Study on effect of Alccofine & Fly ash addition on the Mechanical properties of High performance Concrete

Mr. Sunil Suthar[1] Dr. (Smt.) B. K. Shah[2] Prof. P. J. Patel[3]
[1] PG Student, Structural Engineering
[2]Associate Professor, Structural Engineering
[3] Head & Associate Professor
[1,2]Birla Vishvakarma Mahavidhyalaya Engineering College, Vallabh Vidyanagar, Gujarat -388120
[3]Ganpat University, Kherava, Mehsana, Gujarat

Abstract- This paper presents the results of an experimental investigation carried out for M-70 Grad Concrete and to evaluate the compressive strength and Flexural Strength of Concrete. High Performance Concrete is made by partial replacement of cement by alccofine, fly ash, silica fume. In this study the Class F fly ash used in various proportions 20 to 35%, alccofine 4 to 14% and silica fume 4% to 14% by weight of cement. The mix proportions of concrete had a water binder ratio for Alccofine mix concrete 0.30 and Silica-fume mix concrete 0.32.super plasticizer was added based on the required degree of workability. The total binder content was 600 kg/m3. The concrete specimens were cured on normal moist curing under normal atmospheric temperature. The compressive strength was determined at 7 , 28 , 56 days and flexural strength was determined at 28 and 56 days The results indicate the concrete made with these proportions generally show excellent fresh and hardened properties. The addition of Alccofine, silica fume shows early strength gaining property and that of fly ash shows a long term strength. The ternary system that is Portland cement-fly ash-Alccofine concrete was found to increase the compressive strength of concrete on all age when compared to concrete made with Portland cement-fly ash-silica fume.

Keywords: Compressive strength, Flexural strength, High performance concrete, fly ash, alccofine, silica fume.

I. INTRODUCTION

Fly ash is widely used in blended cements, and is a by-product of coal-fired electric power plants. Two general classes of fly ash can be defined: low-calcium fly ash (LCFA: ASTM class F) produced by burning anthracite or bituminous coal; and high-calcium fly ash (HCFA: ASTM class C) produced by burning lignite or sub- bituminous coal. Utilization of waste materials such as fly ash in construction industry reduces the technical and environmental problems of plants and decreases electric costs besides reducing the amount of solid waste, greenhouse gas emissions associated with Portland clinker production, and conserves existing natural resources. Despite the benefits of fly ash, practical problems remain in field application. At early stages of aging, the strength of concrete containing a high volume of fly ash as a partial cement replacement is much lower than that of control concrete, due to the slow pozzolanic reactivity of fly ash.

Newly developed admixtures allow lowering the water/binder ratio to very low-levels without loss of workability.

The initial interest in the use of silica fume was mainly caused by the strict enforcement of air-pollution control measures in various countries to stop release of the material into the atmosphere. Silica fume is a pozzolanic material which is a by-product of the silicon smelting process. It is used to produce silicon metal and ferrosilicon alloys which have a high content of glassy-phase silicon dioxide (SiO2) and consist of very small spherical particles. Silica fume is known to produce a high-strength concrete and is used in two different ways: as a cement replacement, in order to reduce the cement content (usually for economic reasons); and as an additive to improve concrete properties (in both fresh and hardened states). Therefore, utilization of silica fume together with fly ash provides an interesting alternative and can be termed as high strength and high performance concrete.

Alccofine is mineral admixture produce by Ambuja Cement Ltd. It's a one type of super-pozolanic material it is reduces the permeability in concrete and create dense packing in concrete and ultimately reduces the water content and increases the compressive strength of concrete.

This paper reports the results of an experimental investigation of compressive strength and Flexural Strength of blended cements. Twenty eight concrete mixtures were made for Alccofine mix concrete and twenty concrete mixes for Silica-fume mix concrete in this investigation. These included mixture containing 20% to 40% fly ash alone as cement replacement for Alccofine and Silica-fume mix concrete, Alccofine and Silica-fume mixtures with 4% to 14% weight of Binder.super plasticizer was added on different dosages based on the degree workability to be obtained. A large number of cube and Beam specimens were casted and subjected to normal curing at atmospheric temperature after demoulding.

– *Superplasticizer (SP)*

A new generation PolyCarboxylic Ether (PCE) based super-plasticizer was used. This super -plasticizer is available as a medium brown colored aqueous solution with standard specifications of ASTM C 494 Type G. The specific gravity and pH value of the super plasticizer is 1.056 and 6.5 respectively.

II. MIXTURE PROPORTIONS

The concrete mixture proportions are given in Table 3 for 600kg/m3. The total binder content was kept as 600 kg/m3 and a W/B ratio of 0.30 for Alccofine mix concrete and W/B ratio of 0.32 Silica-fume mix concrete.

All rights reserved by www.ijsrd.com

Mix	OPC %	AL %	FA%
A22	24	6	20
A23	69	6	25
A24	64	6	30
A25	83	7	20
A26	68	7	25
A27	63	7	30
A29	**72**	**8**	**20**
A30	67	8	25
A31	62	8	30

MATERIAL	KG/M^3
OPC (78%)	432
AL (8%)	48
FA (20%)	120
20MM	678
10MM	448
SAND	718
WATER	180
ADMIXTURE (1%)	6

AL-Alccofine , FA-Fly Ash

Table. 1 : Ternary blend for alccofine mix concrete

Mix	OPC %	SF %	FA%
SF1	71	9%	20%
SF2	66	9%	25%
SF3	61	9%	30%
SF4	70	10%	20%
SF5	**65**	**10%**	**25%**
SF6	60	10%	30%
SF7	69	11%	20%
SF8	64	11%	25%
SF9	59	11%	30%

MATERIAL	KG/M^3
OPC (78%)	414
SF (10%)	66
FA (25%)	120
20MM	660.6
10MM	440.4
SAND	695
WATER	191
ADMIXTURE (1.5%)	9

SL-Silica-Fume FA-fly Ash

Table. 2 :Ternary blend for silica-fume

– *In Concrete mix proportion*

(a) Alccofine mix concrete binary mix of OPC+FA and OPC+AL Optimum % of FA was 20% and AL was 8% after that ternary blend was design as follow in TABLE-I.

(b) Silica-fume mix concrete binary mix of OPC+FA and OPC+SF Optimum % of FA was 25% and SF was 10% after that ternary blend was design as follow in TABLE-II.

III. CASTING AND TESTING OF SPECIMENS

For each mix of concrete, three concrete cube specimens were cast each of size 150mmx150mmx150mm. To obtain a homogeneous mix, aggregates were mixed and binders (OPC, FA, AL and SF) were added to the system. After remixing, water was added to the dry mix. Finally, super plasticizer was introduced to the wet mixture. In the fresh concrete slump cone test was performed to ensure the workability. Cube specimens were used to determine the compressive strength and beam specimen size 150mmx150mmx700mm use for flexural strength.

Fig. 1: Compression testing machine

The cubes were cast in three equal layers and each layer was compacted by using a vibrating table and for beam specimen needle vibrator was use. After casting, the molded specimens were left in the casting room at 23 ± 1.7°C for 24 hrs. They were then demoulded and cured. The cube specimens were cured for different ages like 7, 28 and 56 days period to determine the compressive strength at these ages and beam specimen 28 and 56 days period to determine flexural strength of specimen. Figure 1 shows the view of compressive testing machine and Figure 2 shows the view of Flexure testing machine.

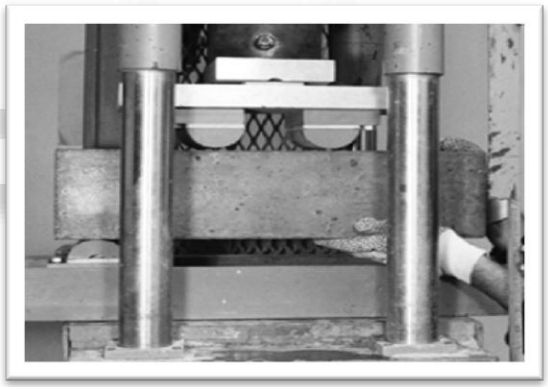

Fig. 2: Flexure testing machine

IV. RESULTS AND DISCUSSION

The results of fresh concrete tests and compressive strength of test specimens up to 56 days, with different amounts of FA+AL and FA + SF addition are discussed in the following paragraphs.

3.1 Properties of Fresh concrete the properties of the freshly mixed concrete, i.e. slump The slump of all Alccofine mix concrete mixtures was around flow 620 mm. and for silica-fume mix concrete was around 450mm flow. The value of flow decreases in silica fume mix concrete and hence the optimum super plasticizer dosage increases, which can be attributed to high specific surface of silica fume. The addition of fly ash has just the opposite effect on the mix properties in terms of workability and optimum dosage of super plasticizer as compared to silica fume. The increase in FA content lowered the plastic viscosity of mixes while maintaining the flow values approximately equal. In other words incorporation of FA and SF increased the super plasticizer demand. This is probably due to the increasing

All rights reserved by *www.ijsrd.com*

paste volume with FA and SF since the specific gravities of these mineral additives are lower than cement.

From the above discussion, it can be stated that fly ash act improves flowability and silica fume has a reverse effect, when added individually and also for in Alccofine good particle size distribution it was give good flowability.

A. *Compressive Strength*

days	Alccofine mix. Compressive strength (Mpa)	Silica-fume mix Compressive strength (Mpa)
7	41.969	40.07
28	54.88	47.11
56	72.97	67.73

Table. 3 : Compressive Strength

The results show that the compressive strength increase for Alccofine mix concrete upto 8% of AL and in silica-fume mix concrete upto 10% of SF. Compressive strength of Alccofine mix concrete for 7,28 and 58 days was more than the Silica-fume mix Concrete.

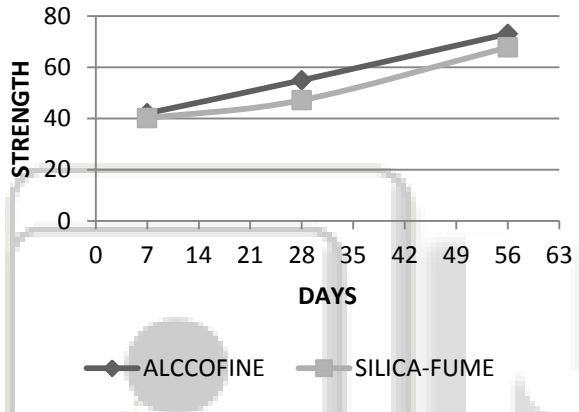

Fig. 3: Compression strength result

B. *Flexural Strength*

days	Alccofine mix. Compressive strength (Mpa)	Silica-fume mix Compressive strength (Mpa)
28	5.75	5.15
56	6.42	6.09

Table. 4 : Flexural Strength

The results show that the Flexural strength increase for Alccofine mix concrete 28 days and 56 days compare with silica-fume mix concrete.

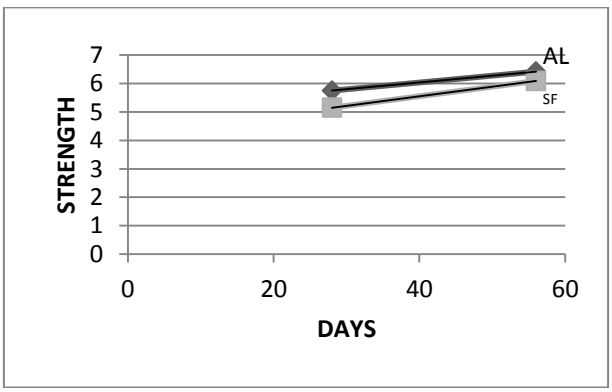

Fig. 4: Flexural strength result

V. CONCLUSION

It is apparent that ternary cementitious blends of Portland cement, alccofine, and fly ash offer significant advantages over binary blends and even greater enhancements over plain Portland cement. The alccofine improves the early age performance of concrete with the fly ash continuously refining the properties of the hardened concrete as it matures. The combination of alccofine and class F fly ash is complementary: the alccofine improves the early age performance of concrete with the fly ash continuously refining the properties of the hardened concrete as it matures. In terms of durability, such blends are vastly superior to plain Portland cement concrete. In some cases, price differences between the individual components may allow the ternary blend to compete with straight Portland cement on the basis of material costs.

- Fly ash increases long-term strength development of silica fume concrete.
- Alccofine increases the particle packing and it increases the strength of concrete.
- By use of super plasticizer reduces the water demand and increases the workability of concrete.
- Fly ash offsets increased water demand of silica fume.
- Very high resistance to chloride ion penetration can be obtained with ternary blends.
- The addition of 8% AL to different FA replacements has a high compressive strength than 10% SF. ternary system of alccofine mix concrete had high compressive strength than all other silica-fume concrete mixes. The optimum and high strength concrete can be obtained with 8% AL and 20% FA.

REFERENCES

[1] P. Vinayagam,Experimental Investigation on High Performance Concrete Using Silica Fume and Superplasticizer,International Journal of Computer and Communication Engineering, Vol. 1, No. 2, July 2012

[2] [1]A R Hariharan [2]A S Santhi [3]G Mohan Ganesh, Study on Strength Development of High Strength Concrete Containing Fly ash and Silica fume ISSN: 0975-5462 Vol. 3 No. 4 Apr 2011 2955

[3] K. C. Biswal[1] and Suresh Chandra Sadangi[2]Paper presented in the Conference on Effect of Superplasticizer and Silica Fume on Properties of Concrete, Trivandrum, Kerela, March 16th, 2011Effect of superplasticizer and silica fume on properties of concrete

[4]]M. Collepardi, S. Collepardi, U.Skarp and R. TroliOptimization of Silica Fume, Fly Ash and Amorphous Nano-Silica in Superplasticized High-Performance Concretes

[5] [1] M. Vijaya Sekhar Reddy, [2] I.V. Ramana Reddy, [3] N.Krishna Murthy , Predicting the Strength Properties of High Performance Concrete using Mineral and Chemical Admixtures , VOL. 3, NO. 1, Jan 2013 ISSN 2225-7217

[6] M. Vijaya Sekhar Reddy#1, Dr. I.V. Ramana Reddy#2, K. Madan Mohan Reddy#3, C.M. Ravi Kumar#4 , PERFORMANCE OF ADMIXTURES ON STRENGTH PROPERTIES OF HIGH PERFORMANCE CONCRETE ,Issue 2 volume 5,

All rights reserved by *www.ijsrd.com*

October 2012 Available online on http://www.rspublication.com/ijst/index.html ISSN 2249-9954

[7] Arunachalam.K [1], Vigneshwari.M [2]Experimental investigation on ultra high strength concrete containing mineral admixtures under different curing conditions ISSN 0976 – 4399

All rights reserved by *www.ijsrd.com*