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Partial Replacement of Pond Ash as a Fine Aggregate in Concrete

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Abstract- the study was conducted to investigate the effect of pond ash as a fine aggregate on concrete properties such as compressive strength, split tensile strength, flexural strength and compare the cost of control concrete and concrete with pond ash. In this investigation the pond ash was partially replaced with river sand. The sand is majorly used material with aggregate in concrete. Today there is a less availability of river sand because of restriction on river mining, river mining affect on the environment also it reduces the water level. Because of all that reasons the cost of sand is increases so we can use pond ash which is by product of coal thermal power plant to reduce the cost of concrete. The pond ash available in bulk quantity which is also have disposal problem. The pond ash affects the environment so it can be used as a sustainable material which is easily available with low cost. The replacement of pond ash with river sand is 0%, 10%, 20%, 30%, 40% and 50%. For this study water cement ratio is 0.40 and the slump was kept constant with the help of plasticizer. It was observed that upto 20% of replacement of pond ash the properties of concrete such as compressive strength, split tensile strength, flexural strength was nearly same as control concrete. For 30%, 40% and 50% replacement of pond ash the strength was decreases.

Index Terms- Pond Ash, Compressive Strength, Split Tensile Strength, Flexural Strength.

1. INTRODUCTION

Due to shortage of river sand there is need to find out best alternative material to river sand. From the research the alternative material for river sand is copper slag, bottom ash, manufacturing sand etc that we can use. In India 70% of energy is generated from coal which leads to high production of fly ash upto 112 million. The high production of pond ash causes disposal problem as well as it reduces the nearby soil and water quality. To solve pollution and less availability of river sand problem there was many research have been done to find out the best alternative to river sand. In this study it was investigated that pond ash is best alternative for river sand that we can use. The pond ash taken from eklahre thermal power plant. The M-40 grade of concrete is used for research.

2. OBJECTIVES

- To investigate the physical properties of materials.
- To investigate the effect of pond ash as partial replacement of fine aggregate.
- To find out optimum percentage of pond ash as substitute for fine aggregate.
- To compare the cost of control concrete and concrete with pond ash replacement.

Literature review

In literature review finding out the alternative materials used to find out the best alternative material to river sand. The materials for river sand were pond ash, copper slag. The investigation by Arumugam K, Ilangovan R, James Manohar D focused on workability of concrete and compressive strength of concrete after replacement of pond ash with river sand.

3. METHODOLOGY

- Literature review- Studied the alternative material used for river sand.
- Procurement of materials- procure the material cement, sand, pond ash, coarse aggregate.
- Laboratory testing of material and mix design- Find out the physical properties of material and prepared mix design.
- Preparation of test specimen- test specimen casted and tested.
- Result and Discussion
- Conclusion.

4. MATERIAL AND METHODS

Ultra tech 53 grade cement used for casting which is widely used in India. The 10mm and 20mm coarse aggregate selection is important because it gives strength and durability and acquired large volume of concrete. The aggregate account 60 to 80 percent of the volume and 70 to 85 percent of the weight of concrete. The shape of coarse aggregate is angular which increases the bond between paste and aggregate which lead to high strength of concrete. The sand is confirming the zone-I according to IS: 383-1970. The pond ash taken from eklahre thermal power plant. BV plasticizer was used to improve the workability of concrete because with increase in percentage replacement of pond ash workability of concrete deceases due to high water absorption of pond ash. For casting and curing drinking water were used.

Physical properties

Fineness modulus- To determine the fineness modulus of 20mm, 10mm aggregate, sand and pond ash sieve analysis method is used. The fineness modulus of 20mm, 10mm, sand and pond ash is 7.3, 7.0, 3.54 and 2.07 respectively.

The specific gravity of materials find out by pycnometer method which is 2.81, 2.68, 2.59 and 1.683 for 20mm, 10mm aggregate, sand and pond ash respectively.

The water absorption of 20mm, 10mm aggregate, sand and pond ash was determined by conventional method which is 1.225%, 1.144%, 1.245%, 20.68% respectively.

Table 1-Physical properties of materials

Particulates	coarse aggregate		Sand	Pond ash
	20mm	10mm		
Fineness modulus	7.3	7.0	3.54	2.07
Specific gravity	2.81	2.68	2.59	1.68
Water absorption	1.225%	1.144%	1.245%	20.68%

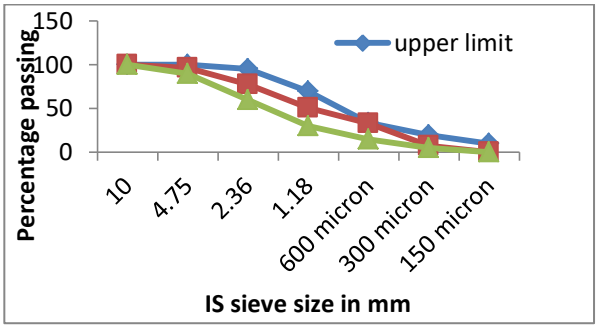

Fig. 1 Particle size distribution confirming zone I

Mix design

Mix design was carried out as per IS: 10262-2009. The replacement of pond ash was 0%, 10%, 20%, 30%, 40%, 50% were considered. M-40 grade of mix design was considered for w/c ratio 0.40. BV plasticizer was used to maintain constant slump 100 ±10mm.

Laboratory testing program

The total 54 cube specimens, 54 cylindrical specimen, 54 beam specimens were casted and tested for compressive strength, split tensile strength, flexural strength at 7, 28 and 56 days. Total 162 test specimen were casted and tested, 3 cube, 3 cylindrical, 3 beam specimen were tested at 7, 28 and 56 days each.

Table 2 mix proportions (Kg) and mix ratio

Cement (kg/mm3)	Fine aggregates	Coarse aggregate (20mm)	Coarse aggregate (10mm)	Water
418.625	688.54	438.78	278.98	167.45
1	1.64	1.14	1.71	0.4

Table 3 concrete mixture with different proportion of pond ash

Mix material % Replacement	Cement Kg/m3	Pond ash Kg/m3	Water Kg/m3	Sand Kg/m3	C. A. 20mm Kg/m3	C. A. 10mm Kg/m3
CC	418.63	-	167.45	688.54	731.30	464.98
10	418.63	44.74	167.45	619.68	731.30	464.98
20	418.63	89.48	167.45	550.83	731.30	464.98
30	418.63	134.22	167.45	481.97	731.30	464.98
40	418.63	178.96	167.45	413.12	731.30	464.98
50	418.63	223.70	167.45	344.27	731.30	464.98

5. RESULT AND DISCUSSION

Compressive strength

Compressive strength of concrete was determined at 7, 28 and 56 days for that the cube of size 150mm*150mm*150mm were casted.

$$\text{Compressive strength } (N/mm^2) = \frac{\text{Ultimate load in N}}{\text{Area of cross section } (mm^2)}$$

From the below graph it was observed that for 10% and 20% replacement the strength of concrete nearly same as Control concrete and for 30%, 40%, 50% replacement of pond ash it was decreases.

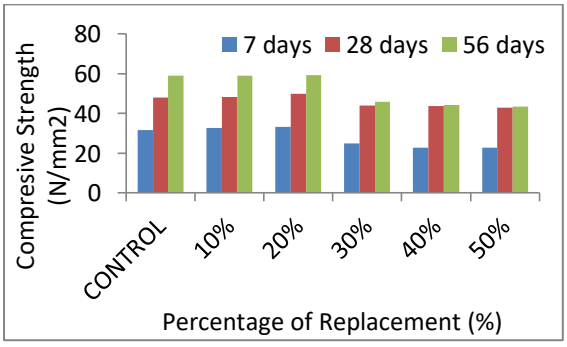

Fig. 2 Compressive strength at various percentage replacements at 7, 28 and 56 days.

Split tensile strength

The split tensile strength was determined at 7, 28 and 56 days for that the cylinder of size 150mm diameter and 300mm height is casted.

$$\sigma_{bt} = \frac{2P}{\pi DL}$$

Where, σ_{bt}= split tensile strength is in N/mm2, P = Maximum load at failure, L = span, D = Diameter of specimen.

From the below graph it was observed that split tensile strength for 10% and 20% was nearly same as control concrete and decreases for 30%, 40%,50% replacement of pond ash.

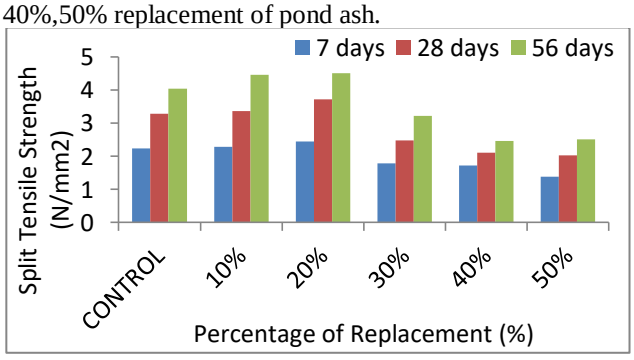

Fig. 3 Split tensile strength of concrete at various replacements at 7, 28 and 56 days

Flexural strength

The flexural strength was determined at 7, 28 and 56 days for that the beam of size 100mm*100mm*500* were casted.

$$\sigma_b = \frac{PL}{bd^2}$$

Where σb= Modulus of rupture in N/mm2, P = Maximum load, L = span, b = width of specimen, d = depth of specimen.

From the graph it was observed that for 10% and 20% replacement the flexural strength of concrete was same as control concrete and decreases for 30%, 40%, 50% replacement of pond ash.

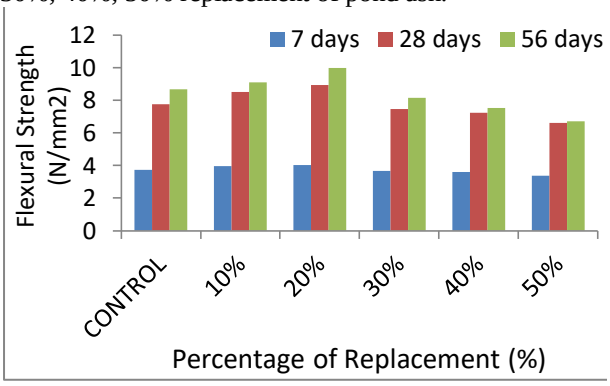

Fig. 4 Flexural strength at various percentage replacements at 7, 28 and 56 days

6. COST ANALYSIS

Composition	Proportion	Cost
CC	1:1.64:2.85	4817
10%PA+90%sand	1:1.64:2.85	4747
20%PA+80%sand	1:1.64:2.85	4676
30%PA+70%sand	1:1.64:2.85	4607
40%PA+60%sand	1:1.64:2.85	4536
50%PA+50%sand	1:1.64:2.85	4465

7. CONCLUSION

It was observed that for 10% and 20% sand replacement the compressive strength was nearly same for 7, 28 and 56 days respectively when compared with control concrete. It was observed that for 10% and 20% sand replacement the split tensile strength was nearly same for 7, 28 and 56 days respectively when compared with control concrete. It was observed that for 10% and 20% sand replacement the flexural strength was nearly same for 7, 28 and 56 days respectively when compared with control concrete. It was noticed that fineness modulus of pond ash is 2.07 so we can used it as a fine aggregate. It was noticed that specific gravity of pond ash is less than sand so that the weight of concrete is less. It was observed that cost of control concrete is more than concrete with pond ash.

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