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Assessment of Ambient Air Quality And It's Probable Health Impact on Human Being Around Chandrapur City

KEYWORDS: Air quality index, Health Impact, RSPM, Chandrapur.

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ABSTRACT *This present study is the ambient air qualities and its impact on human being of Chandrapur district during July 2009 to June 2011 at six different stations. The sample was collected for Respirable suspended particulate matter (RSPM), sulfur dioxide (SO2) and oxides of Nitrogen (NOx). It has been observed that air quality during monsoon period is fairly clean and moderately polluted level and during winter and summer season it is moderately polluted to severely pollute particularly in Ghughus area samples were significantly higher than that of other stations. The average ambient air concentration of SO2 and NOx were found below permissible limits at all sites. It was also observed that RSPM level in almost all samples were higher and the effect cause asthma and various allergy over human being.*

Introduction:
Air pollution is described as the presences of air pollutants in the atmosphere to such an extent that they cause deleterious effects. In recent years there has been significant development activity in terms of industrialization, Urbanization, etc. in Chandrapur and almost all medium and small towns and cities in India (Wahid et al., 2006)[1]. Modernization and enhanced industrial activities have lead to increased use of fossil fuels (Cachier et al., 2005) [2] coupled with sharp increase in vehicular population. Air pollution is one of the major problems in the mining area generally by open cast coal mining and the underground coal mines. All major mining activity contributes to the problem of suspended particulate matter directly or indirectly (Sinha et al., 1997; CMRI. 1998; Chaulya, S. K., 2004) [3, 4, 5].

The respirable particles present in air are responsible for the various health problem such as cardiovascular as well as respiratory diseases (Sagai et al., 1996)[6] of human being because these particles can penetrate deep into the respiratory system, and studies indicates that the smaller the particle, more severe the health impacts (Dockery et al., 1993; Pope et al., 1995; Schwartz et al., 1996) [7, 8, 9]. Ambient particulate matter may be carriers of acidic or toxic species and may have detrimental effects on human health and ecosystems. Besides the effect of particulate matter, literature also suggests that there is a strong relationship between higher concentration of SO_2 and NOx and several health effects (Curtis et al., 2006) [10], like cardiovascular diseases (Zanobetti and Schwartz, 2002; Peters et al., 2004; Chen et al., 2005; Dockery et al., 2005) [11, 12, 13, 14] respiratory health effects such as asthma and bronchitis (Ye et al., 2001; Barnett et al., 2005) [15, 16] and reproductive and developmental effects such as increased risk of preterm birth (Liu et al., 2003) [17].

At elevated concentrations all the metals are harmful to living beings including humans (Yasutake and Hirayama, 1997) [18]. Exposure can occur through a variety of routes; among which inhalation of particles (< 10 µm) is one of the important routes. The inorganic components constitute a small portion by mass of the particulates; however, it contains some trace elements such as As, Cd, Co, Cr, Ni, Pb and Se which are human or animal carcinogens even in trace amounts (ATSDR, 2003; Wang et al., 2006) [19, 20]. The high level of Pb can induce severe neurological and hematological effects on the exposed population especially children, whereas Cd and Ni are known for inducing carcinogenic effects in humans through inhalation. Occupational exposure of Cd is a risk factor for chronic lung diseases (Benoff et al., 2000) [21]. Cr (VI) is known to have toxic and carcinogenic effects on the bronchial tree (Hu et al., 2002; Manalis et al., 2005) [22, 23]. Mn exposure leads to increased neurotoxic impairments (Santos-Burgoa et al., 2001) [24]. The increased level of Cu can lead to respiratory irritance (ATSDR, 2002; Manalis et al., 2005) [25, 23].

Human health risk assessment
The exposure routes considered are inhalation of the metal elements and their ingestion as soil dust. We assume that all of these elements are attached to particles of inhalable size. Dietary intakes, ingestion of water and contribution from other exposure pathways have not been considered due to a lack of data. This study focuses on exposures of adults and small children among which inhalation of particles (< 10 µm) is one of the important routes and other trace elements such as Pb, Cr, Cd, As and Hg.

The reported different types of diseases related hazard from which the mines worker have generally suffered mainly tuberculosis, asthma, liver disease, and other diseases by the respirable particulates depends in size range from

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0.5 to 10µm in the open cast mining areas.

Study Area:
Ballarpur, Ghugus, Gadchandur, MIDC Tadali, and MIDC Chandrapur are located in Chandrapur district of Maharashtra. It is a major store house of medium range of coal and one of the biggest Thermal Power station. Chandrapur district is located in the eastern edge of Maharashtra in 'Vidharbha' region. It is located between 19.30' N to 20.45'N Latitude and 78.46'E longitude. 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. The existing major industries in Chandrapur district include Coal mines of WCL, Cement plants, paper industry, lime mining, steel and Super Thermal Power Plant.

Material and Methods:
In order to know the status of air quality in Chandrapur district, six sampling stations were selected for air quality monitoring. The details about the monitoring sites are given in Table No.-01. Monitoring of the air quality was carried out during **July-2009 to June-2011.**

Sampling methods for gaseous pollutants and Respirable Particulate Matter
The SO_2 concentration in the air is sampled by West-Geake method. NOx concentration in the air sample is measured by Jacob and Hochheiser method. High volume sampler is used to collect samples of NOx present in the ambient air. The interference caused by SO_2 is eliminated by treating with hydrogen peroxide (Senthilnathan, 2007; Harrison et al., 1986; CPCB, 1994) [26, 27, 28]. RSPM is measured gravimetrically with GFA/EPM 2000 filter paper using respirable dust sampler.

Air Quality Index:
Air quality index (AQI) is developed to provide the information about air quality. From a series of observations, an a ratio or number is derived which is an indicator or measure of condition or property the concentration of the major pollutants based on monitored and subsequent converted into AQI shown in Table No-9 using standard formula . The Air Quality Index was calculated by using the method suggested by Tiwari et al., 1987 [29]. The air quality rating of each pollutant was calculated by the following formula,

$$Q = V \times 100 / Vs$$

Where, Qà Quality Rating,
V à The observed value of the Pollutants

Vs à The Standard value recommended for respective Pollutants.

The Vs value used as the recommended national ambient air quality standard for different areas shown in Table No.-09.

The following computation was used to drive the air quality index of the sites under consideration:

$$AQI = 1/3 \times (V_{RSPM} / V_{SRSPM} + V_{SO2} / V_{SSO2} + V_{NOx} / V_{SNOx}) \times 100$$

Where:

V_{RSPM}, V_{SO2} and V_{NOX} = Observed Individual values of suspended particulate matter, respirable particulate matter, sulphur dioxide and oxides of nitrogen respectively.

V_{SRSPM}, V_{SSO2} , V_{SNOx} = Standards values of ambient air quality for respective pollutants.

Results and Discussion:
The air quality prescribed National Ambient Air Quality Standard (NAAQS) values were listed in Table No. 2. The range, average concentration and air quality index regarding for various pollutants at different sampling sites are tabulated in the Table No. 03 to Table No.08 and the description of air quality of various site are tabulated in Table No.10.

The ambient air concentration of RSPM was observed more than the stipulated standards at almost all the sites. It ranged from 50µg/m^3 in Chandrapur to 550µg/m^3 in Ghughus in residential area and 43µg/m^3 in MIDC, Tadali to 420µg/m^3 in MIDC, Tadali in industrial areas. The highest concentration exceeding 100µg/m^3 was observed in all sites. Comparison of our results reveals that the higher levels of particulate matter in the present in the atmosphere. The probable reason for the high levels of atmospheric RSPM may be due to industrial activities.

Gaseous Pollutants were found below the permissible limits at all the sites. The levels of SO_2 and NOx concentrations during year 2009-11 sampling period were well below the permissible limit at all sites. Comparative account of cities based on average pollutant concentration shows that Ballarpur, Chandrapur, Ghughus, Gadchandur, MO MIDC Chandrapur and MIDC Tadali were most polluted.

Since particulate matter has associated with heavy metals and other priority pollutants on its surface, it can pose serious threat to human health with special reference to the respiratory disorders. The association of toxic elements with PM_{10} and smaller particles can be more harmful as these can penetrate deep into the respiratory tract. Hence, high levels of PM_{10} are of major concern in health perspectives and there is an urgent need to regulate the ambient air quality in and around Chandrapur.

Seasonal Variations:
A seasonal comparison SO_2 and NOx level shows a high value in winter. It is observed that in monsoon and summer seasons level is moderate. However, higher concentration of SO_2 noticed in few residential and industrial areas during winter season could be related to the enhanced combustion of fuel for heating. Apart from it, comparatively stable atmospheric conditions in winter may also account for built up concentration of ambient air pollutants (Ravindra et al., 2003)[30]. The NOx concentrations, combined with the intensive ultra-violet radiation, results in photochemical smog with high ozone concentration, which can be adversely affect the human health. The RSPM concentrations, is higher in winter and summer as compare to monsoon seasons in all the sites and it is very well above the permissible limit of CPCB. The sources of such particulates are due to the vehicular and industrial emissions and as also the suspended fine dust carried by the open cast mine present in nearby sites.

Air Quality Index (AQI):
The concentration of the major pollutants are monitored and subsequently are converted into the AQI (Table No.3-8) by using standard formulae, which in the present case

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are defined in experimental section. The higher the value of an index refers to a greater level of air pollution and consequently greater health risks. On the basis of AQI, it can be seen that the residential and industrial areas were moderately to severely polluted in winter and summer seasons and whereas in monsoon it is lie in the range of fairly clean to moderately pollute. It has been also observed that the levels of pollution in the industrial area is very high during the winter and summer seasons as well as the pollution in residential area such as in Ghughus is very high during all the seasons and it is from polluted to severely polluted.

Health risk study of Chandrapur area:

According to survey done we can observed that the quality of the air is polluted during winter and summer seasons due to particulates matter and these pollutants may contains various toxic metals. Such air pollutants are known to cause cardiac and respiratory diseases like asthma, bronchitis in young one and old age person. The individual survey shows that the human being living surrounding areas are suffering from various diseases such as cardiovascular diseases or chronic lung diseases, children and elderly are more susceptible due to polluted air. In the present study it was noticed that a large number of patients visited hospitals during the winter and summer seasons as compare to monsoon seasons. During winter, cold weather condition with high levels of pollutants may aggravate the condition of sensitive population and hence results in increased in health problem.

Conclusion

From the observed data it was marked that the air quality was not so acute at all the six stations. In mining area like Ghughus the RSPM were always found to be more than the CPCB limit and it is dangerous towards the pollution and the health effect on human life. The future scenario will be more complicated in that area. Again same is alarming rate in the MIDC, Tadali and Gadchandur area. Also the Quantity of RSPM is maximum in the month of May and April in all the station due to the clear weather and hot climate. The AQI of residential and industrial areas is high as compared to standards and it indicates the possible threat of air pollutants to the residents of these areas and also probable respiratory problems increase in these areas. The overall monitoring results reveal that the study area is highly polluted with respect to air quality. Hence appropriate measure should be taken right now to reduce the pollution level to safe limit.

Acknowledgements

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I Nilesh P. Nandanwar a research student from Chandrapur a city of Maharashtra State (India) want to submit a research paper in your reputed journal. Chandrapur is an industrial city in Maharashtra state (India) which is 2nd most polluted place in the country.

My study is over the assessment of air pollution in and around the Chandrapur city and its probable health impact on human being. My work is over air pollution and is suitable for publication in Indian Journal of Applied Research. My work is considered under **Science stream (Environmental Sciences and Chemistry)**. The work is original and it is not published and presented anywhere by me.

S. No.	Area	Sampling Code	Sampling Location	Description
1	Ballarpur	S1	Municipal Council Building	R
2	Chandrapur	S2	Administrative Building, Near Bus Stand	R
3	Ghugus	S3	Gram Panchayat Building	R
4	Gadchandur	S4	Gram Panchayat Building	R
5	MIDC, Chandrapur	S5	Multi Organics Pvt. Ltd.	I
6	MIDC, Tadali	S6	Gram Panchayat Building	I

Table No. 01: Details of monitoring sites

Pollutants	Time-weighted average	Concentration in ambient air		
		Industrial Areas	Residential, Rural & other Areas	Sensitive Areas
Sulfur Dioxide (SO_2) ($\mu g/m^3$)	Annual *	80	60	15
	24 hours**	120	80	30
Oxides of Nitrogen as (NO_x) ($\mu g/m^3$)	Annual *	80	60	15
	24 hours**	120	80	30
Respirable Particulate Matter (RPM) (< 10 μ) ($\mu g/m^3$)	Annual *	120	60	50
	24 hours**	150	100	75

Table No. 02: Indian National Ambient Air Quality Standards (NAAQS)

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly 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.

PERIOD	MONSOON-2009				MONSOON-2010			
	SOx	NOx	RSPM	AQI	SOx	NOx	RSPM	AQI
RANGE	10-61	12-29	56-105	27.8-72.5	8-11	14-30	48-110	25.2-52.9
AVERAGE	30.5	20.5	73.25	45.67	9.25	22.75	78	39.33
	WINTER-2009-10				WINTER-2010-11			
RANGE	25-28	14-47	94-197	55.5-89.22	8-20	25-46	114-179	52.6-87.2
AVERAGE	26.75	33.5	154	76.43	13	35	144.25	68.08
	SUMMER-2010				SUMMER-2011			
RANGE	14-40	22-61	90-327	45-151.08	16-34	20-42	67-181	37.33-92
AVERAGE	28.75	42	222.5	103.65	27	30.67	121	64.36

TABLE No-03 AVERAGE AMBIENT AIR CONCENTRATION AND THEIR AQI OF SAMPLING STATION- BALLARPUR (Unit in $\mu g/m^3$)

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PERIOD	MONSOON-2009				MONSOON-2010			
	SOx	NOx	RSPM	AQI	SOx	NOx	RSPM	AQI
RANGE	12-61	21-30	52-79	33.08-53.17	9-18	15-25	54-89	31-43.42
AVERAGE	28.5	24.5	61.5	42.58	13	20.25	65.75	35.77
	WINTER-2009-10				WINTER-2010-11			
RANGE	41-66	28-55	50-140	45.42-90	9-31	24-47	65-141	36.25-79.5
AVERAGE	50	42	97.25	70.75	18.25	33.75	112.25	59.08
	SUMMER-2010				SUMMER-2011			
RANGE	20-43	20-34	89-145	46.33-75.08	19-36	30-40	62-144	41.08-79.67
AVERAGE	32.75	28.5	123.5	66.69	29.67	35.67	106.67	62.78

TABLE No-04 AVERAGE AMBIENT AIR CONCENTRATION AND THEIR AQI OF SAMPLING STATION- CHANDRAPUR (Unit in µg/m³)

PERIOD	MONSOON-2009				MONSOON-2010			
	SOx	NOx	RSPM	AQI	SOx	NOx	RSPM	AQI
RANGE	19-68	15-31	72-154	41.17-92.58	14-22	14-23	110-202	50-86.08
AVERAGE	39	22.25	102.25	59.60	17.75	18.75	153.25	66.29
	WINTER-2009-10				WINTER-2010-11			
RANGE	43-54	22-44	171-360	89.5-160.83	12-19	30-35	188-273	82.67-111
AVERAGE	47.75	36	282	128.89	14.5	32.5	235	97.92
	SUMMER-2010				SUMMER-2011			
RANGE	32-56	17-35	265-550	107.1-210.4	16-39	15-29	228-273	94.42-118.5
AVERAGE	40.75	22	402	160.15	27	23.67	242.75	103.67

TABLE No-05 AVERAGE AMBIENT AIR CONCENTRATION AND THEIR AQI OF SAMPLING STATION- GHUGUS (Unit in µg/m³)

PERIOD	MONSOON-2009				MONSOON-2010			
	SOx	NOx	RSPM	AQI	SOx	NOx	RSPM	AQI
RANGE	47-57	19-21	84-122	59.67-69	9-22	10-22	38-99	23.92-51.33
AVERAGE	52	20	103	64.34	14.25	15.75	71.5	36.33
	WINTER-2009-10				WINTER-2010-11			
RANGE	22-41	22-45	104-228	66.33-108.92	6-23	24-28	119-166	55.5-67.83
AVERAGE	35.75	36.5	146.5	78.94	13.25	26.75	139.25	63.08
	SUMMER-2010				SUMMER-2011			
RANGE	13-47	11-23	118-257	52.67-99.42	16-30	17-34	167-203	82.25-86
AVERAGE	28.25	14.5	181.25	78.23	23.33	24.67	186.5	84.33

TABLE No-06 AVERAGE AMBIENT AIR CONCENTRATION AND THEIR AQI OF SAMPLING STATION- GADCHANDUR (Unit in µg/m³)

PERIOD	MONSOON-2009				MONSOON-2010			
	SOx	NOx	RSPM	AQI	SOx	NOx	RSPM	AQI
RANGE	14-78	15-31	86-128	30.49-64.5	8-17	16-23	74-182	23.11-51.56
AVERAGE	36	20.75	115.5	41.43	13	19	112.75	33.95
	WINTER-2009-10				WINTER-2010-11			
RANGE	66-108	25-45	136-225	59.39-83.33	15-37	25-40	139-212	48.11-65.44
AVERAGE	83.5	35.75	184	74.13	26	33	179.5	56.28
	SUMMER-2010				SUMMER-2011			
RANGE	24-65	18-28	102-216	34.61-73.82	19-39	25-41	115-250	37.78-76.67
AVERAGE	43	22.75	177.5	57.705	31	31.33	180.5	59.24

TABLE No-07 AVERAGE AMBIENT AIR CONCENTRATION AND THEIR AQI OF SAMPLING STATION- MIDC, CHANDRAPUR (Unit in µg/m³)

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PERIOD	MONSOON-2009				MONSOON-2010			
	SOx	NOx	RSPM	AQI	SOx	NOx	RSPM	AQI
RANGE	16-22	10-25	43-113	16.78-38.16	2-9	10-12	192-210	46.28-52.5
AVERAGE	19	17.5	78	27.74	4	10.5	201.25	48.75
	WINTER-2009-10				WINTER-2010-11			
RANGE	20-32	14-23	144-383	45.61-99	10-20	22-26	200-223	54.33-59
AVERAGE	27	18.5	263.25	71.14	13.5	23.5	209.5	56.83
	SUMMER-2010				SUMMER-2011			
RANGE	29-41	16-21	386-420	99.83-109.17	16-32	14-25	144-226	40.33-63.61
AVERAGE	37.5	17.75	406	105.61	24	17.67	185.25	54.91

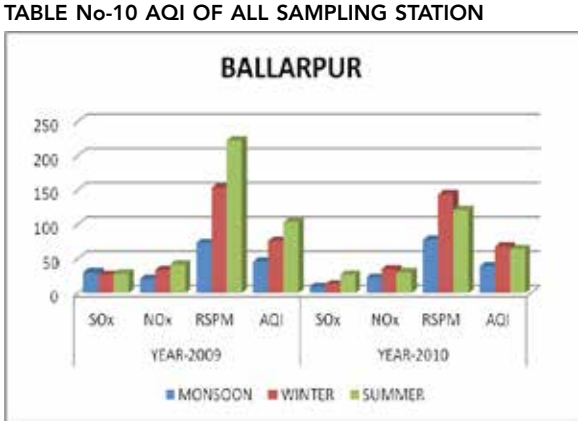
TABLE No-08 AVERAGE AMBIENT AIR CONCENTRATION AND THEIR AQI OF SAMPLING STATION- MIDC, TADALI (Unit in µg/m³)

Category	AQI of Ambient Air	Description of Ambient Air Quality
I	< 10	Very Clean
II	10-25	Clean
III	25-50	Fairly Clean
IV	50-75	Moderately Polluted
V	75-100	Polluted
VI	100-125	Heavily Polluted
VII	> 125	Severely Polluted

TABLE No-09 Air Quality Categories Based on AQI (Tiwari and Ali, 1987)[29]

PERIOD →	MONSOON		WINTER		SUMMER	
YEAR → / STATION ↓	YEAR-2009	YEAR-2010	YEAR-2009	YEAR-2010	YEAR-2009	YEAR-2010
S1	III	III	V	IV	VI	IV
S2	III	III	IV	IV	IV	IV
S3	IV	IV	VII	V	VII	VI
S4	IV	III	V	IV	V	V
S5	IV	IV	IV	IV	IV	IV
S6	III	III	IV	IV	VI	IV

TABLE No-10 AQI OF ALL SAMPLING STATION



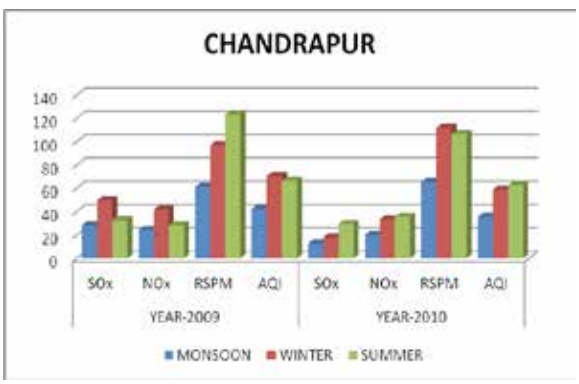
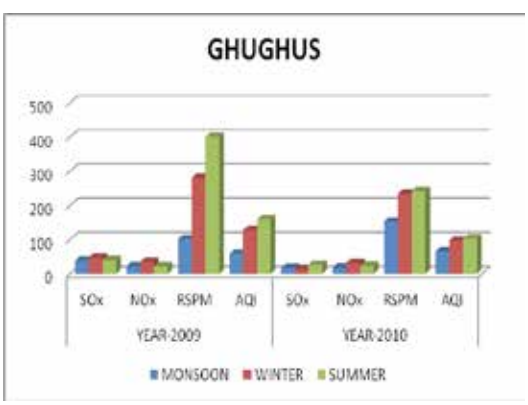


Figure1: Average concentrations of pollutant parameters and AQI at Ballarpur and Chandrapur.



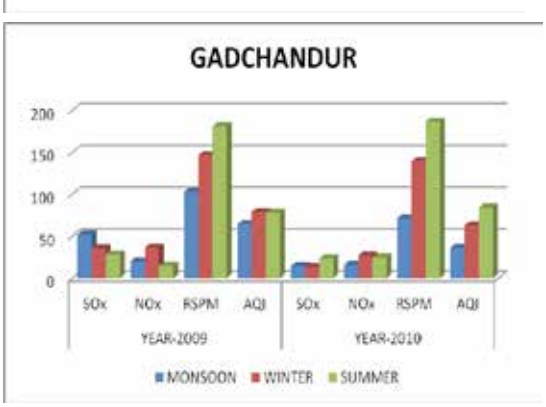


Figure2: Average concentrations of pollutant parameters and AQI at Ghughus and Gadchandur.

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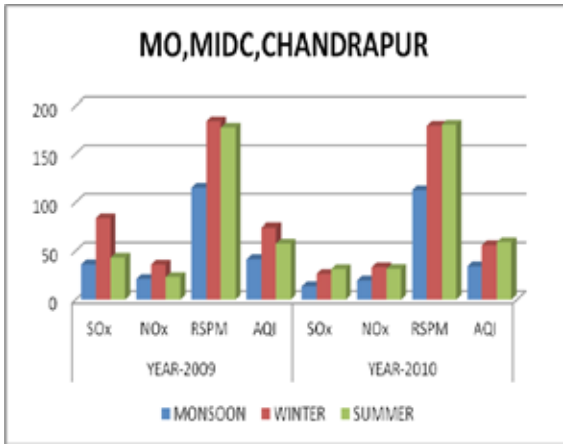

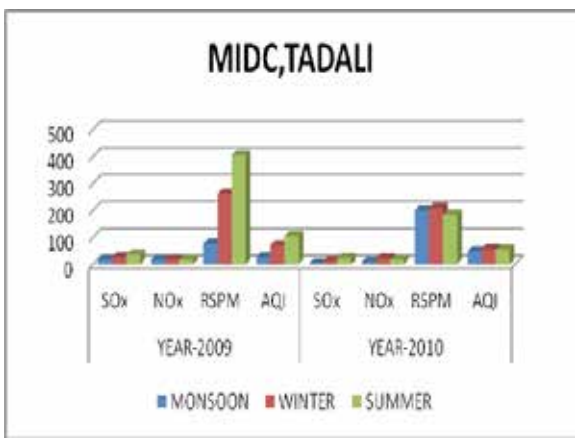

TFigure3: Average concentrations of pollutants parameter and AQI at MO, MIDC, Chandrapur and MIDC, Tadali.

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