A Study of Tensile Strength of Concrete Containing Pond Ash and Micro-Silica

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Abstract— the experiment studies of utilization of pond ash and micro-silica in concrete. The concrete was prepared with varying percentage of pond ash and micro-silica (0, 10, 20, 30, 40%) and it was tested at different ages (7, 28, 56 days). The pond ash was used as replacement for fine aggregate and micro silica for cement. The concrete was prepared with M20 grade with water cement ration 0.45. Experiments were carried out to determine the Split Tensile with those of concrete. It is found that up to 20% replacement Split Tensile strength of concrete will be increase.

Index Terms— **Pond ash, Micro silica, Split Tensile strength**

I. INTRODUCTION

The development of world construction industry play vital role in which concrete being mostly used construction material and main ingredient in the conventional concrete is cement. The amount of cement production emits approximately equal amount of carbon dioxide into the atmosphere which produce ill effect on human and environment. To avoid that lot of earlier research carried to find out alternative material. In the thermal power plant burning of coal it produce fly ash and bottom ash. Both fly ash and bottom ash collected together with water and disposal in pond then it is called as pond ash. Its disposal has big challenge in world. Pond Ash is used only land filling purpose only. Pond ash is available at almost free of cost. To find its use in construction industry to solved disposal problem and decreased cost of construction this is helpful for common person. The byproduct i.e. pond ash as is used to replacement of fine aggregate in concrete is taken into consider. The other by product material is Silica fume, also known as micro-silica.it is an atmosphere (non-crystalline) polymorph of silicon dioxide. It is an ultra fine powder collected as a by-product of the silicon and Ferro silicon alloy production and consists of spherical particles with an average particle diameter of 150 nm. The main field of application is as pozzolanic material for high performance concrete. Ternary Blended Concretes means concrete prepared with more than one by product by-product material. For this study the pond ash was used as replacement for fine aggregate and micro silica for cement. Micro Silica in the ternary blend concrete improves the early age performance of concrete and fly ash improves the properties at the later age.

II. LITERATURE REVIEW

The work carried out by **Arumugam K et.al**[1] is to investigate the possibility of using pond ash in varying percentage as fine aggregate substitute in cement concrete and it is discussed with workability and compressive strength of concrete .**S. Bang et.al** [2] investigated to utilize pond ash as fine aggregate with natural sand for sustainable development of concrete industry in India. Eighteen concrete matrices were designed with 25 and 50 percent pond ash by replacing natural sand as fine aggregate and test specimens were prepared for compressive, flexural and split tensile strength. The concretes of M20, M30 and M40 grades with 25 percent pond ash and 75 percent crushed sand shows compressive strength at 28 days curing 23.49, 14.68 and 9.93 percent higher than the conventional companion mixes respectively. For these mixes the flexural strength was 11.11, 7.30 and 4.88 percent higher and split tensile strength was 4.93, 8.57 and 8.33 percent higher than their conventional companion mixes respectively. The strength development was observed up to 365 days. This investigation shows a wide scope for utilizing pond ash as fine aggregate in concrete. **Prof. P. P. Bhangale et.al** [3]have discussed about has born undertaken through the project to explore the possibility of utilizing this pond ash in the construction industry. Characterization of pond ash sample was carried out and results indicated that pond ash sample can be tried as fine aggregate in concrete' K**. M. Bagwanet.al** [4] have discussed. about pond ash is used as replacement of cement (25 to 45%). The properties concrete in fresh and hardened state was tested and it is found that as a percentage of pond ash increases, the compressive strength of concrete reduces. It is also observed that early age compressive strength of pond ash concrete is low but it is gradually rises as age of concrete increases and it gives good later age strength. **K. M. Bagwanet.al** [5] have discussed with concrete was prepared with different percentage of pond ash (15, 25, 35, 45 and 55 %) and it was tested at different ages (3,7,28,56,90, and 180 days). Results of pond ash concrete were compared with control concrete. For all proportions slump in a range of 100-120 mm was maintained. A property of pond ash concrete in fresh state and hardened state was tested. IST and FST of pond ash concrete goes on increasing as replacement level of pond ash with cement increases this is because of less content of cement. **Gaurav Kantilal Patel et.al** [6] have discussed with 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.**Tuminganet.al** [7] have discussed with pond ash waste is categorized as a hazardous material that requires a change in its management from friable materials into solid materials. Preliminary study of utilizing the

pond ash as replacement materials of concrete, at the early stage, it is used as a partial replacement of fine aggregate in the concrete mixes and investigated by analyzing the effect of the use of the pond ash to the strength of concrete. The cylindrical specimens of concrete with 100 mm in diameter and 200 mm in height are used. The fine aggregate replacement is made with the weight of the pond ash in the sand ratio of 0%, 12.5%, 25%, 37.5% and 50%, with a constant water-cement ratio of 0.49 based on the normal concrete mix design. **Fume Eehab Ahmed Badreldin Khalilet.al** [8]have discussed with concrete mixtures were adapted in such a way to have the same workability and air content. The fresh concrete properties were kept near identical in slump, air content, and unit weight. The variation was in the hardened concrete mechanical properties of compression and tension strength. The carbonation phenomenon was studied for these mixes showing at which mixes of ternary cementations content heavy carbonation attacks maybe produced. **Shweta Goyal et.al**[9]investigated on the role of Fly Ash addition on the super plasticizer dosage, slump, and 28 day and 90 day Compressive Strength of Micro Silica concrete .It was concluded that in the binary mixes Micro Silica increased the super plasticizer demand while Fly Ash decreased the optimum dosage of super plasticizer for constant workability. Three component systems can be designed for high workability with low super plasticizer dosage without impairing much in strength. **Murthi et.al** [10]in their experimental study intended to identify the relationship of Compressive Strength and splitting tensile strength of Ternary Blended Concrete. For this purpose, the applicability of 0.5 power relationship as per IS 456-2000 and then a similar kind of relationship developed for Ternary Blended Concrete. Two kinds of binary blended concrete systems were considered in this study using the optimum replacement of cement by ASTM class Fly Ash (FA) and rice husk.

III. Experimental Program

The present investigation is aimed to study the concrete which are made by partially replacement of pond ash to the fine aggregate and micro-silica. The concrete was prepared with varying percentage (0,10,20,30,40%) of pond ash and micro-silica With water cement ratio 0.45 and using super plasticizer (0,0.5,1,1.5,2 %) respectively.

Cement

The 53 grade Portland JK super Cement (PC) was used. It conforms to IS 12269:1987 (Bureau of Indian Standards 1987) specifications.

Fine Aggregate

The locally available natural sand used for the experimental works. Sand having specific gravity 2.65

Coarse Aggregates

Locally available coarse aggregate having the size 4.75 mm to 20 mm was used in the present work. It having specific gravity 2.78.

Pond Ash

The present samples are obtained from ash ponds of Eklahare village, Nashik taluk, Nasik district, Maharashtra. The samples were oven dried at the temperature of 105-110 degrees. Then it was sieved using 2 mm sieve .the material passing through 2 mm sieve was used in experimental work and results are provided in Table 1

Table 1 Grading and Property of Pond Ash

Description	**Sand / Fine Aggregate**	
Grading of Particle (I. S. Sieve)	Percentage weight Retained	cumulative weight retain
4.75 mm	0	0
2.36 mm	24.1	24.1
1.18 mm	748.6	772.7
500 micron	187.1	959.8
250 micron	10.8	970.6
150 micron	2.8	973.4
75 micron	3.5	976.9
40 micron	4.3	981.2
Fineness Modulus	3.7	
Specific Gravity	2.05	

Micro-silica

Silica fume, also known as micro silica, is an amorphous (non- crystalline) polymorph of silicon dioxide. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles. The main field of application is as pozzolanic material for high performance concrete. Silica fume is an ultrafine airborne material with

spherical particles less than 1m in diameter, the average being about 0.1m. This makes it approximately 100 times smaller than the average cement particle. Figure 1 shows pond ash and micro-silica.

Figure 1 shows pond ash and micro-silica

Super plasticizer
Super plasticizer PLAST AP501 was used as water reducing admixture. It will be help to increase workability.

C**oncrete mixtures**
For this study m20 grade concrete will be selected. Concrete mix design is the procedure of obtaining various ingredients such as cement, aggregate, water and admixtures. Mix was designed as per stipulations laid down in is 456:2000 and is 10262:2009 (bureau of Indian standards). The trial mixes was carried out for selection of control concrete and finally mix with 0.45 water cement ratio was finalized. During mix design water absorption and surface moisture of coarse and fine aggregate were taken into account. The concrete mixtures were prepared replacing cement and fine aggregate indifferent proportions with pond ash and micro-silica. The replacement of pond ash with fine aggregate with percentage was 0,10,20,30,40% and micro-silica with cement was 0,10,20,30,40 %.there is m1,m2,m3,m4,m5 sample which is prepared with replacement of pond ash and micro-silica. For good slump super plasticizer ware used in mix are 0%,0.5%,1%,1.5%,2% in mix sample m1,m2,m3,m4,m5 respectively. Fig 2 shows ternary blended concrete containing of pond ash and silica the various property of fresh concrete such that split tensile strength at 7,28.56 ,90 day checked out. Table 2. Shows concrete mix proportion.

Table 2 Concrete mix proportion

sample	w/c	water	Cement	micro-silica	FA	pond ash	CA
M1	0.45	197.2	438.2	0	650.7	0	1162
M2	0.45	197.2	438.2	10	650.7	10	1162
M3	0.45	197.2	438.2	20	650.7	20	1162
M4	0.45	197.2	438.2	30	650.7	30	1162
M5	0.45	197.2	438.2	40	650.7	40	1162

IV. RESULTS AND DISCUSSIONS

Split Tensile Strength

The mixing of pond ash and micro-silica in concrete then Split Tensile strength of concrete will be finding out with respective to normal mix concrete. Split Tensile Strength of different mix is shown in Table 3. Table 4 shows Split Tensile strength of mix at various days.

7 day Split Tensile Strength

From the table it is seen that the Split Tensile strength at 7 days the mix replacement at 0 % strength is about 2.22 MPa, at 10 % strength is about 2.22 MPa, at 20 % strength is about 2.03 MPa, at 30 % strength is about 1.51 MPa, at 40 % strength is about 1.23 MPa. it is seen that the Split Tensile strength at 7 days the mix replacement up to 20 % the Split Tensile strength is better than normal concrete. at 30 % replacement slightly less than normal concrete. The 40 % replacement has less early strength.

28 day Split Tensile Strength

From the table it is seen that the Split Tensile strength at 28 days the mix replacement at 0 % strength is about 2.74 MPa, at 10 % strength is about 2.97 MPa, at 20 % strength is about 2.41 MPa, at 30 % strength

is about 1.75 MPa, at 40 % strength is about 1.56 MPa. it is seen that the Split Tensile strength at 28 days the mix replacement up to 20 % the Split Tensile strength is better than normal concrete. at 30 % replacement slightly less than normal concrete. The 40 % replacement has less early strength. But it will be increase

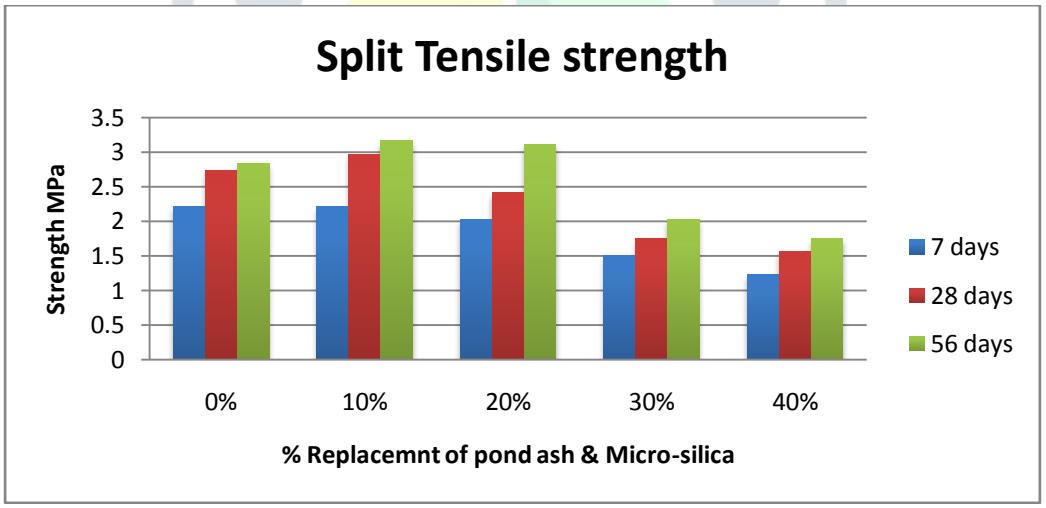
56 day Split Tensile Strength

From the table it is seen that the Split Tensile strength at 56 days the mix replacement at 0 % strength is about 2.83 MPa, at 10 % strength is about 3.16 MPa, at 20 % strength is about 3.11 MPa, at 30 % strength is about 2.03 MPa, at 40 % strength is about 1.75 MPa. it is seen that the Split Tensile strength at 56 days the mix replacement up to 20 % the Split Tensile strength is better than normal concrete. at 30 % replacement slightly less than normal concrete. The 40 % replacement has less early strength. But it will be increase at increasing ages.

Table 3 Split Tensile strength of concrete.

Mix	Pond ash & Silica Replacement %	Split Tensile strength (MPa) at various days		
		7	**28**	**56**
M1	0	2.22 (81.02)	2.74 (100)	2.83 (103.28)
M2	10	2.22 (74.74)	2.97 (100)	3.16 (106.39)
M3	20	2.03 (84.32)	2.41 (100)	3.11 (129.04)
M4	30	1.51 (86.28)	1.75 (100)	2.03 (116)

Table 4 Split Tensile strength of concrete



V. CONCLUSION:-

FROM THE OBSERVATION AND DISCUSSION ON THE TEST RESULTS FOLLOWING CONCLUSION CAN BE MADE

1) Up to 20 % replacement pond ash and Micro Silica in concrete split tensile strength of concrete will be increase at increasing the ages.
2) At 30 % replacement split tensile strength of concrete will be slightly less at 7, 28, 56 days.
3) At 40 % replacement split tensile strength of concrete will be less at 7, 28, 56 days.

4) Results show that Ternary Blended Concrete gives significant advantages over normal mix concrete. Such Concretes show good properties in split tensile strength and it give the solution to disposal of pond ash.

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REFERENCES:

1. Arumugam, K., Ilangovan. R., James Manohar D. (2011), "A study on characterization and use of pond ash as fine aggregate in concrete", International Journal of Civil and Structural Engineering, 2(2), 466-474.
2. R. S. BANG, Y. M. GHUGAL and I. K. PATERIYA, "Strength Performance of Pond Ash Concrete" ISSN 0974-5904, Volume 05, No. 01
3. Prof. P. P. Bhangale, Prof. P. M. Nemade "Study of Pond ASH (BTPS) Use as A Fine Aggregate in Cement Concrete - Case Study" International Journal of Latest Trends in Engineering and Technology (IJLTET) Vol. 2 Issue 2 March 2013
4. K. M. Bagawan, Dr. S. S. Kulkarni, "A Study of Characteristic and Use of Pond Ash for Construction" International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 6, June 2014)
5. K. M. Bagawan, Dr. S. S. Kulkarni , "A STUDY ON PROPERTIES OF CONCRETE USING POND ASH AS PARTIAL REPLACEMENT OF CEMENT" IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308
6. Gaurav Kantilal Patel, Prof. Jayeshkumar Pitroda, "Assessment Of Natural Sand And Pond Ash InIndian Context" International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 10 - Oct 2013
7. Tumingan1, M. W Tjaronge, Rudy Djamaluddin and Victor Sampebulu, "COMPRESSION STRENGTH OF CONCRETE WITH POND ASH AS REPLACEMENT OF FINE AGGREGATE." ARPN Journal of Engineering and Applied Sciences VOL. 9, NO. 12, DECEMBER 2014
8. Eehab Ahmed Badreldin Khalil∗, Mohamed Anwar "Carbonation of ternary cementitious concrete systems containing flyash and silica fume"Construction Research Institute, National Water Research Center Kannater, Kaliobia 13621, EgyptReceived 15 September 2014; received in revised form 24 November 2014; accepted 7 December 2014Available online 9 March 2015
9. Shweta Goyal, Maneek Kumar and B. Bhattacharjee " Potential Benefits of incorporating Fly Ash in Micro Silica concrete" THE INDIAN CONCRETE JOURNAL August 2008 pg 38 – 46
10. P Murthi and V Siva Kumar " Studies on the relationship between Compressive Strength and splitting tensile strength of Ternary Blended Concrete" Vol. 89 February 2009 IE(I) Journal CV
11. Ministry of Environment and Forests (MoEF) Notification, New Delhi, 3rd April, 2007, published in The Gazette of India: Extraordinary [Part II-Sec.3(ii)].
12. Maharashtra State Power Generation Co. Ltd., ―Fly ash Utilization of MahaGenco TPS‖, June 2010, 1-17
13. Dr. Yashpal Singh, ―Fly ash utilization in India‖ posted by Dr. Yashpal Singh on Jan. 6th 2011, comments for fly ash utilization in India .
14. Tahir Kemal Erdem, Onder Kirca " Use of binary and ternary blends in high strength concrete" Construction and Building Materials 22 (2008) pg 1477 – 1483 Ashis Kumar Bera; Ambarish Ghosh; and Amalendu Ghosh, ―Compaction Characteristics of Pond Ash‖,
15. Journal of Materials in Civil Engineering, ASCE, April 2007, pp.349-357.
16. Chai Jaturapitakkul and Raungrut Cheerarot (2003), "Development of bottom ash as pozzolanic material", *Journal of Materials in Civil Engineering, ASCE*, 15(1), 48-53.

Books:

1. Concrete Technology Book by M.S. Shetty, S. Chand and company Ltd. 2008.
2. Concrete Technology Book by M.L. Gambhir.