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RESEARCH ARTICLE

COAL BASED THERMAL POWER PLANT AND ITS IMPACT ON SURROUNDING POND AND OTHER SURFACE WATER: A CASE STUDY OF KOLAGHAT THERMAL POWER PROJECT, WEST BENGAL, INDIA

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ABSTRACT

The Kolaghat Thermal Power Plant (K.T.P.P) is situated on the right bank of the river Rupnarayan in Purba Medinipur district, West Bengal, India. It is well connected with south-eastern Railway, NH- 6 and NH-41. This power plant was established during the sixth Five Years Plan period (1980-85). WBPDCL (West Bengal Power Development Corporation Limited) took the charge of this power plant since 1985. Presently its total power generating capacity is 1260MW, with six units, 210 MW each. K.T.P.P. generates around 7500-8000 metric tons of fly ash every day following the consumption of 18000 tons of coal (Source: KTPP office, 2009). The power plant has been failed miserable to meet the PM emission standard during last few years. So huge amount of fly ash particulate matter (PM) suspended in the air and finally deposited on the ground surface like, water body, vegetation, settlement, etc. It has changes the physico-chemical characteristics of the surrounding surface water. Present paper deals with the fluctuations of physico-chemical and microbial profile of pond water at different station around K.T.P.P.

INTRODUCTION

There has been an increasing demand for electricity generation throughout the world with the ever-increasing growth in human civilization, for example, advances in industrial development and human living standards. This increasing demand can be met only by combustion of fossil fuels. India depends largely on coal reserves for energy needs, which alone contribute 66% of the total power generated in India. One of the major environmental problems associated with the use of coal as fuel in thermal power plants is the production of ash. This problem is particularly important for Indian power station because most of the power stations use a poor quality coal with 35% ash and an average production of 100 million tons of ash per annum. Fly ash consists of finer sized particles, ranging from 0.5-200 um. Due to availability of poor emission control device, fly ash escapes into the atmosphere from the stack. Owing to its relatively small size the fly ash remains suspended for period of time causing air pollution in the surrounding areas and with the passage of time these PM are sediment on the ground surface, like water body, vegetation, settlement area, etc. On this background, the researcher studies the physico-chemical and Microbial profile of the pond water in context of pollution at Kolaghat Thermal Power Project, West Bengal, India.

Location of the study area: The total study area is about 300 sq. km. extending up to a radius of 10 km in all direction from K.T.P.P. This area comprises 90 mouzas (out of total 111 mouza) of Kolaghat block and 63 mouzas (out of total 86 mouzas) of Sahid Matangini block of Purba Medinipur district in West Bengal. This study area is located 87^{o}52'E longitude 22^{0}25'N latitude longitude. It is well connected through NH-6 and NH-41 and South-Eastern railway.

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Objectives

- To have an idea about the physico-chemical conditions of pond and other surface water.
- To investigate the nature of impact of fly ash on the local water bodies.

MATERIALS AND METHODS

Selection of the villages in the study area

At first three buffers are delineated taking the K.T.P.P. in the centre. These buffers start one kilometer away from the plant as this area is used for different purposes such as ash pond and other uses of plant, at the intervals of three kilometers. Then three villages are selected from each buffer in different directions, e.g. north, south and western side. But no villages have been selected from eastern side, because river Rupnarayan covers the major parts of the eastern side of the study area and naturally there is no settlement. Water samples from local water bodies (pond &other surface water) have been collected on the basis of random sampling from selected nine

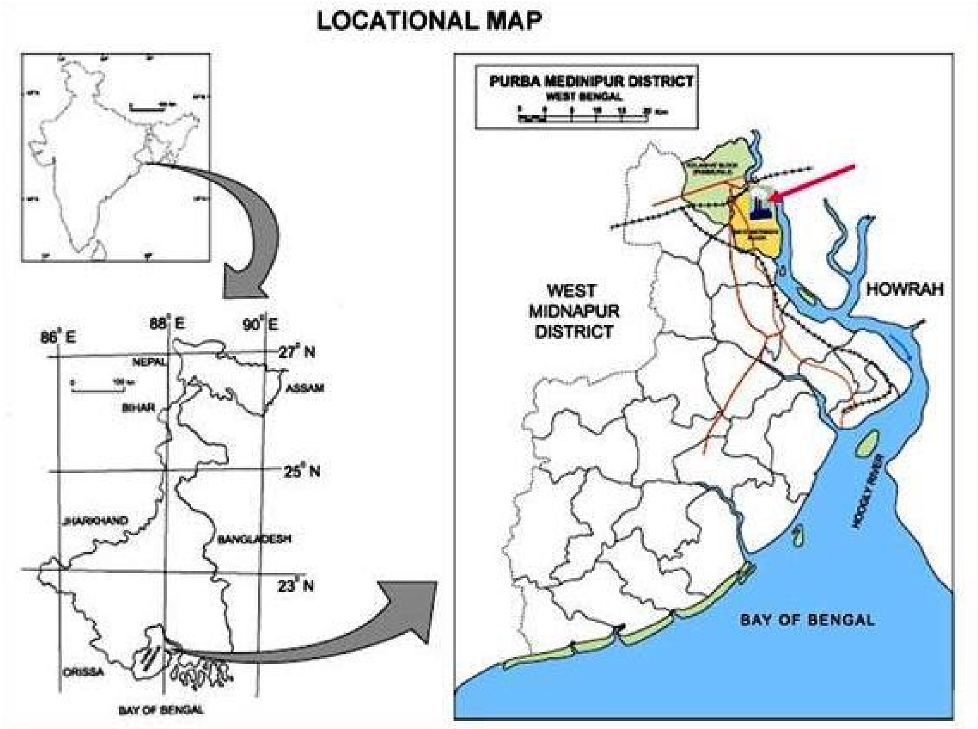

Fig. 1. Location of the Study Area

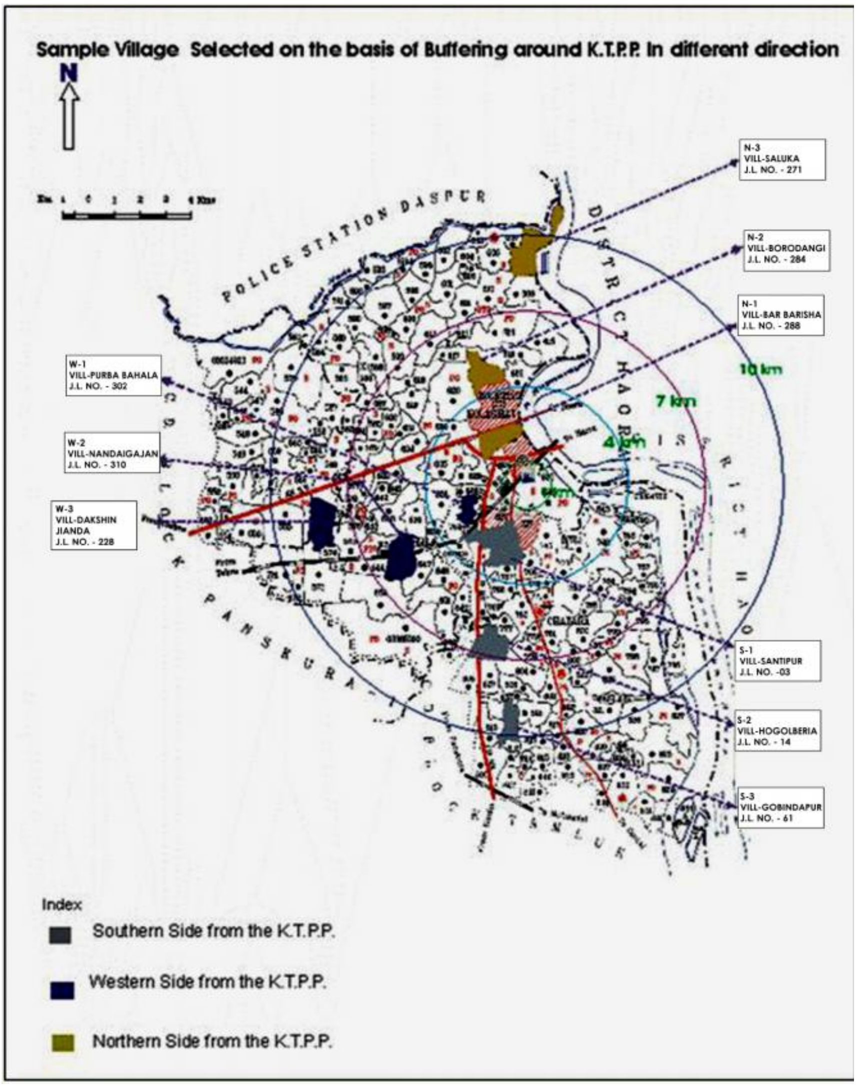

Fig. 2 Site Selection for Pond and Other Surface Water

sample villages for laboratory analysis to find out whether fly ash is making any adverse impact on water quality. Samples were collected during summer season (May – June, 2013). Total 9 samples have been collected and analyzed on the basis of the following parameters, namely –

Table 1. Sample Sites

Sample No.	Remarks
N1	Linked with domestic waste water and domestic land wash water
N2	Linked with domestic waste water and domestic land wash water
N3	No such any linked
S1	Linked with domestic waste water & other similar pond and domestic land wash water
S2	Linked with domestic waste water and domestic land wash water
S3	Linked with domestic waste water and domestic land wash water
W1	No such any linked
W2	Linked with Agricultural land
W3	Linked with Agricultural land

RESULTS AND DISCUSSION

Determination of Physico-chemical and coliform load

The results obtained are mentioned in Table 02 and standards recommended by WHO and BIS for hardness, E. coli and coliform are mentioned in Table 04. Area wise sampling stations are shown in the map of Kolaghat. The hardness of water is caused by multivalent metallic cautions. Total hardness varied between 152-322mg/L. The standard unit for the total hardness specified is 300mg/L and is considered potable; beyond this limit it produces gastrointestinal irritation (ICMR, 1975).

Table 2. Determination of Physico-chemical and Coliform load in pond water in the K.T.P.P. and its surrounding

Sample No. (Pond water)	(1) Coliform (MPN/100ml)	(2) DO (ppm)	(3) BOD (ppm)	(4) COD (ppm)	(5) Water p^H	(6) Water Temp. (ºC)	(7) Alkalinity (ppm)	(8) Hardness (ppm)	(9) EC (mmoh/cm)
N1	24000±350	10.64±2.2	9.32±1.2	76±5.1	7.4±0.01	32.0±2.2	90.6±0.50	160±1.5	1.06±0.002
N2	24000±35	4.0±1.09	21.22±1.5	60±4.5	7.7±0.02	32.5±2.1	54.6±1.05	152±1.2	1.14±0.005
N3	3500±321	1.04±0.02	90.22±2.1	84±6.0	7.8±0.02	32.0±2.0	96.1±0.77	156±1.6	2.04±0.009
S1	60±22	1.32±0.01	88.01±2.5	64±3.2	7.8±0.02	33.0±2.2	90.2±0.52	322±8.2	1.13±0.001
S2	120±30	2.64±0.01	46.55±2.2	40±3.1	7.3±0.01	32.5±2.1	49.2±1.10	172±1.8	1.12±0.001
S3	9200±200	2.0±0.01	45.12±2.0	92±7.7	7.4±0.01	33.0±2.0	48.1±1.01	192±2.0	1.06±0.002
W1	16000±390	6.24±1.68	13.42±1.8	68±5.6	7.2±0.01	32.5±2.1	68.6±2.57	272±4.8	1.54±0.007
W2	330±192	6.0±1.51	24.12±1.7	80±5.9	7.5±0.02	33.0±2.2	69.2±0.75	294±5.0	1.70±0.008
W3	170±55	14.64±2.25	12.92±1.1	72±4.9	7.6±0.02	32.0±2.0	76.3±0.68	276±6.0	1.63±0.007

Source: Data Collected from Study Area and Laboratory Analysis (May-June – 2013).

Table 4. WHO and BIS recommended standards for drinking water quality for hardness and E. coli and coliform

Parameters	WHO (1993)	BIS(1998)
Hardness mg/L	100 – 500	300 - 600
E. coli per 100 mL	-	1
Coliform per 100 ml	<10	<10

Source: http://www.fao.org/docrep/x5624e/x5624e05.htm

Therefore S-I water sample is not potable for domestic purpose. The acceptable limit of total hardness is 500mg/L (WHO, 1983). Based on the total hardness, Sawyer and McCarty (1966) have classified the water into four classes such as soft (less than 75mg/L), moderately hard (75-150mg/L), hard (150- 300mg/L) and very hard (more than 300mg/L). Accordingly nine samples are hard and one sample is very hard. Temperature of the pond water changed from 32.0ºC to 33.0^0 C throughout the sampling stations. The p^H value of the water at different stations was recorded to be within 7.2 to 7.8 in sampling time. Electrical conductivity of water at different stations was recorded to be 1060 to 2040 µmhos/cm. Freshwater, fish ponds, in general, exhibit low EC values which may be expressed as µmoles cm^{-1}. Boyd (1978) stated that natural waters usually have EC values of 20 to 1500 µmhos/cm. But, present result indicates that four pond water (N3, WI, W2 and W3) have high EC value which is not suitable for aquaculture. Natural water has low conductivity, but pollution increases it. Most of the salts dissolved in water can conduct electricity. Thus, the electrical conductivity of water depends upon the concentration of ions and the status of nutrient in it.

Highest value, 2040 µmhos/cm, was recorded at station N3. This might be due to the addition of sewage into it. An increase in electrical conductivity is regarded as pollution indicator in water bodies (Das *et al*., 2006). However, the fluctuation observed in EC was not well within limits as a maximum value of 2040 µmhos/cm which is not permissible for diverse fish population. Dissolved O_2 ranged between 1.04 to 14.64 ppm throughout the sampling stations. Low level of DO is again indicative of polluted nature of water body. Such low level of oxygen was also noted by Iqbal *et al*. (2006) on addition of sewage waste from human settlements to Dal Lake. At station N3 saturation level of dissolved O_2 was very low (1.04 ppm). It may be due to high rate of oxygen consumption by oxidizable matter coming in along with sewage. Total alkalinity ranged between 48.1 to 96.1 ppm among the sampling stations. Maximum values of bicarbonates alkalinity recorded at station N3 was probably due to the input of domestic sewage. Shah, (1988) noticed higher concentration of bicarbonate alkalinity in the domestic sewage during the study of river Jhelum. The BOD and COD of water sample varied from 9.3 to 90.22 ppm and 40.0 to 84.0 ppm throughout the sampling stations. Higher values of BOD may be attributed to the maximum biological activity at elevated temperature, whereas the lowest BOD in indicated lower biological activity. Similar observations were made by Agrawal *et al*., 1976; Rai, 1978; Bagde and Verma, 1985; Rao *et al*., 1985 and Sengar *et al*., 1985. Station wise, the BOD values show high fluctuation primarily due to the addition of domestic sewage. Higher values (69.4 ppm in winter and 109.4 ppm in summer) were recorded at station N3, owing to high amount of organic matter in domestic sewage (Paramshivam and Sreenivasan, 1981; Somashekar, 1985; Kudesia and Verma 1986). Rao, (1976); Campbell, (1978); Mahadevan and Krishnaswamy, (1984) also reported that an increase in BOD and bacterial level as indicative of increasing pollution, which is supported by Sinha, (1988) Chandrashekar *et al.*, 2003. The highest values of COD were recorded at station N3 indicating presence of organic wastes in sewage.

Conclusion

Water is valuable natural resources and now it is facing depleting due to ever increasing consumption in industrial and domestic sector. From the present study, the researcher try to indentifying and analyze the level of depletion of pond and other surface water due to fly ash pollution from K.T.P.P. Out of nine samples, one samples (S-1) is not potable for domestic purpose due to high value of hardness(322 ppm). EC values of four samples are very high and not suitable for aquaculture. The minimization of PM (Particulate Matter) level from the stakes within permissible limit (as guideline by the Central Pollution Controlled Board in India) and proper management of fly ash from ash ponds are the primary and immediate responsibility to the K.T.P.P. authority.

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