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EXAMINATION OF POND ASH IN SELF COMPACTING CONCRETE

SOURAV JADHAV[1], SANTOSH MOURYA[2], NIKHIL VHANMARATHE[3], SHREEYASH ZANZANE[4], Prof. GAURI PATIL[5]

Civil Engineering, Trinity Academy of Engineering, Pune, India[1,2,3,4]

Assistant Professor, Trinity Academy of Engineering, Pune, India[5]

Abstract: Due to rapid industrialization and urbanization the demand for usage of cement is increasing at an alarming rate. On the other hand, fly ash and pond ash is produced in large amount from thermal plants which causes environmental pollution. To overcome above problems pond ash can be effectively utilized with partial replacement of sand in high self-compacting concrete. The fly Ash generation in Indian thermal power stations is liable to shoot up to 365 million tons. In India, about 200 million sq.m of land area is covered up with million tons of pond ash deposits. Although industry has claimed that fly ash is "neither toxic nor poisonous," this is disputed. To minimize the impact of such waste materials on environment proper management is required. Utilization of the waste materials in different purposes is an effective way of management. The utilization of the pond ash is studied as a construction material. Aim is to find out an effective way to use the pond ash as construction material so as to reduce the impact of the hazardous pond ash on environment and human health. Also finding the ways to efficiently use the pond ash waste in order to preserve our precious resources and reduce or eliminate the need for disposal of industrial waste in landfills. The use of pond ash in concrete and its properties such as compressive strength, particle size distribution, and cementations nature of a pond ash is studied. The utilization of pond ash in different construction material effectively such that the strength and quality of construction increases but the cost of the construction decreases is studied. Keywords**:** Include at least 4 keywords or phrases.

Keywords: Pond ash, compressive strength, concrete, admixture and fine aggregate.

I. INTRODUCTION

In India the power stations are mostly coal based which requires a huge amount of coal. As the combustion of coal, it produces a large amount of ash. Coal ash is commonly divided into two subcategories based on particle size. The flash and bottom ash are mixed with water and dumped in ponds called as pond ash. The ash lying in ponds occupy more than 40000 hectares of land, which otherwise would have been fruitfully used for developmental purpose. Pond ash utilization helps to reuse the wastes from thermal power stations as well as to solve the problems of disposal of pond ash, as it contains chemical compounds such as SiO2, Al2O3 etc. which has cementations property to form bond between two adjacent particles.

The ash obtained from the Electrostatic Precipitators (ESP) is presently utilized in cement, concrete, brick manufacturing and for refilling low lying areas. The remaining ash disposed in ponds stand unutilized and creates environmental and health hazard problems. One of the effective ways to utilize this waste material is to use it in concrete as a partial replacement of sand and thereby contribute to the sustainable development of the construction industry. Replacement levels were 10%, 15%, 20%, 25%, and 30%. Specimens were tested for workability immediately after mixing and compressive strength after 7-, 28- and 56-days curing. Hence worldwide research work is 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 possibility of utilization of Thermal Power Plant by-product Pond ash, as replacement to fine aggregate in concrete is taken into consideration.

II. LITURATURE SURVEY/BACKGROUND

1. **Arumugam K et al. (2011)** stated that the study is to investigate the possibility of using pond ash in varying percentage as fine aggregate substitute in cement concrete. They concluded that while the pond ash is used the workability is reduced. With the addition of pond ash there is reduction in slump value of fresh concrete. The unit weight of concrete gets reduced through the addition of pond ash as replacement of fine aggregate since it has lesser specific gravity than fine aggregate for obtaining the required workability, super plasticizers are added while preparing the concrete. The split

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tensile strength and flexural strength of concrete with pond ash increases up to the addition of 20% sand replacement. The compressive strength of concrete with pond ash increases with increased curing period.

2. **Bharatiganesh, Dr. R. Nagendra, Dr. H. Sharadabai, MR Suresh, Harisha C, Krishna KL-(2009)** heighted this paper self-compacting concrete with cementations material 400kg/m3 and fine aggregate i.e., manufactured sand was replaced with pond ash for different steps i.e., 10%, 20%, 30%, 40%, 50% and fresh properties were studied. Results showed that slump flows were comparable with that of normal self-compacting concrete, no specific pattern was observed in T50 sec but satisfied EFNARC specifications. V-funnel time increased with increase in replacement levels of pond ash, paper states that this effect may be the result of finer particles in pond ash. L-box test results for all replacement level were satisfying to EFNARC specification. In this paper it is also explained that pond ash replaced SCC was found viscous with higher replacement levels, this property of pond ash SCC was related to the fineness of pond ash particles and vesicular texture of pond ash particles. Compressive strength of the mixes reduced with increase in replacement level for 50% replacement level 25% reduction in strength was observed for same curing period. The first paragraph under each heading or subheading should be flush left, and subsequent paragraphs should have a five-space indentation. The first paragraph under each heading or subheading should be flush left, and subsequent paragraphs should have a five-space indentation. The first paragraph under each heading or subheading should be flush left, and subsequent paragraphs should have a five-space indentation.

3. **Jai Prakash Reddy (2016)** examined the fresh properties of SCC using pond ash. He produced SCC mixes by replacing fine aggregates by pond ash. Poly-carboxylic based super plasticizer was used to enhance workability of the concrete mixes. Fresh state properties of SCC like flow property, filling property, passing ability and segregation resistances of the mixes were checked by conducting inverted slump flow test, T500mm flow, V-shaped funnel test, V-shaped funnel test at T5min test, L-Box test method, U-Box test method were carried out according to EFNARC guidelines. he concluded that up to 60% pond ash can be replaced to fine aggregates in self-compacting concrete with further replacements after 60% segregation of concrete takes place. Also, up to 50% replacement level self-compacting concrete can be easily handled at further replacement concrete becomes harsh this may be because coarse texture of pond ash.

4. **Priyanka A et.al (2009)** Examined the "Effect of replacement of natural sand by stone dust on the properties of cement mortar" The effect of water cement ratio on fresh and hardened properties of concrete with partial replacement of natural sand by stone dust was investigated. Concrete cube, beam and cylindrical specimens were tested for evaluation of compressive, flexural and split tensile strength respectively. Workability was measured in terms of slump and compacting factor. The concrete exhibits excellent strength with 60% replacement of natural sand, so it can be used in concrete as viable alternative to natural sand.

5. **V Kannan (2016)** evaluated the fresh state and mechanical properties of self- compacting concrete (SCC) with binary and ternary cementations blends of metakaolin (MK) and fly ash (FA). The researcher replaced the cement by Metakaolin (MK) in the percentage 5, 10,15,20,25 and 30%. Six SCC specimens he prepared with cement replaced by fly ash (FA) in the percentage 5, 10,15,20,25 and 30%. Four specimens were prepared with cement replacement in combination of FA and MK. It was observed that unblended self-compacting concrete shows poor performance in relation to strength and durability of SCC. MK and FA blended SCC gave strong and durable SCC due to pozzolanic reaction of MK and FA.

III. PROPOSED WORK/SYSTEM

SCC is a flowing concrete mixture that is able to consolidate under its own weight. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in sections with congested reinforcement. SCC consists of cement, aggregates, water and admixtures which are similar to the composition of normal vibrated concrete, however, the less quantity of coarse aggregates, the large quantity of fines with the incorporation of super plasticizer, the low water to cement ratio gives self-compacting concrete.

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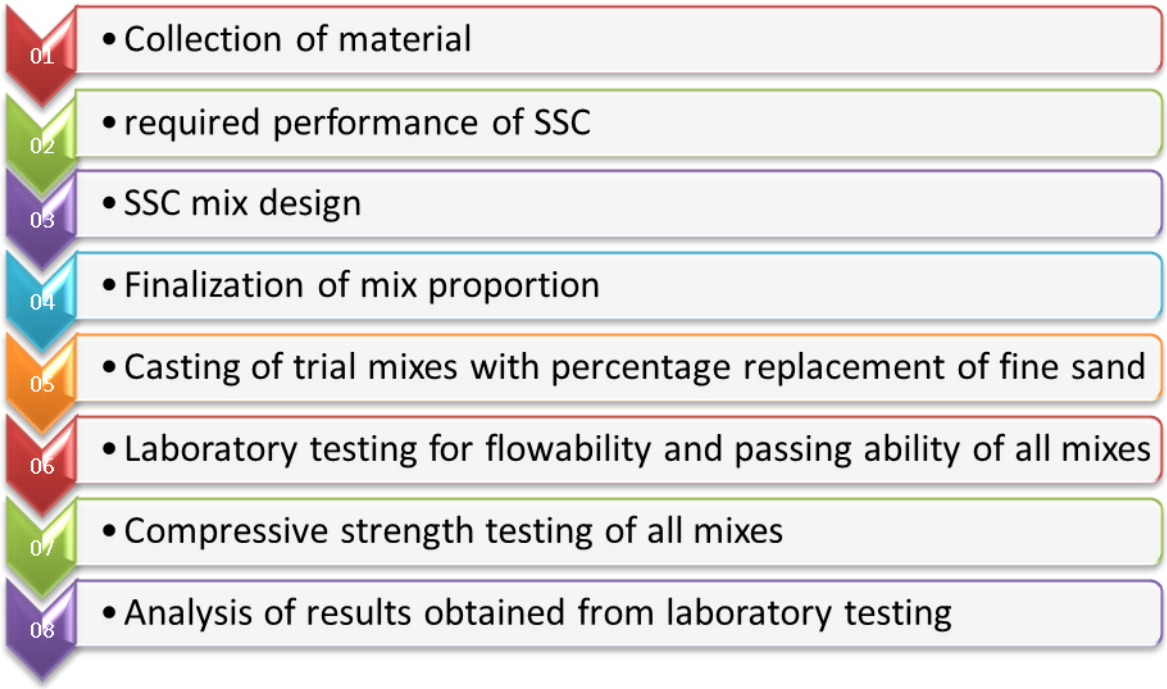

Fig. 1:. Procedure Chart

IV. MATERIALS AND METHODOLOGY

A. ***Cement***

In this present investigation, Pozzolana Portland Cement (PPC) of Birla Gold brand obtained from single batches throughout the investigation was used. The Portland cement contents mainly two basic ingredients namely argillaceous and calcareous. The physical properties of cement are given in table 1.

Table1. Properties of Cement.

Standard Consistency	31%
Initial Setting Time	245 minutes
Final Setting Time	310 minutes
7 days Compressive Strength	31 N/mm2
28 days Compressive Strength	42 N/mm2
Specific Gravity	2.70

Table1: Details of cement material.

B. ***Fine Aggregate***

The fine aggregate, used in this investigation was locally available river sand which was passed through 4.75 mm sieve and its fineness modulus, specific gravity and moisture content were2.83, 2.23 and 2.0 respectively.

C. ***Coarse Aggregate***

The coarse aggregate, used in this investigation was obtained locally available quarry having two different sizes, one fraction was passing through 20mm sieve and its fineness modulus was 7.5, and another fraction passing through 10mm sieve and its fineness modulus is 6.8. The specific gravity and water absorption of coarse aggregate were 0.8 and 2.66 respectively for both fractions.

D. ***Pond ash***

Pond ash obtained from NTPC, Tanda, Ambedkar Nagar (U.P) India was used in this investigation. The physical properties of ponded ash are given in table 2.

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Sl No.	Properties	Value
1	Specific gravity	2.4
2	Water absorption	15%
3	Fineness modulus	2.79

Table2: Physical Properties of Pond Ash

E. ***Concrete***

The concrete mix design was done in accordance with IS 10262(2009). The cement content used in the mix design was taken as 380 kg/m3 which satisfies minimum requirement of 300 kg/m3 in order to avoid the balling affect. Good stone aggregate and natural river sand of Zone-II were used as coarse and fine aggregate respectively. Maximum size of coarse aggregate was 20mm. A sieve analysis conforming to IS 383-1970 was carried out for both the fine and coarse aggregates. Potable water was used for mixing and curing. The water cement ratio (w/c) used was 0.45.

F. ***Mix Design***

M 25 grade of concrete was used in this investigation and fine aggregate was kept as 50% of the total volume of aggregate. Slump test was done to check the workability of concrete

45 control specimens of 150x150x150mm were casted to determine the compressive strength at 7-, 28- and 56-days interval respectively. The resulting mix proportion of cement, fine aggregate and coarse aggregate was taken as 1:1.53:3 with water cement ratio of 0.45 and the quantity of cement is 380 kg/m3.

G. ***Workability***

The workability of concrete was determined by the slump test. It is used to describe the ease or difficulty with which the concrete is mixing, compacting and placing between the forms with minimum loss of homogeneity. The slump values of concrete for different percentage of pond ash and super plasticizer is given in table 3.

Fig.2: Workability Measured by Slump Test.

Sample	% Of Pond ash	Dose of super plasticizer by wt. of cement (%)	Slump value (mm)
M1	0	0.6	35
M2	10	0.6	20
M3	15	0.8	15
M4	20	0.8	15
M5	25	1.0	10
M6	30	1.0	10

Table3: Slump Values

It is shown that workability of concrete made using pond ash decreases with increase in replacement level. The decrease in workability may be due to the increased volume of fine aggregate on equal weight basis as pond ash is lighter than the natural sand. For increased volume of fine aggregate more water is needed for lubrication thereby decreasing the workability.

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J. Compressive strength

The compressive strength of different specimens for same concrete mix is different, so average compressive strength of three specimen sample was used for strength calculation.

Compressive strength of referral concrete as well as concrete made using pond ash as partial replacement of fine aggregate is shown in table no. 4 and fig no.2.

S.NO	Cube designation	Compressive strength (N/mm^2)			% Of Pond ash
		7 days	*28 days*	*56 days*	
1	M_1	19.5	31.31	37.4	-
2	M_2	20.40	33	39.1	10%
3	M_3	20	32.2	38	15%
4	M_4	18	28.1	36.5	20%
5	M_5	16.72	24.50	34	25%
6	M_6	15	23.1	31.5	30%

Table4: Compressive strength of concrete**.**

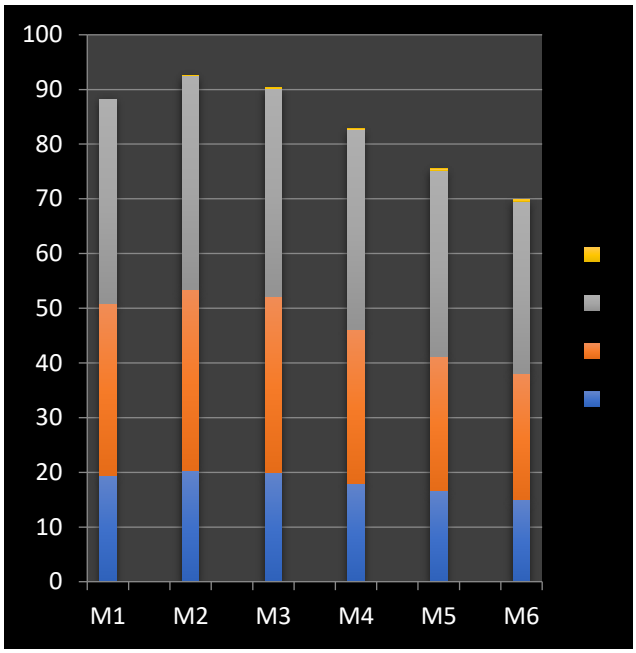

Fig 3*:* Compressive strength of concrete

It is observed that on addition of pond ash up to 20% partial replacement of fine aggregate comparable increased in compressive strength is achieved at all ages as compared to the referral concrete. However, the compressive strength is maximum at 15% replacement level. At this replacement level the compressive strength is 5.78%, 3.19% and 1.60% more than the referral concrete at 7, 28 and 56 days respectively.

The increase in compressive strength is due to the fact that pond ash being pozzolanic material reacts with free lime present in PPC and produce C-S-H gel, which has good binding properties thereby increase the compressive strength in general. Another reason of increase in compressive strength may be packing of voids in concrete by pond ash particles. Further it seems that after 15% replacement level compressive strength is decreased with increase of replacement of pond ash at all the ages. This decrease may be due to fact that volume of pond ash replaced with fine aggregate is substantially more than that needed for packing of voids in concrete. This increase volume needs more water for lubrication resulting decrease in compressive strength.

V. RESULT AND DISCUSSIONS

1. Workability is decreased with increase in replacement level.
2. Up to 15% replacement of fine aggregate by pond ash increase in compressive strength is achieved as compared to referral concrete.
3. At 20 % replacement level compressive strength is comparable to referral concreter however, beyond that compressive strength is substantial decrease at all ages.

VI. CONCLUSION

The density of concrete reduces with the increase in percentage of pond ash. The compressive strength of concrete with pond ash increases with increased curing period.The split tensile strength of concrete with pond ash increases up to the addition of 20% ash sand replacement.The flexural strength of concrete with pond ash increases upto the additio n of 20% ash sand replacement. While the pond ash is used the workability is reduced. For obtaining the required workability, super plasticizers areadded while preparing the concrete. The more pond ash to be added the more super p

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lasticizers are required to be added for obtaining the required workability. With increasing replacement of fine aggrega te with pond ash the average density of concrete shows linear eduction due to lower specific gravity.

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