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Study of Ash Slurry Percentage in High Concentration Slurry Disposal System

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Abstract:

Fly ash disposal through high concentration ash disposal system (HCSD) is followed in many coal based thermal power plants in India. Efforts to reduce the dilution of the slurry will result in energy conservation as well as water conservation. The latter is even more important to overcome the problem of excess water consumption. To evaluate the effectiveness of the slurry disposal system, it is important to measure the concentration of ash in the slurry being transported through high concentration slurry disposal system (HCSD). Attempts have been made to obtain the exact slurry concentration and water retention capacity of fly ash through laboratory experiments. It is observed that the density of slurry varies from 1.17 to 1.60 for different concentration of the slurry and water holding capacity of ash increases with the increase in ash concentration. Maximum possible water recovery is observed between 57-58% of total water used for the slurry concentration.

Keyword: Fly ash, slurry concentration, power plant, slurry density, water recovery

1.0 Introduction:

Lean phase fly ash slurry disposal systems have been in operation for many years in power stations throughout India. Recent advances in high concentration fly ash slurry pumping systems offer advantages for ash disposal systems by virtue of reducing land and water utilisation, and by reducing capital and operating costs. Moreover High concentration slurry disposal system (HCSD system) has more objectives such as:
a) Uniform solids distribution over disposal site b) Consolidation of solids by drying c) Minimum water runoff at toe of deposit d) Maximum utilization of land, thus being environmentally safe and economically attractive.

When pumping with lean phase systems, all the water is pumped back to the power station. In a high concentration slurry pumping system, some of the water that is mixed with the fly ash remains in the ash when the slurry is deposited. This paper examines the fly ash slurry concentration, preparation of its density chart for rapid assessment and its comparison with online density/slurry concentration analyser. It also looks into an assessment of the quantity of water that can be recovered back to the plant from the ash pond. The laboratory tests that are conducted do not include water loss due to evaporation, rainfall and infiltration or disposal site leakage.

2.0 Material and Method:

Bulk density of fly ash was calculated for the first two rows of the ESP of unit 1 (Boiler side) and was found to be as 0.85-95 g/cc. This is basically called as coarse ash and disposed through HCSD system from the silo. A 250 ml cylinder was used in the entire experiment. Weight of water taken in 250ml cylinder was found to be 247.4gms. Concentration of slurry (weight%) was measured according to the following equation -1 (Abbi 2011).

$$\text{Concentration of slurry (weight \%)} = \frac{\text{weight of ash}}{\text{weight of slurry}} \times 100 \quad \text{------ (1)}$$

Maximum water available for return was calculated by filtering slurry through Whatman filter paper- 41 and measuring the filtrate with a measuring cylinder. Values described in Table 1and 2 are the average values of ten readings.

3.0 Results and Discussion:

Fly ash slurry of different concentrations was prepared in laboratory and densities were measured. Results are presented in Table 1. The percentage fly ash slurry ranged from 26.31% to 65.59% and it was found that the high concentration of slurry disposal was carried out in the range of 40% to 50% which corresponds to its density in the range of 1.3-1.40 g/cc or kg/m3. Cross checks were carried out by taking fly ash of different bulk densities from 0.85 to 0.95 g/cc. 1% variation was observed in the slurry percentage and 0.01 variation was observed in density measurement. In HCSD slurry system, maximum water recovery was calculated by pacing the slurry over Whatman filter paper number 41 which has a pore size of 16 micron. The results are presented in Table 2. Water recovery percentage was calculated for 50 to 52% slurry concentration as ash slurry disposal is done at this concentration. It was observed that maximum recovery of water was around 57to 58% of water used for slurry and remaining 42-43% of water was retained by fly ash.

Table 1 Average Fly ash slurry percentage and density chart

Sr. No.	Density in g/cc±0.01	Ash Slurry % ±1% actual	S No	Density in g/cc±0.01	Ash Slurry % ±1% actual
1	1.17	26.30 %	30	1.49	57.15%
2	1.21	30.17%	31	1.493	57.50%
3	1.23	33.61%	32	1.50	58.10%
4	1.26	36.87%	33	1.506	58.50%
5	1.29	39.68%	34	1.51	59.05%
6	1.30	40.31%	35	1.52	59.52%
7	1.30	40.84%	36	1.53	60.12%
8	1.31	41.99%	37	1.53	60.57%
9	1.33	43.07%	38	1.54	61.09%
10	1.36	45.86%	39	1.547	61.54%
11	1.36	46.26%	40	1.55	62.07%
12	1.366	46.66%	41	1.56	62.57%
13	1.37	47.05%	42	1.57	63.15%
14	1.377	47.62%	43	1.575	63.52%
15	1.38	48.17%	44	1.58	64.15%
16	1.38	48.55%	45	1.59	64.51%
17	1.39	48.92%	46	1.60	65.25%
18	1.396	49.39%	47	1.605	65.59%
19	1.40	49.81%			
20	1.40	50.26%			
21	1.41	50.61%			
22	1.41	50.95%			
23	1.42	51.63%			
24	1.43	52.74%			
25	1.44	53.37%			
26	1.45	53.99%			
27	1.46	54.60%			
28	1.47	55.19%			
29	1.48	56.60%			

Table 2: Average Percentage of water recovery possible from disposed ash slurry from ash pond

Sr.No	Ash slurry %	Weight Water stored in ash	Weight of water available for return ml	% Returned water
1	50.26	72.81	101	58.1
2	50.61	75.06	99.50	57.24
3	50.95	74.71	99.10	57.02
4	51.63	74.43	98.75	57.02
5	52.74	72.80	97.90	57.35

This experiment does not consider water loss due to evaporation, rainfall and infiltration or disposal site leakage.

The volume of return water from fly ash pond in high concentration slurry disposal system varies from 12.4 % to 59.8 % of the water required to mix the slurry. There was no relationship between the surface deformation of the deposited slurry and the concentration by weight of the slurry pumped (Bunn et al 2009).

4.0 Conclusion:

It is concluded that most of the power plants are operating HCSD system with 50%-60% fly ash slurry concentration and with density around 1.40g/cc to 1.50g/cc. It is further concluded that at 50% concentration, a maximum of 58 % water recovery is possible. The data also gives an inference of slurry concentration up to 65% at a glance and can be a ready reckoner for the operator.

5.0 Acknowledgement:

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