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Experimental Study of using Pond Ash as Partial Replacement for Fine Aggregate in a Silica Fume Based Concrete

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ABSTRACT

Production of one ton of Portland cement emits one ton of CO2 and different greenhouse gases main to atmospheric pollution. Hence the want arises to exchange cement with some different cementitious material. Disposal of Pond ash which is combination of Fly ash & Bottom ash into massive lakes reasons land air pollution and different environmental effects. The cause of this find out about is to locate the suitability of silica fume as a alternative cloth for cement and pond ash as a alternative fabric for first-rate combination in concrete except compromising the power & sturdiness of traditional concrete. The bodily and chemical property of silica fume and pond ash is to be studied and each the industrial wastes are used to substitute the cement and great aggregate. Pond ash is in part changed for fantastic mixture with the aid of various percentages 10 to 30%, additionally silica fume is introduced by way of 10 to 20% by way of the weight of cement. The specimens will be examined for its mechanical houses such as compressive strength, cut up tensile energy and flexural electricity on 7, 28 & 56 days. After identifying the houses of the concrete mixes, the foremost share of alternative tiers of silica fume and pond ash will be carried out and Reinforced Concrete Beams had been forged to decide the flexural behaviour for the optimized concrete Mix.

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1. INTRODUCTION

In India the strength stations are primarily coal primarily based which requires a large quantity of coal. As the combustion of coal it produces a giant quantity of fly ash. Fly ash is the by using product of thermal strength station which requires a giant place suitable technique for its disposal. Fly ash is accumulated by means of mechanical or electrostatic precipitators from the flue gases of energy plant whereas; backside ash is accumulated from the backside of the boilers. When these two kinds of ash, blended together, are transported in the shape of slurry and stored, the credit is known as pond ash. The complete manufacturing of fly ash in India is over a hundred million tones and the disposal is essential problem. For its disposal thermal electricity station adopts moist technique for its disposal. In moist technique fly ash and backside ash are blended with water and disposed in open lands. Pond ash utilization helps to reuse the wastes from thermal electricity stations as nicely as to clear up the issues of disposal of pond ash, as it consists of chemical compounds such as SiO2, Al2O3 etc. which has cementitious property to structure bond between two adjoining particles.

After the combustion of coal the residues of ash is acquired in all thermal energy plants. This find out about is to inspect the check end result of concrete in which cement is changed by using pond ash. The fly ash got from strength station want appropriate approach for its disposal. So the pleasant appropriate approach which all the strength plant makes use of is moist disposal method. The fly ash, backside ash and water are blended till slurry is acquired and then the slurry is disposed in open lands.

People continuously go from geographical region to city areas thereby many fold amplify in high-rise constructions in the cities. Infrastructure improvement in such areas mainly in creating international locations like India is additionally at a peak. Concrete is the most critical cloth in the building of the high-rise structures and different infrastructure works and river sand is the important uncooked cloth used as first-class aggregate in the manufacturing of concrete. The natural sources of river sand are getting depleted gradually. The demand for the safety of the herbal surroundings and the ban on mining in some areas is similarly annoying the trouble of availability of river sand. At present, the building enterprise is plagued with the shortage of this indispensable constituent fabric of concrete. Therefore, in the existing occasions of scant sources of river sand and growth in infrastructure development, it turns into necessary and extra considerable to locate out its alternative fabric in concrete.

1.1. PRODUCTION OF BOTTOM ASH

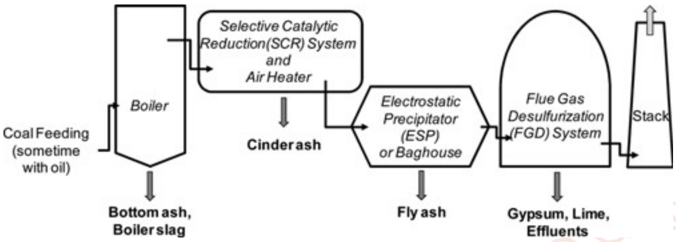

Fig 1.1 Schematic Diagram of Production of By-products from Coal- fired Power Plant

1.2. OBJECTIVE OF THIS STUDY

The primary goals of the investigation are

- To find out about the homes of industrial wastes and their suitability in changing cement and great aggregate
- To learn about the impact of silica fume and Pond Ash on the Workability of concrete.
- To learn about the mechanical houses such as compressive strength, cut up tensile strength, flexural power of the Concrete with silica fume and pond ash.
- To look into the crack sample and flexural conduct of the Reinforced Concrete beams with foremost share of SF and Pond Ash.

2. MATERIALS

2.1. Cement

For this research work Ordinary Portland Cement (OPC) 53 grade conforming to IS 8112 – 1989 was used. American Society for Testing Materials(ASTM) has designated ordinary Portland cement as Type I cement used for general concrete constructions.

2.2. Coarse aggregate

Locally available coarse aggregates having the maximum size of 20mm were used in the present work. Testing of coarse aggregates was done as per IS: 383-1970. The 20mm aggregates were firstly sieved through 20mm

sieve. They were then washed to remove dust and dirt and were dried to surface dry condition.

2.3. Fine Aggregate

The sand used for the experimental programme was locally procured and conformed to grading zone III as per IS : 383-1970 The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust

2.4. Silica Fume

Silica fume also referred as micro silica or condensed silica fume is another material that is used as an artificial pozzolanic admixture. It is a product resulting from reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. When quartz are subjected to 20000C reduction takes place and SiOvapours get into fuels. In the course of exit, oxidation takes place and the product is condensed in low temperature zones. In the course of exit, Silica fume rises as an oxidized vapour, oxidation takes place and the product is condensed in low temperature zones. When the silica is condensed, it attains non-crystalline state with ultra fine particle size. The superfine particles are collected through the filters. It cools, condenses and is collected in bags. It is further processed to remove impurities and to control particle size. Condensed silica fumeis essential silicon dioxide (SiO2) more than 90 percent in non crystalline form. Since it is an airborne material like fly ash, it has spherical shape. It is extremely fine with particle size less than 1 micron and with an average diameter of about 0.1 micron, about 100 times smaller than average cement particles. Silica fume has specific surface area of about 20,000m2/kg, as against 230 to 300 m2/kg. The use of silica fume in conjunction with super plasticizer has been back bone of modern high performance concrete. High fineness, uniformity, high pozzolanic activityand compatibility with other ingredients are of primary importance in selection of mineral admixture. As Silica fume has the minimum fineness of 15,000 m2/ kg, whereas the fumed Silica has the fineness of 190,000 m2/g which is 6 to 7 times finer than Silica fume.

3. EXPERIMENTAL PROGRAMME

3.1. CEMENT

Table 3.1 physical properties of cement

S.NO	Characteristics	Values	Standard value
1	Normal consistency	31%	-
2	Initial setting time(minutes)	36min	Not less than 30
3	Final setting time (minutes)	210 min	Not greater than
4	Fineness (%)	3.5%	<10
5	Specific gravity	3.15	-
6	Compressive strength		
i	3 days	23.8 MPa	Not less than 23 MPa
ii	7 days	34.2 MPa	Not less than 33 MPa
iii	28 days	45.0 MPa	Not less than 43 MPa

3.2. COARSE AGGREGATES

Table 3.2 Sieve analysis of 20mm aggregates

S.NO	Characteristics	Value
1	Type	Crushed
2	Maximum size	20mm
3	Specific gravity(20 mm)	2.8
4	Total water absorption (20 mm)	0.5%
5	Moisture content (20 mm)	--
6	Fineness modulus(20mm)	7.68

3.3. FINE AGGREGATE

Table 3.3 Sieve analysis of fine aggregate

S.NO	Characteristics	Value
1	Type Uncrushed	(natural)
2	Specific gravity	2.60
3	Total water absorption	0.86%
4	Moisture content (20 mm)	--
5	Fineness modulus	2.507
6	Grading zone	III

3.4. PHYSICAL PROPERTIES OF POND ASH

Table 3.4 Physical Properties of Pond Ash

S. No	Types of Test	Test results
1	Specific gravity	1.972
2	Bulk unit Weight	879 kg/m^3
3	Fineness Modulus	2.39
4	Water Absorption	7.2%

3.5. CHEMICAL COMPOSITION OF SILICA FUME

Table 3.5 Chemical composition of silica fumes in %

SPECIFICATION	LIMITS
Form/colour	Powder/white/grey
SiO_2	90%
H_2O(moisture), max	3.0%
Bulk density	600kg/m^3

4. TESTS ON FRESH CONCRETE

4.1. Slump Test

Fig 4.1 slump test

4.2. COMPACTION FACTOR TEST

Table 4.1 Slump values and compaction factor values of partial replacement of Pond ash & Silica fume in concrete.

S.NO	Identification	Slump (mm)	Compaction factor
1	CS	83	0.85
2	M1	79	0.87
3	M2	83	0.94
4	M3	88	0.92
5	M4	91	0.90
6	M5	71	0.91

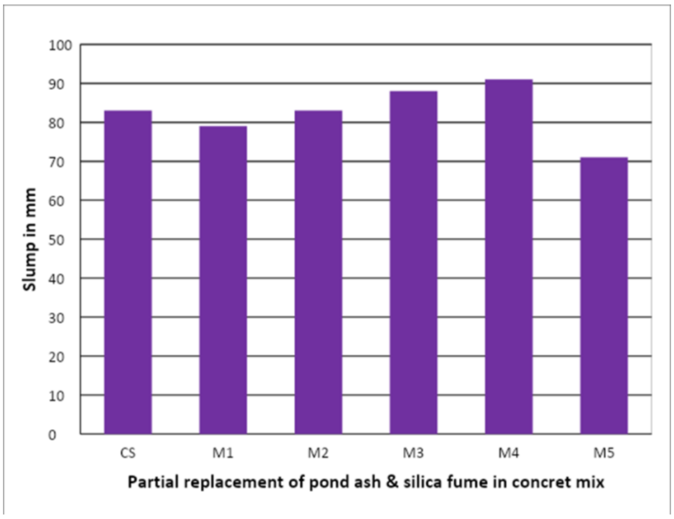

Fig 4.2 variation in slump values

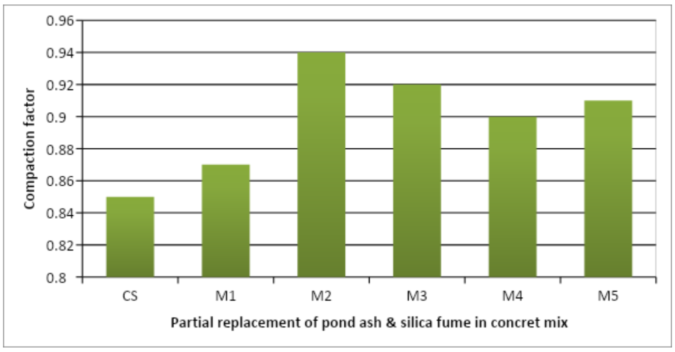

Fig4.3 variation in compaction factor values

4.3. COMPRESSIVE STRENGTH

Table 4.2 Compressive strength for different mix proportions

S.NO	Identification	Compressive Strength N/mm^2		
		7 days	14 days	28 days
1	CS	23.02	29.14	36.92
2	M1	25.36	30.09	37.46
3	M2	27.25	32.54	38.88
4	M3	27.98	34.92	43.25
5	M4	26.27	32.14	35.87
6	M5	29.33	34.77	40.19

Fig 4.4 Experimental setup for Compressive Strength

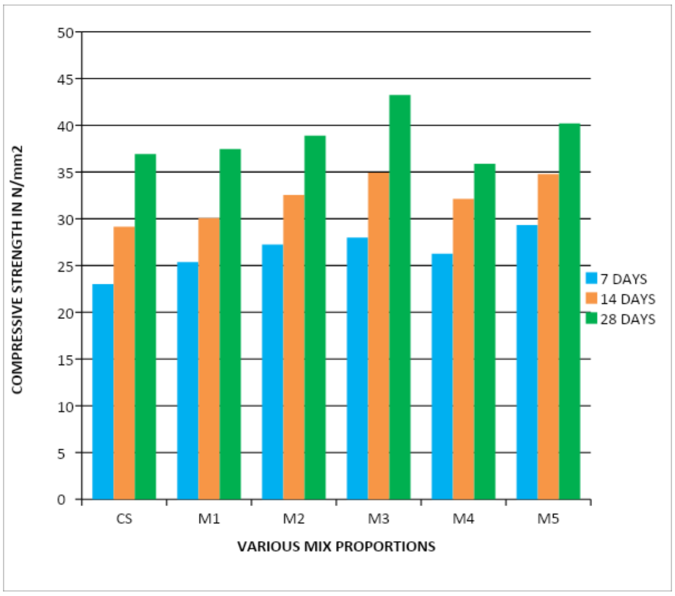

Fig 4.5 compressive strength test

4.4. FLEXURAL STRENGTH TEST

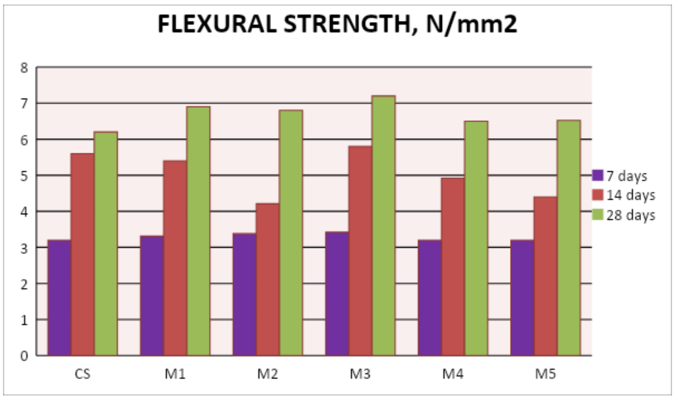

Fig 4.6 Casting of concrete beam specimens

Fig 4.7 Testing of concrete beams specimens

Table 4.3 Flexural strength test for different curing days

S.NO	MIX	FLEXURAL STRENGTH, N/mm^2		
		7 days	14 days	28 days
1	CS	3.20	5.60	6.20
2	M1	3.31	5.40	6.90
3	M2	3.38	4.21	6.80
4	M3	3.20	4.92	6.50
5	M4	3.42	5.80	7.20
6	M5	3.20	4.40	6.52

Fig 4.8 Flexural strength test for beam specimens

4.5. SPLIT TENSILE STRENGTH TEST

Table 4.4 Split tensile strength for different curing days

S.NO	MIX	SPLIT TENSILE STRENGTH IN N/mm^2		
		7 days	14 days	28 days
1	CS	2.18	3.7	4.2
2	M1	2.42	3.91	4.39
3	M2	2.57	3.51	5.52
4	M3	2.84	3.01	3.62
5	**M4**	**3.17**	**4.21**	**5.85**
6	M5	2.96	3.37	3.03

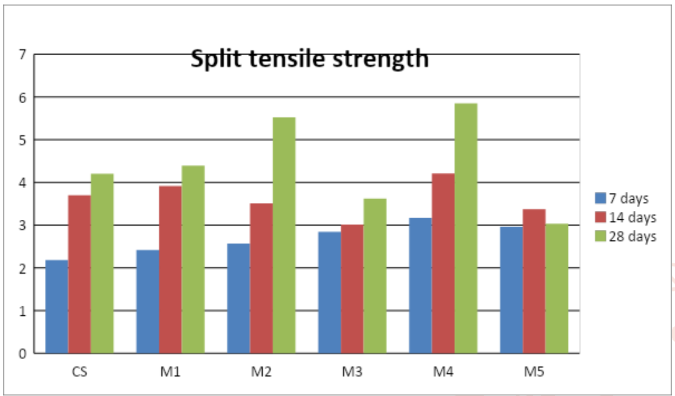

Fig 4.9 Split tensile strength for different curing days

5. CONCLUSIONS

This learn about is targeted on comparative find out about of the use of silica fume and Pond Ash to produce Eco-friendly concrete. The following conclusions are derived based totally on the experimental study.

- Addition of pond ash extensively reduces the workability of concrete mixes whereas the addition of expanded proportion of silica fume improves the workability.
- Concrete Mix-3 containing 12.5 SF& 15% Pond Ash yielded maximum compressive strength
- Concrete Mix-4 containing 15% SF & 20% Pond Ash suggests most price of flexural energy at 28 days.
- The most beneficial proportion of substitute degree of SF for cement is 15% and pond ash for high-quality mixture is 20% barring compromising the workability and mechanical houses of concrete.
- As the share of alternative of pond ash increases, the weight of the specimens decreased due to low density of pond ash.
- It is seen that there is discount of compressive electricity of concrete mixes at 7 days of curing. At 28 days, the compressive energy of the mixes receives improved.
- The cost of cut up tensile power and flexural power additionally decreases at 28 days checking out due to addition of pond ash and silica fume.
- Beams of optimized combine exhibited appropriate flexural behaviour which can be accelerated by using growing the curing period.

REFERENCES

[1] Adakhar, “Compatibility of super plasticizer slag added concrete in sulphate resistance and chloride penetration”, Advances in Civil Engineering Materials and construction technology, 2001, volume 2 Iss 4 pp 33.

[2] Ashis Kumar Beraetal, “Compaction characteristics of pond ash” Journal of materials in Civil Engg, April 2007, volume4, pp 349 -357.

[3] Indian Standards 10262, Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1982

[4] Magudeaswaran. P, Eswaramoorthi. P, “Experimental Investigation of Mechanical properties on Silica fume and Fly ash as Partial Cement Replacement of High Performance Concrete” IOSR Journal of Mechanical and Civil Engineering, Jun. 2013, Volume 6, Issue 4, pp57-63

[5] Ranganath R.V, B. Bhattacharjee and S. Krishnamoorthy, “Influence of size fraction of ponded ash on its pozzolanic activity” Cement Concrete Res, 1994 vol.5, pp 749-761.

[6] Vijaya Sekhar Reddy, I.V.Ramana Reddy, N.Krishna Murthy, “Predicting the Strength Properties of High Performance Concrete using Mineral and Chemical Admixtures” ARPN Journal of Science and Technology, January 2013, vol. 3, No. 1 pp.36-38.

[7] Virenda Kumar, “Compaction and permeability study of pond ash” Journal of The Institution of Engineers (India), May 2004, vol.2, pp 31-35.

[8] R. S. Bang, Y. M. Ghugal, I. K. Pateriya “Strength Performance of Pond Ash Concrete International Journal of Earth Sciences and Engineering” , Feb 2012, Volume 05, No. 01, P.P. 180-185

[9] S. A. Haldive, Dr. A. R. Kambekar, “Experimental Study on Combined Effect of Fly Ash and Pond Ash on Strength and Durability of Concrete”, International Journal of Scientific & Engineering Research, May-2013, Volume 4, Issue 5, p.p 81-86

[10] Arumugam K , Ilangovan R , James Manohar D, “A study on characterization and use of Pond Ash as fine aggregate in Concrete” International Journal Of Civil And Structural Engineering,2011, Volume 2, No 2, p.p 466-477

[11] Bharathi Ganesh, H. SharadaBai, R. Nagendra and B.K. Narendra, “Characterization of Pond Ash as Fine Aggregate in Concrete” Proceedings of International Conference on Advances in Architecture and Civil Engineering (AARCV 2012), June 2012, Vol. 1, p.p. 119-125

[12] Prof. P. P. Bhangale" Study of Pond ASH (BTPS) Use as A Fine Aggregate in Cement Concrete "- Case Study, International jornalof latest trends in Engg. And Technology, Vol 2, Issue 2, March 2013.

[13] Jay Patel, Kunal Patel, Gaurav Patel “Utilization of pond fly ash as a partial replacement in fine aggregate with using fine fly ash and alccofine in hsc” IJRET: International Journal of Research in Engineering and Technology 2013

[14] ArunkumarDwivedi, Dhiraj Kumar S. Lal “Influence of Addition of Pond Ash as Partial Replacement with Sand and Cement on the Properties of Mortar” International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-4, March 2013.

[15] M. P. Kadam, DR.Y.D. Patil “Effect of coal bottom ash as sand replacement on the properties of concrete with different w/c ratio” International Journal of Advanced Technology in Civil Engineering, ISSN: 2231 –5721, Volume-2, Issue-1, 2013.

[16] RemyaRaju, Mathews M. Paul & K. A. Aboobacker “Strength performance of concrete using bottom ash as fine aggregate” International Journal of Research in Engineering & Technology (IMPACT: IJRET) ISSN(E): 2321-8843; ISSN(P): 2347-4599 Vol. 2, Issue 9, Sep 2014, 111-122.

[17] Aparna K. A., Dr. V. Ramesh “Comparative Study of Fly Ash and Pond Ash on Compressive and Flexural Strength of Concrete” International Journal of Civil and Structural Engineering Research 2015 ISSN 2348-7607 Vol. 3, Issue 1

[18] Perumal, K., Sundararajan, R., 2004. Effect of partial replacement of cement with silica fume on the strength and durability characteristics of high performance concrete. In: 29th Conference on Our World in Concrete & Structures: 2526 August 2004, Singapore.

[19] Kumar, P. R., Rao, C. B. K., 2002. Cost effectiveness of silica fume concrete design mixes. In 27th Conference on Our World in Concrete & Structures, 2930 August 2002, Singapore.