

A STUDY ON EFFECT OF PARTIAL REPLACEMENT OF CEMENT BY ALCCOFINE IN FIBER REINFORCED CONCRETE

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Abstract - Supplementary cementitious materials are gaining popularity in the construction industry as these materials are bringing technical revolution in the field of civil engineering. Alccofine is a new generation micro fine material which is important in terms of workability as well as strength. The main aim of this work is to highlight the importance of Alccofine 1203 as cement replacing material in construction industries. The fibers like polypropylene, GI are used which will help to reduce cracking due to creep, shrinkage etc. Both Alccofine and fibers will be beneficial to concrete to achieve better structural performance. Experiments will be conducted to study the effect of Alccofine 1203, polypropylene and GI fibers in different proportions in hardened concrete. Various tests like workability test in terms of slump on fresh concrete and compressive strength, flexural strength tests are conducted on hardened concrete are conducted on Fiber reinforced concrete (polypropylene, GI) with Alccofine used in it.

Key Words: Alccofine 1203, Polypropylene fibers, GI fibers, Compressive strength, Flexural strength.

1. INTRODUCTION

The essential production materials which will be of same significance in the near future are cement based materials. They have to compete with other popular construction materials like timber, rebars & plastic in order to avoid the problems caused due to productivity, economy, quality and environment. These construction materials should be able to meet higher and new demands. Concrete is the only single manufactured substance on the earth which is produced to an amount of 2 billion metric tons per year and most widely used. Attaining high strength is not only the property in order to produce quality concrete in the present climatic conditions. Durability is the most important property of concrete which has the ability to resist against various process of deterioration like chemical attack, weathering action. Even it should be able to hold on to its standard, serviceability when it is open to different environmental conditions.

1.1 FIBER REINFORCED CONCRETE

The concrete mix which consists of discrete, discontinuous and uniformly distributed fibers is called as fiber reinforced concrete (FRC). Fibers are small in size which can be circular or flat in nature and they

do possess certain reinforcement properties. It is usually defined by a parameter known as aspect ratio. It is well-defined as ratio of fiber length to its diameter. It usually varies from 30 to 150. FRC usually increases the structural integrity, tensile strength of concrete & durability of the concrete. It besides reduces air voids. Small, closely spaced fibers in concrete will act as crack resistant materials. These fibers usually regulate plastic shrinkage cracking & drying shrinkage cracking in the concrete. Even these fibers decrease the bleeding of water by lowering permeability of concrete. The quantity of fibers used in concrete is measured as fraction of the total volume of concrete mix & it varies from 0.1 to 3%.

1.2 ALCCOFINE

Alccofine stands as new generation material which is micro fine of particle size finer than cement, silica etc. It is mass-produced in India. The distinctive property of this material is this one has optimized particle size distribution. This one is used as cement replacing material as it increases strength, durability and it even provides resistance against chemical attack.

Alccofine 1203, Alccofine 1101 are the 2 kinds of Alccofine.

Alccofine 1203: This one is a type of Alccofine which has low calcium silicate content. It remains a slag based with high glass content obtained through controlled granulation process which is having ultra fineness. Alccofine 1203 has ultrafine particle size distribution. It is used in construction of high rise buildings, roads, bridges etc.

Alccofine 1101: It stands as another type of Alccofine with high calcium silicate content besides low glass content. It is mainly a grouting material which is used for various process like tunnel works, soil stabilization.

1.3 OBJECTIVES:

The objectives of the project are as follows:

- To know the workability and strength characteristics of concrete by replacing cement partially with Alccofine.

- To compare the strength properties of fiber reinforced concrete by partially replacing cement by Alccofine.
- To compare the strength of FRC with different types of fibres.

2.0 Materials used in the Present study

2.1 Cement

Ordinary Portland cement(OPC) of grade 43 [Brand Name-Ultra tech] is used for all concrete mixes.

Table 1: Physical properties of Cement

SL.NO	PROPERTY	Value	Standard values [IS 12269 (2013)]
1	Soundness (Le-Chatelier Method) (mm)	0.7	10 (Max)
2	Standard consistency (%)	31	Not specified
3	Initial setting time (min)	36	30 (min)
	Final setting time (min)	422	600 (min)
4	Compressive Strength (Mpa)		
	a) 3 days	23	22 (min)
	b) 7 days	34	27 (min)
	c) 28 days	47	43 (min)
5	Specific Gravity	3.15	Not specified

2.2 Coarse Aggregate

Coarse aggregate used in this work is having a maximum size of 20mm and it is locally available. Specific gravity of coarse aggregate was found to be 2.65

2.3 Fine Aggregate

The sand used for the experimental program was locally procured which is free from silt and organic matter and it is conforming to zone II. Specific gravity of fine aggregate was found to be 2.60

2.4 Polypropylene Fibers

It is mixed with concrete at a rate of 0.9kg/cum. It mainly improves the property of fresh concrete. It has an excellent resisting property against acid. It reduces the plastic settlement. Its melting point is high which is about 165°C.

2.5 GI Fibers

These are thin filaments of wires which are cut into required length to provide as reinforcement of concrete, mortar etc. Generally round steel fibers used in this work are 32mm in length and are of 1mm diameter and uniformly distribute in the mix. It is added in an amount of 1% by volume.

2.4 Chemical Admixture

Super plasticizer Conplast SP430, a sulphonated naphthalene polymer based brown liquid is used as a chemical admixture. It has the capability to disperse in water immediately and it is used to reduce the water content up to 29% without the loss of workability, and to achieve greater strength and superior quality of concrete. The specific gravity will be in the range of 1.190-1.210 and the dosage recommended is typically in the range of 0.5-1.5 liters per 100 kg of cement.

2.5 Supplementary Cementitious material

Alccofine 1203 is uniquely refined material based on slag of greater glass content with high reactivity procure by the granulation process under a controlled way. The primal matter contains primary of low calcium silicates. Alccofine 1203 is truly ultrafine material because of its particle size distribution[1200 cm²/g] as a results it reduces the water content for a needed workability. And hence improves compressive strength.

Table 2: Physical Properties of Alccofine 1203

Sl.No	Test	Result	
1	Particle Size Distribution(um)	d10	1.4
		d50	4.2
		d90	9.0
2	Bulk Density (kg/cub.m)	680	
3	Specific Gravity	2.87	

3.0 CONCRETE MIX DESIGN

The process of picking out suitable ingredients of concrete and discovering their relative quantities with objective of producing the required strength and durability and workability as economically as possible is termed the concrete mix design. Mix design is done as per IS 10262 (2009) guidelines.

4.0 RESULTS AND DISCUSSIONS

In the present work, a proportion for standard concrete mix design of M50 was carried out according to IS:10262-2009 recommendations. The different tests like slump test, compressive strength, flexural strength tests were carried out. The results of different tests are tabulated below.

Table 3: Mix proportions of M50 Concrete

Cement brand	OPC 43 grade Ultratech
Maximum nominal aggregate size	20 mm
Zone of Fine aggregate	Zone II
Quantity of cement	437.90 Kg/m ³
Quantity of fine aggregate	638.90 Kg/m ³
Quantity of coarse aggregate	1209.20 Kg/m ³
Quantity of water	153.28 lts
W/C ratio	0.35
Calculated Proportion	1:1.45:2.76
Polypropylene fibers	1% (by volume)
GI fibers	1% (by volume)

Table 4: Slump variations for different trial mixes

% Alccofine	Slump value in mm		
	Plain Concrete	Concrete with Polypropylene fibers	Concrete with GI fibers
0	71	63	60
5	71	63	60
10	74	65	62
15	77	66	64
20	81	69	67

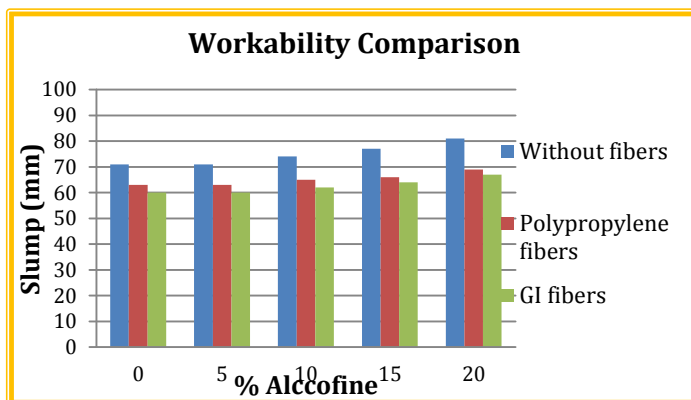


Chart 1: Comparison of workability

Table 5: Compressive strength results of 28 days for different trial mixes

Alccofine %	Concrete with polypropylene fibers	% increase in strength
0	47.92	-
5	49.92	4.17

10	50.95	6.32
15	53.18	10.98
20	55.50	15.81

Table 6: Compressive strength results of 28 days for different trial mixes

Alccofine %	Concrete with GI fibers	% increase in strength
0	55.95	-
5	57.35	2.50
10	58.60	4.73
15	61.10	9.20
20	62.60	11.88

Table 7: Flexural strength results of 28 days for different trial mixes

Alccofine %	Concrete with polypropylene fibers	% increase in strength
0	8.67	-
5	9.20	6.11
10	10	15.34
15	10.75	23.90
20	11.67	34.60

Table 8: Flexural strength results of 28 days for different trial mixes

Alccofine %	Concrete with GI fibers	% increase in strength
0	10.10	-
5	10.40	2.97
10	11.10	9.90
15	11.67	15.54
20	12.34	22.17

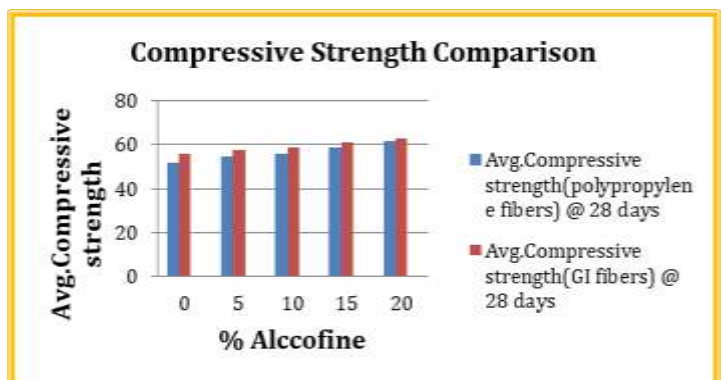


Chart 2: Comparison of compressive strength

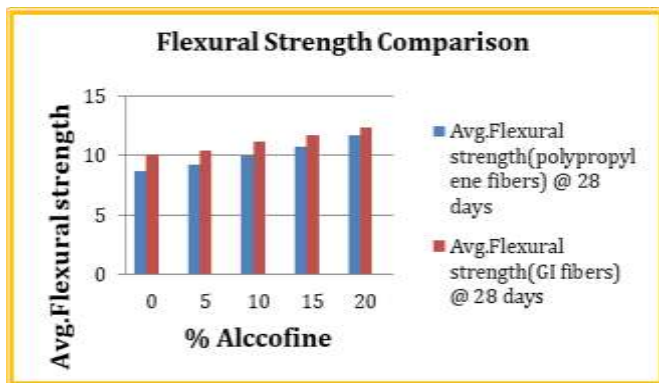


Chart 3: Flexural strength comparison

- From chart 1 it is observed that workability decreases with addition of fibers.
- From chart 2 it is observed that compressive strength increases with addition of GI fibers when compared to polypropylene fibers.
- From chart 3 it is observed that flexural strength increases with addition of GI fibers when compared to polypropylene fibers.

5.0 CONCLUSIONS

- From the test results it can be concluded that addition of Alccofine as a replacement material to cement improves the workability and strength properties.
- Thus the combination of Alccofine 1203 and fibers (polypropylene and GI) increase the mechanical properties of concrete.
- It is also concluded that addition of GI fibers will yield better strength characteristics compared to that of polypropylene fibers.
- Thus the use of Alccofine 1203 can be prompted in concrete as a replacement of cement.

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