

To Study the Effect of Thermal Power Plant on Environment

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Abstract: In India, 65% of total power is generated by Thermal Power Plants (TPP) by using fossil fuels which produce a wide category of emissions. The environmental issues related to TPP have not been addressed comprehensively in the literature. The present study is focused to identify various emissions emitted by TPP and their impact on environment. By using Bacharach Portable Combustion Multi Gas Analyzer, we appraise main pollutant released into the environment from fossil combustion are carbon dioxide (CO₂), sulphur dioxide (SO₂), carbon monoxide (CO). A suitable validated questionnaire has been filled by 100 respondents by using 5 point likert scale. The explored gas emissions as major impacting factor followed by discharged water, fly ash, coal ash with percent point scored (PPS) values as 75.4, 70.2, 68.4 and 67.6. By using pycnometer test, relative density of soil within 1-3 Km (A) and 6-9 Km (B) categorized as medium dense (35-65%) which affects land fertility. For the same, pH of has been examined as acidic with values more than 7. TDS and pH of water has been observed as 5210 mg/l and 8.79 within range A and 4850 mg/l and 8.38 in range B. The study concluded a variety of impacts by TPP which adversely affects air quality, soil degradation and aquatic life by Acidification and eutrophication. Hence, there is an utmost need of preventive measures on emissions that affects environment severely.

Key Words: Thermal Power Plant, Environment, Air Pollution, Water Pollution, Soil Pollution

1 Introduction

In India, energy consumption is intensively increasing day by day due to high expectation of population which is also at higher rate. Mainly, energy is obtained from burning of fossil fuels such as coal which adversely affects environment quality as well as living population [3]. Coal is widely used in thermal power plants for power generation which lead to fulfillment of approximate 75 percent of power demand in India [7].

The power generating thermal plants require a huge various natural resources used for energy generation that is a cause of stress on ecosystem due to misbalancing of natural resources [10]. Environmental deterioration is attributed to emission of large amount of Sulphur oxides, Nitrogen oxides, Suspended Particulate Matter (SPM) and respirable SPM which disperse over 25 Kms radius and cause respiratory and related ailments to human beings and animal kingdom [10] The SPM's and dust combination also a key issue of plants deterioration which is also a part of environment [1]. Furthermore, power plants also lead to global warming by liberating a large amount of carbon emissions (0.9 to 0.95 kg/Kwh) [9].



The literature reveals that a very less work has been done to identify severity of parameters that have major contribution in causing pollution in the environment. Hence, objective of present study was to identify various pollution causing parameters and their severity.

2 Material and Methods

Readings of emissions in air were taken under following three conditions:- a) When Thermal Power Plant was not working b) Emissions within 1-3 Km range when TPP was working c) Emissions within 6-9 Km range when TPP was working. Data has been collected from hundred (100) respondents surrounded within 5 Kms from thermal power plant surveyed. TPS, PPS and Analysis of variance has been used for statistical analysis of data obtained after data collection. Bacharach Portable Combustion Multi Gas Analyzer was used for detecting air emission and pycnometer test performed to analyze relative density of soil and pH also observed. Moreover pH, and TDS of water samples was also recorded.

3 Results

The values of air emissions were recorded when thermal plant was not in working condition for a week as in Table 3.1. Further during working of plant, readings were taken in between a range of 1-3 Km and 6-9 Km from TPP as mentioned in Table 3.2.

Table 3.1 Air emissions (Gg) when TPP was not working for one week in 1-3 Km range

S.No.	Values of Emissions	Mean value of emissions (Gg)
1	2095, 2315, 2345	2250
2	1980, 2145, 2240	2121
3	2265, 2380, 2490	2378
4	2150, 2210, 2495	2285
5	2125, 2208, 2380	2237
6	1921, 2030, 2245	2065
7	1970, 2025, 2140	2045

Various environment impacting parameters has been identified by means of multi gas analyzer and value of emissions also recorded as shown in Table 3.3. Furthermore, TPS and PPS values of parameters as shown in below Table 3.4 were calculated to examine most impacting factor contributing environment pollution.

Table 3.2 Air Emissions (Gg) when TPP was working in 1-3 and 6-9 Km range

S.No	1-3 Km range		6-9 Km	
	Values	Mean Values	Values	Mean Values
1	4665, 4695, 4890	4750	5487, 5525, 5615	5542
2	4590, 4695, 4785	4690	4890, 5015, 5120	5008
3	4310, 4570, 4686	4522	4811, 4870, 5210	4963
4	4295, 4397, 4480	4390	4805, 4922, 5135	4954
5	4245, 4372, 4412	4343	4812, 4895, 5025	4910
6	4170, 4210, 4307	4229	4811, 4897, 5013	4907
7	3945, 4003, 4115	4021	4765, 4790, 4810	4788

Table 3.3 Results of Emissions of Identified Parameters per day

Identified Parameters	Emissions (/day) (Gg)
Carbon dioxide (CO ₂)	1262
Sulphur dioxide (SO ₂)	1110
Carbon Monoxide (CO)	1090
Hydrogen Fluoride (HF)	607
Ammonium Hydroxide	200
Sulphur Oxide	694
Nitrogen Oxide	575

Table 3.4 Level of usage of major parameters affecting environment

S.No.	Parameters	Scoring points					TPS	PPS
		1 B1	2 B2	3 B3	4 B4	5 B5		
1	Location of TPP	24	33	22	16	5	245	49
2	Emissions from TPP	2	20	37	23	18	335	67
3	Effects of Fly ash of TPP	3	15	34	33	15	342	68.4
4	Coal Ash	2	18	34	32	14	338	67.6
5	Gas emissions	5	6	22	41	26	377	75.4
6	Discharged water	3	14	29	37	17	351	70.2
7	Trace elements	6	18	28	32	16	334	66.8
8	Other emissions	4	16	45	20	15	326	65.2



3.1 Experiments on Soil Sample

The soil has been tested by its specific gravity, pH as explained following:

3.1.1 Specific Gravity of Soil Sample

This experiment was performed to determine the specific gravity of soil by using a PYCNOMETER. Specific gravity is the ratio of the mass of given volume of solids to the mass of equal volume of water at 4°C.

$$G = (M2 - M1) / [(M2 - M1) - (M3 - M4)]$$

M1 = mass of empty pycnometer, M2 = mass of pycnometer and dry soil, M3 = mass of pycnometer, soil and water, M4 = mass of pycnometer filled with water only.

Table 3.5 Examined relative density of soil

Relative density range (%)	Relative density (%) (Within 1-3 Km range)	Relative density (%) (6-9 Km range)
0-15 = Very loose, 15-35 = loose 35 – 65= Medium dense, 65 – 80 = Dense, 85 – 100 = Very dense	33	58

3.2 Experiment of Water Sample

Water samples were tested to check pH and TDS values as shown below:

Table 3.6 Examined pH of water

Temperature in (°C)	pH (within 1-3 Km range)	pH (6-9 Km range)
37.2	8.89	8.68

pH < 7 is basic, pH > 7 is acidic, pH > 10 extreme condition, maximum 14.

Table 3.7 TDS of water sample within 1-3 Km and 6-9 Km range from TPP

S.No.	Description	Determination 1-3 Km	Determination 6-9 Km
1	Wt of porcelain evaporating (W1)	35.43	35.43
2	Wt of dish + residue (W2)	34.9	34.94
3	Wt of residue (W) = W2 - W1	0.521	0.485
TDS of water sample(mg/l) = 0.521 /100 × 1000 = 5210 mg/l			4850 mg/l

4 Discussion

The impact of thermal power plant was seen when it was not in working with in a range of 1-3 Km by means of air emissions for a week (Table 3.1). Further, readings were taken in same range when thermal was working for a same time period as shown in Table 3.2, consequently effect of TPP also observed in a range of 6-9 Km (Table 3.3). On the other hand, [11] has indicated air emission effect up to 20-25 Km wide range from a TPP. A number of emissions were identified with their values which effects air environment adversely as mentioned in Table 3.4. Carbon dioxide (CO₂) was most influencing emission which got maximum value because coal has been used as a main source of power generation [15, 2]. In India, coal is of poor quality due to high percentage of ash (35-50 %) [15, 4]. Sulphur dioxide (SO₂) was following emission identified after CO₂ which transform into sulphuric acid causing respiratory issues [14]. Moreover, field crops and bio mass influenced simultaneously with increase of SO₂ [6]. The high percentage of ash in coal also results into formation of carbon monoxide (CO) which has significant influence on environment as per measured value which may results in health issues for living population [8]. Also as per results obtained from point percent score (PPS) values, gas emissions were found to be most influencing followed by fly ash and coal ash mainly. Fly ash and coal ash have an adverse effect on health such as respiratory problem, asthma, tuberculosis etc [12]. The testing of soil and water samples indicated presence of toxic contaminants, chemicals and other suspended particles which may affect crop growth as well as health issues in living beings [13, 5]. Ultimately, emissions from TPP have been observed to cause adverse impact on all form of environment whether air, soil or water.

5 Conclusions

Gas emissions were most affecting parameter followed by discharged water, fly ash and coal ash and mean value of air emissions from thermal power plant within 1-3 km and 6-9 Km were recorded as 5010.2 Gg and 4420.7 Gg respectively. The Relative density and pH of soil were experimented as 33%, 8.14 within the range of 1-3 Km and 58%, 7.96 in 6-9 km from TPP respectively. TDS, TSS and pH of water were examined as 5210 mg/l, 140 mg/l & 8.89 within 1-3 Km & 4850 mg/l, 190 mg/l & 8.68 in 6-9 Km from TPP. Also, relative density and pH values of soil showed that soil properties were badly affected by TPP.

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