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POWER PLANT ASH WATER TREATMENT METHODS AND ITS UTILIZATION FOR DOMESTIC APPLICATION AND GOOD EFFLUENT WATER TREATMENT PRACTICES

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ABSTRACT The water quality from the outlet of Ash Pond of power plants was studied. The water quality was assessed by monitoring various physico chemical parameters like pH, Suspended Solids (SS), BOD, COD, TDS, Oil & Grease, Sulphide (S), Sulphate (SO4--) and Chloride (Cl-) – total 9 parameters. The assessed quality of water was compared with permissible standards prescribed by the Telangana State Pollution Control Board (TSPCB) and found that the ash pond water can be successfully utilized for irrigation and horticulture proposes.

KEYWORDS : Quality Characteristics, Irrigation Water, Ash Pond, Effluent, Physico Chemical Characteristics, CPP.

INTRODUCTION:

Water is essential for all living brings including plants for their existence. Water pollution is far most hazardous creating problem affecting our daily life in multiple dimensions. Industries release their effluents into the water bodies which may alter the physico chemical characters.

The ash produced from the plant is discharged into the ash pond located outside the plant area. The wet ash disposal to ash pond causes building of ash clusters and hence ash level which must be utilized for other useful purposes in order to keep the ash pond empty for further ash disposal. Eisenberg et al. (1986) studied three methods of ash disposal like (a) dumping in disposal area (b) placement compaction in a controlled skill and (c) slurry with water followed by pumping in a lagoon or impoundment. Chopra(2017) recommended the fly ash, by-product of thermal power plant can be used for stabilization of expansive soils. The disposal of Fly Ash is a big problem for environment, so it should be used for good cause like adding of fly ash in the clayey soil in the proportion of 5%, 10%, 15%, 20% and 25% by weight of soil and the properties were compared with parent soil. The slurry of fly ash i.e bottom ash and fly ash with water is pumped into ash ponds.It is very important to know that the ash settles down in the pond quickly.The rate of settling of fly ash is much slower in water (Kumar Hemant et.al 2006)

MATERIALS & METHODS:

The water samples were collected in sterile plastic bottles. The pH of water sample was estimated immediately after collecting water at site itself. The total dissolved solids, TDS, BOD, COD, Chloride, SO4, Oil and Grease as well as Sulphide were estimated as per procedure given in APHA (1987). The samples were collected in weekly intervals for a period of one year. The data obtained in the analysis were presented in Table 1 to 6. The water quality of ash pond outlet was assessed and compared with the standards imposed by APPCB.

RESULTS AND DISCUSSIONS:

Based on pilot plant observation and results validating above data good practice plants have been cited below. The samples analysis comparison at one of the Heavy Water Plants at Manuguru have been validated. In the present study, **pH** of all samples tested was observed between 7.9 to 8.9 which are slightly on alkaline side. High pH in summer may be due to high decomposition activities. The **SS** level was noticed varying in the range 9 to 15 ppm in most months of the year. Occasional fluctuations were also noticed in a small of 15 to 28 ppm in the months of Mar'05 & May'05 (Table 1 & 2).

BOD has traditionally been the most important measure of strength of organic pollution. The BOD level was observed varying in the range of 1.0 to 2.0 ppm, but in the months Aug'05 & Sept'05 (Table 3 & 4), it was noted to be 3 & 4 ppm respectively.

COD level was found ranging between 6.0 to 15.0 ppm in the months Mar'05, Apr'05, Aug'05 & Oct'05 (Table 1, 3 & 4). Little higher fluctuations were noticed in the months Jul'05, Nov'05 & Dec'05 (Table 3 & 5) ranging between 28 to 35 ppm. The lower range fluctuation was again noticed in all weeks of Feb'06 ranging between 8 to 17 ppm.

TDS concentration was noticed varying in the range of 180 to 280 ppm in most of the months during the study. The lowest TDS was noticed 170 ppm (29.09.05, Table 4) and highest it was 580 ppm on the last week of Dec'05 (Table 5). Little higher variations were recorded in all 4 weeks of Feb'06 in the range of 380 to 410 ppm (Table 6). TDS concentration in the body of water indicates the usefulness of water for various applications. TDS level hence is observed far less than the stated value of TSPCB (2100 ppm).

The **Oil & Grease** content in water destined for drinking or any other application is not acceptable. The oil & grease was observed less than 1 ppm in all samples analyzed during the present studies. The oil & grease level prescribed by APPCB is 10 ppm and hence it is much less than the permissible limit.

Sulphide (S--) was observed to be less than 5×10^{-2} ppm (less than 50 ppb) in all samples for analysis. The sulphide content in ash pond outlet water samples is observed far less in comparison to the TSPCB limit (2 ppm).

All contaminated and waste water have normally high sulphate concentration (Rump & Christ, 1992). In the present investigation, sulphate concentration was recorded varying between 60 to 75 ppm in most months of analysis period and also a small range variation between 7 to 18 ppm were also noticed in the month May'05 & Aug'05 (Table 2 & 3). The highest sulphate concentration was noticed 80 ppm on 30.09.05 (Table 4).

Chloride is one of the major inorganic anions in water and waste water. In the analysis of chloride level in ash pond water, most samples revealed chloride variation in the range of 7 to 28 ppm. Occasional fluctuations were also noticed in the range of 28 to 46 ppm (Feb'06, Table 6). In last two weeks of Jun'05 (Table 2), chloride level was found little high range of 98 to 101 ppm. The chloride level is found much below the permissible limit (1000 ppm).

TABLE 1: Analysis of water quality in ash pond of captive power plant at Manuguru

Parameter	Pollution control Board	March2005				April2005			
		09	17	24	31	02	09	15	26
pH at 25°C	5.5-9.0	8.4	8.2	8.6	8.8	8.4	8.5	8.9	8.3
SS(ppm)	100	22	20	23	23	10	13	11	10
BOD3 (ppm)	30	1.0	1.2	1.6	1.1	1.8	1.6	2.0	1.6
COD (ppm)	250	6.0	6.5	6.1	7.0	6.6	6.0	6.7	6.4
TDS (ppm)	2100	205	210	200	205	260	265	270	255
Oil and Grease (ppm)	10	<1	<1	<1	<1	<1	<1	<1	<1
Sulphide (ppm)	2.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate as SO^{4--}(ppm)	1000	75	70	70	70	75	73	75	75
Chloride as Cl^- (ppm)	1000	7	9	11	8	13	16	14	12

TABLE 2 Analysis of water quality in ash pond of captive power plant at Manuguru

Parameter	Pollution control Board	May 2005				June 2005			
		09	17	24	31	02	09	15	26
pH at 25°C	5.5-9.0	8.3	8.5	8.4	8.2	8.6	8.4	8.3	8.8
SS(ppm)	100	28	26	28	25	13	15	12	14
BOD3 (ppm)	30	3.0	2.0	1.5	1.8	2.0	2.3	1.5	1.8
COD (ppm)	250	9.0	13	9.0	10.0	33	30	15	13
TDS (ppm)	2100	185	180	185	182	275	280	275	280
Oil and Grease (ppm)	10	<1	<1	<1	<1	<1	<1	<1	<1
Sulphide (ppm)	2.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate as SO^{4--}(ppm)	1000	09	07	08	11	35	65	70	70
Chloride as Cl^- (ppm)	1000	16	14	18	16	25	17	98	101

TABLE 3 Analysis of water quality in ash pond of captive power plant at Manuguru

Parameter	Pollution control Board	July 2005				August 2005			
		07	14	22	29	05	17	24	31
pH at 25°C	5.5-9.0	8.8	8.4	8.9	8.7	8.6	8.8	8.5	8.7
SS(ppm)	100	13	15	13	11	10	12	13	09
BOD3 (ppm)	30	2.0	2.3	2.2	1.8	4.0	3.0	1.1	1.5
COD (ppm)	250	33	35	31	32	11	09	6.7	6.9
TDS (ppm)	2100	270	280	260	255	180	186	209	202
Oil and Grease (ppm)	10	<1	<1	<1	<1	<1	<1	<1	<1
Sulphide (ppm)	2.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate as SO^{4--}(ppm)	1000	65	65	55	52	10	18	11	65
Chloride as Cl^- (ppm)	1000	25	27	28	24	09	13	07	26

TABLE 4 Analysis of water quality in ash pond of captive power plant at Manuguru

Parameter	Pollution control Board	September 2005				October 2005			
		06	13	22	29	04	11	22	28
pH at 25°C	5.5-9.0	8.6	7.9	8.	8.9	8.2	8.4	7.8	8.7
SS(ppm)	100	12	10	13	12	09	12	04	08
BOD3 (ppm)	30	2.2	1.0	1.8	3.0	2.2	2.5	2.5	2.2
COD (ppm)	250	29	15	10.6	12.8	12	15	12	6.7
TDS (ppm)	2100	170	175	170	175	295	245	240	277
Oil and Grease (ppm)	10	<1	<1	<1	<1	<1	<1	<1	<1
Sulphide (ppm)	2.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate as SO^{4--}(ppm)	1000	70	80	55	65	60	65	71	74
Chloride as Cl^- (ppm)	1000	07	07	10	09	09	09	12	09

TABLE 5 Analysis of water quality in ash pond of captive power plant at Manuguru

Parameter	Pollution control Board	November 2005				December 2005			
		07	17	23	30	03	12	20	31
pH at 25°C	5.5-9.0	8.8	8.7	8.9	8.8	8.0	7.9	8.2	8.0
SS(ppm)	100	15	12	09	07	12	09	04	17
BOD3 (ppm)	30	2.2	2.5	1.5	2.5	2.3	2.5	2.2	3.0
COD (ppm)	250	35	33	29.3	33	35	28.5	2.2	3.0
TDS (ppm)	2100	280	277	269	320	178	196	300	580
Oil and Grease (ppm)	10	<1	<1	<1	<1	<1	<1	<1	<1
Sulphide (ppm)	2.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate as SO^{4--}(ppm)	1000	71	65	75	39	51	60	70	56
Chloride as Cl^- (ppm)	1000	09	14	14	19	11	15	13	19

TABLE 6: Analysis of water quality in ash pond of captive power plant at Manuguru

Parameter	Pollution control Board	January 2006				February2006			
		04	13	22	31	07	15	23	28
pH at 25°C	5.5-9.0	8.9	8.7	8.5	8.8	8.4	8.2	8.1	8.2
SS(ppm)	100	05	08	06	10	15	20	16	19

BOD3 (ppm)	30	1.6	1.4	1.4	1.5	1.2	1.4	1.1	1.2
COD (ppm)	250	28	20	18.5	21.5	11	10	08	17
TDS (ppm)	2100	172	213	204	195	380	408	410	395
Oil and Grease (ppm)	10	<1	<1	<1	<1	<1	<1	<1	<1
Sulphide (ppm)	2.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate as SO^{4--}(ppm)	1000	65	60	60	55	42	48	39	38
Chloride as Cl^{-} (ppm)	1000	19	21	15	11	40	46	36	33

Theis et al(1990) investigated the trace metal in ground water near fly ash disposal sides and noticed potential environmental hazards. Sikka and Kausal (1994) studied fly ash dumping sites of a 440MWthermal plant for characterization and found major matrix element in fly ash to be Si and Al together with significant percentage of Fe, K,Ca, Mg. Khan et al (1996) studied the effects of varying levels of fly ash on pH, Elect. Conductivity (EC) and major plant nutrients in an alkaline fine sandy loam soil of Aligarh dist. (UP). Biswal et al (2001) studied the chemical characteristics of water samples from dug well and tube well near the ash pond of thermal power plant in Angul – Talcher area in pre – monsoon & post – monsoon period. Gluec et al (2001) assessed soil & waste contamination around and ash disposal site from coal fired power plant in western turkey. The high ash content of coal is one of the inherent disadvantages in coal fired power generation, Mahashiro (1987). Prasad and Jaypraksh (2000) analyzed leach ate of fly ash with water from four sources and determined total dissolved solids hardness sulphate, chloride, pH and alkalinity as well as effect of pH on metal release from fly ash. The impact of Kothagudem Thermal Power Station (KTPS) ash pond effluents on quality of water both surface and ground water and water quality was assessed by monitoring various physico chemical parameters like pH, TDS, alkalinity, Ca, Mg, Cl, SO4 at 10 sites, (Sesha Srinivas et al 2007). Fly ash contains all the micronutrients and macro nutrients except organic carbon and nitrogen and due to this exceptional property of fly ash, it can be used in conjunction with chemical fertilizers to increase the yield of various agricultural crops. It may contain radio nuclides and moderate quantities of trace and heavy metals but its effect on the terrestrial and aquatic ecosystem are negligible, Tiwari (2008). Fly ash having high concentration of heavy metals when applied to soil is absorbed by the root system of plants and these elements then enter into food chain. The data on trace elements uptake and accumulation by plant are limiting. Boron infly ash is absorbed by plants and investigators consider boron tobe limiting factor in unweathered fly ash utilization, Elseewi et al (1978).

Fly ash is also used as full or partial replacement of wooden door shutter, wall paneling, partition panels, (Alam and Akthtar, 2011Porwal and Dubey, 2014).

Shrivastava et.al (2015) studied the physiochemical parameters in waters of fly ash discharge pond like pH, Sulphate, Conductivity, Total solids, BOD, COD, etc. and the influence by the constituent of fly ash and water quality used for making ash slurry

The use of excessive quantities of fly ash to alter pH can cause increase in soil salinity especially with unweathered fly ash, Sharma et al (1989). Mir and Sridharan (2013) studied the effect of fly ashes on the volume change behavior of fly ash treated clayey soil and bulk utilization of industrial waste by-product without adversely affecting the environment.

CONCLUSION:

From this study, it is found that the quality parameters of the ash pond outlet water from the plant are well within the permissible limits prescribed by TSPCB and this water can be successfully utilized for irrigation and horticulture. Constant monitoring of ash pond outlet water is made to assess the water quality for various applications and the treated waste water is being used for power generation and for other applications .

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