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A REVIEW PAPER ON PARTIAL REPLACEMENT OF FINE AGGREGATE BY POND ASH

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ABSTRACT

Thermal power plants (TPPs) produce a bigamount of coal ash, whose disposal is a big ecologicalsubject. A chief portion of coal ash is dumped as pond ash in ash pond near TPPs. Properties of pond ash vary from TPP to TPP and likewise within the same ash pond at inflow and outflow point. Pond ash use helps to reduce the consumption of natural resources. Also it help to resolve the problem of disposal of Pond ash because it contains vastquantity of chemical compounds such as SiO2, Al2O3 etc.Partial replacement does not cause any adverse result on properties of fresh concrete.As well as Pond ash is the respectable if used as filler material in concrete.

I. INTRODUCTION

Usage of waste and by-products in concrete will lead to green atmosphere and such concrete can be called as "Green Concrete". The knowledge of using by-products to replace natural aggregates is extrasubstitute solution to attain environmental conservation as well as to obtain a reasonable concrete cost.

The coal fly ashes have toxic metals in much higher concentrations that are released into the environment by thermal power plants based on coal combustion. Disposal of coal fly ash in open and unlined ash ponds causes serious adverse environmental impacts due to its elevated metals concentrations and it's leaching into soils and ground water. Bottom ash is the companion to fly ash in process of coal-burning with an estimated amount of 20%by volume of the whole ash, depending on the type of boiler, dust collection system, burning temperature and the type of coal. Its element is porous, irregular, and coarser than to of fly ash but its chemical composition is not much different. There are a variety of waste materials that can be measured for usage in concrete. The most commonly used waste materials to replace sand and cement in concrete are Fly Ash, Rice Husk Ash, Blast Furnace Slag, Red Mud and Phosphor, gypsum, Silica Fume, Fumed silica, Crushed glass, Eggshells. The throw away products used to replace coarse aggregate in concrete are Palm Oil Shell Aggregate for Lightweight Aggregate Concrete, Crushed Ceramic, glass, waste wood, crushed concrete aggregate. India depends upon primarily on coal for the requirement of power and its power generation is likely to go up from 1, 12,090 MW to 2, 12,000 MW in the year 2013. The fly ash production in Indian Thermal Stations is likely to shoot up to 200 million tones in 2013 from the present level of 120 million tones. The presentyearlymanufacture of coal ash worldwide is probable around 600 million tones. The disposal of fly ash will be a big test to surroundings, particularly when the quantum increases from the present level. Hence worldwide research work was focused to find alternative use of this waste material and its use in concrete industry is one of the effective methods of utilization. Increase in demand and decrease in natural resource of fine aggregate for the production of concrete has resulted in the need of identifying a new source of fine aggregate.

The majority of the Thermal Power plants in Indian accept wet methods of dumping and storage of the ash in large ponds and dykes. In the wet method, both the fly ash collected from electrostatic precipitators and the bottom and grate ash are mix with water and transported to the ponds in a slurry form. Pond ash is being created at anfrightening rate and hard work is required to safely dispose it and if possible find ways of utilizing it. Pond ash being coarser and less pozzolonic is not being used, or more importantly in places where the fine aggregate is contaminated with harmful chemicals such as sulphates and chlorides and pond ash accumulation posing environmental problems. The partial replacement of sand by pond ash in concrete is attempt. It is found that it is probable to use only pond ash as fine aggregate without compromising on strength and durability. This study opens up a chief avenue for consumption of pond ash.

With a growing content of pond-ash, there has been are relatively greater increase in compressive strength, compared to normal concrete, and such trend might be a consequence of decreased water/cement ratio induced by

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the absorption ofmixing water. The reason of this study is to examine the chance of using different fine aggregates such as Pond ash. The disposal of fly ash will be a big test to environment, particularly when the quantum increases from the present level to high. Hence worldwide research work was focused to find alternative use of this waste by product and its use in concrete industry is one of the useful methods of operation in proper manner. Increase in demand of fine aggregate and decrease in natural resource of fine aggregate for the manufacture of concrete has resulted in the need of identify a new basis of fine aggregate. It is also very important to study the effect of this partial replacement of sand on concrete, to find the optimum replacement of fine aggregate.

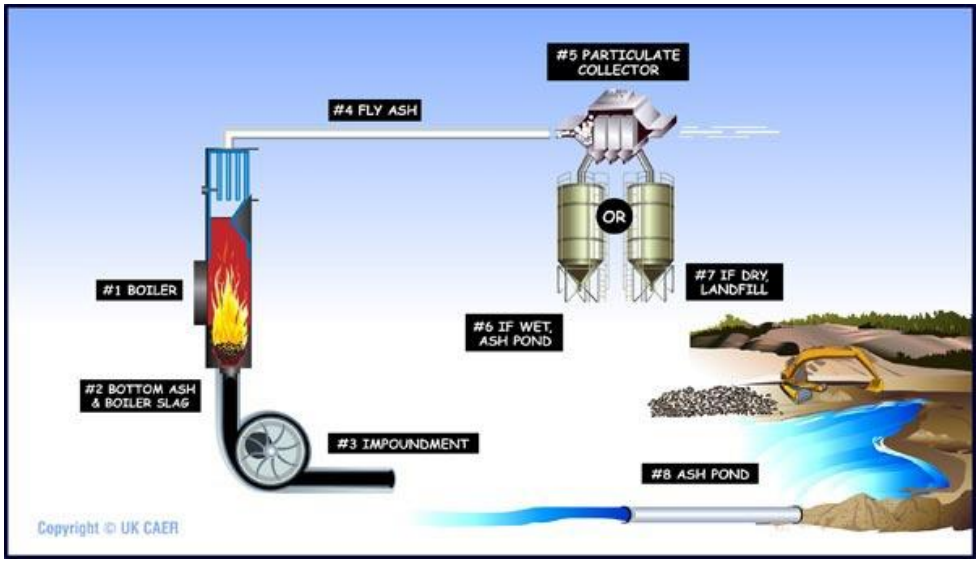

Fig No: 01 Pond ash collection

Products formed during combustion of pulverized coal in thermal power plant stations are:

1) **Fly Ash**
2) **Bottom Ash**
3) **Pond Ash**

1) Fly Ash: - Ash collect from various rows of Electro-static precipitators in dry form is termed as fly ash. It is used in the manufacture of PCC, Concrete & Cement mortar, Lime fly ash bricks, Building blocks, Aerated concrete blocks etc.

2) Bottom Ash: - Ash collected at the bottom of boiler furnace characterized by better geo- technical properties is termed as bottom ash. It is a high-quality material for fill, road and embankment construction.

3) Pond Ash: - Fly ash and bottom ash are mixed with water to form slurry, which is pumped to the ash pond area. In ash pond area, ash gets settled and surplus water is decanted. This deposit ash is called pond ash. This is used in concrete as fine aggregate. Selected pond ash can beuse for producer of building products like lime fly ash bricks/ blocks etc.

II. POND ASH FORMATION

Fly ash and bottom ash are mixed together with water to form slurry, which is pumped to the ash pond area. In ash pond area, ash gets settled and excess water is decanted. This deposited ash is called pond ash.

This is used in concrete as fine aggregate. Selected pond ash can be used for manufacturer of building products like lime fly ash bricks/ blocks etc. Ash is the residue after combustion of coal in thermal power plants. Particle size of the ash varies form around one micron to around 600 microns. The very fine particles (fly ash) collected from this ash generated by electrostatic precipitators are being used in the manufacture of blended cements. Unused fly ash and bottom ash (residue collected at the bottom of furnace) are mixed in slurry form and deposited in ponds which are known as pond ash. Among the industries, thermal power plants are the major contributor of pond ash. Besides,

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this steel, copper and aluminum plants also contribute a substantial amount of pond ash. During the combustion of pulverized coal at the thermal power station the product formed are bottom ash, fly ash and vapors.

The bottom ash is that part of the residue which is fused into particles and is collected at the bottom of the furnace. In India most of the thermal power plants adopt the wet method of ash disposal. The fly ash collected from Electrostatic precipitator and the bottom ashes are with water and disposed in a slurry form in large ponds and dykes. Pond ash differs from fly ash collected from Electrostatic precipitators in a dry form in that it contains a significant amount of relatively coarser particles (greater than 45 µm and up to 150 µm). In this study various compositions of pond ash and their properties with opportunities or utilization of same in the construction industry is considered. When pulverized coal is burnt in a dry, bottom boiler, about 80 percent of the unburnt material or ash is entrained in the flue gas and is captured and recovered as fly ash. The remaining 20 percent of the ash is dry bottom ash, a dark gray, granular, porous, and material that is collected in a water-filled hopper at the bottom of the furnace. The lagooned bottom ash is usually combined with fly ash. This blended fly ash and bottom ash are referred to as pond ash.

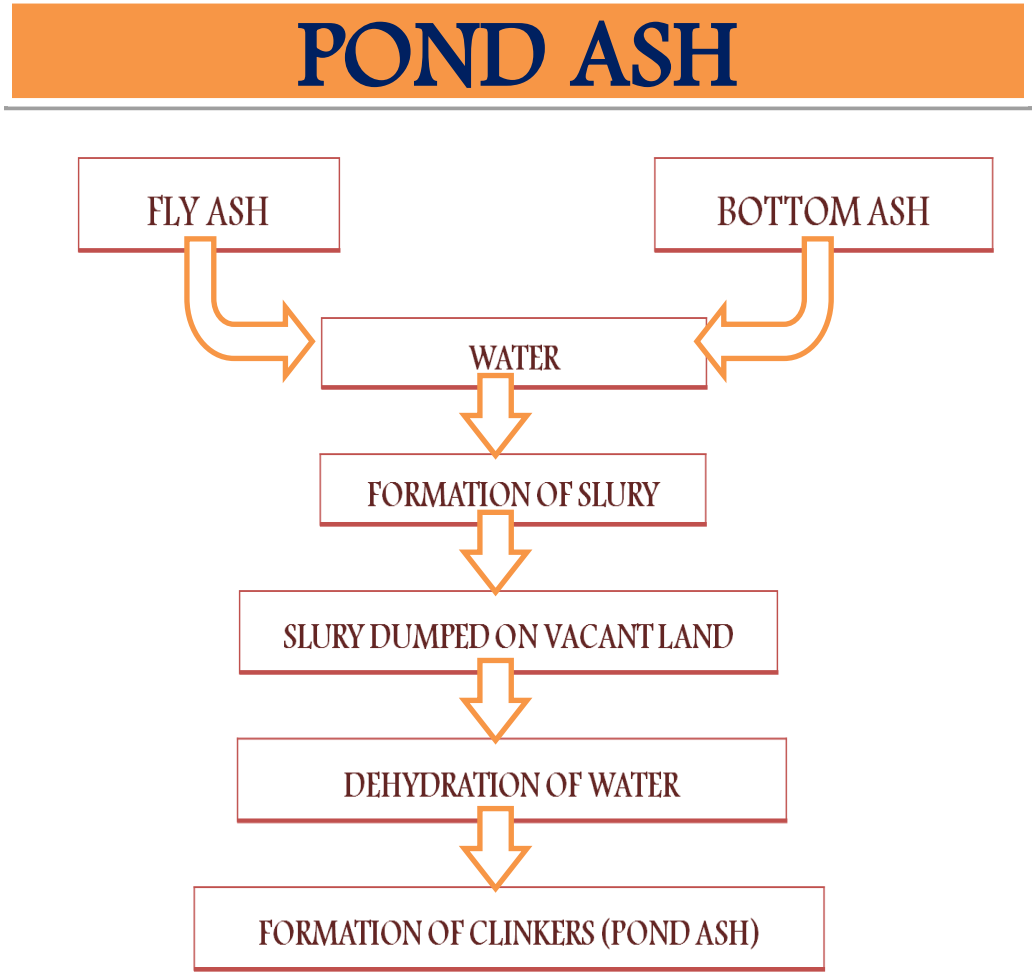

Fig No: 02 Pond ash formation process

III. LITERATURE REVIEW

Kondaivendhan et.al (2011) assessed concretes compressive strength when pond ash was used as a fine aggregate. The pond ash substitute levels were 10%, 20%, 30%, 40% & 50%. The compressive strength of unlike grades of concrete was tested at 7, 28, 56 and 90 days using cubical specimen. From the test results they reported that the

compressive strength increased with increasing curing time. However, the strength development at early curing ages was time-consuming due to pore filling effect. In the case of control mix with sand as fine aggregate (no pond ash) the strength becomes better with time. Even though the cement content was high, the strength increase was insignificant. This may be due to higher w/c ratios (0.48 and 0.38) used in these mixes resulting in higher water filled spaces. It was observed that there was no reduction in the strength upto 40% and 30% of sand replacement in M20 and M40 grade of concretes respectively. However, strength reduction was observed with increasing pond ash replacement levels in both M20 and M40 grade of concrete specimens. The authors concluded that the possibility of replacing sand by pond ash upto 40% and 30% was demonstrated in M20 and M40 grades of concrete correspondingly and replacing sand with pond ash in these grades of concrete meet the minimum probable compressive strengths.

IV. BRIEFINVESTIGATION ON POND ASH

In the thermal power plants the coal is burnt to high temperature the water for making the steam, which in turn is used to run the turbines. The pond ash is a waste product from the boilers. It is mainly obtain from the wet disposal of the fly ash, which when get mixed with bottom ash is disposed off in large pond or dykes as slurry. The pond ash is being generated in an alarming rate. The production of the pond ash is posing a lot of danger to surroundings and thus its sustainable management has become the thrust area in engineering study. As the pond ash is comparatively coarse and the dissolvable alkalies present in it are washed with water, its pozzolanic reactivity becomes low and hence it is not preferred as part replacement of cement in concrete as in the case of fly ash.

The pond ash is a waste product from boilers, where the coal is burnt to heat the water for preparing the steam, which is a common process in most of coal, based thermal power plants. It is mainly obtained from the wet disposal of fly ash. The fly ash gets mix with bottom ash and disposed off in large pond or dykes as slurry. It is also term as ponded fly ash and containcomparatively coarse particles. The huge areas of land are used to store such a mixture of pond ash resulting in land degradation near the thermal power plants. As the pond ash is being produced at anfrightening rate, hence the hard work is required to safely dispose it and if possible find ways of utilizing it. In the pond ash the dissolvable alkalies present are washed with water. The metal oxides, sulphur, siliceous & aluminous materials with less pozzolonic properties than fly ash, are some chiefingredient of pond ash. These ash produced, if disposed offunreasonably, can cause environmental risks i.e. air pollution, surface water and groundwater pollution and thus its safe disposal is essential. In fact, the pond ash is a mixture of fly ash and bottom ash. The main dissimilarity between pond ash and fly ash is their particle size. The pond ash being coarser and less pozzolonic and hence is not being accepted as pozzolona. Thermal power plants create large quantity of ash as by-product, causing serious problem to the surroundings and its disposal. Ash disposal requires large area to dispose and it creates harmfulsurroundings. One way of disposing of pond ash would be its use as a structural fill up material and use as embankment material in highways. Common river sand is costly due to too much cost of shipping from natural resources. Also large scale depletion of these sources creates environmental problems. In such a situation the pond ash can be an cheapsubstitute to the river sand. Pond ash can be defined as remainder and by-product of thermal power plant stations to form fine particles less than 4.75 mm. Usually, Pond ash is used in a large scale for manufacturing of bricks. Use of pond ash as a fine aggregate in concrete mortar draws serious concentration of researchers.

V. EXPERIMENTAL WORK

The physicalpossessions of aggregate &pond ash

Specific gravity

Wash methodically two kg. of aggregate example to eliminate fines, drain and then place in wire bag and submerge in water at a temperature among 22˚C to 30˚C with a shelter of at smallest5 cm. of water above the top of bag. Immediately after involvement, remove the tricked air from the example by lifting the bag containing it, 25 mmoverhead the base of tank and agreeing it to drop 25 times at about 1 drop per second. Keep the bag and aggregate completely absorbed in water for a period of 2 hours later. Consider the bag and example while suspended in water (A-1) Eliminate the bag and aggregate from water. Let to drain for few minutes afterward which mildly empty the aggregate from the basket on dry cloth. Return the empty basket to the water and weigh in water (A-2) Place the aggregate on the dry cloth and mildly surface dry with the cloth and transmission it to the second dry cloth, when the first will eliminate no additionaldampness. Weigh the insincere dried aggregate. (B) Place the aggregate in

a lowdish and keep it in oven for 24 hours at a temperature of 100˚C to 110˚C. Eliminate it from oven, cool in an air close-fitting container and weigh (C).Compute the Specific Gravity By = C/ (B-A) Where, A=A1-A2

Bulk density

This technique of test shelters the procedure for decisive unit weight or bulk density and void of aggregates. The quantity shill be filled to teeming by means of a shovel or scoop, the aggregate being cleared from a height not beyond5 cm above the top of the amount. Care shall be taken to stop, as far as possible, separation of the particle sizes of which the sample is collected. The surface of the aggregate will then be leveled with a straightedge. The remaining weight of the aggregate in the amount shall then be resolute and the bulk density designed in kilogram per litre.

Fineness Modulus

Take 1 kg. of aggregate from laboratory specimen of 10 kg. Position the sieve in order of the size numbers. Fix them in sieve shaker with the pot at the lowest and coffer at top, find out the weight of each sieve. After this procedure calculate total of all % weight of engaged on particular sieve and divide by 100. Hence, value of Fineness Modulus which unit is in number. Which shows the number of sieve from lowest to top and that sieve size is the full size of the aggregate.

Water absorption

Wash methodically two kg. of aggregate sample to eliminate fines, drain and then place in wire bag and submerge in water at a temperature between22˚C to 30˚C with a protection of at least 5 cm. of water overhead the top of basket. Immediately after immersion, remove the entrapped air from the sample by lifting the basket containing it, 25 mm above the base of tank and allowing it to drop 25times at about 1 drop per second. Keep the basket and aggregate completely absorbed in water for a period of 2 hours later. Weigh the basket and sample while suspended in water (A-1) Remove the basket and aggregate from water. Allow to drain for insufficient minutes after which mildly empty the aggregate from the bag on dry cloth. Return the empty bag to the water and weigh in water (A-2) Place the aggregate on the dry cloth and mildly surface dry with the cloth and transmission it to the second dry cloth, when the first will eliminate no further dampness. Weigh the surface dried aggregate. (B) Place the aggregate in a little tray and keep it in oven for 24 hours at a temperature of 100˚C to 110˚C, eliminate it from oven, cool in an air tight vessel and weigh (C)**.** Compute water absorption = [100-(B-C)]/C

Sieve analysis

Pile-up the bulk sample received in conical form till cone flattens. Get the sample for screening by method of quartering so that appropriate weight for sample testing is available. Air dries the sample at room temperature or by heating at 100˚C –110˚C. Weigh the air dried sample. Place the set of sieves in descending order of their sizes on pan. Put the sample in top coarse sieve and fit the lid. Shake entire assembly in every directions for not less than 2 minutes by hand movements/on shaking platform. Remove the lid and weigh the residue carefully retained on each sieve. Tabulate the results on performance.

VI. TESTS TO BE CONSIDERED

1. Workability Test
2. Test for Compressive strength
3. Tension Test

    a. Flexure test
    b. Split tension test

VII.CONCLUSION

Use of Pond Ash in concrete is an significant eco efficiency drive to protect natural recourses of sand. Sand is one of the important ingredient of concrete that can be replace up to a sure limit only. Use of pond ash in concrete can save industry disposal costs and produces a ‘greener’ concrete –for construction. Environmental effects from wastesquantity of cement manufacturing can be reduced through this research. A improved measure by a

supplementary cementitious Construction Material is formed through this research. Pond ash can be use to form various higher concrete grades.

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