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AIR QUALITY ASSESSMENT OF THE SURROUNDING AREA OF A THERMAL POWER PLANT

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ABSTRACT

Energy is linked to the environment so that its production and its use can cause environmental damage. Fossil fuels are put through a burning process called combustion in order to produce energy. Combustion causes the release of various pollutants, such as Carbon monoxide, sulfur dioxide, NOX and particulate matters, which pose health risk and may contribute to acid rain and global warming. Keeping these facts in view present work deals with air pollution due to thermal power plant situated at Birsinghpur District Umaria (M. P.). For this purpose Ambient air Quality monitoring and stack monitoring have been done.

INTRODUCTION

Air is the most important resource for the sustenance of life and other activities in the biosphere. It is one of the important medium for living creatures to survive. All organisms need clean air for their healthy growth and development. Air refers to the invisible, tasteless mass of gases that surrounds the earth so, the physical addition of material, that turns the air impure or unclean is called air pollution. During sixties the importance of developing mathematical model to show pollutant concentrations was recognized by Pasquill1 , Saffmon 2 and other workers. From ADB Report 3 it has been found that International studies of the health, welfare and environmental damages from power and energy projects have found that air pollution impacts Constitute most of the total damages. B. Rao 4 shown that all type of economic valuation of environmental impact involve a certain degree of estimation which are approximation of true values embodying omissions, biases and uncertainty.

Sanjay Gandhi Thermal Power Plant (SGTPP) is located near Manthar village in Pali tehsil of Umaria district it is on the bank of river Johila.

MATERIALS AND METHODS

In order to access air quality of SGTPP region, two type of air monitoring have been done.

A. Ambient air quality monitoring for SO_2, NO_X and total suspended particulate matter (SPM) in and around the SGTPP at different locations.

B. Stack monitoring to assess the present level of emissions of SO_2, NO_X and SPM.

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Table 1. Precentage Number of Days of Wind Based on observations for 30 years.

No.	MONTH	HRS.	N	NE	E	SE	S	SW	W.	NW.	CAL.
1.	January	8.30	3	4	9	15	7	3	2	2	55
		17.30	16	11	3	3	1	3	7	15	41
2.	Feabruary	8.30	2	4	8	11	6	4	4	3	58
		17.30	17	9	5	2	2	4	14	24	25
3.	March	8.30	4	4	8	12	5	5	7	4	51
		17.30	15	6	2	2	2	5	20	30	16
4.	April	8.30	4	5	8	10	6	12	14	9	32
		17.30	16	6	2	3	3	5	22	34	9
5.	May	8.30	3	3	4	7	5	17	26	15	20
		17.30	13	8	2	2	2	6	23	40	7
6.	June	8.30	2	2	2	3	4	25	39	13	10
		17.30	9	8	4	5	4	12	23	23	12
7.	July	8.30	3	4	2	3	5	27	34	10	12
		17.30	4	5	4	4	4	18	28	16	17
8.	August	8.30	2	4	4	4	5	23	33	15	10
		17.30	4	4	4	4	4	15	31	20	14
9.	Sept.	8.30	3	4	9	8	5	17	25	10	19
		17.30	6	7	5	5	3	10	20	15	29
10.	Oct.	8.30	4	6	9	8	3	6	6	4	54
		17.30	8	11	5	3	2	2	3	8	58
11.	Nov.	8.30	1	4	5	9	4	1	1	2	73
		17.30	6	7	3	2	0	1	1	4	76
12.	Dec.	8.30	1	2	7	11	3	2	0	1	73
		17.30	11	7	3	1	1	1	3	6	67
	Annual	8.30	3	4	6	8	5	12	16	7	39
	total or mean	17.30	11	7	3	3	2	7	16	20	31

Ambient Monitoring ?

For ambient air quality analysis Micro high volume air sampling unit has been used. In high volume air samplers, air born particulates are measured by passing air at a high flow rate of 1.0 to 1.3 m^3/min. through a high efficiency filter paper which retains the particles. The instrument measure the volume of air sampled.

Selection of Sites

From the different wind rose data given in the Table 1 and with the help of wind rose diagram (Fig. 1) we can conclude that generally the direction of air at SGTPP remains south eastern. Hence, samples were chosen normally in downwind direction. However few samples were taken from the wind direction.
Location of sites:

i. **Near Silo** - It is situated at 100 mt. distance from plant.
ii. **Main Gate -** The site is at an upward distance of approximately 150 mtrs. from the plant.
iii. **Guest House** - It is situated at 3 km. distance from thermal power plant.
iv. **Hospital –** Site is situated at 4 km. distance from thermal power plant.
v. **Maliaguda Village** - It is 5 km. far from the Sanjay Gandhi thermal power plant.

Sampling of air and its analysis was carried out for as per the standards of Central Pollution Control Board (India).

Stack Monitoring

The basic aim of stack sampling is to collect representative samples at the place of origin to determine the total emission rate of pollutants. The objectives of stack sampling are-

(a) To know the efficiency of installed control equipments.
(b) To obtain data on source emission parameters.
(c) To acquire data from an innocuous individual source so as to determine the cumulative

Table 2. Ambient Air Quality analysis

S.N.	Name of Sampling site	Distance from plant	Parameters	Season Summer	Monsoon	Winter
1.	Near Silo area	100 mtrs	SPM	575.30	516.47	512.2
			SO_2	25.60	22.78	21.48
			NO_X	65.28	40.00	37.68
2.	Main Gate	150 mtrs	SPM	515.62	457.86	452.19
			SO_2	27.08	18.03	21.32
			NO_X	32.00	26.40	24.62
3.	Guest House	3 km.	SPM	348.08	121.80	149.98
			SO_2	20.64	21.40	19.63
			NO_X	25.44	20.63	18.54
4.	Hospital	3.5 km.	SPM	238.48	138.38	142.00
			SO_2	12.00	11.00	15.60
			NO_X	18.64	16.00	15.32
5.	Maliaguda Village	5 km.	SPM	218.62	83.54	110.6
			SO_2	10.00	9.00	7.11
			NO_X	16.24	14.20	12.24

all values are in unit $\mu g/m^3$

effects of many such sources.

(d) To determine compliance with emission regulation.

The particulate matter as well as gaseous emission sampling was carried out from stack ducks after both ID fans. For sampling and analysis of particulate and gaseous matter EPA technique 5 was used with the help of stack monitoring kit.

RESULTS AND DISCUSSION

Ambient Air Analysis

To assess the environmental pollution in the Sanjay Gandhi thermal power plant region, various sampling site for ambient air analysis were selected -

1. Near Silo - A1
2. Main Gate - A2
3. Guest House - A3
4. Hospital - A4
5. Maliaguda Village - A5

Air quality of Sanjay Gandhi thermal power project situated at Manthar, Birsinghpur region was monitored for two successive years at various sites for SPM, SO_2 and NO_X. The various results are given in Table 2 and 3. These parameters are regularly monitored in each season in every year. The different sampling site is given in Fig. 2.

In Silo area SPM was found to be exceeding in every season throughout the year except in monsoon season in Table 2. Its range was from 480.97 to 575.30 $\mu g/m^3$, while sulphur dioxide and oxides of nitrogen were found to be within the permissible limit. The concentration of SO^2 was found to be between 19.80 to 27.06 $\mu g/m^3$. Similarly NO_X was observed in the range between 28.40 to 65.28 $\mu g/m^3$.

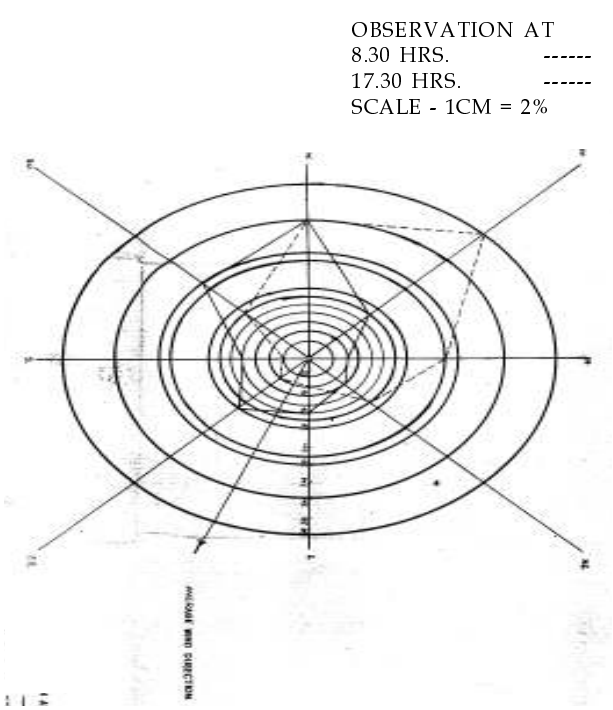
At main gate which is situated at 150 mtrs distance from thermal power plant, the SPM was found to be within the permissible limit except at summer in the year 2001. When it's concentration was found 515.62$\mu g/m^3$ otherwise the concentration range of SPM was from 349.73 to 515.62 $\mu g/m^3$. The concentration of SO_2 and NO_X was found in the range of 13.32 to 27.08 $\mu g/m^3$ and 24.62 to 32.0 $\mu g/m^3$ respectively.

Air quality at guest house which is situated about 3 kms. from the plant was found to be within the prescribed limits. At this site SPM was assessed in the range of 121.80 to 348.08 $\mu g/m^3$. SO_2 was observed in between 12.02 to 20.64 $\mu g/m^3$ while NO_X ranges between 18.54 to 32.00 $\mu g/m^3$.

The concentration of SPM at hospital (3.5 Km) was found to be in the range 138.38 to 138.48 $\mu g/m^3$. The range of SO_2 was found to be in between 11.0 to 19.02 $\mu g/m^3$ while the range of NO_X was in between 15.32 to 33.2 $\mu g/m^3$. So, values of all these parameters fall within the permissible limit as prescribed by Central Pollution Control Board.

Similarly at Maliaguda Village (5 km) the SPM, SO_2 and NO_X in the ambient air was found to be within the prescribed limit. The concentration of SPM ranges from 83.54 to 227.08 $\mu g/m^3$ while the concentration of SO_2 and NO_X were found to be in the range of 6.06 to 10.0 $\mu g/m^3$ and 12.24 to 16.24 $\mu g/m^3$ respectively.

The results of stack samplings are given in Table 4 and 5. The concentration of Particulate matter in unit I, II, III and IV was 187.11, 159.02, 185.4 and 168.5 µg/Nm^3 respectively which were found to be exceeding the limits of 150mg/Nm^3 as prescribed by CPCB or SPCB for thermal power plants.



BIRSINGHPUR THERMAL POWER STATION

Fig. 1 The wind rose diagram of SGTPP

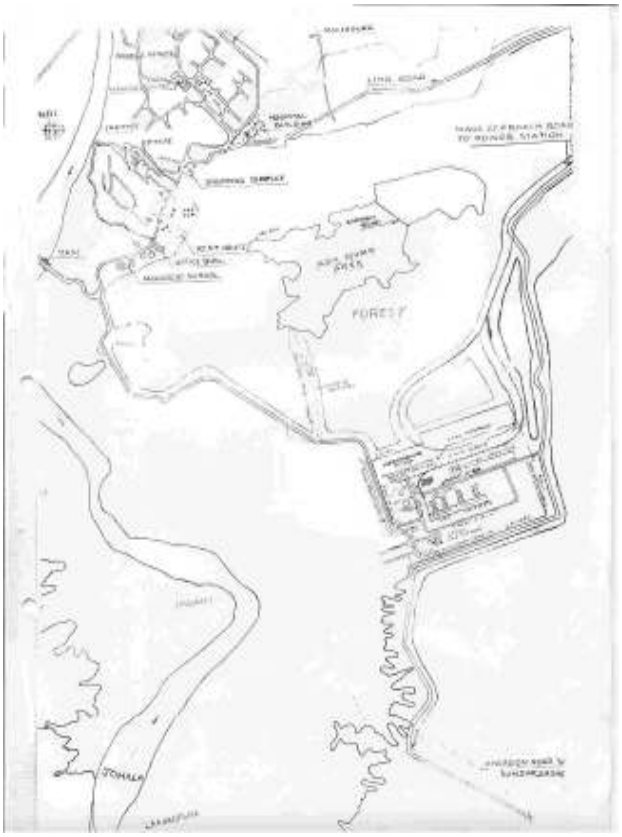


Fig. 2 Sampling stations for Air Analysis

Table 3. Ambient Air quality Analysis

S.N.	Name of Sampling site	Distance from plant	Parameters	Season Summer	Monsoon	Winter
1.	Near Silo area	100 mtrs	SPM	530.9	480.97	531.97
			SO_2	27.06	24.82	19.80
			NO_X	35.07	28.40	31.23
2	Main Gate	150 mtrs	SPM	394.73	421.23	488.52
			SO_2	19.21	13.32	22.12
			NO_X	30.40	28.02	26.55
3.	Guest House	3 km.	SPM	258.02	157.35	210.02
			SO_2	21.59	13.02	12.02
			NO_X	32.00	25.06	21.42
4.	Hospital	3.5 km.	SPM	234.43	218.03	195.60
			SO_2	19.02	17.00	15.47
			NO_X	33.20	23.03	18.56
5.	Maliaguda Village	5 km.	SPM	178.08	227.08	220.85
			SO_2	9.22	6.06	8.11
			NO_X	15.26	12.48	13.65

all values are in unit µg/m^3 Stack monitoring

Table 4. Stack Monitoring at SGTPP

Particulars	Unit - I	Unit- II
Height of stack	200 meter	200 meter
Temperature of flue gas (°C)	149	160
Velocity of gas (m/sec)	15.82	21.56
Ambient temperature (°C)	37	37
Stack temperature (°C)	135	130
Efficiency of ESP	99.87%	99.67%
Suspended particulate matter (mg/Nm^3)	187.11	159.02
Sulpher dioxide (mg/Nm^3)	380	365
Oxides of nitrogen (mg/Nm^3)	190	186

Table 5. Stack Monitoring at SGTPP

Particulars	Unit- III	Unit- IV
Height of stack	200 meter	200 meter
Ambient temperature (°C)	25	25
Stack temperature (°C)	130	135
Temperature of flue gas (°C)	140	145
Velocity of gas (m/sec)	19.62	15.28
Efficiency of ESP	99.56 %	99.78 %
Suspended particulate matter (mg/Nm^3)	185.4	168.5
Sulphar dioxide (mg/Nm^3)	395	368
Oxides of nitrogen (mg/Nm^3)	201	195

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