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Comparative Study of Ambient Air Quality around Chandrapur

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Abstract:
This paper is a comparative study between the ambient air qualities of Chandrapur district . It was observed that RSPM level in almost all station samples were higher during dry season. The pollution level of SO_2, NOx and RSPM mass concentration was significantly increased in the area under industrial impact.

Keywords:Industrial Pollution, RSPM, Ambient Air, Seasonal Variation, Chandrapur.

1. Introduction:

Urban air pollution is due to the vehicular emission as well as industrial emission is a matter of concern because of exposure of large number of people to it. Vehicular emission and industrial emission is responsible for higher level of air pollutant such as SPM, RSPM, SO_2, NO_x and various organic and inorganic pollutants including trace elements and it affects the environment as well as human health (Caselles et al., 2002; Kaushik et al., 2006; Sharma et al., 2006; Maitre et al., 2006; Curtis et al., 2006; Jayaraman., 2007) . Air pollution occurs when the air contains substances in quantities that could harm the comfort or health of humans and animals, or could damage plants and materials. These substances are called air pollutants and can be either particles, liquids or gaseous in nature (Alias, M. et al, 2007).

In India, pollution has become a great topic of discussion at all levels and especially the air pollution because of the enhanced anthropogenic activities such as burning fossil fuels, i.e. natural gas, coal and oil-to power industrial processes and motor vehicles. Among the harmful chemical compounds, this burning puts into the atmosphere, are carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), and tiny solid particles-including lead from gasoline additives-called particulates (Goyal, P. et al., 2003).

A study conducted by the World Bank indicates premature deaths of people in Delhi owing to high levels of air pollution (Review of air quality management system in India).

Combustion is also an indirect cause of acid rain, because NO and NO_2 and SO_2 are released to the atmosphere. A survey by Central Pollution Control Board has identified 23 Indian cities to be critically polluted. Amongst them the air pollution of Chandrapur is most alarming. An extensive study in the analysis of the concentration of the critical pollutants (Stern et al., 1968; Jayanthi,V. et al., 2006) such as Sulphur dioxide (SO_2), Nitrogen oxide (NOx) and RSPM present in the ambient air is made during the sampling period.

1.1.Sulphur dioxide: The gas is produced by the combustion of fossil fuels (Naik,S., 2005). Sources include industrial activities such as commercial and home heating and vehicle emissions. The amount of SO_2 emitted is directly related to the sulphur content of the fuel (Air Quality Monitoring Network, 2008).

1.2. Nitrogen oxides (NOx): NOx represents the sum of the various nitrogen gases found in the air, of which Nitric Oxide (NO) and Nitrogen Dioxide (NO_2) are the dominant forms. Forest fires can be a large natural source of NOx (Air Quality Monitoring Network, 2008).

1.3. RSPM: Natural sources of primary PM include windblown soil and mineral particles, biological material such as pollen, spores and bacteria and debris from forest fires (National Ambient Air Quality Objectives for Particulate matter, 1998). PM_{10} is generally subdivided into a fine fraction of particles 2.5 μm or less ($PM_{2.5}$), and a coarse fraction of particles larger than 2.5 μm (National Ambient Air Quality Objectives For Particulate matter, 1998). *Primary particles* are those such as carbon particles from combustion, mineral particles derived from stone abrasion, and sea salt. *Secondary particles* are those that are formed in the atmosphere by the chemical reaction of the gases, which combine to form less volatile compounds that then condense into particles (Balaceanu,C. et al., 2004).

2. Study Area:

The main concern of the project is to measure the concentration of sulphur dioxide, NO_X, and RSPM taking sampling at different stations with the help of respirable dust sampler. These two critical gaseous pollutants and the particulate pollutants are in abundance in Chandrapur environment since it is an industrial area and a little change in their concentration in ambient air can make a strong effect on the existing living stock causing many adverse effects on health and skin.

The stations were so chosen that there can be adequate safety measures as well as reduced interference of the local public with the devices used for the experiment. We investigated the decided sampling stations and found out the possible problems and the possible precautions to be taken while handling and use of the device for the project.

The monitoring stations chosen are:

1. Station-1: Administrative Office, Near Bus Stand, Chandrapur
2. Station-2: Municipal Corporation Building, Ballarpur
3. Station-3: MIDC, Chandrapur
4. Station-4: Gram Panchayat Building, Ghugus
5. Station-5: Gram Panchayat Building, Gadchandur
6. Station-6: Gram Panchayat Building, MIDC, Tadali

The air quality issues at Chandrapur have also been studied under US Asia Environmental Program by a team of experts from US-EPA in September, 2004. They carried out the institutional analysis and recommended a pilot project to implement the Visible Emission Observations (VEOs) from the stationary sources, as an alternate approach to manage the air quality at Chandrapur.

3. Experimental Methods for the Pollutants:

In order to know the status of air quality in Chandrapur district, six sampling stations were selected for air quality monitoring. Monitoring of the air quality was carried out during **July-2009 to December-2011.**

3.1. Sampling methods for gaseous pollutants

The SO_2 concentration in the air is measured by West-Geake method. NOx concentration in the air sample is measured by Jacob and Hochheiser method. RSPM is measured gravimetrically with GFA/EPM 2000 filter paper using respirable dust sampler.

4. Results and Discussion:

The monthly average concentration for various pollutants regarding and different sampling sites are given in the Figure No.1 to Figure No.18 and tabulated in the Table No. 1 to Table No.3.

4.1. BALLARPUR:

The monitoring result at Ballarpur indicates that the values of RSPM in Winter as well as in Summer are above the CPCB limit for residential area. During the given period the work of road concreting was going in the city. The minimum value of RSPM was 48µg/m^3 and the maximum value was 327µg/m^3. The SO_2 value ranges from 8µg/m^3 to 61µg/m^3 within the prescribed limit. The NOx value ranges from 12µg/m^3 to 61µg/m^3 and within the prescribed limit.

4.2. CHANDRAPUR:

The monitoring station is near the main city bus stand and a large number of vehicles of all types are always engaged in transport. The minimum value of RSPM was 54µg/m^3 and the maximum value was 145µg/m^3 during month of July and May respectively. The average values of Winter and Summer will be higher than the prescribed limit of CPCB for residential area. The SO_2 and NOx values were in the prescribed limit. The SO_2 value ranges from 8µg/m^3 to 66µg/m^3 while the NOx value ranges from 15µg/m^3 to 55µg/m^3 respectively.

4.3. GHUGHUS:

The monitoring station is situated in residential area which is surrounded by several opencast coal mines and heavy vehicle transportation of these coal mines. The minimum value of RSPM was 72µg/m^3 and the maximum value was 550µg/m^3. It is observed that the value of RSPM it is very high and it is very well above the prescribed limit and it gradually increased in Winter and Summer throughout the monitoring period. The value of SO_2 ranges from 12µg/m^3 to 68 µg/m^3 . The value of NOx ranges from 14µg/m^3 to 44µg/m^3. The values of SO_2 and NOx are within the prescribed limit in all season. Therefore in this area the pollution level which is quite high due to RSPM and it is worsening day by day and has badly affected the daily life of people of Ghughus Township. The future scenario will be more complicated in that area.

4.4. GADCHANDUR:

The monitoring station is situated in residential area of Gadchandur. The area is surrounded by several number of cement factories. The minimum value of NOx is 9µg/m^3 and maximum value is 45µg/m^3 and it is well below the prescribed limit of CPCB. The value of SOx is ranges from 6µg/m^3 to 57µg/m^3 and it is within the prescribed limit of CPCB. The minimum value of RSPM was 38µg/m^3 in Rainy Season and the maximum value was 257µg/m^3 in Summer. It is also observed that in the winter season the RSPM value is above the prescribed limit of CPCB. The average value of RSPM in all the season is very high that is well above the standard value 100µg/m^3.

4.5. MIDC, CHANDRAPUR

The monitoring station is situated in the industrial zone MIDC area of Chandrapur. The minimum value of SO_2 was 8 µg/m^3 and the maximum value was 108µg/m^3. Similarly the value of NOx it is well below prescribed limit. The NOx value ranges from 15µg/m^3 to 45µg/m^3. But the value of RSPM it is above the prescribed limit by CPCB for industrial zone. The minimum value for RSPM is 44 µg/m^3 in Rainy Season and the maximum value is 250µg/m^3 in Summer. In Summer as well as in Winter the values of RSPM were high and above the prescribed limit. So in the MIDC area of Chandrapur there is increase in the pollution in Winter as well as Summer season .

4.6. MIDC, TADALI

The monitoring station is situated in industrial zone near WCL coal mines. The minimum value of SO_2 was 2 µg/m^3 and the maximum value was 41µg/m^3. Similarly the value of NOx is well below prescribed limit. The minimum value of NOx is 10 µg/m^3 and the maximum value of NOx 26 µg/m^3 . But the value of RSPM is well above the prescribed limit by CPCB for industrial zone. The minimum value for RSPM is 43 µg/m^3 and the maximum value is 420µg/m^3 and the maximum number of value was observed to be very high and it is more than the prescribed limit of CPCB 150 µg/m^3. The values of RSPM are high in all Season and well above the prescribed limit. So in the MIDC area of Tadali there is gradual increase in pollution in winter as well as summer.

5. Conclusion:

From the observed data it was marked that the pollution was not so acute during dry season at all the six stations. In Industrial area like Ghughus the RSPM in winter season is found to be more than the CPCB limit and it is dangerous towards the pollution. Also the Quantity of RSPM is maximum in Summer during the month of May and April in all the station due to the clear weather and hot climate. Concentration of NOx and SO_2 is also increases during Winter and Summer season and it is significant in all station. The overall monitoring results reveal that the study area is highly polluted with respect to air quality.

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Supplement Paper

Figure 1: Average concentration of SOx at Ballarpur during July2009-December 2011 (**Unit in µg/m^3**)

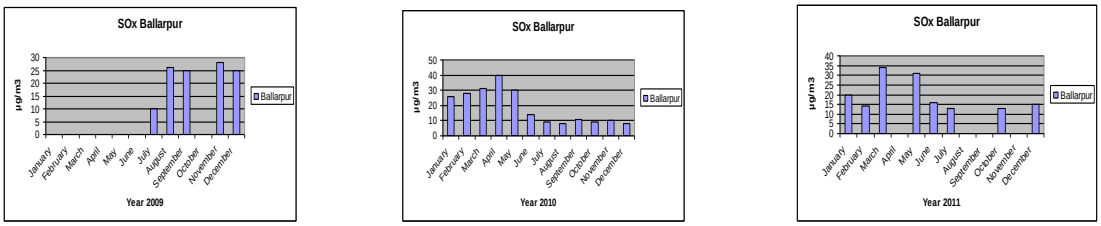


Figure 2: Average concentration of SOx at Chandrapur during July2009-December 2011 (**Unit in µg/m^3**)

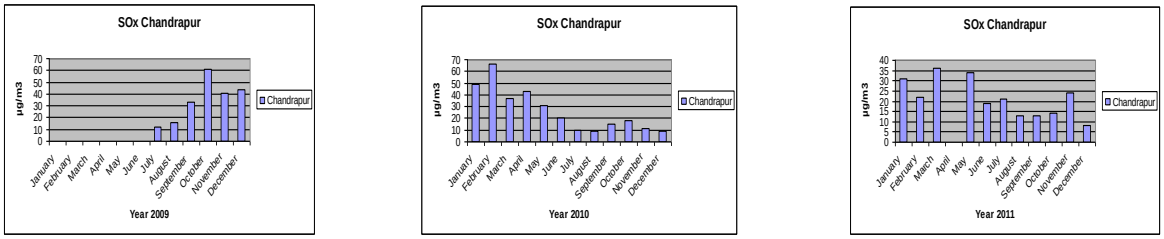


Figure3: Average concentration of SOx at Ghughus during July2009-December 2011 (**Unit in µg/m^3**)

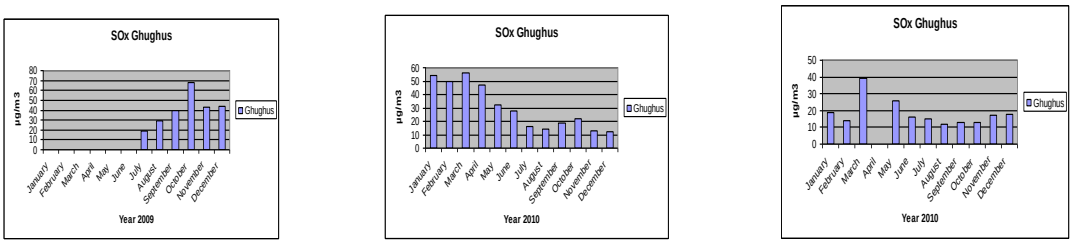


Figure 4: Average concentration of SOx at Gadchandur during July2009-December 2011 (**Unit in µg/m^3**)

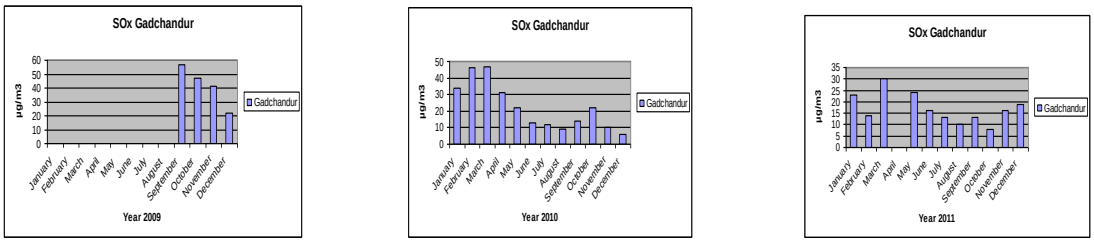


Figure5: Average concentration of SOx at MIDC Chandrapur during July2009-Dec. 2011 (**Unit in µg/m^3**)

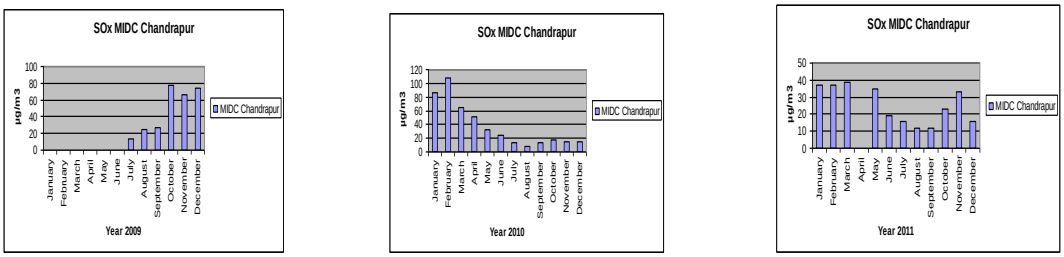


Figure 6: Average concentration of SOx at MIDC Tadali during July2009-December 2011 (**Unit in µg/m^3**)

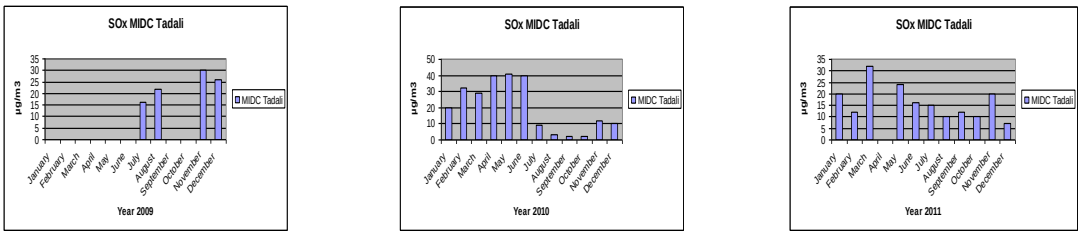


Figure 7: Average concentration of NOx at Ballarpur during July2009-December 2011 (**Unit in µg/m^3**)

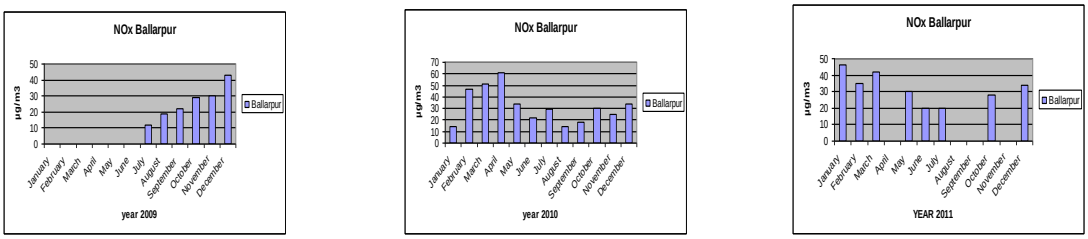


Figure 8: Average concentration of NOx at Chandrapur during July2009-December 2011 (**Unit in µg/m^3**)

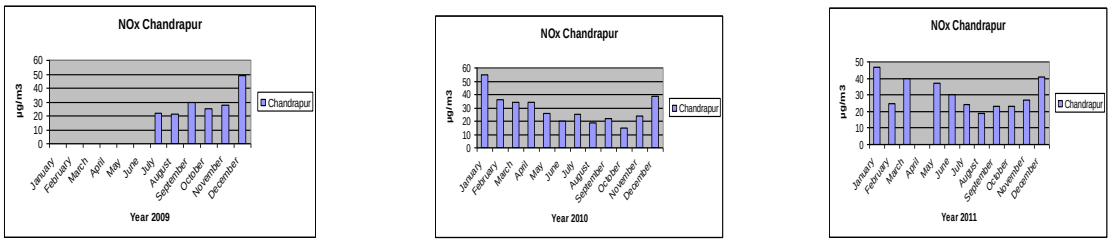


Figure 9: Average concentration of NOx at Ghughus during July2009-December 2011 (**Unit in µg/m^3**)

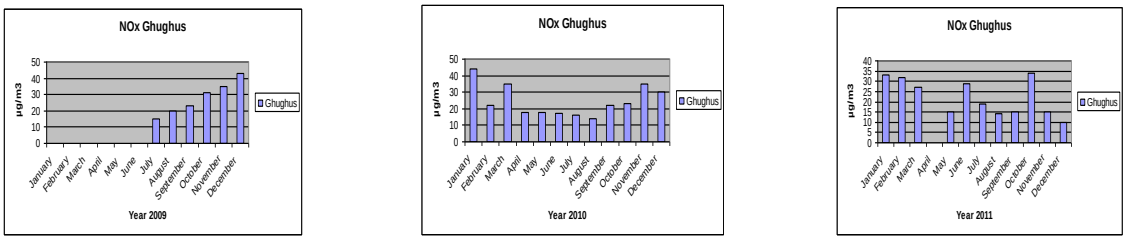


Figure 10: Average concentration of NOx at Gadchandur during July2009-December 2011 (**Unit in µg/m^3**)

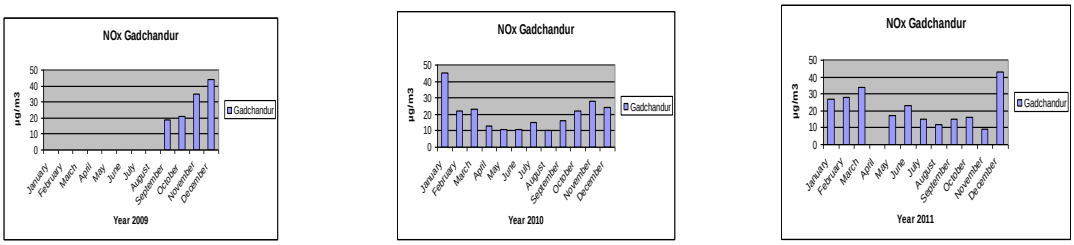


Figure11: Average concentration of NOx at MIDC Chandrapur during July2009-Dec.2011 (**Unit in µg/m^3**)

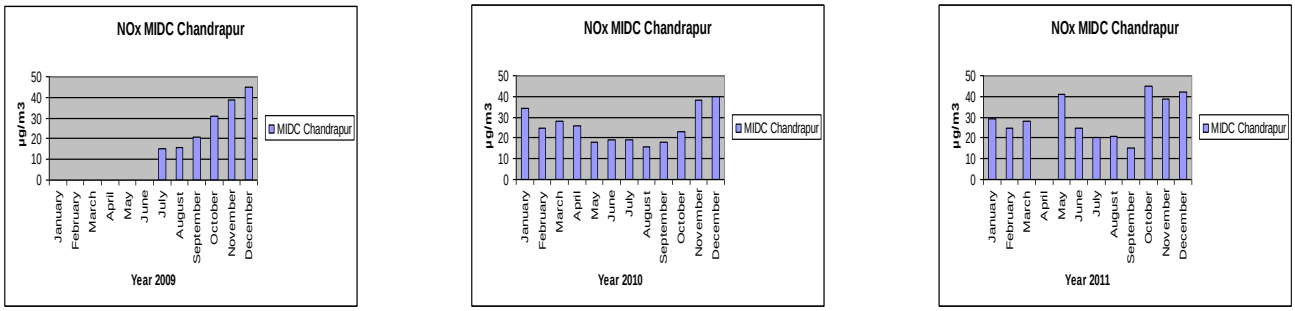


Figure12: Average concentration of NOx at MIDC Tadali during July2009-December 2011 (**Unit in µg/m^3**)

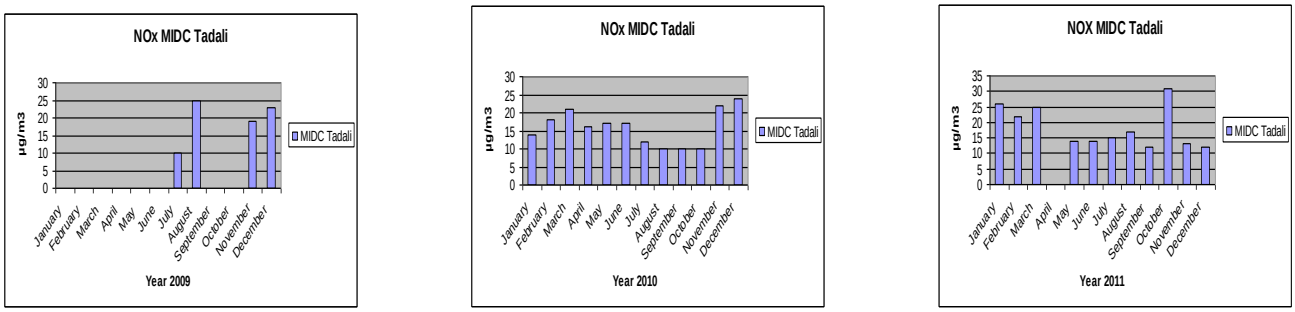


Figure13: Average concentration of RSPM at Ballarpur during July2009-Dec.2011 (**Unit in µg/m^3**)

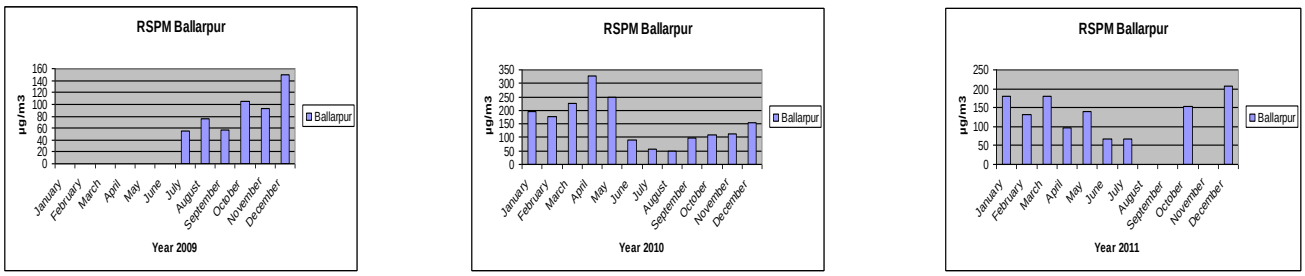


Figure14: Average concentration of RSPM at Chandrapur during July2009-Dec.2011 (**Unit in µg/m^3**)

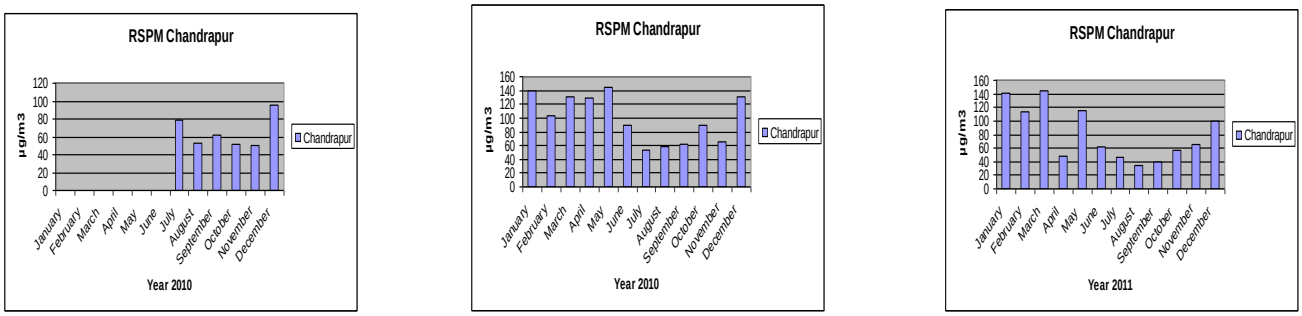
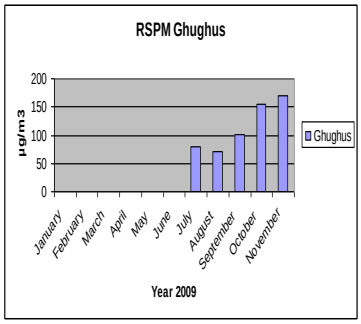
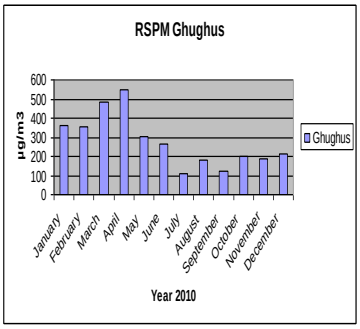


Figure15: Average concentration of RSPM at Ghughus during July2009-Dec.2011 (**Unit in µg/m^3**)





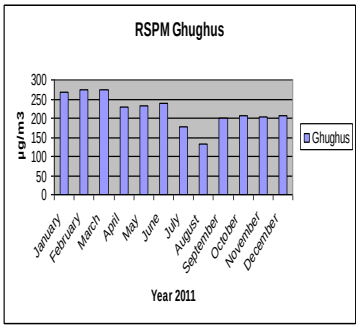
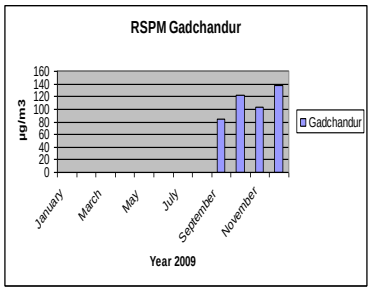
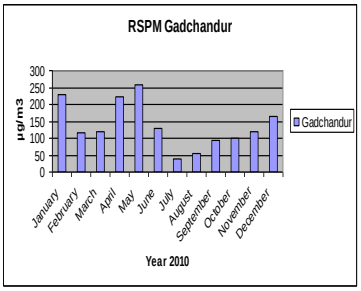


Figure16: Average concentration of RSPM at Gadchandur during July2009-Dec.2011 (**Unit in µg/m^3**)





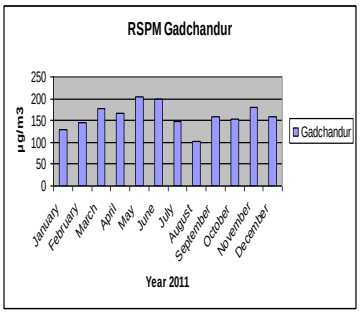
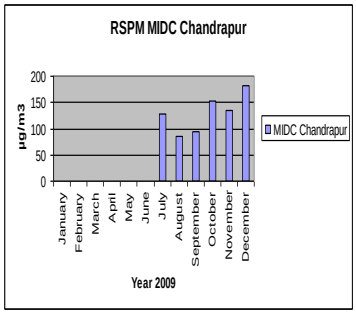
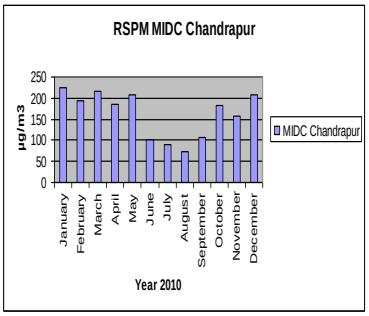


Figure17: Average concentration of RSPM at MIDC Chandrapur during July2009-Dec.2011 (**Unit in µg/m^3**)





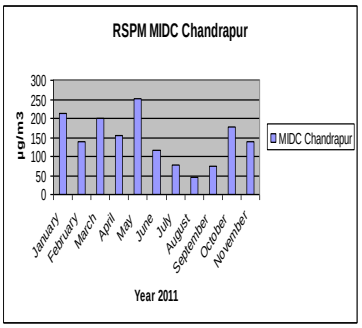
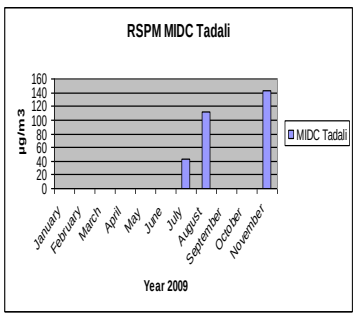
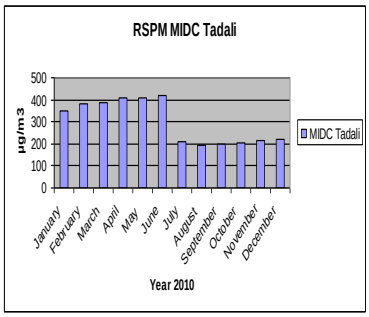


Figure18: Average concentration of RSPM at MIDC Tadali during July2009-Dec.2011 (**Unit in µg/m^3**)





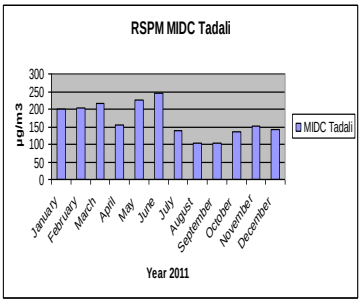


TABLE-1 AMBIENT AIR QUALITY MONITORING RESULTS FOR SO_2 FOR SAMPLING JULY 2009-DECEMBER 2011 FOR ALL STATIONS (**Unit in µg/m^3**)

Period	SO_2																	
	Ballarpur			Chandrapur			Ghughus			Gadchandur			MIDC Chandrapur			MIDC Tadali		
	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR
January	NR	26	20	NR	49	31	NR	54	19	NR	34	23	NR	86	37	NR	20	20
February	NR	28	14	NR	66	22	NR	50	14	NR	46	14	NR	108	37	NR	32	12
March	NR	31	34	NR	37	36	NR	56	39	NR	47	30	NR	65	39	NR	29	32
April	NR	40	NR	NR	43	NR	NR	47	NR	NR	31	NR	NR	51	NR	NR	40	NR
May	NR	30	31	NR	31	34	NR	32	26	NR	22	24	NR	32	35	NR	41	24
June	NR	14	16	NR	20	19	NR	28	16	NR	13	16	NR	24	19	NR	40	16
July	10	9	13	12	10	21	19	16	15	NR	12	13	14	13	16	16	9	15
August	26	8	NR	16	9	13	29	14	12	NR	9	10	25	8	12	22	3	10
September	25	11	NR	33	15	13	40	19	13	57	14	13	27	14	12	NR	2	12
October	61	9	13	61	18	14	68	22	13	47	22	8	78	17	23	NR	2	10
November	28	10	NR	41	11	24	43	13	17	41	10	16	66	15	33	30	12	20
December	25	8	15	44	9	8	44	12	18	22	6	19	74	15	16	26	10	7

TABLE-2 AMBIENT AIR QUALITY MONITORING RESULTS FOR NO_X FOR SAMPLING JULY 2009-DECEMBER 2011 FOR ALL STATIONS (**Unit in µg/m^3**)

Period	NO_X																	
	Ballarpur			Chandrapur			Ghughus			Gadchandur			MIDC Chandrapur			MIDC Tadali		
	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR	2009 YEAR	2010 YEAR	2011 YEAR
January	NR	14	46	NR	55	47	NR	44	33	NR	45	27	NR	34	29	NR	14	26
February	NR	47	35	NR	36	25	NR	22	32	NR	22	28	NR	25	25	NR	18	22
March	NR	51	42	NR	34	40	NR	35	27	NR	23	34	NR	28	28	NR	21	25
April	NR	61	NR	NR	34	NR	NR	18	NR	NR	13	NR	NR	26	NR	NR	16	NR
May	NR	34	30	NR	26	37	NR	18	15	NR	11	17	NR	18	41	NR	17	14
June	NR	22	20	NR	20	30	NR	17	29	NR	11	23	NR	19	25	NR	17	14
July	12	29	20	22	25	24	15	16	19	NR	15	15	15	19	20	10	12	15
August	19	14	NR	21	19	19	20	14	14	NR	10	12	16	16	21	25	10	17
September	22	18	NR	30	22	23	23	22	15	19	16	15	21	18	15	NR	10	12
October	29	30	28	25	15	23	31	23	34	21	22	16	31	23	45	NR	10	31
November	30	25	NR	28	24	27	35	35	15	35	28	9	39	38	39	19	22	13
December	43	34	34	49	39	41	43	30	10	44	24	43	45	40	42	23	24	12

TABLE-3 AMBIENT AIR QUALITY MONITORING RESULTS FOR RSPM FOR SAMPLING JULY 2009-DECEMBER 2011 FOR ALL STATIONS (**Unit in µg/m^3**)

Period	RSPM																	
	Ballarpur			Chandrapur			Ghughus			Gadchandur			MIDC Chandrapur			MIDC Tadali		
	YEAR 2009	YEAR 2010	YEAR 2011	YEAR 2009	YEAR 2010	YEAR 2011	YEAR 2009	YEAR 2010	YEAR 2011	YEAR 2009	YEAR 2010	YEAR 2011	YEAR 2009	YEAR 2010	YEAR 2011	YEAR 2009	YEAR 2010	YEAR 2011
January	NR	197	179	NR	140	141	NR	360	268	NR	228	128	NR	225	212	NR	351	200
February	NR	176	131	NR	103	113	NR	357	273	NR	117	144	NR	193	139	NR	383	202
March	NR	224	181	NR	131	144	NR	487	273	NR	118	178	NR	216	201	NR	386	215
April	NR	327	97	NR	129	48	NR	550	228	NR	222	167	NR	185	156	NR	409	156
May	NR	249	139	NR	145	114	NR	306	232	NR	257	203	NR	207	250	NR	409	226
June	NR	90	67	NR	89	62	NR	265	238	NR	128	198	NR	102	115	NR	420	244
July	56	55	67	79	54	46	81	110	177	NR	38	148	128	89	78	43	210	138
August	75	48	NR	53	58	35	72	178	132	NR	56	101	86	74	44	113	192	103
September	57	99	NR	62	62	40	102	123	200	84	93	159	94	106	74	NR	198	103
October	105	110	153	52	89	56	154	202	207	122	99	152	154	182	178	NR	205	134
November	94	114	NR	50	65	65	171	188	203	104	119	179	136	158	140	144	213	152
December	149	153	206	96	130	100	240	211	206	137	166	159	182	209	165	175	223	141