Fly Ash Utilisation for Value Added Products
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Environmental evaluation of coal ash on soil behaviour — A case study of Chandrapura thermal power station

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ABSTRACT

In this study environmental evaluation of coal ash on soil around Chandrapura thermal power station (CTPS) of DVC has been presented. Results indicate that a well planned coal ash control strategy and its utilisation has to be applied to check the coal ash pollution in the area.

Key words : *Coal ash evaluation, Soil behaviour*

1.0 INTRODUCTION

The thermal power plants generate huge quantity of coal-ash as a solid waste material of coal combustion. These coal ashes are usually collected in the hoppers of Electrostatic Precipitators (ESPs) and disposed in the ponds or lands and some of these enter to atmosphere by passing through the stack along with flue gases. The atmosphere, being an important medium for metals in the coal ash deposition has been found around thermal power plants. Coal ash and some of the re-suspended ash from ash ponds get deposited in nearby environment (5-10 Km) of a thermal power station. These coal ashes enter the terrestrial or aquatic environment by wet or dry deposition. In one study it is found that about 37 trace elements pass from a coal fired power plant to the eco system. The most toxic metals found concentrated on the surface of coal ash were Co, Ni, Bi, Sb, Zn etc. Most living organisms possess little or no tolerance to these elements because they are not normally encountered in the enviroment. The extent of the pollution of a soil by a particular toxic element can be plagued by determining its concentrations and comparing this with the unpolluted soil contents. Also, distribution profile of toxic elements provides an insight into their behaviour during weathering and availability to plants.

In order to assess the level of coal ash deposition in the areas around C.T.P.S., study on the coal ash deposition and presence of toxic elements during the period Jan to June 1996 was carried out.

2.0 STUDY AREA

The Chandrapura Thermal Power Station of Damodar Valley Corporation is situated in the state of Bihar covering an area of 750 ha of land. It is bounded by the river Damodar on the south, Pokharia alla on the east and hills on north and west. This power station has a power generation capacity of 720 MW, with coal consumption of about 8,000 tonnes/day. It uses coal having 40-55% of ash content and generates about 4,500 tonnes of ash per day. The total maximum discharge of effluent from fire operation unit is about 27,255 m^3/day.

3.0 SAMPLING SITES

Considering the criteria for site selelction has, following stations were selected for monitoring.

1. Sampling station 3: located at 1 Km in SW direction from plant.
2. Sampling station 4: located at 1 Km in SE direction from plant.
3. Sampling station 2: located at 1 Km in NW direction from plant.
4. Sampling station 1: located at 1 Km in NE direction from plant.

4.0 SAMPLING PROCEDURES

Samples of soils were collected from each of the four sampling sites which are located at a distance of about a Km in four different directions with respect to the emission source by, digging layer thickness of 30 cm once in a month during January to June '96. These samples were collected in polyethylene bags to minimise sample contamination.

5.0 ANALYTICAL PROCEDURES

5.1 Reagents

Standard solution of the metals, each having a concentration of 1000 mg of the metal ion per ml of soil samples.

5.2 Sample preparation

Soil samples were prepared for drying by breaking down aggregates, spreading the soil on cemented floors and thoroughly mixed and dried in an oven at 1100°C for three hours. Representative sub-sampling of the dried soil was carried out by coning and quartering to the desired weight. One gram quantity of soil was taken from each sample and digested in a Teflon digestion bomb, using 10 ml. acid mixture of HF, HCl and HNO_3 by placing it in an oven at 180°C for 30 minutes. There after the solution was made up to 100 ml. volume in a volumetric medium of 0.1 m EDTA to suppress the interference of phosphate, carbonate, iodide, flouride and acetate. Analyses of these metals were carried out by using an atomic absorption spectro-photometer (GEC-902) by adopting the recommended procedures as mentioned in the manual. The concentrations of toxic metals in the coal ash are shown in Table 1.

Table 1: Concentration of Toxic Metals at 30 Cm depth of soil from January to June '96

Site. No.	Dist-ance	Depth	Direc-tion	Month	METALS					
					Zn	Ni	Pb	Co	Bi	Sb
1.	1 Cm	30 Cm	SW	Jan	12	80	78	64	1	1
				Feb	10	78	79	62	2	1
				Mar	11	79	76	63	1	2
				Apr	10	78	78	64	1	1
				May	13	81	79	65	2	2
				Jun	12	80	78	64	2	2
2.	1 Cm	30 Cm	SE	Jan	15	102	90	75	2	10
				Feb	12	100	98	73	1	9
				Mar	14	103	89	74	1	12
				Apr	13	100	91	73	1	9
				May	15	102	90	76	2	10
				Jun	16	104	92	78	2	12
3.	1 Cm	30 Cm	NW	Jan	12	90	84	68	1	8
				Feb	11	89	81	66	1	6
				Mar	12	90	80	67	2	5
				Apr	10	88	82	65	1	4
				May	11	89	84	67	2	6
				Jun	12	90	83	68	2	8
4.	1 Cm	30 Cm	NE	Jan	14	88	86	72	2	10
				Feb	12	86	83	72	1	9
				Mar	11	87	85	71	2	7
				Apr	13	85	84	71	2	9
				May	12	86	83	70	1	8
				Jun	14	88	86	72	2	10

Concentration in ppm.

6.0 RESULTS AND DISCUSSION

The results confirm that the soil horizon around the thermal power station has received an intake of toxic metals from the coal ash emitted by the power station. The concentration status (in ppm) element wise, in the top 30 cm thickness of the soil implies that coal ash permeated the soil horizon around the thermal power station. The concentration of all the elements is maximum in the SE direction and the minimum values also in the contaminated soil are considerably high in all the four directions. This may prove hazardous for the crop generation capacity of the soil as well as for the animals grazing the grass on land surface near the power station and human health especially the infants.

7.0 CONCLUSION

The present study clearly indicates that the soil around the thermal power station has been significantly influenced by toxic elements emitted from power station. However, to find its effect on vegetation, a detailed study is required to be conducted and more preventive methods have to be adopted to control the emission of coal ashes.

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