

EXPERIMENTAL INVESTIGATION OF HIGH STRENGTH CONCRETE WITH ALCCOFINE OF M65 GRADE CONCRETE

Dr. M. Srikanth¹, H. Rakesh²,

¹Associate Professor, Department of Civil Engineering, KITS Warangal, India

²PG Scholar Department of Civil Engineering, KITS Warangal, India

ABSTRACT: *This article presents the results of an experimental study conducted to evaluate the mechanical properties of a high strength concrete with alccofine. High strength concrete is manufactured by partially replacing cement with alccofine and fly ash. In this study, fly ash was used in a constant proportion of 20% and alccofine at 0, 6, 8, 10, 12 and 14% by weight of cement. The proportions of the concrete mix had a constant binder/water ratio of 0.25 and a superplasticizer was added depending on the degree of workability required. The concrete samples were cured in normal wet curing at normal atmospheric temperature. The results indicate that concrete manufactured with these proportions generally has excellent hardening and freshness properties since the combination is somewhat synergistic. The addition of Alccofine shows an initial property of strength gain and that of fly ash a long-term resistance. It has been found that the ternary system consisting of ordinary Portland concrete, fly ash and alccofine, increases the mechanical properties of concrete at any age compared to concrete made with fly ash and Alccofine alone.*

Keywords: *Mechanical properties, High strength concrete, Fly ash, Alccofine.*

I. INTRODUCTION

The creation of quality concrete in the current climate does not only depend on the achievement of high strength properties. Improving the durability of concrete to maintain a longer life and produce a greener concrete is becoming one of the main criteria for obtaining quality concrete. The compressive strength of concrete is important because the main properties of concrete, such as the elastic modulus and the tensile strength, are related to this property. The compressive strength of the concrete also plays a vital role in the load capacity of the structures. The compression test is the most common test performed on hardened concrete because it is an easy test to perform and most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. In this work, the substitution of cement by different percentages of 0, 6, 8, 10, 12, and 14% of ultra-fine slag (Alccofine) has been studied. It has been found that the use of alccofine not only improves the mechanical properties of the concrete but also improves the workability and fluidity of the mixture. Alccofine-1203 is a specially processed product based on a high content of glass with a high reactivity obtained through the controlled granulation process. The raw materials are composed mainly of low calcium silicates. Processing with other selected ingredients results in a controlled particle size distribution (PSD). The calculated value based on PSD is around 12000 cm² / g. and it's really ultra-thin. Due to its unique chemistry and ultrafine particle size, Alccofine-1203 provides lower water demand for given workability, even up to 70% cement replacement according to the concrete performance requirement. Fly ash is widely used in mixed cement, and is a byproduct of coal power plants. Two general classes of fly ash can be defined: fly ash with low calcium content (LCFA: ASTM class F) produced by the combustion of anthracite or bituminous coal; and fly ash with a high calcium content (HCFA: ASTM class C) produced by burning lignite or bituminous coal. The use of waste materials such as fly ash in the construction industry reduces the technical and environmental problems of plants and reduces electrical costs, in addition to reducing the amount of solid waste, greenhouse gas emissions associated with the Portland clinker production and conserves existing natural resources. Despite the benefits of fly ash, practical problems still apply in the field. In the early stages of aging, the strength of the concrete containing a high volume of fly ash as a partial replacement for the cement is much lower than that of the control concrete, due to the slow pozzolanic reactivity of the fly ash.

This article presents the results of an experimental investigation of the mechanical properties of mixed cement. These included a control mixture, a mixture containing 20% fly ash maintained as constant as cement replacement (C + F), blends with 0, 6, 8, 10, 12 and 14% alccofine alone as a replacement for cement (C + A), and a mixture that combines fly ash and alccofine as cement replacement (C + F + A). The proportion of Cementitious materials in water remained constant at 0.25 for all mixtures; The super plasticizer was added in different doses according to the degree of workability to be obtained. A large number of samples of cubes, cylinders, and prisms were moulded and subjected to normal curing at atmospheric temperature after demolding. The mechanical properties were determined at 7, 14 and 28 days.

II. Experimental Investigation

A. Cement

In this present work, 53 grade ordinary Portland cement (OPC) is used for casting cubes and cylinders and prisms for all concrete mixes. The cement is of uniform color i.e. Grey and is free from any hard lumps. The various tests conducted on cement are specific gravity, initial and final setting time and fineness. Testing on cement is done as per IS codes. The properties of Portland cement are reported in below table

TABLE I

Properties of Cement

Tests	Results
Standard Consistency	32%
Fineness	0.12%
Specific Gravity	3.15
Initial Setting Time	120 minutes
Final Setting Time	220 minutes

B. Fly ash

In present work, the fly ash is procured from Kakatiya thermal Power plant and it is located in chelpur village, Bhupalpally (District), Telangana.

TABLE II

Properties of Flyash

Tests	Results
Specific Gravity	2.2

C. ALCCOFINE

In present work, the ALCCOFINE is procured from Ambuja Cements Limited and it is located at Goa.

TABLE III

Physical Properties of Alccofine

Tests	Results
Specific Gravity	2.9

TABLE IV

Chemical properties of Alccofine

Tests	Results
CaO	31%-33%
Al ₂ O ₃	23%-25%
SiO ₂	33%-35%

D. Fine Aggregate

The sand used for this project was locally procured and conformed to grading zone II as per IS 383-1970.

TABLE V
Properties of Fine Aggregate

Tests	Results
Specific Gravity	2.62
Bulk Density	1.5gm/cm ³
Grading Zone	II
Fineness modulus	3.2
% of Voids	35%
Void Ratio	0.53

E. Coarse Aggregate

Locally available coarse aggregate having the maximum size of 16mm and minimum size of 10mm is used in the present work.

TABLE VI
Properties of Coarse Aggregate

Tests	Results
Specific Gravity	2.77
Bulk Density	1.402gm/cm ³
Void Ratio	0.9
% of Voids	49.8%
Fineness Modulus	7.1

F. Water

Potable tap water is used for the preparation of specimens and for curing specimens.

G. Superplasticizer

Master Glenium Sky 8233 superplasticizer is used. It is an admixture of a new generation based on modified polycarboxylic ether.

H. Mix Design

Mix design is a process of finding the proportions of concrete mix in terms of ratios of cement, fine aggregate, coarse aggregate. The grade designation gives the characteristic strength requirement of concrete. The mix design is done as per IS: 456-2013 and IS: 10262-2009.

TABLE VII
Mix Design of M65 Grade Concrete

Materials	Cement	Fine aggregate	Coarse aggregate	Water (lit.)
Quantity (kg/m³)	575	730	1100	143.75
Proportions	1	1.26	1.91	0.25

I. Mix Designation

In the present work total, 6 mix proportions were used. In the 1st mix, cement is replaced with 20% fly ash was cast. From 2nd to 6th mix cement was replaced with 20% constant replacement of fly ash and Alccofine with 0%, 6%, 8%, 10%, 12%, and 14% respectively.

TABLE VIII

Mix Designation	Cement	Fly ash	Alccofine	FA	CA
M-1	80	20	0	100	100
M-2	74	20	6	100	100
M-3	72	20	8	100	100
M-4	70	20	10	100	100
M-5	68	20	12	100	100
M-6	66	20	14	100	100

III. RESULTS AND DISCUSSIONS

A. Compressive Strength:

TABLE IX

Average Compressive strength for 7, 14 & 28 days

Mix Composition		Compressive Strength		
		7 DAYS(N/mm ²)	14 DAYS(N/mm ²)	28 DAYS(N/mm ²)
M-1	0%	48.2	58.91	70.54
M-2	6%	50.5	62.2	73.36
M-3	8%	53.8	66.43	77.89
M-4	10%	52.1	65.3	76.14
M-5	12%	50.6	63.74	74.12
M-6	14%	49.87	60.99	73.4

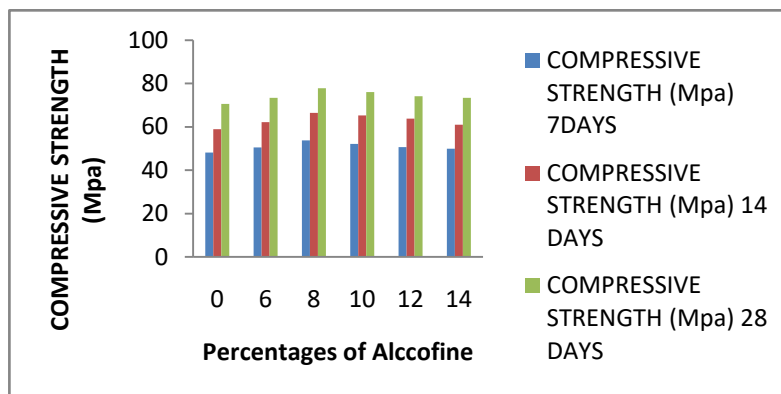


Fig.1.Compressive strength for 7, 14 &28 days

By adding of alccofine as partial replacement of cement there is a gradual increase in strength of the concrete up to 8% replacement of cement. After that as the percentage of alccofine increases, the concrete becomes brittle in nature, so there is a decrease of strength in concrete.

B. *Split Tensile Strength:*

TABLE X

Average Split Tensile strength for 7, 14 & 28 days

Mix Composition		Split Tensile Strength		
		7 DAYS(N/mm ²)	14 DAYS(N/mm ²)	28 DAYS(N/mm ²)
M-1	0%	3.85	4.71	5.64
M-2	6%	4.04	4.9	5.86
M-3	8%	4.30	5.31	6.23
M-4	10%	4.16	5.22	6.09
M-5	12%	4.04	5.09	5.93
M-6	14%	3.98	4.87	5.87

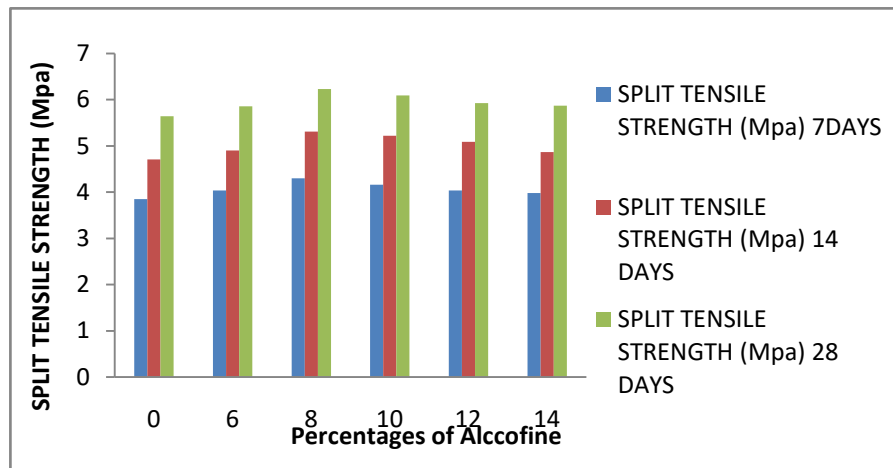


Fig.2. Split tensile strength for 7, 14 & 28 days

C. *Flexural Strength:*

TABLE XI

Average Flexural strength for 7, 14 & 28 days

Mix Composition		Flexural Strength		
		7 DAYS(N/mm ²)	14 DAYS(N/mm ²)	28 DAYS(N/mm ²)
M-1	0%	4.33	5.3	6.45
M-2	6%	4.54	5.60	6.68
M-3	8%	4.84	5.99	7.12
M-4	10%	4.7	5.91	6.9
M-5	12%	4.58	5.76	6.7
M-6	14%	4.52	5.52	6.6

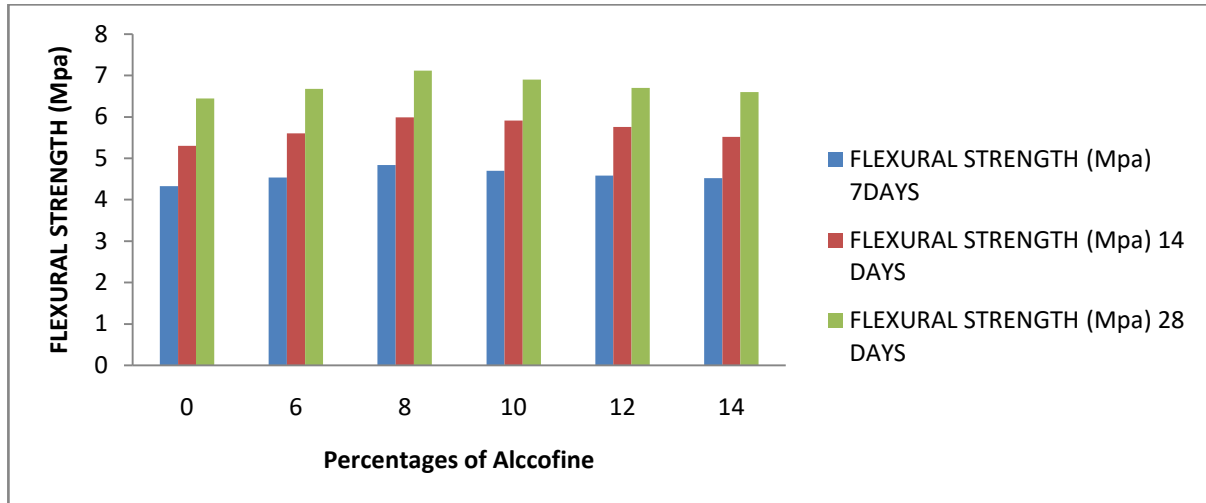


Fig.3. Flexural strength for 7, 14 & 28 days

IV. CONCLUSIONS

- Fly ash increases long term strength of the concrete.
- As Alccofine is added as partial replacement of cement it increases the fresh properties and mechanical properties like compressive strength, split tensile strength and flexural strength.
- Alccofine content of 8% as partial replacement of cement increases 10.5% of compressive strength, 11% of split tensile strength compared to conventional concrete, at the age of 28 days curing.
- Flexural strength of 8% of Alccofine concrete beam is 10.5% more when compared to the conventional concrete beam.

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