Effect on Fly Ash on Concrete's Strength

Mohnish Saiyed[1] Shrinath Parikh[2] Yogesh Solanki[3]
[1,2,3]Student
[1,2,3]Department of Civil Engineering
[1,2,3]Sardar Patel Engineering Campus, Anand, India

Abstract— Fly ash, a waste generated by thermal power plants is as such a big environmental concern. Fly ash is used as a supplementary cementitious material (SCM) in the production of Portland cement concrete. Fly ash is a by-product of burning pulverized coal in an electrical generating station. Specifically, it is the unburned residue that is carried away from the burning zone in the boiler by the flue gases and then collected by either mechanical or electrostatic separators. Fly ash concrete has economic and environmental advantages. It also makes concrete sustainable. Use of fly ash in concrete imparts several environmental benefits and thus it is ecofriendly. It saves the cement requirement for the same strength thus saving of raw materials such as limestone, coal etc required for manufacture of cement. Fly ash is pozzolanic material & it improving the properties of concrete like compressive strength & Durability. The results obtained are discussed and compared with the available literature.

Key words: Fly Ash, Cement, Fly Ash Concrete, Compressive Strength

I. INTRODUCTION

In the present era of growth and development, progress is taking place in all the fields. But, in the light of progress, man is ignoring nature and harming it. Construction area, with the use of virgin materials like cement, is also posing the threat of global warming and environmental degradation. The challenge in front of civil engineering community is to provide sufficient, economical and comfortable infrastructure without causing any hardship for environment.

Taking sustainable development in view, an attempt has been made to reduce the use of cement in concrete by replacing it with otherwise waste materials such as fly ash, slag, silica fume and rice husk . The use of fly ash in concrete has been encouraged all over the world .Though this has been tried at some places in India but the percentages replacements of cement by fly ash are very small and only less than 25% of total fly ash produced is being utilized. A confidence is required to be built up in developing countries like India to make use of fly ash concrete in various fields of construction.

Fly ash is the best known, and one of the most commonly used, pozzolans in the world. Fly ash is the notorious waste product of coalbased electricity generating thermal power plants, known for its ill effects on agricultural land, surface and sub-surface water pollution, soil and air pollution and diseases to mankind. Researchers have proposed few ways of reusing fly ash for variety of application. One of the most common reuse of fly ash is in cement concrete. Fly ash particles are almost totally spherical in shape, allowing them to flow and blend freely in mixtures. That capability is one of the properties making fly ash a desirable admixture for concrete. These materials greatly improve the durability of concrete through control of high thermal gradients, pore refinement, depletion of cement alkalis, resistance to chloride and sulphate penetration, and continued micro structural development through a long-term hydration and pozzolanic reaction. The utilization of by-products as the partial replacement of cement has important economic, environmental and technical benefits such as the reduced amount of waste materials, cleaner environment, reduced energy requirement, durable service performance during service life and cost effective structures.

II. EXPERIMENTAL WORK

A. Properties of Fly Ash

The fly ash particles are generally glassy, solid or hollow and spherical in shape. The hollow spherical particles are called as cenospheres. The fineness of individual fly ash particle rage from 1 micron to 1 mm size. The fineness of fly ash particles has a significant influence on its performance in cement concrete. The fineness of particles is measured by measuring specific surface area of fly ash by Blaine's specific area technique. Greater the surface area more will be the fineness of fly ash. The other method used for measuring fineness of fly ash is dry and wet sieving. The specific gravity of fly ash varies over a wide range of 1.9 to 2.55.

It can be seen that all parameters are within permissible limits.

1) Concrete Mix Design

In the present study, M20 grade with nominal mix as per IS 456-2000 was used. The concrete mix proportion (cement: fine aggregate: coarse aggregate) is 1: 1.5: 3 by volume and a water cement ratio of 0.5 is taken. The fly ash is blended in cement at a rate of 5 to 25% by weight of cement I n steps of 5%.

B. Compressive Strength Determination

% FLY ASH	COMPRESSIVE STRENGTH(N/mm^2)					
	3 DAYS	7 DAYS	21 DAYS	28 DAYS	60 DAYS	90 DAYS
0	8.44	11.55	21.77	26.06	37.10	37.99
5	8.00	12.44	24.15	24.88	29.00	36.88
10	7.55	7.77	20.14	20.29	31.33	40.44
15	5.77	7.99	15.55	19.86	26.21	35.41
20	4.44	8.44	14.22	19.10	30.22	39.88
25	5.59	6.21	11.84	18.66	23.33	33.77

Fig 2: Flexural strength development of fly ash concrete

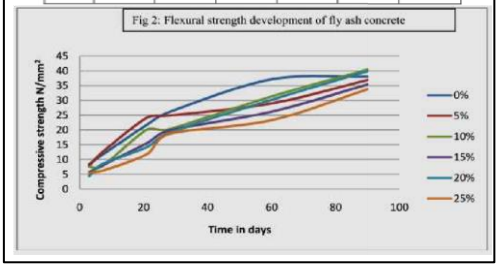

Table 1: Compressive strength of cement-fly ash concrete

In this test sample of concrete is filled in the mould of size 15cm x 15cm x 15cm and top of mould is strike off. A total number of 18 cubes were casted. Fly ash is added in place of cement in concrete in 6 different percentages starting from 0%, and raised the mixing of fly ash up to 25%, at an interval of 5%. The specimens are covered with the wet gunny bags

for 24 hours. Then after sample is removed and kept for curing in curing tank. At the end of curing period sample is removed and tested immediately. The testing is done under Universal Testing Machine. The load is applied smoothly and gradually. The crushing loads are noted and average compressive strength for three specimens is determined for each which is given in table 1.

III. RESULTS AND CONCLUSIONS

A. Compressive strength of fly ash concrete

The characteristic compressive strength of various blends of concrete is presented in table no. 1. Figure 1 shows the graphical representation of data of table no 1.

The curve in fig 1 show the rate of compressive strength development of various blends of fly ash concrete over a span of 90 days.

It can be seen that 0% fly ash i.e. concrete with no replacement of cement with fly ash, has maximum rate of compressive strength development at 60 days and after it becomes nearly constant. 5% fly ash has maximum rate of compressive strength development upto the age of 21 days and then after its rate decreases. Strength development at later stage is negligible. The rate of strength development is large upto 21 days for 10% fly ash and then after its rate becomes negligible for few days and after 28 days it increases uniformly. Its final strength development is also maximum than any other fly ash blends. After 90 days of storage the concretes containing 10 % of fly ash, related to cement mass, gained a compressive strength about 6 % higher than the concrete without addition for Ordinary Portland cement. For fly ash blends greater than 10% fly ash, the rates of strength development as well as final strengths both reduce with addition of fly ash. In long terms, concrete with higher proportions of fly ash gains strength comparable with that of pure concrete.

It is important to note from table 2 that the strength of concrete decreases with the increase in % of replacement of cement with fly ash at 28 days. But, at 90 days we get maximum strength for 10% fly ash addition.

IV. CONCLUSION

This research concludes the study on ― the effect of fly ash on the properties of concrete‖ for nominal mix of M20 grade of concrete are as follows.

Slump loss of concrete increases with increase in w/c ratio of concrete.

For w/c ratio 0.35 without any admixtures, initial slump cannot be measured by slump cone test as it is very less.

Concrete with 10% and 20% replacement of cement with fly ash shows good compressive strength for 28 days than normal concrete for 0.35 w/c ratio.

REFERENCES

[1] American concrete institute "use of fly ash in concrete" ACI 2322R-96,1996:34.
[2] ASTM Standard c616, 2006.
[3] ASTM Standard c192,2006
[4] www.concrete.org
[5] http://en.m.wikipedia.org>wiki>flyash
[6] www.ashgroversources.com > showcase4
[7] www.proash.com
[8] www.acaa-usa.org American coal ash production.
[9] www.cement.org
[10] IS 3812-Specification for fly ash for use as pozzolona and admixture, Part-I (2003), Part-II (2003)
[11] IS 1727-Methods of test for pozzolanic materials.(Reconfirmed 2004)
[12] IS 456-2000 Specifications for plain and reinforced concrete.
[13] Marta Kosior-Kazberuk (2007) Strength Development of concrete with fly ash addition, Journal of Civil Engineering and Management, ISSN1822-3605 online.

