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Baseline Air Quality Monitoring For Palvoncha Thermal Power Plant

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Abstract
The paper describes the experience and results from three months of baseline air quality monitoring campaigns in the Palvoncha city, Khammam District of Andhra Pradesh. Air quality measuring is still less experienced in South India. In this study the air pollutants majorly concentrated. Air quality measurement of PM_{10}, $PM_{2.5}$, NOx and SO_2 concentrations has been done in several locations in Palvoncha.
***Key words*:** Air pollution, Air quality monitoring.

I. INTRODUCTION

The paper is an attempt to describe complex problems concerning air quality in Palvoncha city of Andhra Pradesh, in an Indian perspective. The town is one of the most developed ones in Andhra Pradesh, famous for its history and rapid progress into a modern but traditional location of human development [1]. Air pollution in a modern city has became a serious environmental problem, because of the combined effects of various pollutants upon the physical and mental health of citizens and the quality of urban life in general [2], [3], [4]. Urban air pollutants arise from a wide variety of sources although they are mainly a result of combustion processes. Today, the largest source of pollution in urban areas is the fleet of transportation (motor vehicles), and to a lesser extent industry and household. Traffic-generated pollutants include10 micron Particulate Matter (PM_{10}), 2.5 micron Particulate Matter (PM2.5), Nitrogen Oxides and Sulfur Dioxide. On warm summer days the strong sunlight leads to enhance to buildup of SO_X and NO_X ozone through the oxidation of nitrates and sulfates.

Health impacts of vehicular exhaust pollutants are well documented. Respirable particulate Matter (RPM), or PM_{10}, and gaseous pollutants such as nitrogen oxides are known to have detrimental effects on human health and the relationship between air pollutants and health has been widely studied - an increase in yearly average PM_{10} concentration increases the number of respiratory hospital admissions and the mortality rate [5]. There is also an association between concentration of nitrogen dioxide (NO_2) and hospital admissions associated with cardiovascular diseases. Nevertheless many authors achieved research in the domain, for the Balkan region especially [6], [7], [8]. Many cities set up fixed air quality monitoring stations to monitor the air quality on a continuing basis and to measure concentrations of major pollutants at roadside and urban background locations. Many cities and countries have also set short- and long-term air quality objectives for acceptable, alert and limit concentration levels of pollutants. Based on observations made at monitoring stations, advisories and warnings are issued when concentration of one or more pollutants exceeds the values. The planning authorities may also use measurements at background monitoring stations to formulate pollution abatement measures and to examine the effectiveness of these measures. Long-term measurements at monitoring stations may be used to investigate the relationship between the population exposure to air pollutants and the incidence rate of diseases [9], [10].

There are many ways to measure air pollution, with both simple chemical and physical methods and with more sophisticated electronic techniques, in addition to modeling possibilities, according special tailored programs, according emission factors and pollutant inventory, for real or probable meteorological conditions [9], [10], [11]. Passive sampling methods provide reliable, cost-effective air quality analysis, which gives a good *indication* of average pollution concentrations over a period of weeks or months. Passive samplers are so-called because the device does not involve any pumping. Instead the flow of air is controlled by a physical process, such as diffusion. Active sampling methods use *physical or chemical methods* to collect polluted air, and analysis is carried out later in the laboratory. Typically, a known volume of air is pumped through a collector (such as a filter, or a chemical solution) for a known period of time. The collector is later removed for analysis. *Automatic* *methods* produce high-resolution measurements of hourly pollutant concentrations or better, at a single point. Pollutants analyzed include Nitrogen oxides, Sulfur dioxide, and Particulates. The samples are analyzed using a *variety of methods including spectroscopy*. The sample, once analyzed is downloaded in real-time, providing very accurate information. *Remote optical, long path analyzers* use spectroscopic techniques, make real-time measurements of the concentrations of a range of pollutants. The paper relates to the experience and results from a range of over 90 days of air quality monitoring campaigns in the Palvoncha of Andhra Pradesh, achieved in special selected sites, for which local concern and complain raised: cross roads, industrial areas, and in parks. Research has been carried out in order to detect the effects of the principal polluting sources of the city, and to measure their contribution to the general situation of the air quality. The semi-mobile monitoring station was in operation for a period of 3 months, beginning in March 2013 and ending in May

2013. Air quality measuring is still less experienced in South Asian countries. The APPCB undertook on line experiments Near Thermal power plant project proposed area, using measuring methods, in accordance to the Central Pollution Control Board (CPCB), but also remote controlled open path techniques. The values measured may be analyzed as scientific values for the monitoring periods, on the specific locations, and may be used scientifically to raise alert and interest of the local community and inform the population. The disadvantage of being fixed determines that they measure only in the local area, and only if all are functional in the entire city, might determine an average attested value. If a particular episode or a special site is of concern, only a mobile laboratory, specialized and attested, might perform such relevant data measuring, on line. Air pollutants and meteorological parameters were measured. The ½h mean value was preferred over the regulated 1h mean value in order to capture high peaks of pollution, for better identification of pollution sources and influences. The comparison between measured values and regulated admissible limit values was not a major purpose of this study.

In Andhra Pradesh SO_2 and NO_x control and air quality analysis have not a traditional approach and presently efforts are notable, direct from the ministry and authorities of resort, agencies, but also independent laboratories, institutes and industrial units. The SO_2 and NO_x monitoring equipment at sources is expensive and available only in some major power stations or main polluters, the control of the pollutant emissions at the souse is presently achieved, on a regular program, approved individually the environmental agencies, through direct measurements once per year or in best cases quarterly or monthly.

II. EXPERIMENT

The presented air quality monitoring campaign has been done in 2013 in several locations in Palvoncha.

Figure 1. Location of the Proposed area

During the campaign PM10, PM 2.5, SO_2 and NO_X were measured. At the same time the traffic structure has been establish and meteorological parameters recorded (wind speed and direction, air temperature and humidity). All equipments are calibrated at the start of the campaigns with traceable to NIST provided special calibration gases and under strict EN ISO/CEN 17025:2005 quality control specifications.

In figure 2 the conceptual scheme of the air quality monitoring station is presented. All instruments are programmed to measure the pollutants concentration in air continuously, and the output signal is collected and recorded by a data acquisition PC board. All instruments are calibrated with etalon gases, traceable to the station. The monitoring station is equipped with a metrological verified station and the values for wind speed and direction, air temperature, pressure and humidity are continuously measured and recorded.

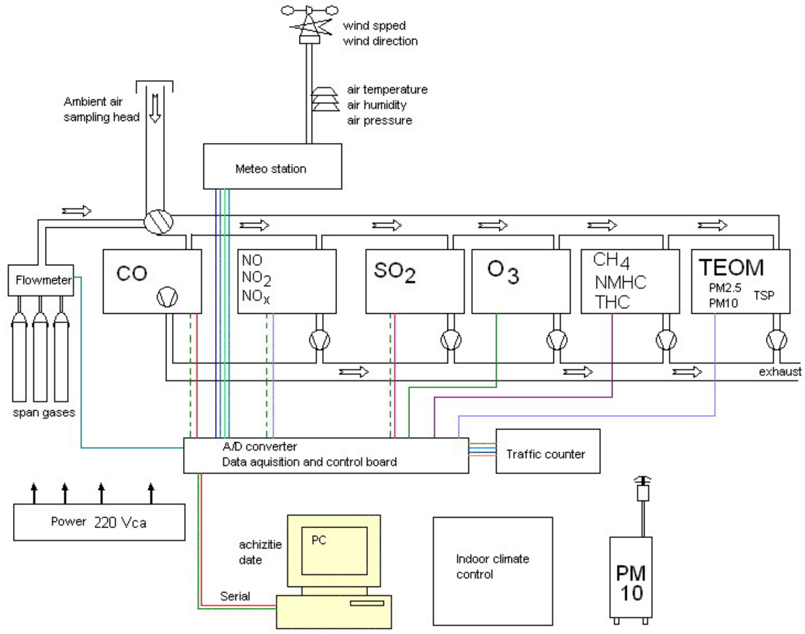

Figure 2. The Schematics of the AQM Mobile Station.

The concentration in air of significant air pollutants is regulated by CPCB directives. The limit values (in reference to normal pressure and 20 °C) for concentration of the pollutants measured are:

National Ambient Air Quality Standards			
Pollutant	**Averaging Period**	**Level**	**Frequency**
PM-10	24-hours	150 ug/m3	4th high
PM-2.5	24-hours	35 ug/m3	98th percentile
	Annual	15.0 ug/m3	Annual average
Sulfur dioxide (SO2)	1-hour	75 ppb	99th percentile
Nitrogen dioxide (NO2)	1-hour	100 ppb	98th percentile
Ozone	8-hour	0.075 ppm	4th high
Carbon Monoxide (CO)	1-hour	35 ppm	2nd high
	8-hour	9 ppm	2nd high
Lead	3-months	0.15 ug/m3	Highest average

2.1 Design Network for Ambient Air Quality Monitoring Stations

The following criterion was taken into account in the design of ambient air quality monitoring network:

The priority area for air monitoring/sampling was identified by considering the predominant wind direction and wind speed,

topography / terrain of the study area, density of population within the region, residential and sensitive areas. Meteorological data at the project site during study period is an essential

requirement for proper interpretation for baseline air quality status and same is also useful in prediction of impacts through mathematical models.

2.2 Meteorology Station

Meteorological study is a crucial part in Environmental Impact Assessment Study. In order to assess the background environmental conditions a weather monitoring station was installed at a height of 3 m above the ground level in the project vicinity for continuous recording of micro meteorological parameters like wind speed, wind direction, cloud cover, rainfall, air temperature and relative humidity. This site is free from hindrance and open from all direction. The collected meteorological data during summer season were analyzed for hourly variation.
The following meteorological parameters were recorded during the study period:

- Wind speed
- Wind direction
- Temperature
- Humidity
- Rainfall
- Cloud Cover

2.2.1. Temperature

Average temperature in the study area varied between 17oC to 43oC during the study period. Mean daily variation of maximum, minimum and average temperature were recorded at site during March-May 2013.

2.2.2. Relative Humidity

Relative humidity in the study area was found varied between 12 % to 91 %. Mean daily variation of maximum, minimum and average Humidity at site was also recorded.

2.2.3. Pressure

The air pressure in the study area was observed to vary between 1001 hpa to 1016 hpa during March-May 2013. Mean daily variation of maximum, minimum and average Pressure at site was recorded during study period.

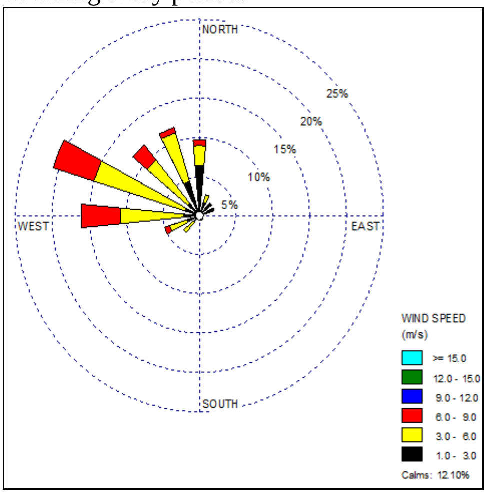

Figure 3. Wind Rose Diagram of March 2013

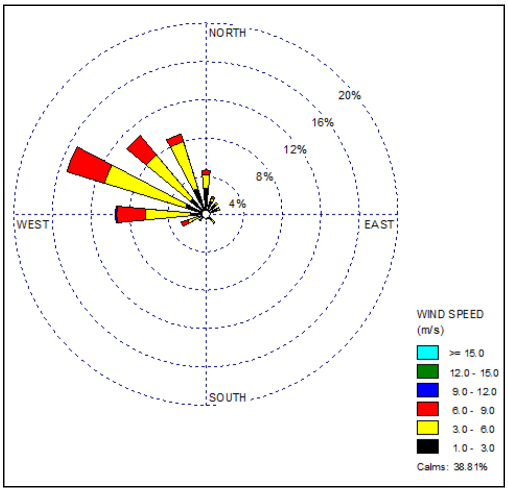

Figure 5. Wind Rose Diagram of May 2013

2.2.4. Wind Speed

The wind speed in the study area was observed between Calm to 13.61 m/s. The average wind speed in the area was observed 2.54 m/s. Mean daily variation of maximum, minimum and average Wind speed at site was recorded during study period.

2.2.5. Wind Direction

From the wind rose diagram it is observed that predominant wind direction is NW to SE and the windrose diagram 3.1.

2.2.6. Rainfall

No rainfall observed in the study area during the study period.

2.2.7. Cloud cover

In the study area, clear weather prevails in most of the time during study period.

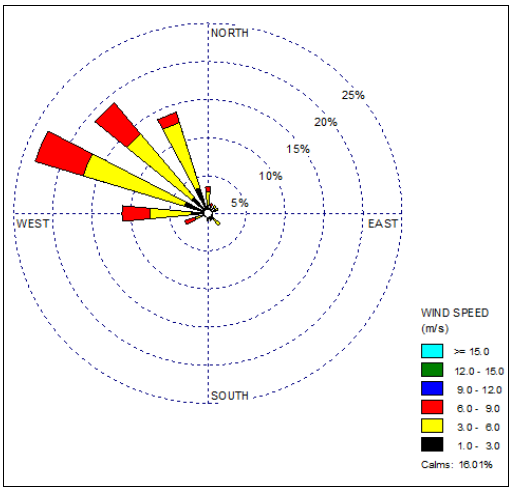

Figure 4. Wind Rose Diagram of April 2013

2.3 One Season AAQ Data

Ambient air quality was monitored twice in week for 24 hourly average basis as per standard guidelines of CPPCB and NAAQS. The conventional and project specific parameters such as PM 10 ,PPM 2.5 , Sulphur Dioxide (SO_2), and oxides of nitrogen (NOx), were monitored at different monitoring location around 10 Km radius from the project site during the study period.

2.4 Air Monitoring Station

Overall 4 locations were identified for study of air quality including a station near project site (salt pan) and four in surrounding villages. A North West and south west part of the study area is occupied by mud flats and salt pans. No villages and habitation observed in this portion of the study area.

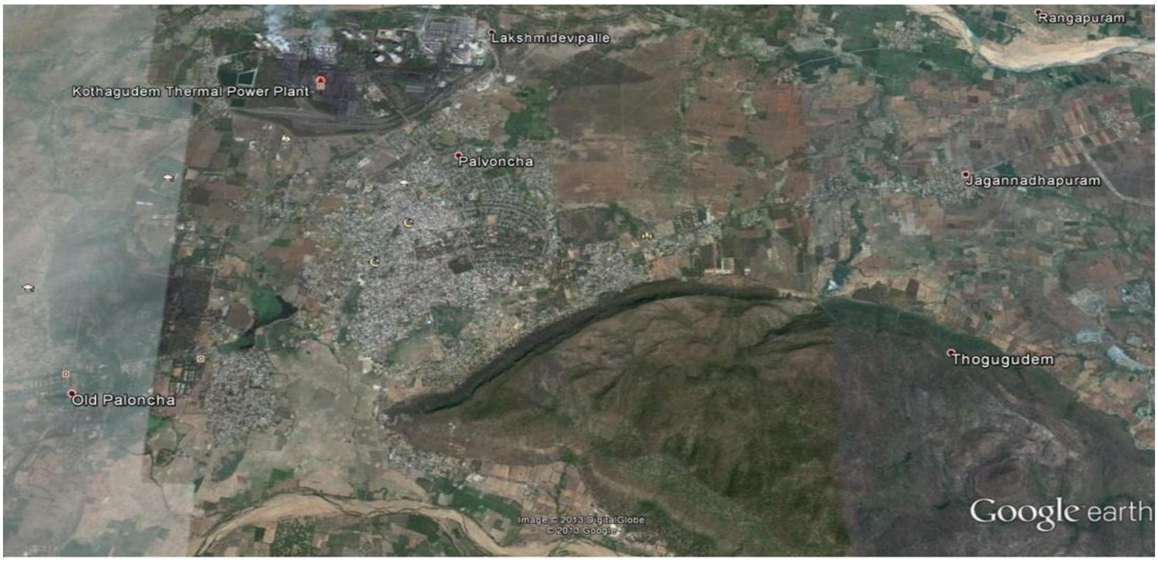

Figure 6. Air sampling locations

Hence the monitoring locations of were selected in the immediate surroundings villages of the project site.

The air monitoring locations were also selected considering the prevailing meteorological condition in the study area, the nearby road networks. The sampling station was placed at a height of minimum 3 mm above the ground level. The air monitoring locations are depicted on the study area map as given below table.

Table 1. Air monitoring locations

Village	Direction	Approx. Aerial Distance	Latitude	Longitude
Lakshmidevi Temple	NE	1.75	17^0 36' 58"	80^0 41' 31"
Palvoncha	SE	1.88Km	17^0 37' 23"	80^0 42' 30"
Somulagudem	NE	3.39Km9+	17^0 37' 52"	80^0 43' 30 "
Rangapuram	EE	2.3 Km	17^0 37' 34"	80^0 45' 44"
Jagannatha Puram	SE	2.37Km	17^0 36' 21"	80^0 51' 13"
Thodugudem	SE	4.17	17^0 35' 15"	80^0 44' 55"
Punukula	NW	6.96 Km	17^0 38' 36"	80^0 40' 43"

III. Method of Analysis

The different analysis method used for different pollutants with the minimum detection limit is given in the table below table 2.

Table 2: Analysis methods and Instrument details

S. No	Name Of Parameter	Monitoring Technique	Detection Limit	Instrument Details
1	PM 10	IS 5182 (Pt 23)	4µg/m3	Respirable Dust sampler / Weigh Balance
2	PM 2.5	IS 5182 (Pt 23)	2µg/m3	Fine Particulate sampler/ Weigh Balance
3	SO 2	IS-5182(part 2):2001 EPA modified West and Gaeke method	0.5µg/m3	Gaseous sampler attached with Respirable Dust sampler Spectro Photometer
4	NOx	IS-5182(part 6):2006 Jacobs – Hochheiser method – First revision	5.5µg/m3	Gaseous sampler attached with Respirable Dust sampler / UV – VIS Spectro Photometer

IV. Results and Discussion:

The Ambient Air Quality monitoring results are tabulated for the monitored locations and presented in the following sections. The observed 24-hour Minimum, Maximum and average value of PM 10 , PM 2.5 SO_2, NOx, concentrations have been presented in table 3

S.No.	site	code
1	NearProject site	1
2	Location-1	2
3	Location-2	3
4	Location-3	4
5	Location-4	5
6	Location-5	6
7	Location-6	7

Table 3: Analysis methods and Instrument details

Parameters	**Observed values**	**SAMPLING LOCATIONS**							**CPCB limits**
		NearProject site	Location-1	Location-2	Location-3	Location-4	Location-5	Location-6	
PM10	*Min*	51.0	55.3	42.0	47.0	54.8	49.0	51.0	100
	Max	80.0	92.0	81.2	82.0	93.0	89.1	77.2	
	Avg	65.6	72.8	62.7	64.9	69.8	67.1	65.2	
	98 percentile	78.1	91.5	78.8	78.8	89.3	85.8	77.1	
PM2.5	*Min*	30.6	31.0	25.2	28.2	31.8	29.4	30.6	60
	Max	48.0	53.8	47.1	49.2	55.8	53.5	46.3	
	Avg	38.6	42.7	36.9	38.2	41.0	39.5	38.3	
	98 percentile	46.2	52.8	46.4	46.5	52.8	51.5	45.4	
NOx	*Min*	10.5	14.7	14.6	14.6	16.2	15.8	14.8	80
	Max	24.2	28.3	24.9	28.2	22.4	24.8	24.1	
	Avg	18.0	21.4	20.7	21.0	19.4	20.0	18.7	
	98 percentile	23.8	27.7	24.8	27.1	22.2	24.4	23.4	
SO_2	*Min*	6.8	7.9	7.6	8.3	6.2	7.8	7.2	80
	Max	15.3	17.2	15.4	17.9	15.6	16.9	19.5	
	Avg	10.6	13.6	12.0	14.1	11.6	12.9	12.0	
	98 percentile	14.7	17.2	15.1	17.7	15.3	16.4	17.2	

PM_{10}

The peak PM_{10} 24-hours average concentrations in the study area were observed in the range of 42.0 to 93.0µg/m3, with the average mean values in the range of 62.7to 69.8 µg/m^3. At all locations air quality values were lower than that of the NAAQ standard (100 µg/m^3) (figure 7).

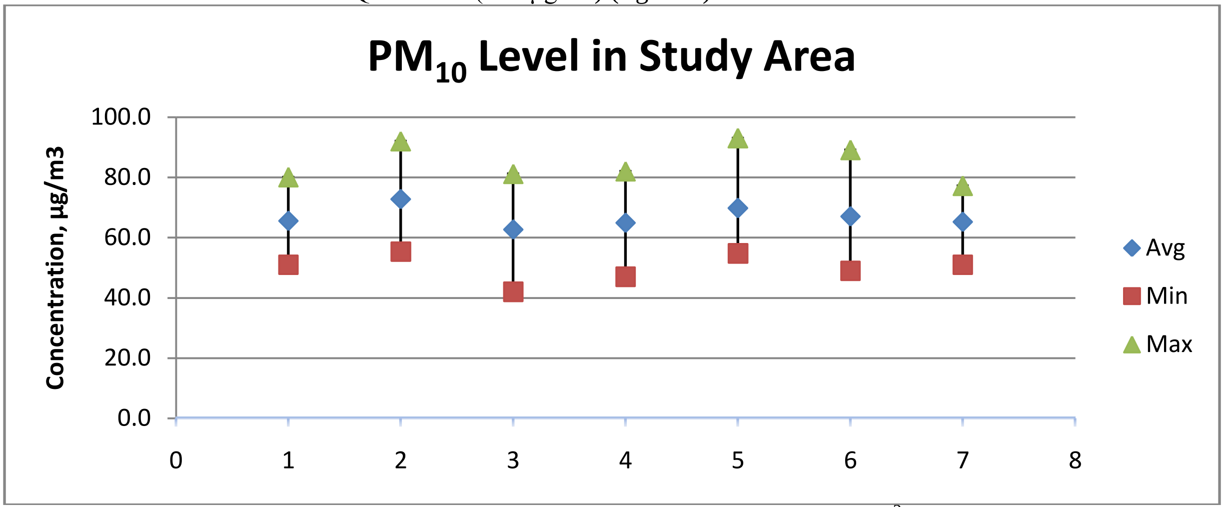

Figure 7. Measured Ambient PM_{10} concentration (µg/m^3)

PM2.5

The minimum and maximum value for $PM_{2.5}$ was found between 25.2to 55.8µg/m^3, with the average values ranges between 36.9 to 42.7µg/m^3 which is lower than that of the NAAQ standard (60 µg/m^3) (figure 8).

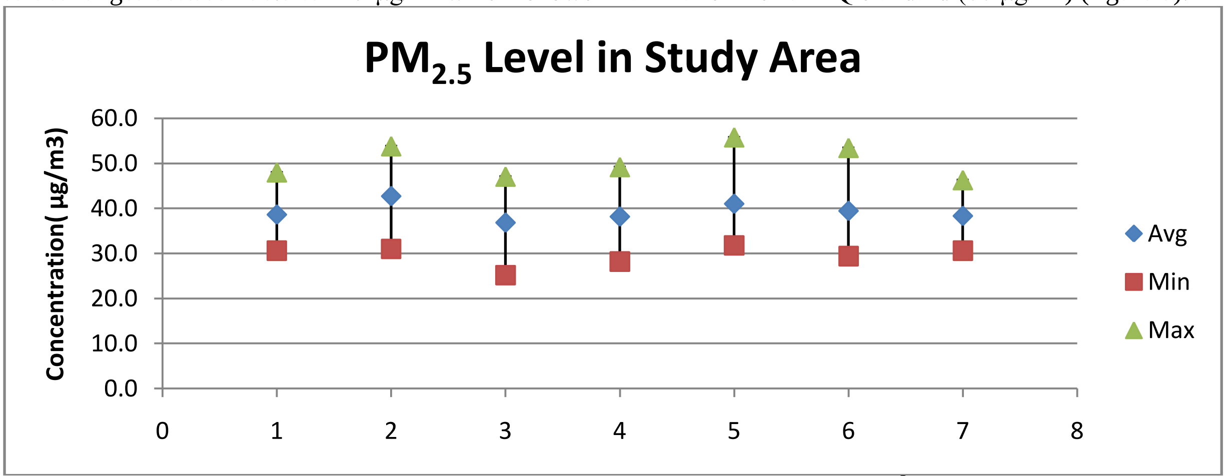

Figure 8. Measured Ambient $PM_{2.5}$ concentration (µg/m^3)

NO_x

The nitrogen oxide concentration in the study area varied between 10.5 to 28.3 µg/m^3, with the mean values in the range of 18.0 to 21.4µg/m^3 which is lower than that of the NAAQ standard (80 µg/m^3) (figure 9).

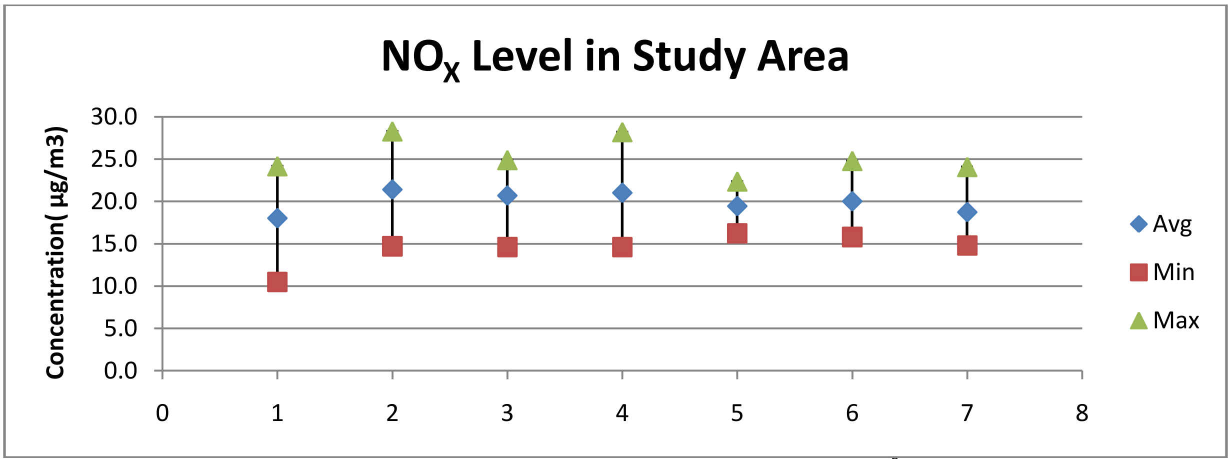

Figure 9. Measured Ambient NO_X concentration ($\mu g/m^3$)

SO_2
The maximum concentration of sulphur dioxide in the study area was observed as $19.5 \mu g/m^3$ where as the minimum $6.2\ \mu g/m^3$ and average value ranges between $10.6 \mu g/m^3$ to $14.1\ \mu g/m^3$ (figure 10).

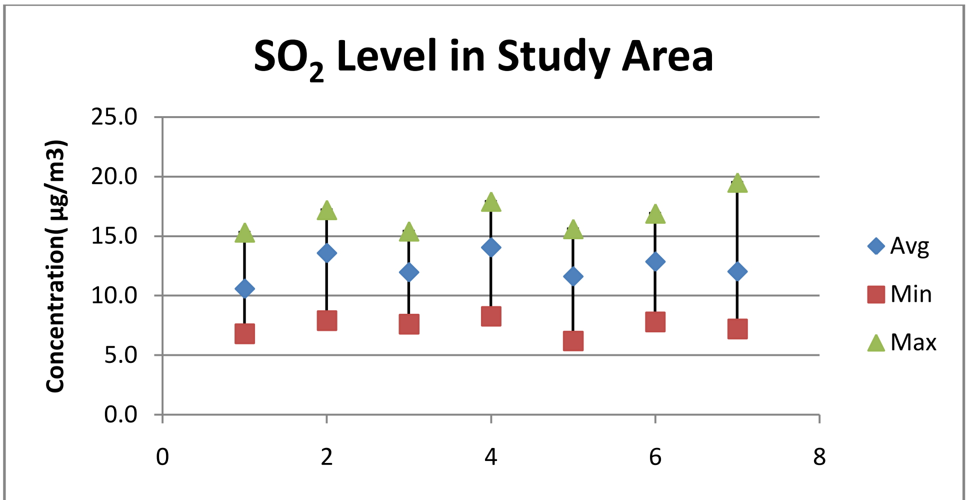

Figure 9. Measured Ambient SO_2 concentration ($\mu g/m^3$)

V. Conclusion

An air quality impact assessment has been conducted for both construction and operational phases of proposed thermal power plant in Andhra Pradesh Reclamation Development Phase I. The fugitive dust assessment for the construction has concluded that watering in all works area during working hours would be required to control the fugitive dust impact. Potential dust impact would be generated from the site clearance, ground excavation, construction of the associated facilities and transportation of soil during the construction phase.

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