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AMBIENT AIR QUALITY IN RAMAGUNDAM INDUSTRIAL CITY.

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ABSTRACT

Clean air is the foremost requirement to sustain healthy lives of humankind and those of the supporting ecosystems which in return affect the human wellbeing. Release of various gaseous emissions and particulate matter (PM) has been on the rise due to rampant industrialized growth. Anthropogenic emissions of various kinds are being pumped into the atmosphere (called primary pollutants) and lead to the formation of new pollutants due to chemical reactions in the atmosphere (called secondary pollutants). These are building up the concern of ambient air pollution (AAP) as a prominent global threat to human health in many ways. According to the Fifth Assessment Report of the IPCC, nearly all the non CO_2 climate altering pollutants are health damaging, either directly or by contributing to secondary pollutants in the atmosphere.

The main aim of the paper is to evaluate the urban ambient air quality in Ramagundam Industrial City. The criteria pollutants are evaluated are $PM_{2.5}$ (or) Suspended Particulate Matter (SPM), PM_{10} (or) Respirable Particulate Matter (RPM), Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_2). The focus on just these four is for the sake of monitoring the general state of air quality and it does not mean that the other air pollutants do not impact health of humans and that of the environment. Relevant data on air quality is obtained from Telangana Pollution Control Board (TSPCB) and the assessment was carried out through applying the method called Exceedence Factor (EF). An in-depth analysis has been made by using the above method with the available data on air pollution. While applying EF method, the air quality gets classified into four different categories of pollution level are Critical, High, Moderate and Low.

KEYWORDS | Air Quality, SPM, RPM, SO_2, NO_2, Exceedence Factor, TSPCB.

Introduction:

The atmosphere of Earth is a layer of gases surrounding the planet Earth that is retained by Earth's gravity. The atmosphere protects life on Earth by absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night (diurnal temperature variation), the common name given to the atmospheric gases used in breathing and photosynthesis is air. By volume, dry air contains 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.039% carbon dioxide and small amounts of other gases. Rapid urbanization and industrialization has added other elements or compounds to the pure air and thus caused the increase in pollution. In order to prevent, control abate air pollution, the air (prevention and control of pollution) Act was enacted in 1981, According to section 2(b) of Air (prevention and control of pollution) Act, 1981 'air pollution' has been defined as 'the presence in the atmosphere of any air pollutant', As per section 2(a) of Air (prevention and control of pollution) Act, 1981 'air pollution' has been defined as 'any solid, liquid, or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment', Therefore ambient air quality standard is developed as a policy guideline that regulates the effect of human activity upon the environment so that pollutant emission into the air can be regulated. Standards may specify a desired state of limit alterations. The main aim of the paper is to evaluate the urban ambient air quality in Ramagundam Industrial City. The criteria pollutants are evaluated are Suspended Particulate Matter (SPM) or $PM_{2.5}$, Respirable Particulate Matter (RPM) or PM_{10}, Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_x).

Study Area:

The Present Study has been carried out in Ramagundam. It is located on the banks of Godavari River in the Karimnagar district of Telangana State. The town of Ramagundam gets its name from a combination of two words: (Rama + Gundam). A famous temple of the Hindu God Lord Rama is situated in the old part of the town and 'Gundam' means Water Springs. Ramagundam is known as town Of Energy. As of 2011 census, the city had a population of 2,29,644 making it the fifth most populous city in the state. Its Latitude and Longitude are 18°80' N and 79°45' E respectively. It has an average elevation of 179 meters (590 feet). It is about 250 Kilometers (155 mi) north east of state capital Hyderabad and 60 km from Karimnagar. Ramagundam city is situated in the Godavari valley coalfields and has one of the India's largest Thermal Power stations in south region under NTPC. Ramagundam is considered to be second polluted city in Telangana State after Hyderabad because Mostly industries are connected with Godavarikhani - NTPC Ramagundam. Some of them are Fertilizer Corporation of India, Kesoram Cement, National Fertilizers Limited, Engineers India Limited, TSGENCO thermal power station, Kesoram (Birla) cement factories, NTPC (RSTPS – Ramagundam Super Thermal Power Station).

Database and Methodology:

The Study has been completed based on secondary sources of data. The data pertaining to the concentration of air pollution into the ambient air has been obtained from the Telangana Pollution Control Board (TSPCB). The annual average, monthly average and seasonal average concentration of criteria pollutants into the ambient air has been interpreted by comparing the monitored data from TSPCB with the National Ambient Air Quality Standards (NAAQS). The assessment of air quality has done by applying the method called Exceedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard) introduced by Central Pollutant Control Board (CPCB). While applying EF method, the air quality gets classified into four different categories of pollution level are Critical, High, Moderate and Low.

$$\text{Exceedence Factor} = \frac{\text{Observed annual mean concentration of criteria pollutant}}{\text{Annual standard for the respective pollutant and area class}}$$

The four air quality categories are:

- Critical pollution (C) : when EF is > 1.5;
- High pollution (H) : when the EF is between 1.0-1.5;
- Moderate pollution (M) : when the EF is between 0.5-1.0; and
- Low pollution (L) : when the EF is < 0.5.

Sources of Air pollution in Ramagundam:

Urban arrears are considered to be the world's primary sources of air pollution and hazardous waste generation. Currently the world's urban complexes, which occupy less than 5 per cent of the earth's land area, produce as much as 80 per cent of the CO_2 pollution (Ghosh and Maji, 2011). Several factors causes air pollution in Ramagundam. Among them the main factor is NTPC, where the abundance use of Coal and poor controlling is making the NTPC the major air polluting factor. The main factors are Industries located in Ramagundam such as NTPC (RSTPS – Ramagundam Super Thermal Power Station), SCCL (Singareni Colleries Company Limited), Fertilizer Corporation of India, Kesoram Cement, National Fertilizers Limited, Engineers India Limited, TSGENCO thermal power station, Kesoram (Birla) cement factories.

NTPC Ramagundam, a part of National Thermal Power Corporation is a 2600 MW Power station situated at Ramagundam in Karimnagar district in the Indian state of Telangana. It is the current largest power station in South India. It is the first ISO 14001 certified Super Thermal Power Station in India. The Singareni Collieries Company Limited (SCCL) is a government owned coal mining company. It is involved in coal extraction in Telangana, in the Pranhita Godavari Valley region, which has significant coal reserves, with proven geological reserves estimated at 8,791 million tonnes. Ramagundam is one of the important operating area of singareni collieries. There are three divisions (RG-1, RG-2, RG-3) and Adriyala project area in ramagundam region. Singareni collieries has established a thermal power project of 1,200 MW (2 X 600 MW) in the town Jaipur of Bellampalli region in ADILABAD district. There is a proposal to establish one more 600 MW unit at Jaipur power plant.

Ambient Air Quality in Ramagundam:

The ambient air quality monitoring network involves measurement of a number of air pollutants at different locations in the country. The TSPCB (Telangana State Pollution Control Board), nodal agency to monitor air quality in Telangana, regularly monitors ambient air quality of major towns and industrial areas of the state throughout the year using manually operated Respirable Dust Samplers. In case of Ramagundam the TSPCB monitoring the air quality data from the year 2010 in only one station i.e Ramagundam municipal complex. Air qualities at this station were monitored during the period 2010 to 2014 for four criteria pollutants namely Suspended Particulate Matter (SPM) or $PM_{2.5}$, Respirable Particulate Matter (RPM) or PM_{10}, Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_2). But from the year 2015 parameter SPM was dropped from the criteria pollutants and new parameter NH_3 was introduced because NAAQS has discontinued recording the SPM parameter.

NAAQS (National Ambient Air Quality Standards) of CPCB Revised National Ambient Air Quality Standards (NAAQS) [NAAQS Notification dated 18th November, 2009]

Sl. No.	Particulates	Time weighted Average	Concentration in Ambient Air	
			Industrial, Residentia, Rural and other areas	Ecologically Sensitive Area (Notified by Central Govt.)
1	Sulpher Dioxide (SO2), µg/m^3	Annual *	50	20
		24 Hours**	80	80
2	Nitrogen Dioxide (NO2), µg/m^3	Annual *	40	30
		24 Hours**	80	80
3	Particulate Matter (Size < 10 Mg) or Pm10 µg/m^3	Annual*	60	60
		24 Hours**	100	100
4	Particulate Matter (Size < 2.5 Mg) or PM2.5 µg/m^3	Annual *	40	40
		24 Hours	60	60

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

** 24 hourly 08 hourly or 01 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

Annual Average concentration of Ambient Air Quality.

Table 1: Annual Average concentration of Ambient Air Quality in Ramagundam (2010-2014)

Sl. No.	Observed year	Annual Average (µg/m^3)			
		RPM	SPM	SO_2	NO_x
1	2010	70	235	5.3	13.3
2	2011	66	163	5.4	11.6
3	2012	82	214	9	15
4	2013	74	195	11.2	16.1
5	2014	57	141	5.8	13.8
6	2015	65	NA	7.0	25

NA = Data Not Available.
Note: [Standards: RPM-60 µg/m^3; SPM-40 µg/m3; SO_2-50 µg/m^3; NO_x-40 µg/m^3]
Source: TSPCB (Telangana State Pollution Control Board).

The annual average concentration of pollutants into the ambient air in Ramagundam has revealed that the value for the parameters RPM and SPM exceeded the values of NAAQS (National Ambient Air Quality Standards) in almost all the observed years i.e. from 2010 to 2015(Table 1). SPM values are exceptionally exceeded the values of NAAQS in all the observed years. 141 µg/m3 was the least recorded value of SPM in the year 2014 among all the observed years. Which is three and half times greater than the SPM Standards (SPM-40 µg/m3) of NAAQS. RPM was recorded highest values of 82 µg/m^3 and 74 µg/m^{3}in the years 2012 and 2013 respectively but in the year 2014 it was decreased to 57 µg/m^3 which is below the standard value (RPM-60 µg/m^3) of NAAQS. Again in the year 2015 it was increased to 65 µg/m^3. It is clearly observed that the concentration of SO_2 and NO_X remained within the limits of national Standards (SO_2-50 µg/m^3; NO_X-40 µg/m^3) where the recorded value has found to be very low in all the observed years.

Monthly Average concentration of Ambient Air Quality

Table 2: Monthly Average concentration of Ambient Air Quality in Ramagundam (2013)

Sl. No	Month, Year	Annual Average Concentration (µg/m3)			
		RPM	SPM	SO_2	NO_x
1	Jan-13	122	265	BDL	12.0
2	Feb-13	118	289	35.4	24.9
3	Mar-13	94	237	23.3	23.0
4	Apr-13	82	224	18.3	22.2
5	May-13	94	298	5.9	9.9
6	Jun-13	34	127	5.4	21.4
7	Jul-13	36	74	4.0	10.2

8	Aug-13	33	98	9.0	17.1
9	Sep-13	45	123	5.6	9.8
10	Oct-13	44	112	4.1	9.0
11	Nov-13	81	211	8.0	12.8
12	Dec-13	152	356	4.7	16.7
13	Average	74	195	11.2	16.1

Note: [Standards: RPM-100 µg/m^3; SPM-60 µg/m^3; SO_2-80 µg/m^3; NO_2-80 µg/m^3]

Source: TSPCB (Telangana State Pollution Control Board).

The monthly average concentrations of RPM were recorded higher than the national standards (RPM-100 µg/m^3) during the months of January, February and December with values 122 µg/m^3, 118 µg/m^3,152 µg/m^3 Respectively (Table 2). While the Lowest RPM parameter were recorded in the month of August with 33 µg/m^3. In case of SPM all the months are exceeded the national standards (SPM-60 µg/m^3). The highest value for SPM were recorded in the month of December with the value 356 µg/m^3, which is six times greater than the national standard. The concentration of SO_2 and NO_x remained within the national standards (SO_2-80 µg/m^3; NO_2-80 µg/m^3) for the entire year.

Seasonal Average concentration of Ambient Air Quality.

Table 3: Seasonal Average concentration of Ambient Air Quality in Ramagundam (2013).

Seasons	Concentrations in (µg/m^3)			
	RPM	SPM	SO_2	NO_x
Summer(Mar-May)	90	253	15.83	18.36
Monsoon (June- Aug)	34.33	99.66	6.16	16.23
Post Monsoon (Sept Nov)	56.66	148.66	5.9	10.53
Winter (Dec-Feb)	130.66	303.33	20.05	17.86

Note: [Standards: RPM-60 µg/m^3; SPM-40 µg/m^3; SO_2-50 µg/m^3; NO_2-40 µg/m^3]

Source: TSPCB (Telangana State Pollution Control Board).

The seasonal concentration of ambient air quality in Ramagundam has revealed that the concentrations were higher during the winter season with values 130.66 µg/m^3 for RPM and 303.33 µg/m^{3}for SPM which were much more than the prescribed national standards. Low concentrations were recorded during monsoon season with values 34.33 µg/m^3 for RPM which was nearly half the value labelled as standard and 99.66 µg/m^{3}for SPM and was nearly two and half times greater than the prescribed national standards. The recorded values of $SO_2$and NO_x remained within the standards for all the seasons (Table 3).

Air Quality assessment in Ramagundam

Table 4: Urban Ambient Air Quality in Ramagundam during (2010-2015)

Sl. No.	Observed Year	Air Pollutants, Annual Concentration and Pollutant Level											
		RPM			So_2			NO_x			SPM		
		Annual Average (µg/m^3)	Value of EF *	Air Quality **	Annual Average (µg/m^3)	Value of EF *	Air Quality **	Annual Average (µg/m^3)	Value of EF *	Air Quality **	Annual Average (µg/m^3)	Value of EF *	Air Quality **
1	2010	70	1.1	H	5.3	0.1	L	13.3	0.3	L	235	5.8	C
2	2011	66	1.1	H	5.4	0.1	L	11.6	0.2	L	163	4.0	C
3	2012	82	1.3	H	9	0.1	L	15	0.3	L	214	5.3	C
4	2013	74	1.2	H	11.2	0.2	L	16.1	0.4	L	195	4.8	C
5	2014	57	0.9	M	5.8	0.1	L	13.8	0.3	L	141	3.5	C
6	2015	65	1.0	M	7.0	0.1	L	15.2	0.3	L	NA	NA	NA

***Value of Exceedence Factor**
****L = Low, M = Medium, H = High, C = Critical.**
Source: TSPCB (Telangana State Pollution Control Board).

The analysis of the criteria pollutants by applying Exceedence Factor (EF) has revealed that out of total five Observed years SO_2 and NO_x shows low concentrations in all the years. With regard to the parameter SPM, all observed years come under critical category of air pollution. Similarly for RPM, four Observed years out of six come under High category and remaining two in Medium category of pollution level (Table 4). By looking at the concentration of pollutants mainly RPM and SPM into the ambient air as obtained through the results, it is now quite clear that the air in Ramagundam is highly polluted where all the observed years came under critically and highly polluted categories. The most striking point here is that not a single observed year has fallen under low level of air pollution.

Air Quality Trends in Ramagundam

To know the concentration of pollutants into the ambient air and its varying nature, a trend analysis has done for the year ranges 2010 to 2015 with the criteria pollutants namely RPM, SPM, SO_2, and NO_xin Ramagundam.

The trend in annual average concentration of SO_2 have been found to be lower than the NAAQS during all the observed years. For the year 2013, the recorded value of SO_2 was 11.2 µg/m^3 which was much below than the NAAQS and even lower than the next two years (2014 and 2015) but higher than the previous three years (2010, 2011 and 2012). This indicated that a fluctuating trend has prevailed within the NAAQS limits in Ramagundam for SO_2 concentration into the ambient air.

The parameter NO_x is also following the same trend as followed by NO_2. For the year 2013, it was recorded 16.1 µg/m^3 which was below the NAAQS and it was more than the previous two years which was 11.6 µg/m^{3}in 2011 and 15 µg/m^{3}in 2012 but it was less than the next two years which was 13.8 µg/m^3 in 2014 and 15.2 µg/m^3 in 2015. It means it is also following fluctuating trend within the NAAQS limits like SO_2 over the Ramagundam Region.

The annual average concentration of SPM for all the observed years has been recorded higher than the NAAQS. For the year 2013, it was recorded 195 µg/m^3 which was five times greater than the NAAQS. In comparison with the other observed years it was greater than the years 2011 (163 µg/m^3) and 2014 (141 µg/m^3) but less than in 2010 (236 µg/m^3) and 2012 (214 µg/m^3). It is clearly understood that the parameter SPM following fluctuating trend beyond the NAAQS limit.

The values of RPM were also recorded beyond the NAAQS limits (60 µg/m^3) except in the year 2014 (57µg/m^3). In the year 2013 the recorded values of RPM was 74 µg/m^3 which is lesser than in the year 2012 (82 µg/m^3) but greater than in the years 2010 (70 µg/m^3), 2011 (66 µg/m^3), 2014 (57 µg/m^3), 2015 (65 µg/m^3). It shows that the parameter RPM following fluctuating trend beyond the NAAQS limits.

Conclusion

The ambient air quality in Ramagundam has been found critical as the concentration of SPM and RPM into the air violating the national standards and exceeded the NAAQS limits. The concentration of pollutants much beyond the permissible limit during the winter season, where in monsoon season the lowest concentration has been recorded. It is clearly observed that the parameters of SO_2 and NO_x shows low concentrations in all the

observed years. And the values are within the NAAQS limits. It seems at least for now, there is no need to worry on SO_2 and NO_x parameters but the problem is with SPM and RPM as these levels were reached critical level and fluctuating time to time. The average levels of both SPM and RPM are posing a real threat to the urban dwellers. Thus there is need for combating particulate matter concentrations in the study area by implanting proper management measures such as implant the water sprinklers at the ash ponds to check the raising dust in the air, using latest technology instead of obsolete, increase of public transport system, improvement in road maintenance, traffic management and strengthening of green belt with suitable plant species.

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References:

1. K. Suresh Kumar, N. Srinivas, K.A. Sunil, 2014. Monitering and Assessment of Air Quality with reference to dust particles (PM10 and PM2.5) in Urban Environment. IJRET (International Journal of research in Engineering and Technology) Volume: 03 Special Issue: 16 ICPECDM-December 2014, eISSN: 2319-1163 pISSN: 232.
2. CPCB, Ministry of Environment & Forests, August 2014. National Ambient Air Quality Status and Trends-2012(NAAQMS/.../2014-15).
3. www.en.wikipedia.org/wiki/Ramagundam.
4. CPCB, Ministry of Environment & Forests, September 2006. Air Quality Trends and Action Plan for Control of Air Pollution from Seventeen cities (Series: NAAQMS/29/2006-07)
5. www.tspcb.cgg.gov.in/Environment/Ambient%20Air%20Quality_Standar ds_2009.pdf
6. Tushar Kumar, April 21, 2012. Environmental Issues & pollution Control Measures in Power Sector.
7. R.B. Singh and Senaul Haque, February 2016, Urban Ambient Air Quality and Respiratory Health in Kolkata: A Dispensary Level Analysis. Journal of Urban and Regional Studies. Vol. 2, No. 1, Pp. 7-21.
8. TERI (2003), Transportation economics and environment issues that influence product of strategy. Tata Energy Research Institute, New Delhi.
9. DPCC (2007), Delhi Pollution Control Committee report, New Delhi.
10. APPCB (2007), Status of ambient Air Quality in Andhra Pradesh – 2007, Andhra Pradesh Control
11. Mukhopadhyay, k. 2009. Air Pollution in India and its Impact on the Health of Different Income Groups. Nova Science publishers, Inc., New York.
12. WHO. 2003. Health Aspects of air pollution with particulate Matter, Ozone and Nitrogen dioxide. Report of a WHO working group, Bonn.
13. WHO. 2008. World Health Statistic. World Health Organisation.
14. Schwela, W., Haq, G., Huizenga, C., Han, et al. 2006. Urban Air pollution in Asian Cities Status, Challenges and Management. Earthscan Publishers, London.
15. Saldiva, P. H. N., Lichtenfels, A. J. R. C. and paiva, P.S. 1994. Association between Air pollution and Mortality due to respiratory Diseases in Children in Sao Paulo, Brazil: A Preliminary Report. Environmental Research. Vol. 65. Pp 218-25.
16. Mukherjee, A. and Mukherjee, G. 1998. Occupational Exposure of the Traficpersonal of Calcutta of lead and Carbon Monoxide. In air pollution in Kolkata: An Analysis of Current Status and Interrelation Between Different Factors by Spiroska et al. 2011. Vol. 8 (1) Pp. 181-124.
17. Gurjar, B. R., Butler, T. M., Lawrence, M. G., and Leliveld, J. 2007. Evaluation of Emissions and air quality in Megacities. Atmospheric Environment. Vol. 42. Pp. 1593-1606.
18. Faiz, A. and Sturm, P. J. 2000. New Dimensions: Air Pollution and Road Trafic in Developing Countries, Atmospheric Evnironment. Vol. 12. Pp. 94-103.