regularly monitoring volatile organic compounds (VOC's) in the ambient air at Sirifort using continuous Analyzer. The surrounding area of the monitoring station is flat plateau with dense residential localities, commercial establishments and a famous sports complex. There is no major immediate source of air pollution in the vicinity of Sirifort monitoring station. However, there may be some impact of vehicles plying on a busy road at a distance of approximate 100 meters from the station.

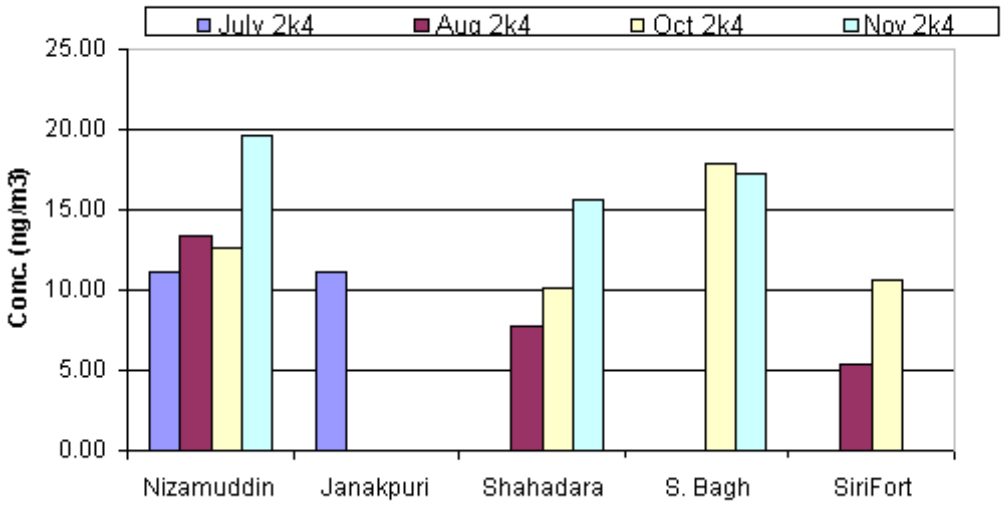
The monthly mean concentration observed was found to be in the range of 3.9 µg/m 3 to 18.4 µg/m 3 and 7.7 ug/m 3 to 47.3 ug/m 3 of Benzene and Toluene respectively. The maximum mean concentration of Benzene (18.4 µg/m 3) and Toluene (47.3 µg/m 3) observed in the month of November and the minimum value 3.9 µg/m 3 and 7.7 ug/m 3 in month of March. High levels in November may be attributed to the low inversion conditions in winter month.



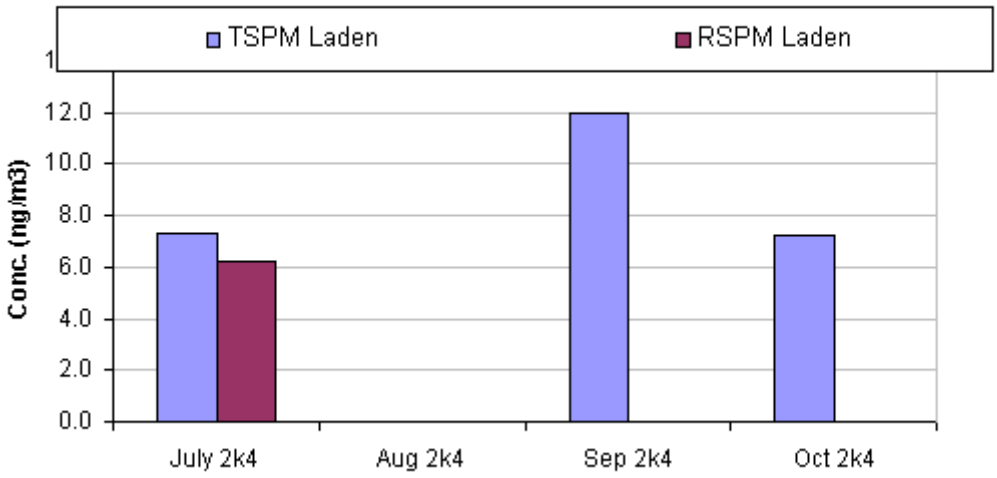
AVERAGE CONCENTRATION OF BENZENE AND TOLUENE DURING -2004

Poly aromatic Hydrocarbons (PAHs) Monitoring in Ambient Air in Delhi

Poly Aromatic Hydrocarbons are one of the EPAs seven specific categories of air toxics. These pollutants pose serious health hazards in urban areas because of multiple sources especially vehicular traffic, thermal power plants, and industrial & domestic fuel burning. Central Pollution control Board has started particulate PAH measurement. The samples are collected at six NAAQM (TSPM laden PAH) locations and one integrated monitoring station at ITO (TSPM and RSPM laden PAH). 15 important PAH compound such as major PAH Napthalene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Chrysene, Benzo (a) anthracene, Benzo (b) fluoranthene, Benzo (k) fluoranthene, Benzo (a) pyrene, Benzo (ghi) perylene, Dibenzo(ah) anthracene, Indeno (cd) pyrene, Coronene are analysed after extraction in toluene and using GC-FID . The results of total PAHs levels measured at selected NAMP stations & at ITO are shown in following figures.



Total Ambient Particulate PAH in Delhi



Total PAH in Total & Respirable Ambient Particulate in Delhi

Ambient air quality monitoring in Delhi by Mobile van

The ambient Noise monitoring have been conducted at 10 (Ten) sites i.e. Redfort, Pusa Road, Lawrence Road, Badli, Jhilmil, Windsor Place, Connaught Place S.P. Marg, Mathura Road, Safdarjung using ambient air quality monitoring van during May to July 2004. Results obtained from the monitoring are depicted in the table below:

Locations	**Date**	**Morning**	**Afternoon**	**Evening**	**Night**
		(09-10 Hrs.)	**(13-14 Hrs.)**	**(18-19 Hrs.)**	**(00-01 Hrs.)**
		dB(A)			
REDFORT	07-05-04	59.6	59.8	64.7	57.4
PUSA ROAD	13-05-04	79.2	76.5	77.7	71.1
LAWRENCE ROAD	18-05-04	68.8	72.1	68.9	66.9
BADLI	20-05-04	59.0	62.1	54.2	57.1
JHILMIL	25-05-04	74.0	75.1	70.8	74.1
WINDSOR PLACE	26-05-04	71.5	74.2	74.6	69.7
CONNAUGHT PLACE	02-06-04	69.1	72.2	78.9	70.9
S. P. MARG	03-06-04	74.8	68.7	66.9	65.8
MATHURA ROAD	07-06-04	80.0	75.4	75.6	70.7
STANDARD		65	65	65	55

BTX Profile in Fugitive Emissions & Ambient Air at Mathura Refinery

The BTX profile of fugitive emissions and ambient air at Mathura Refinery using ATD-GC-FID techniques is presented in following table.