International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 4, Issue 1, January 2015)

Effect of Fly Ash in PPC Concrete

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***Abstract*-- The era of infrastructure increased in recent year, so the advancement of concrete technology exaggerated day by day in life. Use of concrete exaggerated the consumption of natural resources and energy sources. In recent years, inordinate measure of fly ash is generated in thermal industries. The previous couple of years, some cement firms have started mistreatment ash in producing cement called hydraulic cement, however, the utilization of ash remains terribly low. There's intolerably opportunity for the fly ash in cement likewise as in concrete.**

This work describes the use of Non-conventional artifact (Fly ash) that is definitely out there. During this work cement and fine aggregate has been partly replaced by fly ash consequently within the range of 0% (without fly ash), 10%, 20%, 30%, 40% and 60% by weight of cement for M-25 Mix Concrete mixtures were molded, tested and compared in terms of compressive and split strength.

I. INTRODUCTION

Portland cement is an essential component of concrete, and India currently produces about 100 million tons of this material annually; the manufacturing of Portland cement in India directly results in the emission of over 80 million tons of CO2 annually. Without the introduction of new technologies and practices to use larger proportions of supplementary cementing materials (SCMs) such as fly ash, either directly in concrete production, or through the increased use of blended cements incorporating significant percentages of SCMs, the production of ordinary Portland cement, will increase significantly in India to meet the rapidly increasing demand from the concrete industry. Consequently, this would translate into a significant increase of CO2 emissions.

Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits. These industrial wastes are dumped in the nearby land and the natural fertility of the soil is spoiled. Fly ash is the finely divided mineral residue resulting from the computation of ground or powdered coal in electric power generating thermal plant. Fly ash is a beneficial a mineral admixture for concrete.

It influences many properties of concrete in both fresh and hardened state. Moreover, utilization of waste materials in cement and concrete industry reduces the environmental problems of power plants and decreases electricity generation costs. Cement with fly ash reduces the permeability of concrete and dense calcium silicate hydrate (C-S-H). Research shows that adding fly ash to concrete, as a partial replacement of cement (less than 35%), will benefit both the fresh and hardened states. While in the fresh state, the fly ash improves workability. This is due to the smooth, spherical shape of the fly ash particle. The tiny spheres act as a form of ball bearing that aids the flow of the concrete. This improved workability allows for lower water-to-cement ratios, which later leads to higher compressive strengths.

II. JUSTIFICATION

The present work is an attempt to explore fly ash as a material of hope for twenty first century. The present work is a part of compressive and splitting program where in experimental investigation have been carried out to ashes the effect of replacement of regular material by a cheaper substitute i.e. fly ash on strength of concrete. For this study cubes and cylinders were cast by replacing cement (PPC) by fly ash. Compressive strength and splitting tensile strength of fly ash concrete were finding. To achieve this comparative study cubes and cylinders were cast replacing cement (PPC) by 0%, 10%, 20%, 30%, 40%, 50% and 60% with fly ash. These cubes and cylinders were tested after 7, 28 and 56 days. To identify compressive and tensile strength a nominal mix 1:1.67:3.32 were used during the investigations.

III. OBJECTIVE OF INVESTIGATION

The study has been carried out with the following objective:

1. To study suitability of fly ash as cement replacement in Portland Pozzolana Cement (PPC) concrete with the view to compressive strength.
2. To study suitability of fly ash as fine aggregate replacement in Portland Pozzolana Cement (PPC) concrete with the view to compressive strength.

3. To study suitability of fly ash as cement replacement in Portland Pozzolana Cement (PPC) concrete with the view to tensile strength.
4. Cost analysis.

IV. Materials And Method

In order to study the effect of fly ash as partial cement replacement on the strength of concrete, 117 cubes and 63 cylinders for a mix have been cast in the laboratory. Cubes (150mm×150mm×150mm) and cylinders (radius 150mm and height 300mm) were cast using a design mix of (1:1.67:3.32, where 3.32 is the proportion of 10mm and 20mm aggregate), an effort has been made here to get the strength of cubes made up with different percentage of fly ash to the respective strength of conventional concrete at the end of 7, 28 and 56 days of moist curing and to have an idea about the optimum percentage of fly ash which does not affect the strength of non-conventional concrete considerably. There is also check the workability before filling the cubes, for workability there is so many test for find such as slump, compacting factor etc. shown in fig.1 given below:

Fig.1 Test for find such as slump, compacting factor

V. Methods Used For Specimen Preparation

A. *Mix Design:* M 25 grade of concrete was used in this investigation and fine aggregate was kept as of the total volume of aggregate. The resulting mix proportion of cement: fine aggregate; coarse aggregate was taken as 1:1.67:3.32 (Where 3.32 is the proportion of 10 mm and 20 mm size aggregate) with water cement ratio of 0.46 and the quantity of cement is 380 kg/m3

B. *Setting Time:* Concrete product was usually being demoulded 18 to 20 hours after casting.

C. *Mixing Process*: The mixing is an extremely important aspect of concreting and it is important to follow the recommendation. Even a small deviation can have a large influence on the workability of the wet concrete and so the properties and appearance of final composite 180 control specimens (117 cubes + 63 Cylinders) were cast to determine the compressive strength and split tensile strength at 7, 28 and 56 days respectively. The specimens were mix using a design mix 1:1.67:3.32 where 3.32 is the proportion of 10 mm and 20 mm size aggregate).

D. *Vibration Of Mould:* In this process the mould was vibrated as the concrete mix was poured into it. The vibration has two functions. It enabled the mix to fill the mould completely. It release air trapped in the mix and allows compaction to take place. After mould filling removed any excess concrete which may interfere with de molding when the concrete has set Carry out final toweling when the concrete is still green, if is easier to do this to achieve a good trowel face than grinding when the concrete has set in the present study vibration table was used for vibration.

E. *De-Moulding:* It took more time to de-mould, clean and re-apply release agent that it does to fill the mould. A steady force is quicker and more effective than hammering the mould. It also causes less damage if a product is overstressed on de-moulding it may crack at a later date. Therefore, de-moulding should be carried out with care. Concrete products should be carried out with care. Concrete products should not be allowed to dry out after de-moulding before being put into cure. The mould was cleaned as soon as possible after de-moulding.

F. *Release Agent:* It was considered best to use as little release agent as possible. Only a thin film is necessary. Excess release agent collecting in the bottom of the mould will cause discoloration. Release agent was applied by impregnated sponges or cloths.

G. *Curing:* Concrete products with low water cement ratio ratios can rapidly dry out it this occurs before hydration is complete. The cement never achieves its full strength and the concrete properties are adversely affected. To ensure compete hydration. It was essential that products were kept moist immediately after de-moulding and during the curing period.

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Several methods of achieving this are currently in use, including storage in humidity chamber or fog room, sealing in polythene bags, or total immersion in water. As a guide to practical curing regimes. Concrete products will achieve a substantial proportion of their ultimate strength when the main cure is carried out for 7, 28 and 56 days, in humidity of greater than 95% RH (relative humidity) and with a minimum temperature of 200 C. A suitable post-curing regime will allow the remainder of the strength to be achieved.

H. Testing Of The Specimens: Compressive and split tensile strength of cubes and cylinders have been determined as per IS 516-1959 at a loading rate of about 140 kg/cm2 /min (about 30 tonne per minute) on 2000 tonne compression testing machine shown in (Fig.2). Two dial gauges in diametrically opposite directions were cast for testing are:-

- The cubes size 150mm for compressive strength.
- The cylinder size 300mm height and dia. 150mm for split tensile strength.
- The details of cubes and cylinders and their nomenclature are given in Table 1, 2 and 3.

Fig. 2 Compression Testing Machine

TABLE 1 Cubes, Cement partially replaced with fly ash

S.No.	Cube designation	Size (mm)	Fly ash %age
1	A1	150×150×150	0
2	A2	150×150×150	10
3	A3	150×150×150	20
4	A4	150×150×150	30
5	A5	150×150×150	40
6	A6	150×150×150	50
7	A7	150×150×150	60

TABLE 2 Cubes fine aggregate partially replaced with fly ash

S.No.	Cube designation	Size (mm)	Fly ash %age
1	B1	150×150×150	0
2	B2	150×150×150	10
3	B3	150×150×150	20
4	B4	150×150×150	30
5	B5	150×150×150	40
6	B6	150×150×150	50

TABLE- 3 Cylinders, cement replaced partially with fly ash

S.No.	Cylinder designation	Size (mm) Radium × Height	Fly ash %age
1	C1	150×150×150	0
2	C2	150×150×150	10
3	C3	150×150×150	20
4	C4	150×150×150	30
5	C5	150×150×150	40
6	C6	150×150×150	50
7	C7	150×150×150	60

IJRDET
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VI. Results And Discussions

Table 4 Compressive strength of concrete when cement replaced

S.No.	Cube designation	Compressive strength (N/mm^2)			%age of fly ash
		7 days	28 days	56 days	
1	A1	22.7	31.8	35.90	0
2	A2	20	33.3	38.4	10
3	A3	20.6	33	38.9	20
4	A4	17.7	28.8	37.3	30
5	A5	14.2	20.7	28.5	40
6	A6	12.9	19.1	24	50
7	A7	7.4	14.9	17.3	60

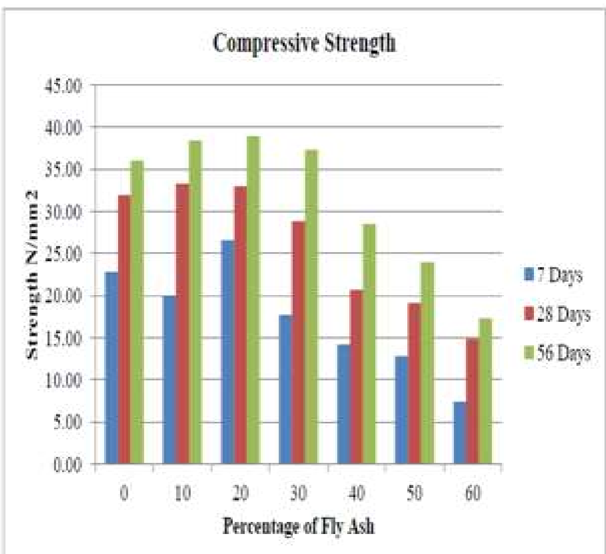

Fig 3 : Compressive strength of Fly Ash Concrete [cement replaced (Column Chart)]

Table 5 Compressive strength of concrete when fine aggregate replaced

S.No.	Cube designation	Compressive strength (N/mm^2)			%age of fly ash
		7 days	28 days	56 days	
1	B1	22.7	31.8	35.90	0
2	B2	24.5	32.88	36.78	10
3	B3	25.11	32.97	37.28	20
4	B4	25.97	35.31	40	30
5	B5	26.51	35.4	40.4	40
6	B6	27	36.8	42.47	50

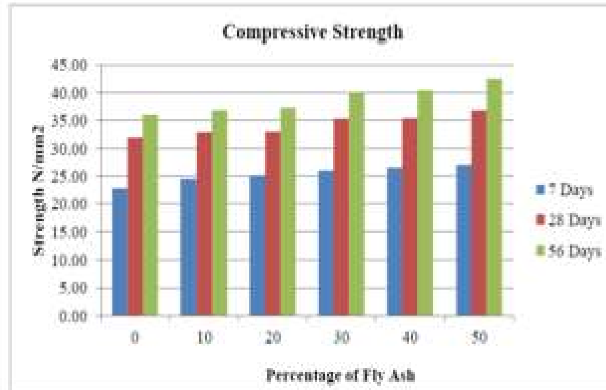

Fig4 : Compressive Strength of Fly Ash Concrete [fine aggregate replace (Column chart)]

7.1 Split Tensile Strength Of Fly Ash Concrete (Cement Partially Replaced With Fly Ash)

Table 6 Split tensile strength of fly ash concrete when cement replaced

S. No.	Cube designation	Compressive strength (N/mm^2)			%age of fly ash
		7 days	28 days	56 days	
1	C1	4.5	6.9	7.9	0
2	C2	6.0	7.8	9.9	10
3	C3	5.5	8.0	8.5	20
4	C4	3.0	5.3	6.3	30
5	C5	2.8	5.0	5.4	40
6	C6	2.3	3.7	5.3	50
7	C7	1.9	2.8	4.2	60

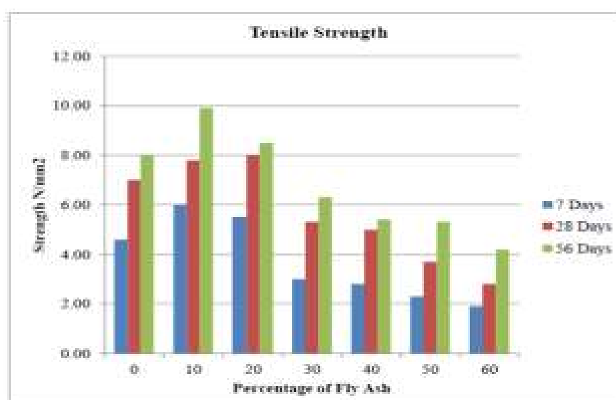

Fig 5 : Split Tensile Strength of Fly Ash Concrete [cement replaced (Column chart)]

VII. Cost Analysis

In the present study the cost of 1m3 Referral concrete (M-25, with PPC). The cost is Rs. 2021.92. By using fly ash at 30% cement replacement material the cost of 1m3 new concrete is Rs. 1637.92.

The cost of material is given below according to market rate (NOV 2014)-

1. Cement (PPC) Rs. 5.8 kg
2. Fly Ash NIL (only transportation charge)
3. Fine Aggregate Rs. 1.10/kg
4. Coarse Aggregate (10mm) Rs. 0.80/kg
5. Coarse Aggregate (20mm) Rs. 0.85/kg

By using Fly ash at 30% in concrete as cement replacement material, the material cost may decrease up to 23.34%.

VIII. Conclusions

From the above study following conclusions are drawn:

1. Compressive Strength (when cement replaced with fly ash)
2. The compressive strength of fly ash concrete up to 30% replacement level is slightly equal to referral concrete at 28 and 56 days.
3. Optimum replacement level of fly ash is 20%, at 20% replacement level increase in strength at 28 and 56 days is 1.9% & 3.2%.
4. Compressive strength (when fine aggregate replaced with fly ash)
5. The compressive strength of fly ash concrete at 50% replacement level increased in strength with referral concrete is 15.4% and 18% at 28 & 56 days.
6. Splitting tensile test (when cement replaced with fly ash)
7. The split tensile strength of fly ash concrete up to 20% replacement level is more than referral concrete at 7, 28 and 56 days.
8. Optimum replacement level of fly ash is 20%
9. At 20% replacement level increase in tensile strength at 7, 28 and 56 days is 13%, 5.63% and 19.0%.
10. Cost analysis By using Fly ash at 30% in concrete as cement replacement material, the material cost may decrease up to 23.34%.
11. It is observed that in PPC gains final strength after the 56 days curing.
12. Increase in strength after 56 days curing showed because of slow hydration process of Fly Ash PPC concrete. Since Fly ash is a slow reactive Pozzolanic material.

IX. Future Scope

Cement is replaced with the fly ash up to 30% for which strength is increased, however optimum replacement level could not be predicted since trend of strength due to replacement of cement with fly ash in PPC concrete is reported to be in increasing order.

When cement is replaced beyond 30% up to 60% by the fly ash then it gives more accurate behavior of PPC concrete in construction of PPC.

REFERENCES

[1] Alhassan A. Y. Apata A.O.. (2012) “The Behaviour of Portland – Pozzolana Cement Concrete in Aggressive Environments”. Journal of Emerging Trends in Engineering and Applied Sciences. (ISSN: 2141-7016). (JETEAS) 3 (4): 2012 pp. 673-676. Jeteas.scholarlinkresearch.org. © Scholarlink Research Institute Journals.

[2] Alam J., Akhtar M.N., (2011) “Fly ash utilization in different sectors in Indian Scenario”. International journal of emerging trends in Engineering and Development. Issue 1, Vol 1 August.

[3] Bakoshi T., Kahno K., Kawasaki S., Yamaji N., (1998) “

[4] Badur S. Choudhary R, (2008) “Utilization of hazardous wastes and By-products as a green concrete material through s/s process: a review,” Advanced Study Center Co. Ltd.Rev.Adv.Master.Sci.24-61

[5] Berndt M.L. (2009) “Properties of sustainable concrete containing fly ash, Slag and recycled concrete aggregate.” Construction and Building Materials Volume 3, Issue 7, Page no. 2606-2613.

[6] Cangialosi F., Intini G. Liberti L., Notarnicola M., Di Canio F., (2010)

[7] Chakraborty A.K. (2005) “HVFAC for Structural Applications,” Department of Civil Engineering Bengal Engineering and Science University, Shibpur, Howrah – 711103, West Bengal, India. May.page 1-24.

[8] Despande, V.P. (1982) “Removal of suspension from ash slurry in Effluent of stream Generation plant. “Indian Journal of environmental Health 24(1).

[9] Ghafoori N., Cai Y., Ahmadi B., (1997) “Use of dry bottom ash as a fine aggregate in roller compacted concrete,” ACI Spec. Publ. (SP-171) 487-507. February.

[10] Gupta M.K., Kumar A., (2008) “factors affecting cement content in concrete”, department of civil environmental engineering Delhi college of engineering Bawana Road, Delhi-110042 University of Delhi July 2008.

[11] Gawatre D.W., Meshram V.G., (2013) “Study of various fineness of fly ash as a partial replacement of cement in concrete”. International Journal of Scientific & Engineering Research Volume 4, Issue 1, January. ISSN 2229-5518.

[12] Alvin Harison , Vikas Srivastava , Chandra Bhan Gupta, “Fly Ash as Supplementary Cementious Material in Portland Pozzolana Cement Concrete” International Journal of Engineering Trends and Technology (IJETT) – Volume 6 Number 3- Dec 2013.