Geotextiles in Decanting Wells of Flyash Ponds

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ABSTRACT: Disposal of fly ash of Thermal Power Stations is to be done meticulously. Ash slurry from the plant is discharged into an ash pond. During the process ash gets settled down and standing water passes through decanting wells and filters of embankment. Water discharged through decanting wells does contain ash particles in excess of prescribed limit of 100 ppm. This results in pollution of natural water streams and ponds, making the surrounding fields infertile. Geotextile is expected to play a vital role in preventing the pollution due to effluent of ash ponds. Experiments are conducted in the laboratory to find out the effectiveness of non-woven geotextiles in filtering the ash slurry. Various parameters that influence the filtration characters are discussed. The results help to conclude that geotextile can play a vital role in revitalising the functions of decanting wells and seeing that the ash concentration is within the allowable limits in the discharged effluent.

1. INTRODUCTION

Fly ash is a residue of coal burnt in Thermal power stations. Fly ash utilisation in India is about 2 to 3% vis-a-vis the developed countries which is about 60 to 75%. The un-utilised fly ash from coal fired Thermal Power Stations located away from sea coasts is usually disposed of by pumping it into an ash pond in the form of ash slurry by mixing ash with water in desired proportion. Ash pond is formed by raising earthen embankments alround in an area varying between 200 to 1200 acres depending on capacity of plant, grade of coal used, area of land available etc. As ash slurry in the pond exudes towards the bund/embankment, some part of ash gets settled at the bottom and balance remains suspended in standing water. The standing water finds its wayout through the filters of bund and decanting wells.

2. FUNCTIONING OF DECANTING WELLS

Decanting wells drain out the water to a large extent. Further the bunds may be constructed with locally available soil like black cotton soil which may not allow desired seepage of ash slurry as the soil itself is impervious which may make the filters ineffective.

2.1 Description of Decanting Well

A decanting well is usually a R.C.C. well having circular or rectangular perforations on the surface as shown in Fig.1 which are expected to drain out standing water in the ash pond. The wells are usually located at a considerable distance from the embankment along the length of embankment at intervals on the down stream side of ash pond. Barrels connected to decanting wells lead the effluent to natural courses or a channel which will lead to natural streams.

2.2 Functioning of Decanting Well

The apertures of decanting well are just able to drain out standing water. The bottom courses of apertures are subsequently plugged as soon as the ash level raises upto the bottom level of aperture. In this process full poten tial of well is not utilised Moreover the porewater in deposited ash may not find exit which leads to development of pore pressures which may effect the safety and stability of embankment structures also.

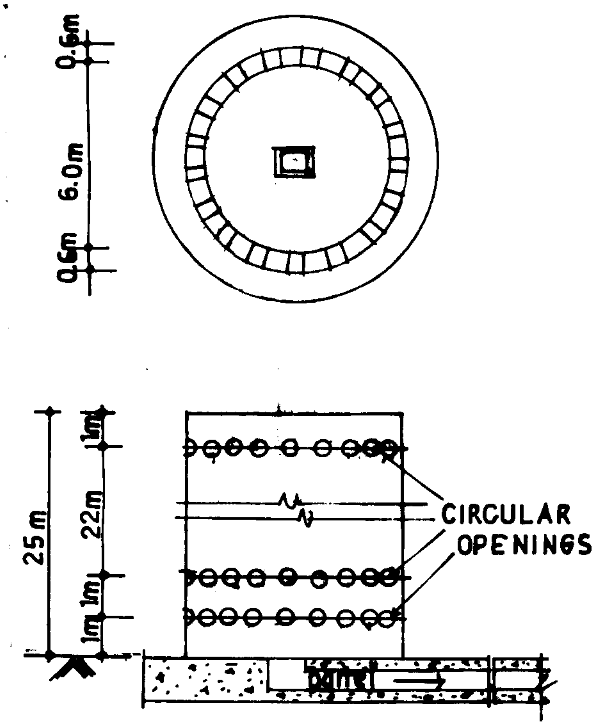

Fig.1· R.C.C. decanting well
(not to scale)

2.3 Environmental Pollution

The water letout from decanting well contains objectionable presence of ash concentration which leads to environ mental pollution in the form of ground water pollution, pollution of natural water courses and effecting the fertility of fields. The Pollution Control Board fixes the limit as 100 ppm as a tolerable limit of ash concentration. The level of ash concentration increases in case of small ash ponds which have lesser length of travel of slurry and less detention period.

In Conventional decanting wells where mere openings are made in R.C.C.well, ash water effluent finds exit directly whose concentration may be beyond tolerable limits. Use of geotextiles for various functions has been well documented by Koerner (1986), Rao & Raju (1990) and Subramanyam (1989); particulars of its use for filtration. Use of geotextiles in decanting wells also can be highly beneficial to arrest movement of ash particles.

Experimental investigation has been programmed to make laboratory scaled model of decanting wells wrapped with geotextiles. The investigation made is presented below.

3. MATERIALS USED

For conducting experiments, fly ash is obtained from a Thermal Power Station at Vijayawada, India and non-woven geotextiles manufactured by M/s.Charminar Non-woven Limited, Hyderabad, India are used.

3.1 Flyash

Coarser ash is deposited in the initial reaches of disposal point and finer ash gets deposited near the embankment. The flyash generally contains percentage of ash finer than 75 micron and 2 micron size as 62.4% & 15% respectively. Dry density is 9.03 KN/m^3 and water content under full saturation is about 46%. Coefficient of permeability of ash under natural deposited condition is $2x10^{-4}$ cm/sec.

3.2 NonWoven Geotextile

The properties of Non-woven geotextile used in this study are furnished in Table 1.

Table 1 Properties of Non-woven Geotextile.

S.No.	Parameter	Thin Geotextile Value	Thick Geotextile value
1.	Weight	2.5 N/sqm	3.5 N/sqm
2.	Fibre content	100% PP[a]	100% PP[a]
3.	Thickness	2.5 mm	3.2 mm
4.	WP[b]	100 lts/sqm/sec	60 lts/sqm/sec
5.	Tensile strength for:		
	MD[c]	350 N	700 N
	CD[d]	420 N	800 N
6.	Elongation		
	MD[c]	85%	90%
	CD[d]	80%	80%
7.	MBS[e]	1800 KN/sqm	2600 KN/sqm

a PP = Poly propylene
b WP = Water permeability at 5 cm water column
c MD = Machine direction
d CD = Cross direction
e MBS = Mullen bursting strength

4. LABORATORY TESTS

Model of decanting well is prepared by carving a wire mesh to a cylindrical shape of 5cm dia and 45 cm height welded inside to a circular container of 30 cm dia and 45 cm height at centre duly making opening at bottom. A geotextile is wrapped around the mesh as shown in Fig. 2 and assembly is made leakproof. The mesh is expected merely to reinforce the geotextile and act as a skeleton. The discharge through geotextile is observed after allowing it to saturate with ash slurry for 24 hrs and the effluent collected is tested for presence of ash concentration to ascertain filter efficiency. The rate of flow through geotextile of 2.5 N/sqm and 3.5 N/sqm variety is observed at heads of 15 cm and 25 cms under ash slurry concentration of 1:250, 1:80 and 1:16. The experimental programme is also intended to determine the capability of geotextile to drainout pore water entrapped in the deposited ash layer. 10 cm thick ash

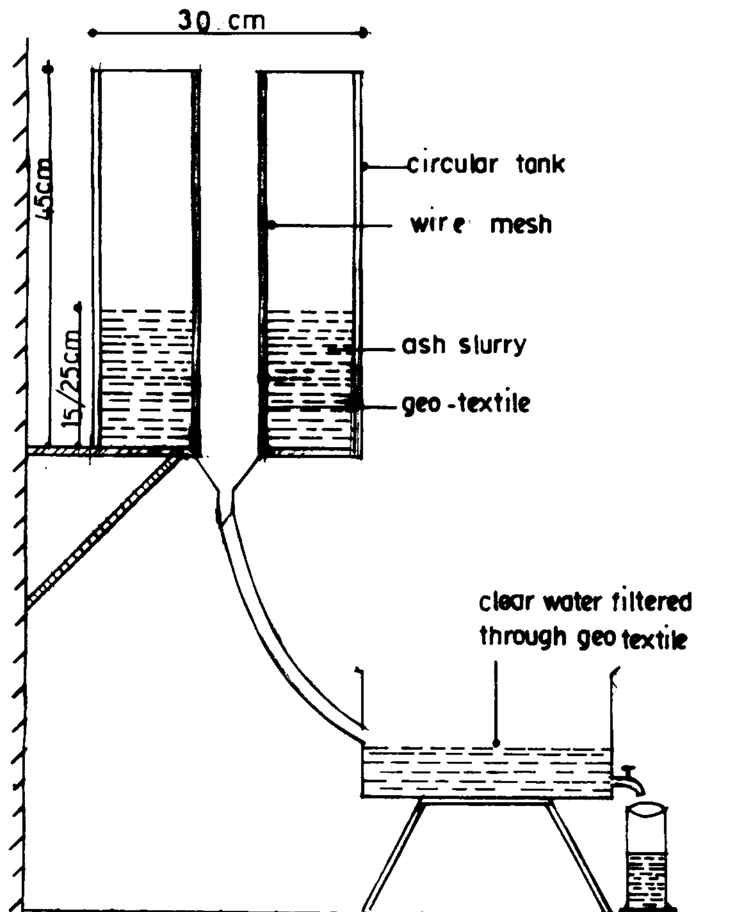

Fig.2- Model decanting well using geo-textile with various proportions of ash slurry (at 15/25cm.. head) (not to scale)

was first deposited in the model decanting well keeping a standing water of 5 cm over it. Discharge continuously taking place was measured, keeping constant height of standing water. Discharge through a 10 cm thick ash deposit under 5 cm head of standing water is noted. The geotextile above 10 cm ash layer in the model is wrapped with an impermeable material to see that pore water from deposited ash only is discharged through geotextile.

In any ash pond, there is always deposition of ash continuously taking place. It is desirable that the pore water in the deposited ash is continuously drained out so as to improve stability of retaining bunds as well as improving the storage capacity. of ash pond. The ash deposited in bund over a time, becomes like a surcharge on the already deposited ash.

To study the effects of surcharge on deposited ash in draining the pore water experiments are also carried out in the model study applying surcharge loads on the 10 cm thick ash deposit as shown in Fig.3. Under different surcharge loads, seepage taking place through geotextile wrapped decanting well has been measured. The experimental observations are furnished in Tables 2 & 3. The results of model studies performed as described above are presented in Tables 2 & 3.

5. ANALYSIS OF RESULTS

The presence of ash in the effluent collected from decanting well model through geotextile is found to be less than the permissible limit of 100 ppm. Rate of flow through geotextile is proportional to head and inversely proportional to ash concentration. It implies that location of well should be far away from the disposal point and nearer to the bund where concentrations of ash in standing water is less. Rate of flow increases with the exposure of virgin portion of geotextile with the raise of standing water and ash deposit level. Geotextile is able to show a wayout to the pore water in deposited ash. The raise in the ash level acts as a surcharge and accelerate the process of dissipation of pore pressure which will be an added safety factor to the stability of earthen embankment.

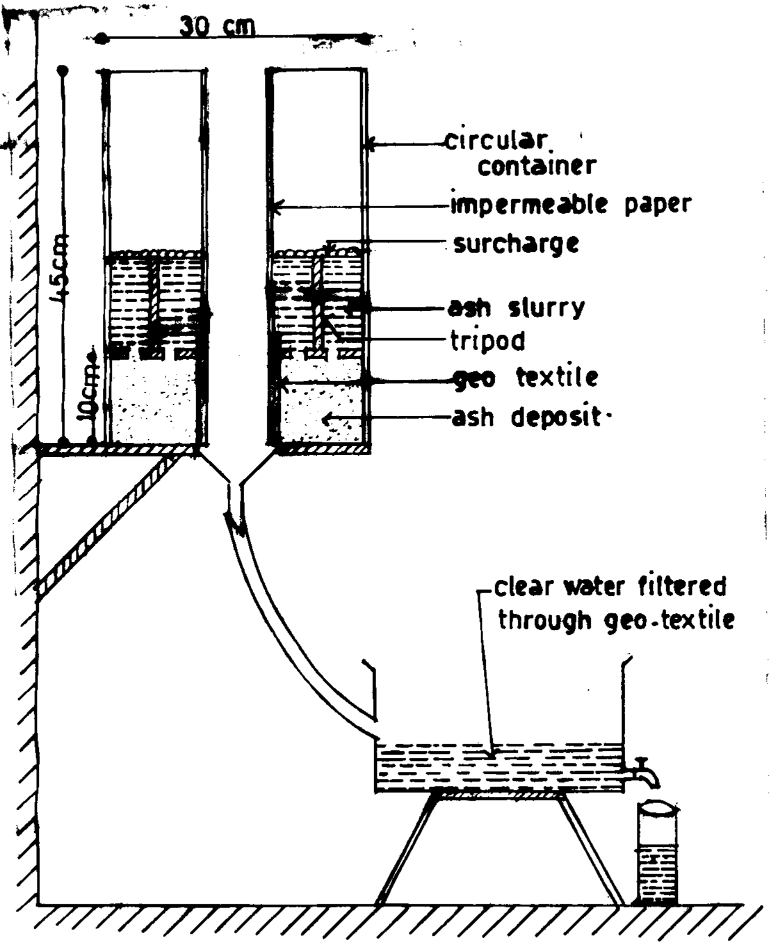

Fig.3- flow taking place under surcharge through 10 cm ash deposit (not to scale)

Table 2 Experimental Observations.

Description Ash slurry	Head (cm)	Discharge (ml/min)	Ash presence in effluent (ppm)
Geotextile of 2.5 N/sq.m.			
1 : 250	15	80	75
	25	230	82
1 : 80	15	70	79
	25	80	85
1 : 16	15	40	89
	25	110	255
Geotextile of 3.5 N/sq.m.			
1 : 250	15	60	50
	25	200	69
1 : 80	15	50	75
	25	270	70
1 : 16	15	28	193
	25	86	81

Table 3 Experimental Observations with surcharge on ash.

Surcharge (KN/m^2)	Rate of flow through the 10 cm ash layer at 5 cm head (ml/min)	
	Geotextile of 2.5 N/sq.m	Geotextile of 3.5 N/sq.m.
2.5	27	33
5.0	20	26
10.0	15	16

6. CONCLUSIONS

Geotextile can play very useful role in filtering flyash in decanting wells. It helps in filtration as well as satisfying the requirements of preventing environmental pollution of streams, fields etc. The economy of using geotextile permanently depends on the location of site, cost of material, lead etc. The benefits of using geotextile include both tangible and non tangible results. Hardly, cost of geotextile is 4% of cost of decanting well. Dissipation of pore water pressure results in proper consolidation of ash which will help to enhance the capacity of ash pond and also enhance the safety of embankment.

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