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Air Quality in and around the Industrial Corridor of Jharsuguda and Sambalpur District, Odisha, India and the Rate of Pulmonary Diseases

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ABSTRACT

A study for assessment of air quality was carried out in and around the Industrial belt of Jharsuguda and Sambalpur district of Odisha, India. The 24 hrs average concentrations of Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), were determined at regular intervals throughout three seasons for three years at ten monitoring stations in residential areas and industrial areas. The 24 hrs average SPM and RPM concentrations were 340.64µg/m3 and 131µg/m3 in industrial corridor. During the study period, 24 hrs and annual average RPM and SPM concentrations exceeded the respective standards set in the Indian National Ambient Air Quality Standard (NAAQS) protocol as well as USEPA, EU,WHO and World Bank standards at most of the residential and industrial areas. The SPM, RPM have exceeded the permissible standard throughout the year. Several field trips around the study area have been conducted and standard method have been applied to measure the air quality parameters for consecutively three years (2017, 2018 and 2019) to evaluate the present status of air pollution. The Air pollution has affected the inhabitants and pulmonary diseases are in rising. This locality immediately needs remedial measures to control the pollution rate and to provide a quality life to the inhabitants.

KEYWORDS: Dust, Tuberculosis, Air Quality, Pulmonary Diseases, Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM)

I. INTRODUCTION

The environmental pollution in an industrial cluster is a matter of great concern and also a critical issue for the public. Pollution in a cluster being a complex multi-dimensional problem is often difficult to measure and manage and it is very difficult to predict its effect on the environment and man. To address such a complex problem, we have made an attempt to study a cluster of Odisha. It is located in the district of Sambalpur and Jharsguda (Fig.1), which is considered a critically polluted area. Huge deposits of coal in the area and a vast water reservoir (Hirakud), mineral availability along with good connectivity of road and rail makes the area a most ideal site for the production of thermal power, sponge iron, iron and steel , aluminium smelter and cement. Small scale industries like rice mills, bricks kilns and stone crushers are also operating in this area. The major problem in the region is air pollution from different power plants and other metallurgical industries. The major air pollutants are suspended particulate matters, sulphur dioxide, oxides of nitrogen and carbon dioxide. The particulate matter going to the atmosphere is generally of size 0.1 to 100 micron of particle size. The inhabitants are exposed to the dust continuously and get infected with infectious and contagious pulmonary disease such as Tuberculosis. Field surveys adopting questionnaire method have been carried out around the study area to detect the effect of dust and threat of pulmonary disease mostly Tuberculosis. (Attfield and Hodous, 1992; Levinson and Jawetz, 2003). Dust causes disastrous effects and various health hazards. 2 to 20 micron size of dust particles affects the lungs and dust particles having 2-3 micron size are more dangerous. Epithelial tissue of lungs is affected by the dust of about 1micronsize (Attfield and Hodous, 1992; Attfield and Seixas, 1995; Henneberger and Attfield, 1996).The less the size of the dust greater is the deposit in the lungs. The dust finally causes lesions in the lungs.

II. METHODOLOGY

Standard method and analysis was performed for collection of sample and laboratory studies [IS: 5182(part-4):1999, IS5182 (Part-6):1975, IS: 5182(Part-2):1969.]

Present Study

The air samples were collected in every month in each season i.e during winter (December to February), pre-monsoon (March to May), post monsoon (October and November) and brought to the laboratory and ambient air quality monitoring were analyzed. The mean of various parameters were compared with National Ambient Air

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Quality Standards. The present work was carried out to provide information on the ambient air quality in the Industrial area. The location of sampling station are shown in Fig-1 and details are in Table-1

a) Location of Sampling Stations

Table-1

Station Code	Name of Location and	Direction from core area and Nature of the locality	Distance from core (in km)	Description of the location
S1	Jharsuguda Town	North ,Town	20	Town area
S2	Brundamal	North, Railway siding	12	Railway platform is near to it
S3	Thelkoli	North, Industrial Area	6	Iron and Steel industry near to this place
S4	Village Tumbekela	South, coal mines and residential Area	15	M/S Talabira Coal mines of Hindalco operating near to it.
S5	Main gate of Aditya Birla Aluminium smelter Main Gate	Core area	0	Industrial area
S6	Main Gate Shyam DRI plant	South	05	Shyam DRI steal and Power plant and other two small sponge Iron Plants.
S7	Rengali	South-East, residential	10	Small town area Railway track is 1KM away from sampling station
S8	Sason Canal	Residential Area and side of SH-10	15	2nos of sponge iron plants and rice Mills operating in this area
S9	Seven Hills Residential School	South East , Residential	20	No industries are located in this area. Sampling station is located near to SH-10
S10	Aithapali, Sambalur	Market and commercial Area	25	Commercial Area Located side of SH-10 and NH-6

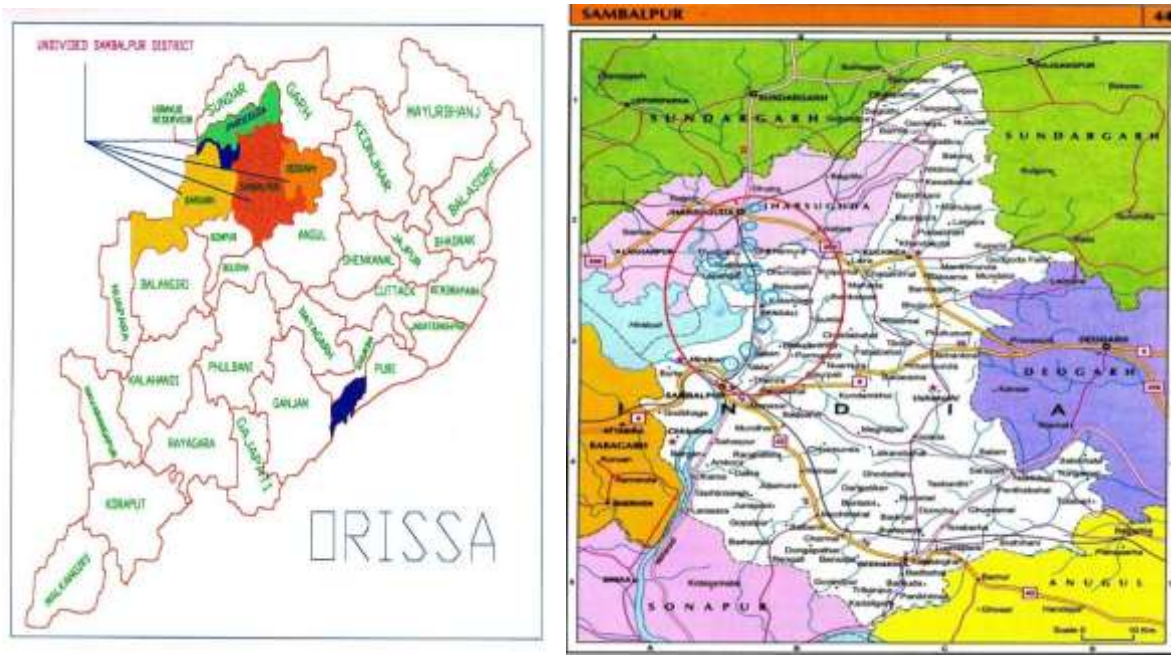

Fig-1: Location of Sampling Stations

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III. MODELING AND ANALYSIS

The study area has been considered to be an area covered within a radius of 30kms Jharsguda town covering Sambalpur. The survey has been conducted during period of three years from January 2017 to December 2019. The Suspended Particulate Matter (SPM) also known as PM_{10}, Respirable Particulate Matter (RPM) also known as $PM_{2.5}$ are collected on a fortnightly basis, during the first and the third week of each month, throughout the year except rainy season by running the Respirable Dust Samplers (Model: Envirotech, APM 451 and 460 with gaseous sampling attachment) for 8 hours in the day time (10.00AM to 6.00PM). The measured values have been compared with 24 hourly standard stipulated as per National Ambient Air Quality Standard (NAAQS), prescribed by CPCB, India for Residential, Rural and other. Sampling was done as per the standard sampling procedure of Bureau of Indian Standard [IS: 5182(part-4):1999, IS5182 (Part-6):1975, IS: 5182(Part-2):1969].

IV. RESULTS AND DISCUSSION

SPM and RPM concentration: The estimated dust concentrations in various sampling locations are presented in the Table-1. The estimated SPM and RPM concentrations in and around the industrial sites are more than the residential areas.

Detection of Pulmonary Disease: To find out the effect of dust on the health of people living in and around the study area, a sample of public (330inhabitantsin2017,312 in 2018 and327in2019)were interviewed using a questionnaire. Questions in the questionnaire were drafted to detect the public's awareness to pulmonary diseases mostly the Tuberculosis. This preliminary survey adopting questionnaire method made us possible to detect early symptoms of pulmonary diseases among the local inhabitants. Due to the air pollution the local inhabitants are also being affected by respiratory disorders like black lung, bronchitis, asthma, pulmonary fibrosis and many other diseases such as eye irritation, hypertension, lung cancer, etc. The numbers of suspected persons detected are181, 223 and 245 during 2017, 2018 and 2019 respectively.

The three years average data of SPM and RPM have shown in the Table-2 and Table-3 respectively. Year wise concentration of SPM for ten sampling stations has been shown in Fig-2. Concentration of SPM of each sampling station S1 to S10 have been shown in the Fig-3 to Fig-12

Table-2: Three years Average data of the pollutants SPM

Station Code	SPM in PPM			
	2017	2018	2019	Avg.
S1	334.43	339.87	332.37	335.56
S2	437.33	335.37	340.37	371.02
S3	450.13	453.53	460.60	454.75
S4	438.87	437.67	341.67	406.07
S5	336.87	339.87	334.20	336.98
S6	442.53	436.87	441.53	440.31
S7	322.90	334.43	330.43	329.25
S8	218.43	224.47	222.80	221.9
S9	180.80	185.40	182.40	182.87
S10	325.83	327.33	330.00	327.72
Avg.	350.41	341.66	331.56	340.64

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Table-3: Three years Average data of the pollutants RPM

Station Code	RPM in PPM			
	2017	2018	2019	Avg.
S1	128	130	125	127.7
S2	130	131	139	133.3
S3	151	151	158	153.3
S4	135	134	140	136.3
S5	127	125	130	127.3
S6	148	149	149	148.7
S7	120	121	122	121.0
S8	119	118	120	119.0
S9	120	121	120	120.3
S10	121	120	128	123.0
Avg.	129.9	130	133.1	131.0

Table-4: National Air quality standards 1994 for sulphur dioxide ,oxide of nitrogen and respirable particulate matter and international standards[2]

		Concentration of ambient air ug/m^3						
		Indian Standard			**International standards**			
Pollutant	**Time weighted average**	**Industrial area**	**Residential area**	**Sensitive area**	**USEPA**	**EU**	**WHO**	**World Bank**
RPM	**Annual Average**	**120**	**60**	**50**	**50**	**40**	**50**	**50**
	24 hrs	**150**	**100**	**75**	**150**	**50**	**-**	**150**
SPM	**Annual Average**	**360**	**140**	**70**	**75**	**150**	**60-90**	**80**
	24 hrs	**500**	**200**	**100**	**260**	**300**	**150-230**	**230**
SO2	**Annual Average**	**80**	**60**	**15**	**80**	**80**	**40-60**	**50**
	24 hrs	**120**	**80**	**30**	**365**	**250**	**100-150**	**150**
NO_x	**Annual Average**	**80**	**60**	**15**	**100**	**200**	**-**	**-**
	24 hrs	**120**	**80**	**30**	**-**	**-**	**150**	**-**

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a. Graphical Analysis of Concentration of SPM:

Concentration of Respirable Particulate Matter (RPM) also called PM_{10} have been analyzed graphical for easy understanding the critical concentration level as compared to the standard in the following Fig-2 to Fig-16.

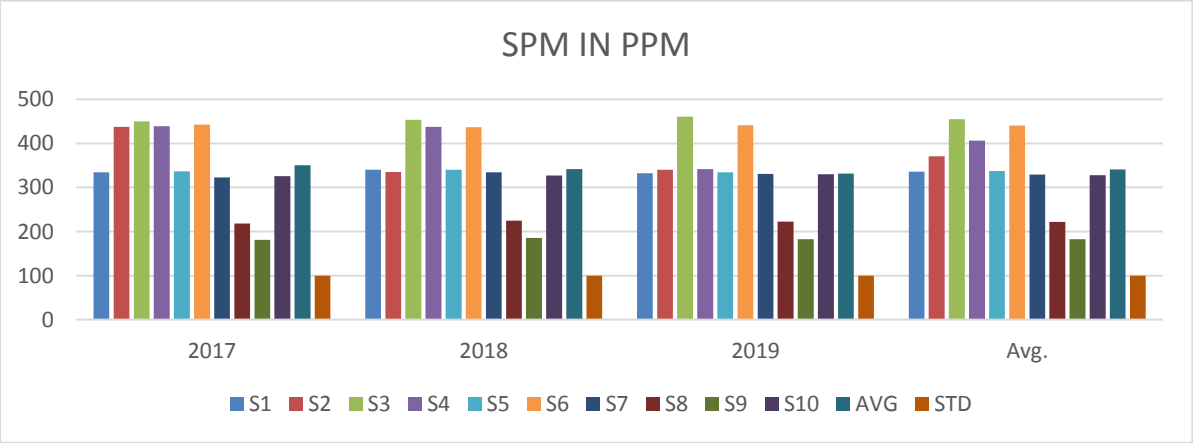

Fig-2: Year wise concentration of SPM for ten sampling stations

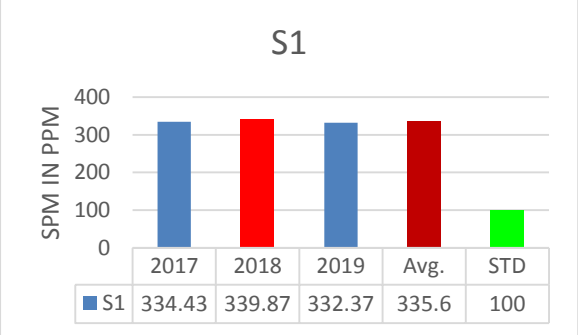

Fig-3: SPM of Sampling station-S1

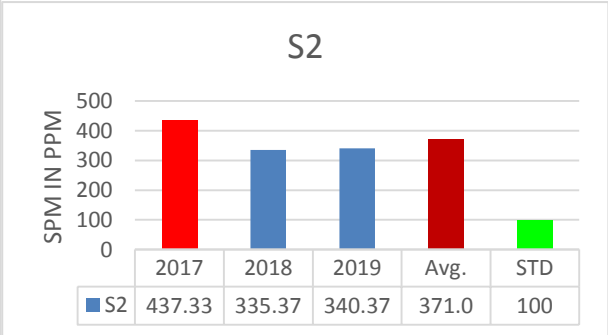

Fig-4: SPM of Sampling station-S2

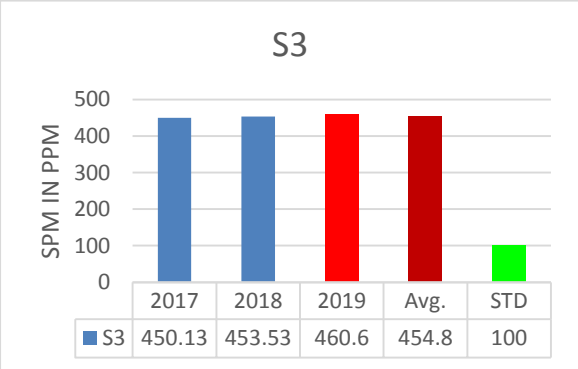

Fig-5: SPM of Sampling station-S3

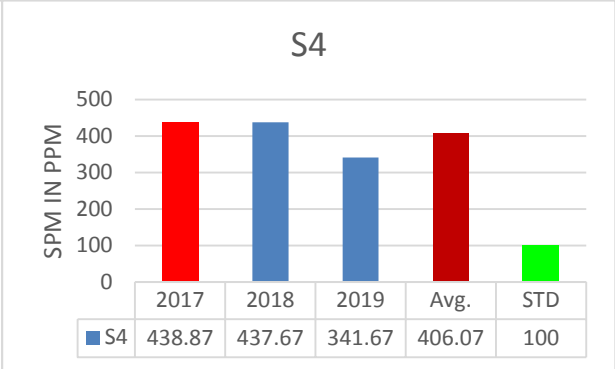

Fig-6: SPM of Sampling station-S4

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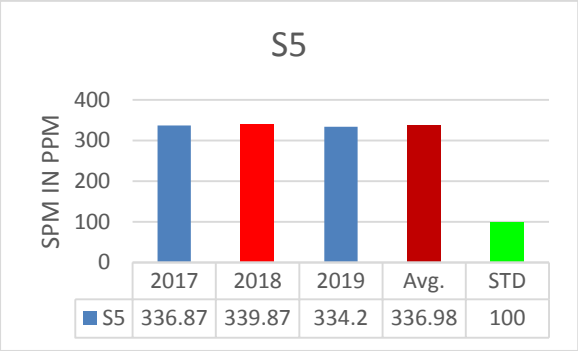

Fig-7: SPM of Sampling station-S5

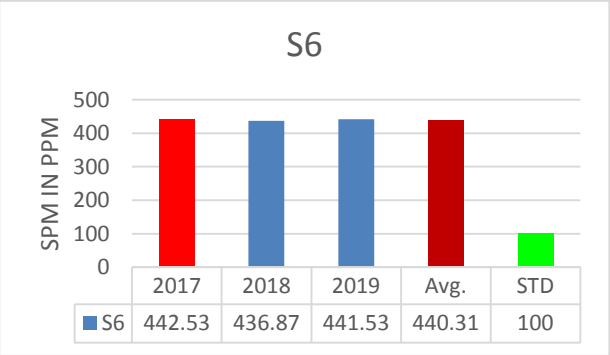

Fig-8: SPM of Sampling station-S6

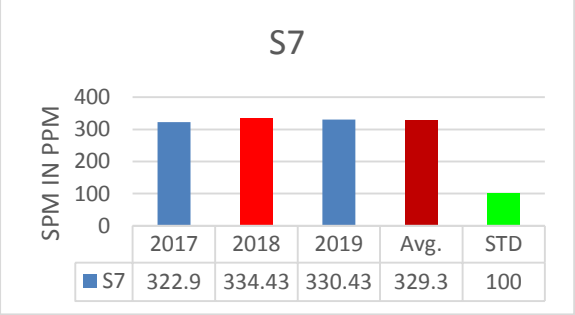

Fig-9: SPM of Sampling station-S7

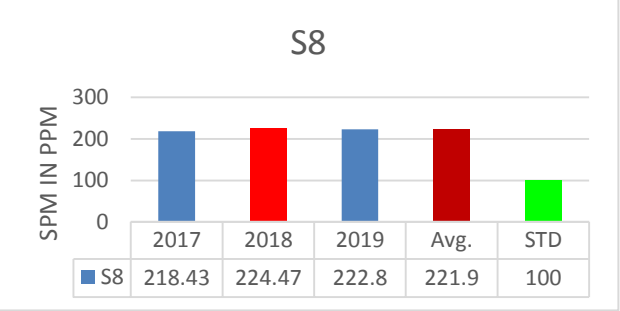

Fig-10: SPM of Sampling station-S8

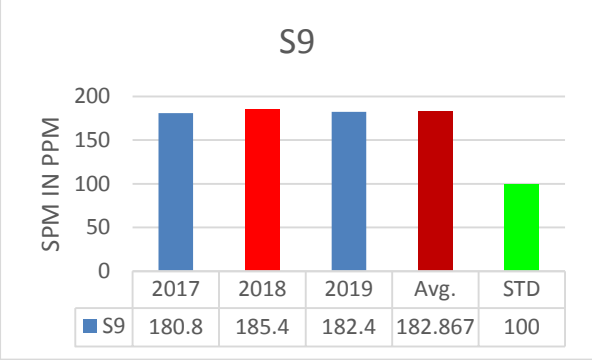

Fig-11: SPM of Sampling station-S9

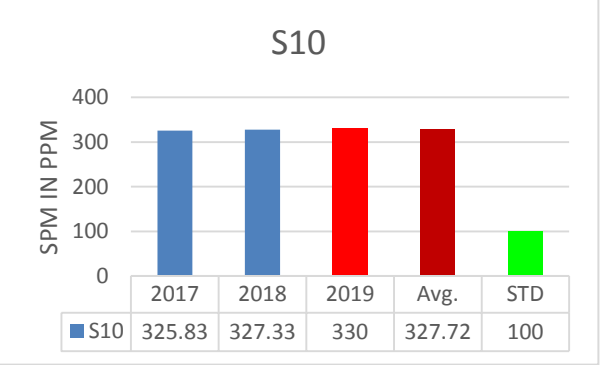

Fig-12: SPM of Sampling station-S10

The concentration of Suspended Particulate Matter (SPM) Year wise 2017, 2018 and 2019 have been shown with its standard acceptable values in Fig-13 to Fig-15 and three years average in Fig-16. It has been observed that in all the sampling stations the values are exceeding the limit which is a great concern of survival with healthy life. This leads to different diseases along with related respiratory diseases.

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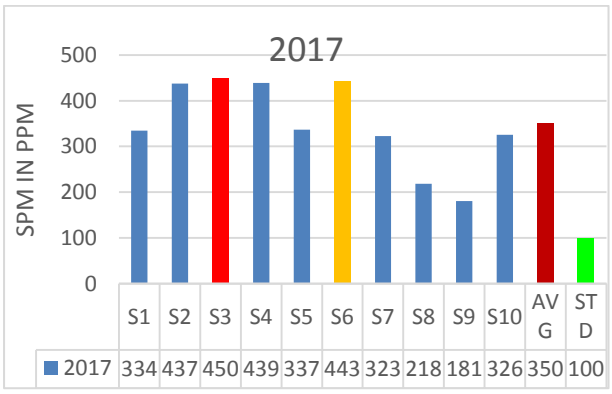

Fig-13: SPM for the year 2017

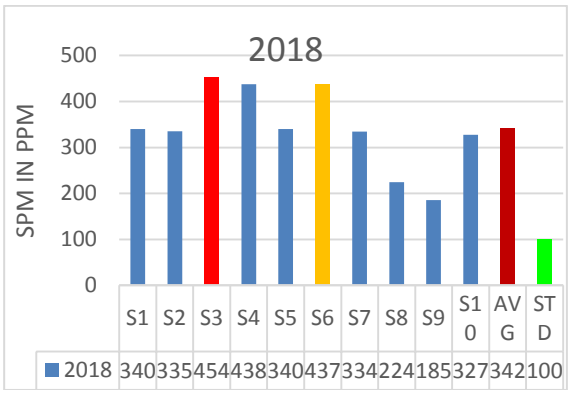

Fig-14: SPM for the year 2018

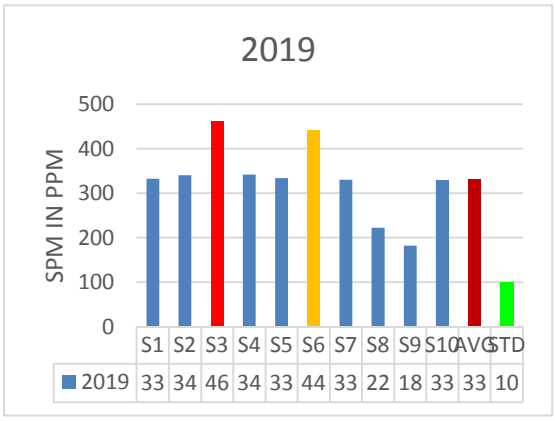

Fig-15: SPM for the year 2019

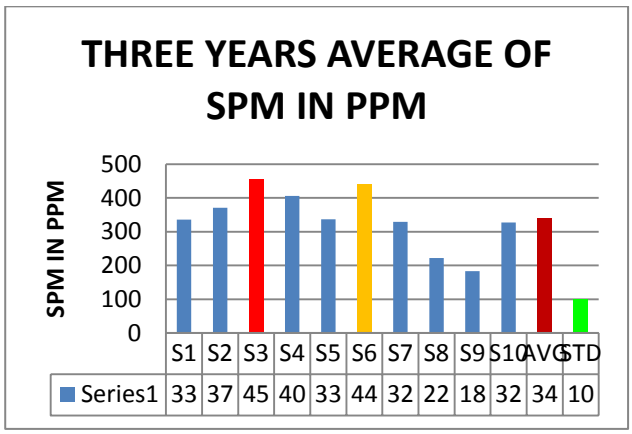

Fig-16: Average of SPM for three years

b. Graphical Analysis of RPM:

Concentration of Respirable Particulate Matter (RPM) also called $PM_{2.5}$have been analyzed for easy comparison with different standard values in the Fig-17.Sampling station wise comparative study has been represented in Fig-18 to Fig-27. Year wise studies have been done in Fig-28 to Fig-30. Average of three years study have been shown in Fig-31

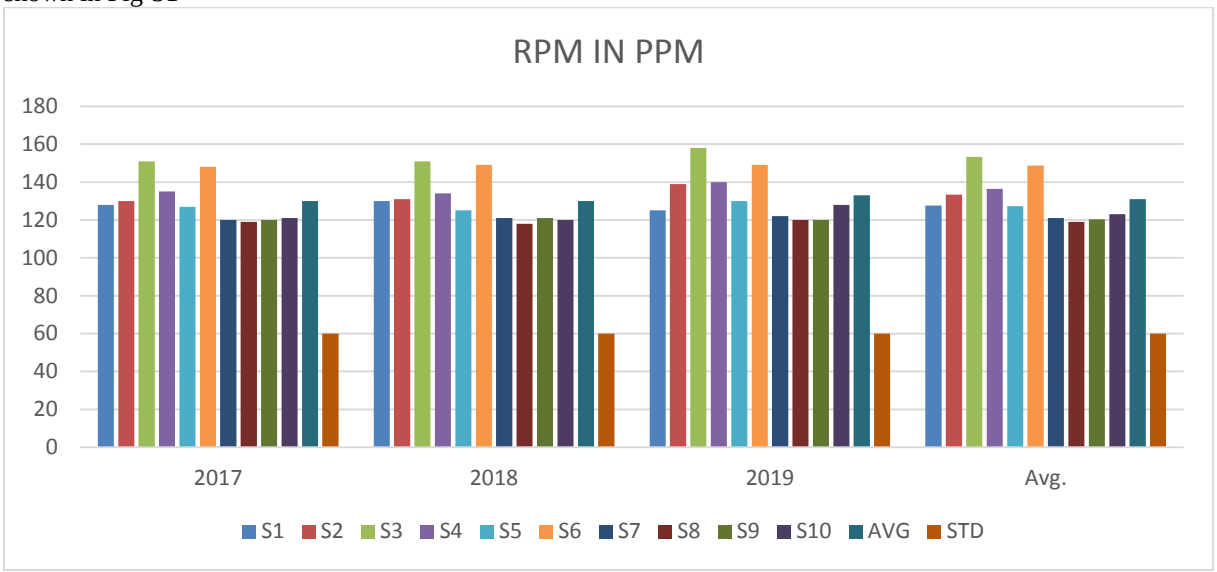

Fig-17: Year wise concentration of RPM for ten sampling stations

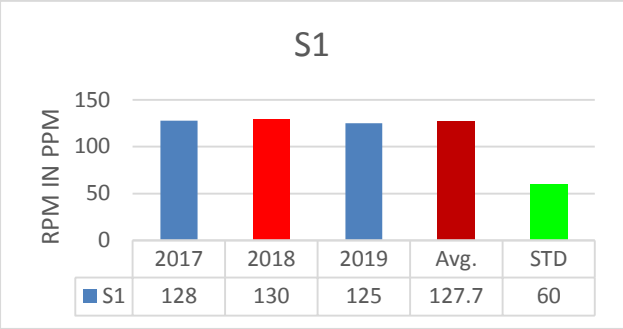

Fig-18: RPM of Sampling station-S1

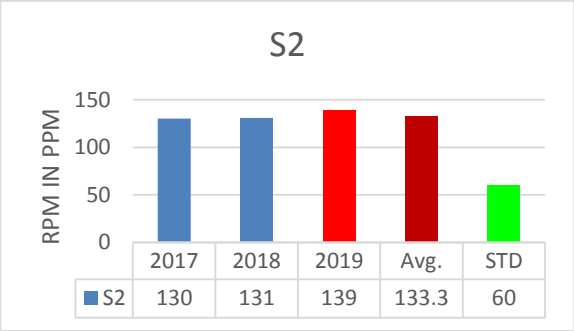

Fig-19: RPM of Sampling station-S2

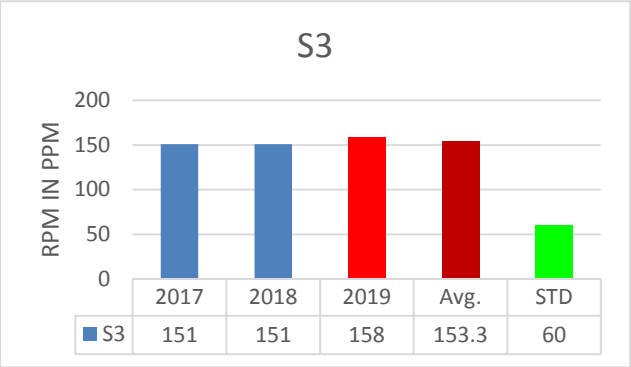

Fig-20: RPM of Sampling station-S3

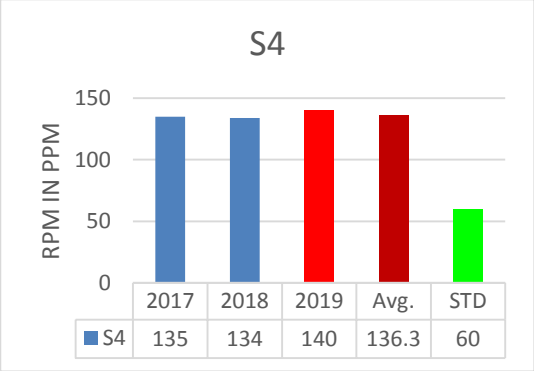

Fig-21: RPM of Sampling station-S4

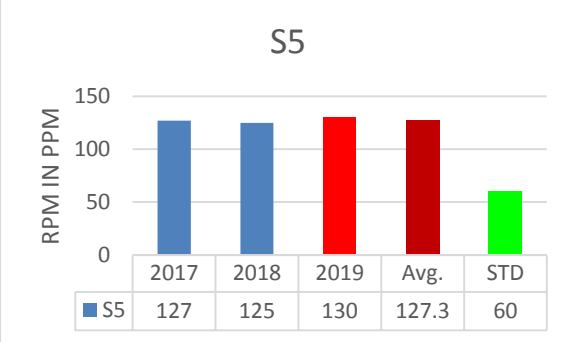

Fig-22: RPM of Sampling station-S5

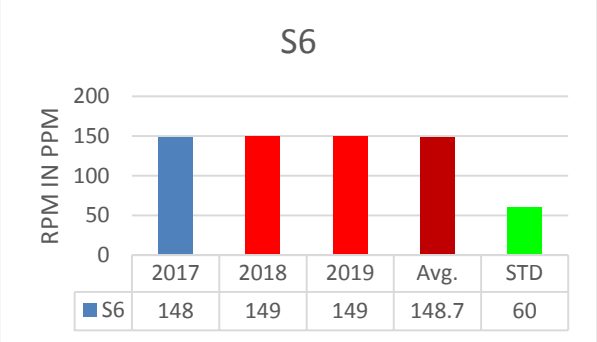

Fig-23: RPM of Sampling station-S6

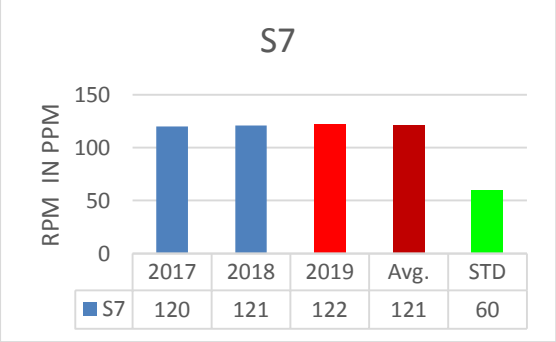

Fig-24: RPM of Sampling station-S7

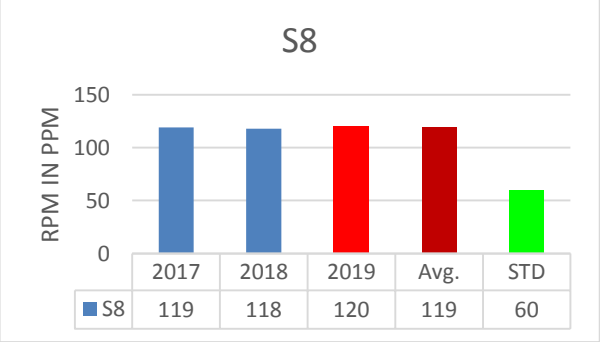

Fig-25: RPM of Sampling station-S8

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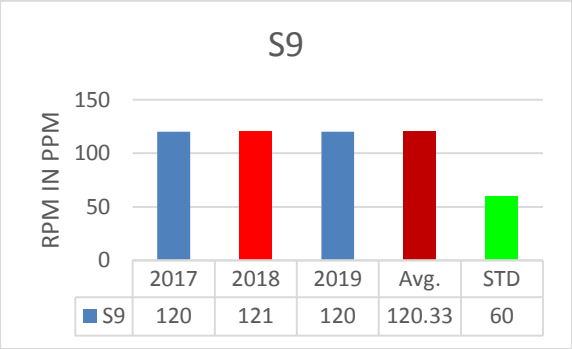

Fig-26: RPM of Sampling station-S9

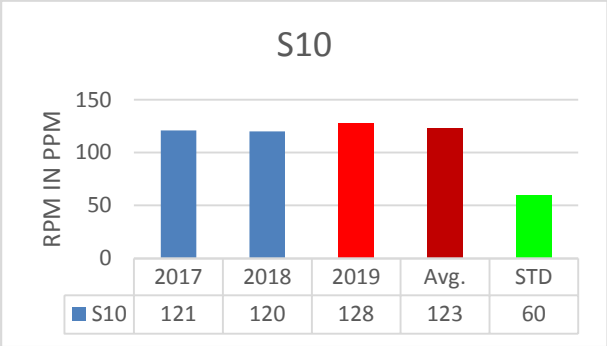

Fig-27: RPM of Sampling station-S10

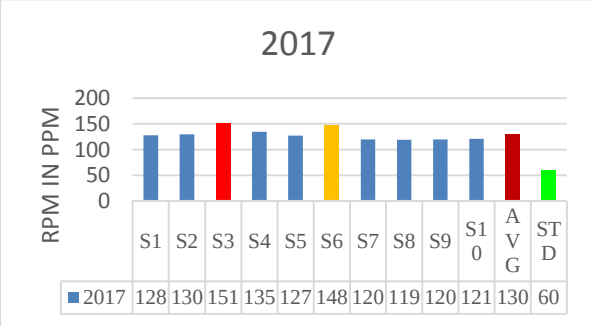

Fig-28: RPM for the year 2019

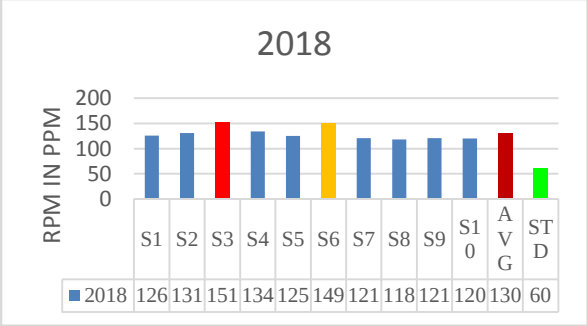

Fig-29: RPM for the year 2019

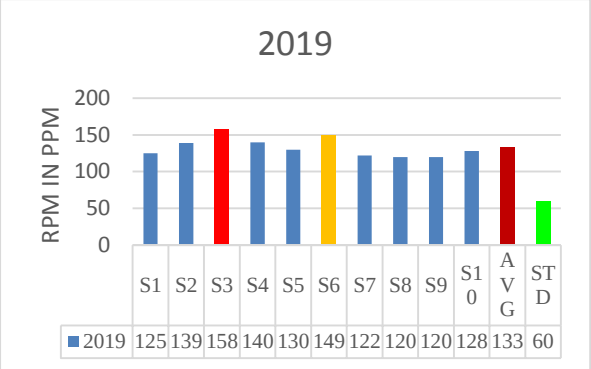

Fig-30: RPM for the year 2019

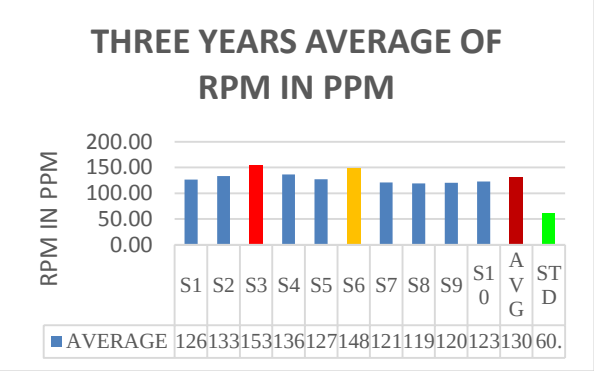

Fig-31: Average of RPM for three years

V. CONCLUSION

In the present study, estimation of the air pollution in the investigated area has been carried out and it was found that the two important parameters SPM and RPM had higher values than its standard limit. Therefore it is obvious that the number of suspected Tuberculosis infected patients are detected high for consecutive three years in a row (2017, 2018 and 2019). The study shows that both air pollution with SPM as well as RPM and number of Tuberculosis patients have increased significantly in the successive years of investigation. It is also evident from the records of the CDMO office of Jharsuguda that the district has recorded Tuberculosis as a serious health hazard in the district. In last 5 Years 83926 cases of Tuberculosis has been registered and 60 cases of death due to Tuberculosis also has been registered. (District Disaster Management Plan Jharsuguda, ODISHA 2018 Volume-I). The results depict a direct relationship between air pollution and pulmonary diseases. It has been observed that in all the sampling stations the values of SPM and RPM are exceeding the standard limit which is of great concern for survival of local inhabitants with a healthy life.

ACKNOWLEDGEMENTS

The authors acknowledge friends and family members who helped immensely in this research work

VI. REFERENCES

[1] A. K. De, (1987). Wiley Eastern Limited, New Delhi, India.
[2] Attfield, M.D. and N.S. Seixas. (1995). Prevalence of pneumoconiosis and its relationship to dust exposure in a cohort of US bituminous coal miners and ex-miners. Am. J. Industr. Med., 27, 137-151
[3] Attfield, M.D. and T.K. Hodous. (1992). Pulmonary function of US coal miners related to dust exposure estimates. Am. Rev. Respir. Dis., 145, 605-609
[4] Badhwar, N., et.al, (2005), Guidelines for Ambient Air Quality Monitoring, Indian Journal of Air pollution control, Vol – V, No-1, pp 76-85.
[5] Boubel R W, Fox D L., Turner D B, Stein AC, (1994). Fundamental of air pollution, Academic Press, USA, 3rd Edition, pp. 106--110 & 203-222.
[6] Bradhawar R C, Trivedi R C, Sen Gupta B, (2004). The air quality status and trends in India. Indian Journal of Air Pollution Control, V (1): pp. 71-79. 4.
[7] Brown J H, Cooke K M, Key F G , Hatch T F, (1950). Influence of particle size upon the retention of particulate matter in the human lungs. Journal of American Public Health Association, 40: 4
[8] Chowgale, R., (2007). Air Pollution and Health Effects, J.Ind. Assessment for Environmental Management, 34(1), pp 34-37.
[9] Henneberger, P.K. and M.D. Attfield. (1996).Coal mine dust exposure and spirometry in experienced miners. Am. J. Respir. Crit Care Med., 153, 1560-1566.
[10] https:// www.epa.gov.data standard.
[11] IS: 5182 Part- II, (1969).Code of India Standard Measurement of Air Pollution.
[12] IS: 5182 Part IV, (1973). Code of India Standard Measurement of Air Pollution.
[13] IS: 5182 Part IV, (1999). Code of India Standard Measurement of Air Pollution.
[14] IS: 5182 Part VI, (1975). Code of India Standard Measurement of Air Pollution.
[15] IS: 5182 Part VIII, (1976). Code of India Standard Measurement of Air Pollution.
[16] Levinson, W. and E. Jawetz. (2003).Medical microbiology and immunology: Examination and broad review. McGraw Hill, Singapore.
[17] National Ambient Air Quality Standard (CPCB) Notification, 11 April 1994, New Delhi.
[18] Panda R B, Pradhan D, (2011). Assessment of air quality in Talcher Industrial Complex & its Health Impact. International Journal of Environmental Science, I: 5-13
[19] State of Environment, (2006). State Pollution Control Board, Orissa, India.
[20] WHO (2008). Air quality Guide line (particulate-------SOx) summary of risk assessment, WHO.
[21] www.worldbank.org