

# Operation & Maintenance of Tailings Earth En Dam Specially For Disposal of Fly Ash from Thermal Power Stations

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**Abstract-** Several tailings earthen dams have failed during monsoon. Due to failure of tailings dam, stored tailings waste gets release in downstream area causing environmental hazard. Ash produced by combustion of coal in thermal power stations are stored in ash pond. No well-defined provision of operation and maintenance exists for ash pond. Therefore, this paper describes various issues related to operation and maintenance of ash pond.

**Index Terms-** Discharge shaft, dam beam, ash pond embankment, raising of ash pond.

## I. INTRODUCTION

Fly ash is pumped to ash pond in the form of paste under High Concentration Slurry Disposal (H.C.S.D.) or mixed with water in a ratio varying from 1 part ash and 8-20 parts of water. Ash particles settle down in the ash pond and water is allowed to drain through discharge shafts or decant towers. Precast dam beams are placed in the periphery of discharge shaft to allow discharge of clear water. Due to poor maintenance of ash pond, situation become alarming to the extent of even breach of earthen bund which creates pollution to water bodies and surrounding area. This paper describes important issue related to operation and maintenance of ash pond. Particle size distribution of fly ash and engineering parameters are indicated in the table No.1 & 2.

## II. AIM AND OBJECTIVES

Mines tailings such as copper tailings, lead-zink tailings, aluminium tailings and coal ash tailings are stored in tailings dam. Properties of the mine tailings and coal ash are indicated in the table No.3. Out of various alternatives use only few quantities of these are utilized therefore, balance huge quantity is to be disposed and stored in tailings earthen dam are causing challenges to engineers. Apart from construction of tailings earthen dam, good operation and maintenance of dam is very important. Main objective of the publication of this paper is to describe various steps and precaution to be taken for operation and maintenance of ash pond throughout the year i.e. including rainy season in which flooding/overtopping may occur due to storm water.

## III. RESEARCH METHODOLOGY

Various points regarding operation and maintenance of ash pond are based on experience and as per site condition. However, some laboratory tests are performed to know the engineering parameters of fly ash.

1. Operation of Ash Pond: Ash slurry pumped to ash pond is spreaded over entire area uniformly. To allow discharge of water through discharge shaft having turbidity less than 100 ppm, it is essential to place dam beam such that atleast 50 mm layer of water is there to check air pollution by blowing wind. Discharge of water from wiers having same turbidity level i.e. below 100 ppm by placing dam beam as the ash level raised in the ash pond. For even spreading of ash slurry inside the ash bund small drain in the shape of garland is prepared manually. Sufficient quantity of precast concrete dam beam are stacked nearby each discharge shaft so that as and when required i.e. on rising of ash level in the pond, these beams can be placed on discharge shaft so that only clean water can flow through discharge shaft.

Effort has been made to distribute ash slurry discharge in the ash pond such that every discharge shaft can be uniformly loaded, this will facilitate uniform raising of ash level in the ash pond. This will also give the clear picture about raising of ash level in the near future, so that necessary construction programme of raising of bund can be chalked out. Raising of embankment is very difficult during monsoon. Therefore, this work is carried out during fair weather only.

In addition to above, commercial alum has been utilized to settle ash particle nearby discharge shaft speedily. Therefore alum blocks (30 to 35 Kg weight) placed regularly near every discharge shaft. Sufficient quantities of dam beam are casted in advance, looking to the requirement keeping in consideration in raising of ash level in next three months.

2. Maintenance of Pitching and toe-drain: Dry boulder pitching, toe-drain on the down stream slope is to be maintained on time-to-time. Random Rubble Masonary Drains constructed on the down stream slope are normally damaged during monsoon is to be maintained properly. Grouted pitching can also be collapsed due to settlement of embankment, as compaction of earth is not proper on the slopes. Therefore maintenance of pitching is most essential after monsoon. In addition to these kuchha drains is to be de-silted regularly to facilitate flow of

seepage water. Turfing on the down stream face of the earthen embankment is to be carried out where pitching is not possible.

3. Maintenance of Discharge Shaft: Due to continuous contact of water and pressure of fly ash, steel section including bracings of discharge shaft may bend/corrode. Therefore, periodical maintenance of discharge shaft is essential. Anti corrosive painting on steel structure may be applied annually. Prior to painting, if necessary, additional bracing may also be provided by welding to maintain regular dimension of discharge shaft. Regular cleaning of discharge shaft is essential to facilitate free flow of decant water. Therefore, cleaning schedule of shaft may be fixed so that by rotation discharge shaft can be cleaned once in a month. During cleaning it has to be ascertained that all bracings are firm and shaft is in perfect shape, otherwise necessary welding may be done as per requirement.

Looking to the raising of ash level necessary arrangement for raising of discharge shaft, by welding suitable sections may also be scheduled, atleast 6 months in advance. This is very difficult during monsoon.

4. Plantation:- In the down stream slope plantation of eucalyptus tree is very successful because it can grow in submerged soil/marshy soil. Inside the ash pond, Beshram (Ipomea) twinges are planted to check air pollution in case of dry surface in the ash pond. Subabul can also be planted inside ash pond and on the down stream slope of the bund. Roots of these plants conserve the soil erosion during monsoon.

5. Instrumentation: Settlement gauge, piezometer, inclinometer and other instrument are installed during construction of ash pond. However due to passage of time, lack of maintenance/replacement these sophisticated instrument are not found in working condition even after careful maintenance. Raising of ash level can be determined based on the daily intake in the ash dyke. Accordingly suitable action can be taken for extension of discharge shaft and raising of embankment in second and third stages

Apart from above, special care is to be taken during monsoon because discharge shaft has to facilitate additional discharge of storm water of the entire area of ash pond. On the other hand, rainwater can damage earthen embankment in the form of heavy rain cuts in down stream slope. Good drainage all along the bund provides phreatic line at very low level Therefore, round the clock vigilance is essential to safeguard the earthen bund from severe damage. Following are the main points to be kept in mind during monsoon

6. Pre-monsoon repair: Pre-monsoon repair and maintenance is necessary to avoid any hazardous situation during monsoon. Works for raising of earthen embankment and discharge shaft cannot be executed during monsoon. Following pre-monsoon works and stacking of material is essential before onset of monsoon

1. Looking to the raising of ash level in next six month (i.e. including rainy season) work of raising of earthen embankment and discharge shaft, if necessary, may be carried out.

2. Stacking of dam beam, Bolder and sand fill bags (Atleast 2000 Nos.) near every discharge shaft, and various important points where rain cuts/ soil erosion may occur during to monsoon.
3. Repair and maintenance of pitching, toe-drain chute and drainage paths.
4. Cleaning of discharge shaft to insure flow of water/storm water gets discharged without hindrance.
5. Plugging of ash slurry pipelines buried in the embankment due to raising of level of ash.
6. All tools and plants are checked for running condition. Ladder, torch, flood light, portable emergency light set, crow bar, spade, pick axe, axe, rope, empty bag (jute/polythene having atleast one cubic feet capacity for filling sand/fly ash), rain coat and umbrella.
7. Lighting arrangement through out the periphery of the bund should be maintained.
8. Pedestals of ash slurry pipelines be maintained.
9. Approach road to the ash pond should be maintained and necessary arrangement for motorable position on the embankment of the ash pond may be done.
10. Chainage post are to be maintained (with Update RL) through out the periphery of the ash pond so that during monsoon the actual / exact location can be identified / conveyed to control room / supervisors by the patrolling team.

7. Maintenance during monsoon: This depends on pre-monsoon maintenance. If pre-monsoon maintenance is perfect, then only watch and ward and timely action to discharge storm water evenly through all discharge shafts is necessary. During monsoon following are the main points to be kept in mind:

- i) Round the clock watch and ward.
- ii) Regular patrolling on the bund is essential to observe rain cuts on the down stream slope and level of water in the ash pond. Immediate action to release accumulated storm water through discharge shaft may be done by raising dam beams of the discharge shaft. Care should be taken while lifting dam beam that only clear water is flown.
- iii) Rain cuts on the slope of the embankment may be filled by boulders and sand bags. Necessary drainage arrangements should be done so that no further soil erosion occurs at that point.
- iv) Whenever continuous rainfall occurs for more than an hour, dam beams are to be removed promptly from discharge shaft to reduce the level of water in the ash pond. Therefore, during heavy rains a team of 4-6 persons for each discharge shaft are to be deputed to take immediate action.

A close monitoring may be done to ensure the safety of ash pond from over topping of water.

Apart from above, plantation in nearby areas of the ash pond and turfing on the downstream slope of the embankment may be carried out.

8. Post Monsoon Repair: Repairing of pitching, toe drain, surface drains and heavy rain cuts which were filled during monsoons may be maintained properly. Necessary maintenance in the discharge shaft may be carried out on priority.

#### IV. RECOMMENDATIONS

Round the clock watch and ward, regular maintenance of ash pond is essential for safety of dam from environmental hazards. Special attention is to be given during monsoon.

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#### Tables and figures

**Table No.1 – Particle size distribution of fly ash**

Gravel	0%
Sand (Coarse)	0%
Sand (Medium)	1-2%
Sand (Fine)	70 – 80%
Silt	20 – 25%

**Table No.2 – Engineering properties of fly ash of STPS and SGTPS of M.P.**

Specific gravity	2.2 to 2.4
Plasticity	Non-plastic
Angle of internal friction	30 - 40
Cohesion (kg/cm <sup>2</sup> )	Negligible
Permeability (Centimeter per second)	0.0003-0.0008

**Table No. 3 – Properties of mine tailings**

Type of waste	Max Dry Density KN/M3	Optimum dry density KN/M3	Strength parameter C=0, O
Copper talings	19.8	6.8	33.5
Lead Zinc tailings	18.9	11.8	33
Aluiminium tailings	19.2	11.4	30.5
Iron tailings	28.6	9.8	38
Coal ash	12.1	28	33