

EXPERIMENTAL INVESTIGATION ON CONCRETE WITH PARTIAL REPLACEMENT OF THERMAL POWER PLANT WASTES AND LECA

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ABSTRACT

Invention of new methods in strengthening concrete is under work for decades on track of such invent fly ash and bottom ash alters the compressive, tensile and flexural strength of concrete to a good extent and hence it imprints as a good solution for strengthening concrete. Ordinary Portland cement (Grade 53) fly ash, bottom ash and LECA of fine aggregate and coarse aggregate are the materials used for this investigation. Experimental investigation on concrete mix M20 and M30 is done as per recommended procedures and relevant codes under the following case. The concrete mix (M20 and M30) is made by the Partial replacement of Ordinary Portland cement grade 53 with fly ash, fine aggregate with bottom ash, and coarse aggregate at the rate of 5%, 15%, 25% and 35% in each mix and their compressive strength, tensile strength and flexural strength (with reinforcement) of concrete are discussed in the present investigation.

Keywords: LECA, M20, Flexural strength.

1. INTRODUCTION

Waste and by-products have been introduced into Indian concrete industry to conserve natural resources and environment as well as to reduce the cost of concrete (Kasemchaisiri et.al)[1]. As an example, fly ash, a by-product from thermal power plants, has been widely used in Indian concrete industries as a pozzolanic material for replacing a part of cement due to its main benefits on workability and durability. The idea of using by-products to replace natural aggregates is another alternative solution to achieve environmental conservation as well as to obtain a reasonable concrete cost. 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 (Bhangale et.al)[2]. Pond fly ash and contains relatively coarse particles. The coal fly ashes contain toxic metals in much higher concentrations that are released into the environment by thermal power plants based on coal combustion. Bottom ash is the companion to fly ash in process of coal-burning with an approximate amount of 20 % by volume of the total ash, depending on the type of boiler, dust collection system, burning temperature and the type of coal. Its particle is porous, irregular, and coarser than that of fly ash but its chemical composition is not much different. Though, fly ash had been proved to enhance various properties of Concrete. In this research work an attempt is made to find out the possibility of using pond ash in conventional concrete. The part of the sand is replaced by pond ash in different composition and the concrete is made in conventional method. large quantity of coal ash is being

produced every day in Thermal Power Plants, leading to many environmental problems. It is of prime importance to carry out research works on the feasibility of using alternative materials like Pond Ash, a waste by product and its suitability for potential utilization in concrete constructions, which can replace sand partially or fully as an alternative construction material contributing to sustainability and reducing burden on environment.

2. RELATED WORK

The disposal of fly ash will be a big challenge to environment, especially 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 effective methods of utilization in proper manner. Increase in demand of fine aggregate 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. 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. Energy generation is increasing day by day due to rapid industrialization. Energy generation through thermal power plants is very typical now days. Pond ash from these thermal plants is available in large quantities. Pond ash utilization helps to reduce the consumption of natural resources. In current time natural sand are using and it is costly so it's require to replace by Pond Ash. Use of alternative material in concrete such as industrial by product coal Ash (Fly Ash and Pond Ash) is an important eco efficiency drive. 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 research paper reports the basic properties of Pond ash. It also compares these properties with natural sand. Basic changes in both type of aggregate properties were determined by various test as per require IS code, thus, it is a suitable to use pond ash as fine aggregate or partial replacement with natural sand.. Concrete is a construction material composed mainly of Cement.

3. STUDY

To develop the conventional concrete of grade M25, and investigates the influence of the use of Pond ash as a replacement for natural fine aggregates on the properties of concrete in the fresh and hardened state and also on durability. Use of Pond Ash in concrete is an important eco efficiency drive to conserve natural resources of sand. Ash is the residue after combustion of coal in thermal power plants. 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. Most of the Thermal Power plants in Indian adopt wet methods of disposal 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 mixed with water and transported to the ponds in a slurry form. Pond ash is being produced at an alarming rate and efforts are required to safely dispose it and if possible find ways of utilizing it. As it is very important to do disposal of this waste product of Thermal Power Plant, this study gives some ideas to utilization of Pond ash. Natural sand is commonly used as fine aggregate in concrete. There is scarcity of natural sand due to heavy demand in growing construction activities which forces to find the suitable substitute, also due to extensive construction activity natural sand is becoming expensive and scarce. The purpose of this study is to investigate the possibility of using alternative fine aggregates such as Pond ash. The disposal of fly ash will be a big challenge to environment, especially when the quantum increases from the present level to high.

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. Therefore the study of properties of concrete with different proportion of replacement of sand by pond ash is covered in this project work. It is not just the study of concrete properties by partial replacement of sand but also one eco friendly drive to do disposal of waste product of Thermal Power Plant that is Pond ash, because by using pond ash in concrete we are not going to disturb environment any way.

4. ANALYSIS

As the famous phrase says that, every coin has two sides. Till this moment we saw only the easy way of use of pond ash as replacement of natural sand but from the another side there are some limitations on such replacement. This study is work on the concept of partial replacement of sand (one of the important ingredient of concrete) by pond ash (waste byproduct of thermal power plant), with different proportions. The investigation of previous research paper shows that, if the partial replacement of sand exceeds some limit that affects the properties of concrete on large scale, it will prove dangerous or it is not possible to use such concrete practically.

Sr. No.	% Pond ash	Slump (mm)
01	0	113
02	5	105
03	10	100
04	15	96
05	20	90
06	25	80
07	30	75

Table.1. LECA Test

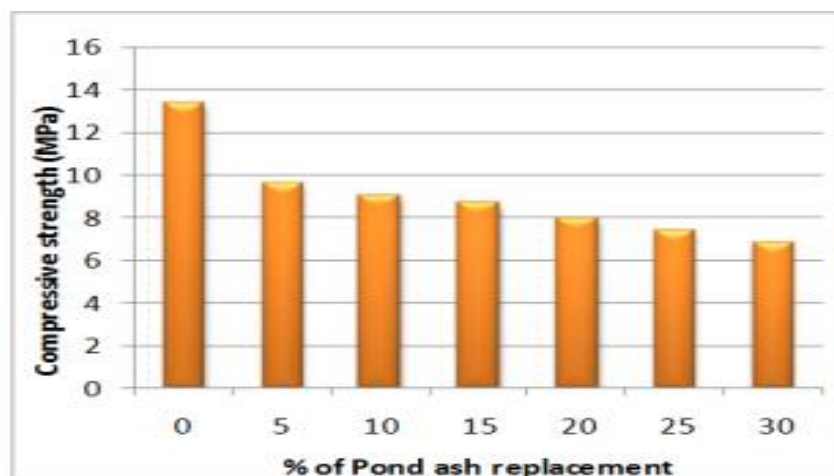


Fig.1. Pond Ash analysis

Apart from pollution to ground water, another major concern is dust pollution in the surrounding area during heavy wind. To prevent dust pollution, water sprinklers shall be arranged in the beach area which is in dry condition. The dust pollution is more from the pond which is not in operation and where construction is in progress by excavating the fly ash. For the pond which has reached the ultimate height and no further extension of height is warranted, the surface shall be covered with a 300mm thick soil layer. Suitable vegetation shall be grown over the area which ensures no dust pollution. The fly ash gets mixed with bottom ash and disposed off in large pond or dykes as slurry. It is also termed as ponded fly ash and contains relatively coarse particles. The large 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 an alarming rate, hence the efforts are 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 main constituents of pond ash.

CONCLUSION

Indian Standard method is easy method for the mix design of M25 grade concrete. As percentage of pond ash is increased the workability is reducing. It is observed from results that the splitting tensile strength of concrete increases only up to partial replacement of 20% of natural sand by pond ash, beyond that it decreases with the increase in the percentage of fine aggregates replacement with the pond ash. It is observed from results that the splitting tensile strength of concrete increases only up to partial replacement of 20% of natural sand by pond ash, beyond that it decreases with the increase in the percentage of fine aggregates replacement with the pond ash. The chloride solution is not affect on the compressive strength of concrete also. That mean when natural sand is replaced by pond ash then there is no any adverse effect on durability of concrete.

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