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MANAGEMENT OF FLY ASH OF KOLAGHAT THERMAL POWER STATION, PURBA MEDINIPUR, WEST BENGAL

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Abstract

Coal is India's most abundant resource, and it will continue to play a pivotal role in the country over the upcoming decades. There currently exist in India 82 coal-fired power plants. Fly ash is, alone, a waste product and its responsible disposal poses a huge problem. From each power station, thousands of tons of fly ash are pumped into the ash ponds in the form of slurry (fly ash mixed with water) every day; these ponds occupy thousands of hectares of agricultural land all over India. Kolaghat Thermal Power Station (KTPS) is the second largest thermal power station in West Bengal. Huge amount of ash from this plant is disposed off in surrounding land and water bodies leading to air, water and soil pollution. Overflow of pond ash towards residential areas is causing unnecessary human exposure and has serious health risks due to the high content of heavy metals. The villagers are even more affected when monsoon season begins, as the ash is deposited in the fields and farmers use ash-laden water to irrigate. This has an adverse affect on agricultural productivity and blocks the drainage system. Proper management of fly ash is required to avoid environmental disasters in near future.

Key Words: *Air pollution, siltation of river bed, surface and ground water contamination.*

Introduction

Kolaghat Thermal Power Station (KTPS) is a major thermal power station in West Bengal. It is located at Mecheda (22°24′56″N, 87°52′12″E), approx. 55 km from Kolkata in the Purba Medinipur district. The power plant is operated by West Bengal Power Development Corporation Limited. The power plant has six power generating units of 210 MW each for a total capacity of 1260 MW. The units were commissioned in two stages during the period of 1984 to

1995. The KTPS is generating about 7500-8000 metric tones of fly ash every day by consuming a total of 17500 tones of coal. Presently the plant has only 132 hectares of land located 4-5 km away from it. Five ash ponds are now operating on it. The fly ash which is coming out of the chimneys generally subsides in the surrounding areas generally 3 – 4 km away.

Table 1 Installed Capacity of the Plant

Stage	**Unit Number**	**Installed Capacity (MW)**	**Date of Commissioning**	**Status**
I	1	210	September 1990	Operational
I	2	210	March 1986	Operational
I	3	210	October 1984	Operational
II	4	210	April 1995	Operational
II	5	210	May 1991	Operational
II	6	210	January 1994	Operational

Source: KTPS Office, 2012

Production of Ash

Combustion of coal in the Boiler results in generation of ash. A device called Electro Static Precipitator (ESP) is used to prevent ash from flying out the chimneys (3 big and 3 small). Ash is collected in hoppers below the ESP and is disposed off by two methods:

a) Dry System: Ash is conveyed by compressed air to storage tanks called SILO (5 big concrete tanks, each of 2000 MT capacity). Some companies (Ambuja Cement, Madras Cement Company) collect ash from SILO for their use in air proof tanks at nominal charges.

b) Wet System: Slurry (ash mixed with water) is disposed off in large ponds (ash ponds). There are six ash ponds located 4-5 km south of the power station. The ash is kept exposed in the sun to dry and is collected by many companies for their use.

Environmental Problem

i. Air Pollution: Unburnable mineral material becomes ash. The concentration of most trace elements in coal ash is approximately 10 times the concentration in the original coal. Emission of green house gases (CO2, SO2 etc.) is another cause of air pollution.

Each power generating unit has individual ESP as Air Pollution Control Device (APCD) and unit no. 1, 2 & 3 are connected to individual stack of height 120m and unit 4, 5 & 6 are connected to individual stack of height 220 m. The trade effluent is treated in ETP (Effluent Treatment Plant) and six ash ponds. Opacity meter was also installed to monitor the emission concentration continuously.

Table 2 PM Emission of the Plant

Sample Collected from	**Parameter**	**Results Obtained (mg/Nm3) on**		**Permissible Limit (mg/Nm3)**
		24.1. 2012	**16.4. 2012**	
Boiler Unit no. 1	PM	884.20	3354.6	150
Boiler Unit no. 2		1310.08	909.47	
Boiler Unit no. 3		2269.30	312.01	
Boiler 5 (Pass A)		951.90	486.67	
Boiler 5 (Pass B)		799.25	508.44	
Boiler 6 (Pass A)		232.39	968.66	
Boiler 6 (Pass B)		298.07	297.47	

Source of Data: West Bengal Pollution Control Board, August, 2012

The treated effluent from ETP (physico-chemical type) is recycled to make ash slurry and the rest is discharged to local canals (Denan canal, Banpur canal, Midnapore canal) and Rupnarayan river. The inhabitants of the surrounding area are facing severe air pollution from fly ash generated by the industry. They also alleged that Midnapore canal, Denan canal are filled up with thick layer of ash. The crops and vegetation have been damaged due to significant stack emission and discharge of ash laden effluent from the industry. The field surveys showed that more than 1000 people are affected due to fly ash exposure and 50-55% is affected with asthmatic disorder due to fly ash exposure. The West Bengal Pollution Control Board has been accused Kolaghat Thermal Power Station for causing an environmental disaster in its locality since August, 2003. At a hearing on the fly ash spill-over that affected three villages of Andulia, Ruxa Chowk and Bon Mecheda inhabited by nearly 1,000 people, PCB officials gave the responsibilities to KTPS authorities to task for failing to curb the disaster. The industry also failed miserably to meet the PM emission standard during sampling on 24.01.12 and 16.4.12 (Table 2).

The authority opined that they are trying to maintain the PM emission standard but it is difficult because it is an old plant. Planning is formulated to enhance the efficiency of ESPs to meet the PM emission standard.

ii. Surface Water Contamination: Groundwater and surface water are fundamentally interconnected. It is often difficult to separate the two because they feed each other. This is why one can contaminate the other.

Fly ash consists of silica, aluminum, iron and calcium oxides plus other minor constituents. It has been used in a variety of applications in road construction including as an addition to cement and concrete, for grouting mines and caverns, as a fill material for embankments, in road stabilized mixes etc. The mentioned application options of fly ash and a long term experience in such applications prove its advantages. But this is only waste material with variable chemical and mineralogical composition whose uncontrolled application and deposition could have harmful effects on environment.

Continuous deposition of fly ash in the Rupnarayan river results in excessive siltation of river bed and increasing potentiality to flood. Properties of fly ash depend on the type of coal used in the combustion process and the process itself in the power plants and this significantly influences the change in ash composition, possible radioactive properties and heavy metal concentration. Studies have shown that fly ash dumping continued to cause surface water contamination during flooding. Influences on water quality have the presence of heavy metals (As, Cd, Cu, Cr, Hg, Pb, Zn etc.,) and organic matter (benzol, phenol etc.).

Pollution of Rupnarayan river results in decreasing fish population and other aquatic organisms.

Table 3 Physico-Chemical Characteristics of Water (Mean of 3 Seasons) of Rupnarayan River

Parameters	**Results Obtained**	**Ideal /Permissible Limit**
Temperature (^oC)	27.3	15-20
pH	7.8	6.5-8.5
Transparency (cm)	10.9	60
Salinity (‰)	0.5	0-30
Alkalinity (mg/litre as CaCO3)	94.5	20-100
Free CO2 (mg/litre)	2.5	< 2
Total Hardness	114.9	15-120
Ca-Hardness (mg/litre as CaCO3)	76.6	10-80
Mg-Hardness(mg/litre as CaCO3)	38.3	5-40
Conductivity (micromho/cm)	1082.4	100-2000
Total Dissolved Solid (mg/litre)	613.5	500
Total Suspended Solid (mg/litre)	599.5	350
Grain Size (diameter in mm)	0.3-0.5	.001-2
D.O. (mg/litre)	7.4	5-10
C.O.D. (mg/litre)	87.9	<10

B.O.D. (mg/litre)	3.1	0.8-5.0
Total kjeldahl N (mg/litre)	2.7	<0.5
Total phosphate P (mg/litre)	0.5	<10
Chloride (mg/litre)	175	<250
Available Stream Energy (Joule)	12.4	>25
Velocity of Water (metre/ sec)	0-0.5	>1
Water Discharge (m3/sec)	<10-32	>50

Source of Data: Data collected by the author in 3 seasons, 2012

iii. Groundwater Contamination: Since coal contains trace levels of arsenic, barium, beryllium, boron, cadmium, chromium, thallium, selenium, molybdenum and mercury, its ash will continue to contain these traces and therefore cannot be dumped or stored where rainwater can leach the metals and move them to aquifers. Leaching and movement of water through materials containing soluble components significantly influence the surrounding soil, surface water and groundwater. Variable chemical composition of fly ash can contain elements that will infiltrate groundwater by leaching and ultimately present danger to the flora, fauna and human health.

Table 4 Physico-Chemical Characteristics of Soil (Mean of 3 Seasons) of Rupnarayan River Basin

Parameters	**Results Obtained**	**Ideal / Permissible Limit**
Temperature (ºC)	35.8	15-25
pH	7.8	6.5-8.5
Salinity (‰)	0.1	<0.5
Organic Carbon (%)	4.5	6-8
Soil Texture (%): Sand	17.8	23-52
Silt	43.6	28-50

Clay	38	7-27

Source of Data: Data collected by the author in 3 seasons, 2012

Where fly ash is stored in bulk, it is usually stored wet rather than dry so that fugitive dust is minimized. The resulting impoundments (ponds) are typically large and stable for long periods, but any breach of their dams or bunding will be rapid and on a massive scale. The amount of some elements like aluminum, iron, arsenic and manganese above than WHO guideline of safe drinking water denotes significant contamination of the ground water. The pH of the water samples of tube wells range from 7.04 to 8.75 indicates alkaline nature of water.

Agricultural productivity in the surrounding region has been declining during the last three decades. Some of the farmers are of the opinion that the fly ash has also to some extent hindered the production. The layer of the fly ash sometimes blocks the air circulation in the soil and saplings cannot have sufficient amount of nutrients and food and as a result the growth is thwarted.

Radiometric survey and geo-chemical analysis of the ash ponds were taken by the Department of Radio Physics and Geology of Kharagpur IIT to assess the quality of toxic elements that contaminate the soil and ground water system. Most of the toxic elements like arsenic, cadmium, chromium, nickel, cobalt, copper, antimony etc. are infiltrated in soil and ground water through leaching from the bottom ash. Radioactivity due to the presence of uranium, thorium and potassium in ash was found 2-3 times greater than the safe level. The bricks and cement made of fly ash of KTPS show high concentration of uranium and thorium. Apart from mixing in air these radio elements are concentrated in soil and water. Tube wells located near ash ponds yield high activity of radon than those located in distant areas. Increased incidence of leukemia, bone sarcomas and chromosomal aberrations are due to radio toxicity of thorium. Prolonged exposure in this area may lead to lung and bone cancer.

Table 5 Chemical Analysis of Liquid Effluent

Parameters	**Permissible Limit**	**Results Obtained**	
		Plant Outlet	**Ash Pond**

pH	6.5 to 8.5	8.2	8.7
Total Soluble Salt (mg/litre)	100	72	82
BOD (mg/litre)	20	16	22
COD (mg/litre)	80	25	28
Oil Grease (mg/litre)	20	8.6	7.6
Chromium (mg/litre)	0.2	0.24	0.26
Copper (mg/litre)	1.0	0.2	0.1
Zinc (mg/litre)	1.0	0.8	0.8
Iron (mg/litre)	1.0	0.35	0.46
Phosphate (mg/litre)	5.0	0.04	1.2

Source of Data: Data collected by the author on 16.5. 2012

Disposal and Market Sources

In the past, fly ash produced from coal combustion was simply dispersed into the atmosphere and deposited in ash ponds. This created environmental and health concerns that prompted laws which have reduced fly ash emissions to less than 1% of ash produced. The recycling of fly ash has become an increasing concern in recent years due to increasing landfill costs and current interest in sustainable development. Other environmental benefits to recycling fly ash includes reducing the demand for virgin materials that would need quarrying and substituting for materials that may be energy-intensive to create such as portland cement.

Fly Ash Reuse

West Bengal Power Development Corporation Ltd (WBPDCL) made an agreement with Gujarat Ambuja Cement Ltd (GACL) for supplying them ash from the Kolaghat Thermal Power Station for making portland pozollona cement (ppc) in June, 2003. This was part of the State-owned WBPDCL's long-term strategy to utilise the fly ash generated by the 210x6 MW KTPS located in Midnapore district. The initiative involving GACL is in line with the suggestions made by a Japanese consultancy organization which conducted a study on fly ash utilization for KTPS. As such, detailed project reports have been prepared for making burnt fly-ash clay bricks, fly ash lime bricks and ppc.

WBPDCL exports fly ash to Bangladesh, utilizing it for making ppc. The RPG-controlled CESC already has an agreement with GACL on ppc. A burnt fly ash brick plant has already been set up to utilize 40,000 tonnes of fly ash, as a short-term strategy, WBPDCL has also taken up some other projects to reduce the fly ash problem. Under the present environment protection norms (for controlling air pollution) dispersion of respiratory particle matter has to be kept within 150 mg. This has not been the case with some of the older units of the KTPS implementation of which started in 1985 and was completed in 1993. Not all the units under KTPS conform to the stipulations (efforts are now underway to tackle this problem with installation of latest technology besides the conventional electrostatic precipitators). The industry has submitted an action plan on 02.04.12 mentioning that they are planning to improve stack emission by replacing collecting plates and discharge electrodes in ESPs of unit no. 1 to 3.

WBPDCL started utilisation of its fly ash ponds for vegetation purpose with the help of the Bidhan Chandra Agricultural University. This is in addition to the efforts launched by WBPDCL jointly with the Central Fuel Research Institute at its Bakreswar Thermal Power Plant for using ash for soil improvement. Ash is also used for railway and road embankments and for making concrete roads, cumulative utilisation of fly ash by KTPS has been 1.81 crore cubic metres till March 2003. The figure stands at 2.09 crore cubic metres for WBPDCL as a whole. These technologies, while reducing the spread of particles (like fly ash) into the air necessitate greater attention to utilization.

Recommendations

The management and control of air, water and soil resource systems are multi-disciplinary tasks requiring different techniques and considerable changes in the present approaches towards tackling the problems. Some suggestions are given below:

1. Taking necessary steps to comply with environmental norms with efficient functioning of air pollution control devices attached to all units operations.

2. Formulation of a time bound action plan annually regarding upgradation or modification of ESPs to meet the PM emission standard.

3. Extensive plantation of at least 5000 saplings at suitable location in consultation with local gram panchayat in each monsoon.

4. A great integration of qualitative and quantitative aspect of both surface waters and groundwater, taking into account the natural flow conditions of water within the hydrological cycle. Dredging of Rupnarayan river and other canals should be done to enhance the water bearing capacity.

5. Physico-chemical analysis of ash ponds, river water to check the extent of remediation by using mycorrhizal inoculation. Practically all plant life is dependant upon a relationship with Mycorrhizal fungi. Mycorrhizae (meaning fungus roots) form a symbiotic relationship with the roots of 95% of the worlds' plant families, and aid nutrient exchange, increase resistance to disease and drought, and ultimately reduce the need for chemical fertilizers by around 40%. Mycorrhizae make plant growth possible, linking the roots of plants to the surrounding soil. This inoculation is found to be beneficial to attain plant growth (shoot height and leaf surface area) and thus plants get effectively rooted in the soil. Various fruits, vegetable and flowers are reported to grow well after mychorrhizal treatment.

Utilization of mychorrhizal treatment can play a very good role because of its metal sequestering properties for effective metal bioremediation on fly ash dumps. The mycorrhizal treatment offers an economically feasible biological means for assuring plant production at fly ash contaminated sites. Mychorrhizal produces organic acids that combine with some heavy metals to form compounds that are less mobile and less likely to pollute groundwater and surface runoff. Glomus intradice is one of the most resistant fungal species for fly ash and plays a major role in heavy metal remediation.

6. Evaluation of metal bioremediation in soil. 7. Observation of plant growth before and after mycorrhizal treatment.

References

1. Chauhan and Chakravarti (2002): Radon Activity and Exhalation Rates in Coal Fired Thermal Power Plants.pp.146.

2. Dhadse S, Kumari P and Bhagia LJ (2008), Fly ash Characterization, Utilization and Govt. initiative in India – A Review, Journal of Scientific and Industrial Research, Vol. 67, pp.11-18.

3. District Statistical Handbook, Purba Medinipur, Bureau of Applied Economics & Statistics, Government of West Bengal,2006 Vol. II, No. 2, Article 2— 11

4. Mondal A & Sengupta D (2005), Radionuclide and trace element contamination around Kolaghat Thermal Power Station, WB, Environmental Implications, Current Science, Vol. 88, No 4 , pp.620-624.

5. Mishra U (2004), Environmental Impact of Coal Industry and Thermal Power Plants in India, Journal of Environmental Radioactivity, Vol.72, pp.35-40.

6. Naruwaka et al. (2005): Investigation on chemical Species of Arsenic, Selenium and Antimony in Fly Ash from coal Fuel Thermal Power Stations.pp.127.

7. Nielsen, M.T. and H. Livbjerg. (2002): Formation and Emission of Fine Particles from Two Coal Fired Power Plants.pp.78.

8. Papp and Deszo (2003): Estimate of the Dose-Increment due to Outdoor Exposure to Gamma Rays from Uranium Progeny Deposited on the Soil around a Coal Fired Power Plant.pp.148.

9. Sharma Pervez (2004): A Case Study of Spatial Variation and Enrichment of Selected Elements in Ambient Particulate Matter around a Large Coal-Fired Power Station in Central India.pp.78.

10. Triantafyllou et al (2006): Levels and Trend of Suspended Particles around Large Lignite Power Stations.pp79.