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RESEARCH ARTICLE

FEASIBILITY STUDY ON CHARACTERIZATION AND USE OF POND ASH AS FINE AGGREGATE IN CONCRETE BEAMS UNDER FLEXURE

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ABSTRACT

Concrete is the very important product used in all types of constructions. It plays a very vital role in every construction. Concrete is a freshly mixed material which can be molded into any shape. The relative quantities of cement fine aggregate coarse aggregate and water mixed together control the properties in the wet state as in the hardened state. Cement is manufactured in factories and it is made available up to the required optimum quantities for the construction field. But aggregates are naturally available and their availability is limited one. Since the construction industry is developing very fast the requirement of concrete and their constituent materials are also increasing day by day. Hence the need becomes inevitable to find various alternate means for the aggregates and accordingly the researchers are going on in this way. Now a day practically it seems most probably coarse aggregate is available without any scarcity. But the availability of fine aggregate becomes difficult day by day. Fine aggregate is taken from the river beds which are the natural sources for storing the river water. Hence more than the certain quantity of fine aggregate cannot be taken from natural resources. Hence the need arises to find alternative for the fine aggregate. The material which is known as pond ash is available ash waste byproduct material from the thermal power plants. In India most of the thermal power plants use wet system for disposal of ash. The bottom ash from the boilers and the fly ash from the precipitators are mixed together and pumped off in the form of slurry to lagoons, where water is drained of or recycled. This material is being referred as pond ash. In this project work the material pond ash is experimentally analyzed and studied for its suitability as replacement as fine aggregate in concrete. So far few researchers analyzed its suitability as fine aggregate by finding the compressive strength of concrete. But in this project work the split tensile strength of concrete and flexural strength of concrete were analyzed by replacing pond ash as fine aggregate.

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INTRODUCTION

India's power generation has undergone a tremendous growth since independence. The production of ash has also increased from 17.06 million tons during 1990-1991 to 68.82 million tons in1996-1997 and has crossed 100 million tons in year 2000. The ash needs to be managed properly or otherwise it will cause land, air and water pollution. Hence it is a serious concern about utilizing it to the maximum extent. With the increasing use of low grade coal of high ash content, the current production of ash will be more than 100 milliontons per year. Primarily the fly ash is displayed off using either dry or wet disposal systems. In dry disposal systems, the fly ash is transported by trucks, chute or chute or to the site and disposed off by constructing embankments. In wet disposal system the bottom ash from the boilers and the fly ash from the precipitators are mixed together and pumped off in the form of slurry to lagoons, where water is drained off or recycled. This material is being referred as pond ash. About 1000 million tons of such ash referred to as pond ash is available in India, almost free of cost. Fly ash collected through hoppers has been widely accepted as a pozzolona and is being used by the cement manufacturing industries. Pond ash being coarser and less pozzlolnaic is not being used for cement manufacturing. By observing recent reports it seems that France leads the world by utilizing 50% of fly ash followed by West Germany and United Kingdom, while India utilized hardly 1% of the annual fly ash production of nearly 100 milliontons. So far pond ash is not at all used for any purpose anywhere in the country. It was dumped as a waste by product material in almost all thermal power stations. In this project the pond ash was collected from Mettur thermal power station, in Salem district. The collected pond ash was light blue in color. It seemed as river sand while seeing. If the pond ash is not to be used properly or disposed from the power station site there will be more problems due to the storage of wastage materials.

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Materials

- Cement
- Fine aggregate
- Coarse aggregate
- Pond ash
- Super plasticizer

Cement

Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel and cursed stone to make concrete. Cement and water form a paste that binds the other materials together as the concrete hardens.

1. The color of the cement should be uniform.
2. The cement should give uniform cool feeling when touched with hand. If a small quantity of cement is thrown in a bucket of water should sink.
3. The compressive strength after three days should not be less than 16 N / mm²
4. The compressive strength after seven days should not be less than 22 N /mm²
5. The tensile strength after 3 days should be 2.0 N / mm²
6. The tensile strength after 7 days should be 2.5 N / mm².

Fine Aggregate

Sand used for experimental program was locally procured and conformed to is:383-1970.the sand was first through IS 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust it tested per is :2386-1963.the sand belongs to grading zone II.

Table 1. Properties of Fine Aggregate

S.No	Properties	Observed value
1.	Fineness modulus	2.94
2.	Specific gravity	2.60
3.	Water absorption	Nil

Coarse Aggregate

The material which was retained on BIS test size 4.75 mm was termed as Coarse aggregate the broken stone is generally used as Coarse aggregate. The nature of work decide the the maximum size of Coarse aggregate. The maximum size of 20 mm was used in work the aggregate was washed to remove the dust and dried to surface dry condition it tested by using IS : 2386-1963.

Table 2. Properties of Coarse Aggregate

S.No	Properties	Observed value
1.	Fineness modulus	6.25
2.	Specific gravity	2.60

Pond Ash

In wet disposal system the pond ash from the boilers and the fly ash from the precipitators are mixed together and pumped off in the form of slurry to lagoons, where water is drained off or recycled. This material is being referred as pond ash. About 1000 million tonnes of such ash referred to as pond ash is available in India, almost free of cost.

Super Plasticizer

These are the modern type of water reducing admixtures, basically a chemical or a mixture of chemical that imparts higher workability to concrete. It consists of formaldehyde. It is the use of sp which has made it possible to use bottom ash as fine aggregate and particularly to give high workability to the concrete. Here super plasticizer used is CHERA PLAST. MIX DESIGN M-20

Table 3. Properties of Pond Ash

S.No	Properties	Observed value
1.	Color	Light grey
2.	Specific gravity	2.17
3.	Fineness Modulus	1.25

Table 4. Concrete Mix Proportion With 0%, 25%, 50%, 75% Pond Ash

Water	Cement	Fine aggregate	Coarse aggregate
186kg/m^3	372kg/m^3	637kg/m^3	1231kg/m^3
0.5	1	1.71	3.31

Mix proportion:

Pond ash: 0% to 75%
Super plasticizer: 0.5 dosage

RESULTS AND DISCUSSION

Compressive Strength of Pond Ash with Varying % of Pond Ash. Split Tensile Strength of Pond Ash with Varying % of Pond. Flexural Strength of Pond Ash with Varying % of Pond Ash

Discussion of compressive strength of cubes with pond ash

Analysis of Pond Ash for Compressive Strength

Analysis of test results – 7 Days strength

The M2 concrete which is added with 25 % pond ash gives 91.53 % of the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 77.96 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 71.17 % of the strength of the control cubes.

Analysis of test results – 28 Days strength

The M2 concrete which is added with 25 % pond ash gives 89.77 % of the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 85.22 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 78.4 % of the strength of the control cubes.

Analysis of test results – 56 Days strength

The M2 concrete which is added with 25 % pond ash gives 5.67 % more strength than the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 1.13 % more strength than the control cubes. M4 concrete which is added with 75 % of pond ash gives 95.45 % of the strength of the control cubes. From the above analysis it is well known that the strength of the concrete added with pond ash increases with the increase of time period. The difference of the strength of the control cubes and the pond ash added cubes are becoming less and less with the increase of the curing time period. 56 days strength results gives better results than the 7 days and 28

Table 5. Mix proportion for various percentage of pond ash replaced

Mix Designation	Pond ash Fraction of Fine Aggregate	Cement (kg)	Pond ash (kg)	F.A (kg)	C.A (kg)	Water (lit)	SP (lit)
M1	0 % PA	372	---	637	1231	186	1.75
M2	25 % PA	372	160	477	1231	186	1.75
M3	50 % PA	372	319	318	1231	186	2.50
M4	75 % PA	372	477	160	1231	186	2.50

Table 6. Compressive Strength Test Results for 7, 28 & 56 Days

Sl. No	Percentage of pond ash added	Average Load in kg	7 Days split tensile strength (N/mm ^{2})	28 Days split tensile strength (N/mm ^{2})	56 Days split tensile strength (N/mm ^{2})
1	0 %	21167	2.33	3.25	3.4
2	25 %	20167	2.12	2.97	3.46
3	50 %	19000	2.05	2.76	3.32
4	75 %	17833	1.91	2.54	3.11

Table 5. Split Tensile Strength Test Results for 7, 28 & 56 Days

Sl. No	Percentage of pond ash added	Average Unit wt. of concrete in Kg / m ^{3}	7 Days compressive strength (N/mm ^{2})	28 Days compressive strength (N/mm ^{2})	56 Days compressive strength (N/mm ^{2})
1	0 %	2540	26.22	38.22	39.11
2	25 %	2420	24	35.11	41.33
3	50 %	2380	20.44	33.33	39.55
4	75 %	2346	18.66	30.66	37.33

Table 6. Flexural Strength test results for 7, 28 & 56 Days

Sl. No	Percentage of pond ash added	Average Load in kg	7 Days Flexural strength (N/mm ^{2})	28 Days Flexural strength (N/mm ^{2})	56 Days Flexural strength (N/mm ^{2})
1	0 %	2100	3.56	5.11	5.33
2	25 %	2000	3.22	4.89	5.22
3	50 %	1867	2.89	4.55	5.00
4	75 %	1700	2.67	4.22	4.44

days curing periods.28 day's results are also useful and it satisfies the strength requirements of the specified design mix.

Analysis of Pond Ash for Split Tensile Strength

Analysis of test results - 7 Days strength

The M2 concrete which is added with 25 % pond ash gives 90.99 % of the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 87.98 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 81.97 % of the strength of the control cubes.

Analysis of test results - 28 Days strength

The M2 concrete which is added with 25 % pond ash gives 91.38 % of the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 84.92 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 78.15 % of the strength of the control cubes.

Analysis of test results - 56 Days strength

The M2 concrete which is added with 25 % pond ash gives 1.76 % strength more than the control cubes. M3 concrete which is added with 50 % pond ash gives 97.65 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 91.47 % of the strength of the control cubes.

Analysis of Pond Ash for Flexural Strength

Analysis of test results - 7 Days strength

The M2 concrete which is added with 25 % pond ash gives 90.44 % of the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 81.17 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 75.00 % of the strength of the control cubes.

Analysis of test results - 28 Days strength

The M2 concrete which is added with 25 % pond ash gives 95.69 % of the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 89.04 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 82.58 % of the strength of the control cubes.

Analysis of test results - 56 Days strength

The M2 concrete which is added with 25 % pond ash gives 97.94 % of the strength of the control cubes. M3 concrete which is added with 50 % pond ash gives 93.80 % of the strength of the control cubes.M4 concrete which is added with 75 % of pond ash gives 83.30 % of the strength of the control cubes.

Conclusion

The following conclusions are drawn from the observations of the compressive strength test, Split tensile test and Flexural

Strength test made by using the pond as partly replacement for fine aggregate from 0% to 75%

1. The density of concrete reduces with the increase in the percentage of pond ash.
2. The compressive strength of concrete with pond ash increases with increased curing period.
3. The Split tensile strength of concrete with pond ash increases with increased curing period.
4. The Flexural strength of concrete with pond ash increases with increased curing period.
5. While pond ash is used the workability is reduced. For obtaining the required workability the superplasticisers are added while preparing the concrete. The more pond ash we add the more superplasticisers are required to be added for obtaining the required workability.
6. With increasing replacement of fine aggregate with pond ash, the average density.

Of concrete shows a linear reduction due to its lower specific gravity.

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