

# Use of Pond Ash as Partial Replacement of Fine Aggregate in Concrete – A Review

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**Abstract:** Due to rapid industrialization & urbanization, energy consumption and generation is increasing day by day. Thermal Power Plants generates major portion of the energy. By-products from these plants such as fly ash, bottom ash, pond ash are disposed in large quantities. In current scenario using natural sand is costlier due to the increased demand and limited supply. Hence there is scope for using alternative material like Pond ash as Fine Aggregate (FA). Pond ash utilization helps to reduce the consumption of natural resources. It is also the social responsibility of researchers to encourage the beneficial use of industrial by- products in order to preserve resources, conserve energy and reduce or eliminate the need for disposal of industrial waste in landfills. This paper reviews the use of Pond ash as partial replacement of fine aggregate in concrete thereby searching for an alternative to sand.

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**Key Word:** *Pond Ash, Bottom ash, Sand, Industrial waste*

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## I. Introduction

An alternative solution to conserve natural resources and to obtain a reasonable concrete cost, an idea of using industrial waste or by-products plays important role. After burning coal, 70% extracted as fly ash and remaining 30% precipitated as bottom ash. The obtained bottom ash is usually combined with fly ash. Approximately 30 percent of the coal ash is handled wet and disposed as Pond ash.

### Pond Ash

As per IS 3812 (Part-1):2003, Pond ash is defined as Fly ash or bottom ash or both mixed in any proportion and conveyed in the form of water slurry and deposited in pond or lagoon.

## II. Literature Review

**Dhirajkumar Lal et al. (2019)** had focused on the use of coal-based pond ash from Bhusawal thermal power plant (India) as a fine aggregate and cement replacement in cement mortar at a replacement percentage from 0% to 100%. Two series of cement mortar mixes were prepared. Experimental analysis based on properties of mortar such as compressive strength, flexural strength, workability, setting time, bulk densities had been done by addition of pond ash in a mortar. Investigation on the physical properties of mortar incorporating pond ash through Xray diffraction (XRD), X-ray Fluorescence (XRF), and

scanning electron microscope (SEM) with an energy dispersive X-ray analysis system (SEM-EDX) was also done to study microstructure analysis and to correlate these physical properties with mechanical properties of cement mortar. It was found that the addition of pond ash leads to an increase in the amount of CSH gel in the mortar which in turns improve the performance of mortar up to certain level of replacements.

**Tushar G. More *et al.* (2015)** had studied the basic properties of Pond ash and also compared these properties with natural sand. Pond ash was used to replace sand in varying percentage as 0%, 5% 10%, 15%, 20%, 25%, 30% and the properties of fresh and hardened concrete such as slump and compressive strength, tensile strength, flexural strength was checked. An effect on durability by using sulphate attack, chloride ion penetration, drying shrinkage was also studied. The result had showed that concrete gives good strength with pond ash as partial replacement of fine aggregate.

**Bong-Chun Lee *et al.* (2011)**, had presented an applicability of Pond Ash (PA) concrete in construction of real size structure. Two domestic PA samples with normal performance were selected and two replacement ratios (25% and 50%) to fine aggregate were considered for five PA concrete structures consisting of column, slab, and wall. In order to evaluate the property of fresh concrete, several tests including air content, slump, and setting time were performed. Using cored out samples from hardened PA concrete structure, tests for strength, resistance to carbonation and chloride penetration were carried out and compared with control samples. Additionally, tests for rebound hardness, drying shrinkage, and hydration heat were performed for PA concrete structure. The test results showed that PA concrete has reasonable strength and durability performances compared to those of normal concrete. The paper had suggested that, the PA aggregate can be more actively used for RC structures with better quality control for content of fly ash, bottom ash, and unburned carbon.

**G. Sudheer Kumar *et al.* (2017)**, had provided the results of experimental studies carried out on the use of Pond ash as Fine Aggregate (FA) in concrete. The properties of Pond Ash were compared to the standard sand. The pond ash added by weight is 10%,20%,30%,40%,50% and 60% respectively as replacement of FA in concrete. Experiments carried out indicate that Pond ash as partial replacement of sand improves the mechanical properties. The strength properties were determined for various percentages (10-60%) of replacement of Fine Aggregate with Pond ash. The test results had indicated that the workability of pond ash concrete can be improved and the strength characteristics were comparable to those of conventional concrete.

**A Srikanth *et al.* (2021)** had studied the behavior of pond ash. Change in compressive strength and slump values were studied. Thirty six concrete matrices were designed with 0, 10, 20, 30, 40 and 100 percent pond ash by replacing fine aggregate. The concretes of M20 with 0 percent pond ash and 100 percent fine aggregate shows compressive strength at 28 days curing 89.51 percent higher than

conventional concrete mixes. The slump values had decreased from 50mm for 0 percent pond ash to 0mm for 100 percent pond ash.

**Bharathi Ganesh *et al.* (2011)**, had summarized various characteristics of Pond Ash as fine aggregate in concrete with its engineering properties such as its shape, gradation, texture, physical, chemical and also morphological aspects when used in concrete. The properties like Specific gravity, loss on ignition, SEM analysis, X-ray diffraction analysis, workability, chemical properties was studied. The study had showed that Specific gravity of pond ash was lower than natural sand and can be utilized as Fine Aggregate in concrete.

**Romeekadevi. M *et al.* (2015)**, had showed that partial replacement of cement with fly ash and pond ash can be used for construction which reduces the cement scarcity and overall cost of construction. M60 grade of concrete was achieved using cement, fly ash, pond ash, fine aggregate, coarse aggregate and sodium silicate(SS). Tests were carried out for compressive strength, split tensile strength and flexural strength for M60 grade concrete.

**Avadhut Kshirsagar *et al.* (2020)** had studied two grades of concrete M30 and M40, to establish suitability of pond ash as replacement of fine aggregate in concrete. For each grade, concrete mixes were prepared replacing 15%, 17.5%, 20%, 22.5% and 25% of conventional fine aggregate with pond ash. Concrete specimens thus prepared were tested for compressive strength and flexural strength at the end of twenty-eight days curing. Results of tests had showed significant difference between strengths of conventional concrete and concrete with pond ash. Amongst specimens with pond ash, the specimens with replacement level of 20% had showed maximum strength.

**Ms.Priyanka Garde *et al.* (2019)** had focused on Pond ash utilization as a partial replacement of fine aggregate (Natural sand) in concrete. In this investigation fine aggregate were replaced by pond ash by 0%, 10%, 20% and 30% by weight of fine aggregate to determine the strength properties. The Casting of cubes and cylinders were done to determine the compressive strength and split tensile strength respectively, for 7, 28, 56 days and 90 days of curing. It was found that pond ash upto 20% replacement of FA for M30 grade of concrete without compromising strength gives good results.

**T Shajeeh Fasil *et al.* (2023)** had revealed that 30% GGBS and 20% pond ash replacement of cement yielded the best results. According to research, industrial wastes can replace the cement and fine aggregate up to 40% and 20% in concrete by GGBS and Pond Ash, respectively.

### III. Result & Discussion

From reviewing the research papers related to pond ash replacement following results can be obtained:

- 1) The compressive strength of concrete with pond ash increases with increased curing period.
- 2) While the pond ash is used the workability is reduced. For obtaining the required workability, super plasticizers are added while preparing the concrete.

3) The split tensile strength of concrete with pond ash increases up to the addition of 20% ash as a sand replacement.

4) The flexural strength of concrete with pond ash increases up to the addition of 20% ash as a sand replacement.

#### IV. Conclusion

Though the results of characterization of Pond Ash confirm its suitability in concrete as fine aggregate, it is essential to develop the knowledge and experience about use of Pond Ash as fine aggregate in concrete, for proper design and execution of the concrete constructions. Effective utilization of Pond Ash as constituent in concrete – a second largest material used next to water, reduces the burden as it encourages large scale utilization of industrial waste, facilitates human habitation, replacing fast depleting natural resource, so as to contribute to sustainable construction.

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