

EXPERIMENTAL INVESTIGATION ON M 20 GRADE OF CONCRETE INCOPERATED WITH ALCCOFINE

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ABSTRACT

The presence of Alccofine at optimum levels in conventional concrete is expected to increase compressive strength and provide resistance to chloride attack, seawater attack and accelerated corrosion attack. The main objectives of this work focus on the compressive and flexural strengths of concrete with Alccofine partially substituted for cement. This project focuses on the experimental study of concrete with different percentages of Alccofine in place of cement. 0%, 5%, 10% and 15% for 7 days, 14 days and 28 days. The design combination performed during the experiment was M20 and compared to conventional. Different percentages of Alccofine increase the strength of the initial concrete phase. Alccofine as filler reduces permeability and improves workability of fresh concrete.

Keywords: *Compressive strength (CS), Flexural strength (FS), Alccofine*

1. INTRODUCTION

Concrete is one of the predominant material used in construction industry. The concrete is cast in any desirable shape. The concrete is used in various forms in structures depending on the load carrying capacity. For flexural and axial loading steel reinforcement is induced in concrete. The plain cement concrete is poor in tension but shows some optimum compressive strength, and little resistance to cracking. The steel reinforcement in reinforced concrete structures suffers from corrosion due to improper alignment of reinforcement which results in failure of structure due to minimum cover. Apart from all these the addition of various chemicals that may be byproducts can enhance the compressive strength up to certain dosage which can be a boon for improving the compressive strength including resistance against chemical attacks to certain extent as compared to conventional concrete. The scarcity of material mainly cements results in deficiency of concrete. There are several replacement induced for cement like fly ash, bottom ash, GGBS, Metaoklin etc. These materials are tested in the laboratory through partial and full replacement of cement towards strength and other properties of concrete with conventional concrete. The replacement shows some advantageous qualities while compared to cement. Alccofine is a product obtained through controlled granulation. It is a slag, consist of high glass content with ultra fine particle size. The water demand is reduced but workability is maintained up to 70% replacement and shows good performance in concrete. Alccofine can also be utilized as a good water redundant to improve the strength parameters and other properties of concrete. Alccofine is used as cement replacement mainly for two reason, to stabilize the scarcity of cement and improve the properties of concrete in their life cycle. Therefore, utilization of Alccofine together with fly ash provides better results to mechanical properties of concrete. Alccofine 1203 is a slag based supplementary cementitious materials having ultra-fineness with optimized particle size distribution. Due to its unique chemistry and ultra fine particle size Alccofine 1203 provides reduced water demand for a given workability, even up to 70% replacement level as per requirement of concrete performance and it is manufactured by Ambuja Cements Ltd. In this experiment alccofine is used partially with varied percentage of 5%, 10%, 15% by weight of cement.

2. RESEARCH METHODOLOGY

In the current exploration work concrete has been mostly supplanted by Alccofine-1203 in M20 Grade of cement. The substitution levels are 0%, 5%, 10% and 15% by weight of cement. The properties researched are functionality, compressive quality, flexural quality. The examples of standard shapes (150mm×150×mm×150mm), and standard shafts (150mm×150mm×700mm) were projected from various blends having various substitutions levels of Alccofine powder. The examples were restored in water for required time.

3. MATERIAL & THEIR PROPERTIES

3.1 Cement

An OPC 43 grade Ultra Tech Cement was used in this study. The physical properties were found using respective IS codes. The properties are given in table below:-

Table 1: - Properties of Cement

S.NO	SPECIFICATION	VALUES
1	Specific Gravity	3.13
2	Standard Consistency	32%
3	Initial Setting Time	30 min
4	Final Setting Time	600 min

3.2 Fine Aggregate

The sand used in this research work acquired from natural river passing through 4.75mm I.S. Sieve The properties of sand obtained using respective codes are given in table below. shown in Table-2

Table 2:- Properties of Fine Aggregate

S.NO	SPECIFICATION	VALUES
1	Specific Gravity	2.63
2	Fineness Modulus	2.93
3	Bulk Density(Kg/m ³)	1645
4	Water Absorption(%)	0.94

3.3 Coarse Aggregate

In this research work locally available crushed aggregate of sizes 20mm and 10mm were used. The aggregates were tested and following results were obtained, shown in Table 3

Table: 3-Properties of Coarse aggregate

S.NO	SPECIFICATION	VALUES
1	Specific Gravity	2.66
2	Fineness Modulus	6.75
3	Bulk Density(Kg/m ³)	1585
4	Water Absorption(%)	0.64
5	Impact value	21.10
6	Abrasion Value	24.97

3.4 Alccofine

Alccofine 1203 is the new generation micro fine material of particle size much finer than other materials like cement, fly ash etc. The Alccofine is manufactured by Ambuja Cements Ltd was used in this experiment as a mineral admixture. The products alccofine 1203 is a supplementary cementitious material suitably replaces silica fume used in high performance concrete. It is obtained from the materials of the iron ore industry. The chemical composition of the alccofine shows higher percentage of the alumina content and silica

content. It has unique characteristics to enhance the performance of concrete in fresh and hardened stages. It can be used as practical substitute for silica fume.

Table: 4- Chemical Properties of Alccofine

S.NO	SPECIFICATION	VALUES
1	CaO	61-64 %
2	SO	2-2.4 %
3	SiO ₂	21-23 %
4	AlO	5-5.6 %
5	FeO	3.8-4.4 %
6	MgO	0.8-1.4

3.5 Water

Potable water available from nature sources free from deleterious materials was used for mixing as well as for curing of all the mixes tried in this investigation.

4. MIXDESIGN

The mix design was done using IS: 10262-2019 and IS: 456--2000. The calculated proportion for 1m³ is given below:-

Table-6 Mix Proportion for M 30 Concrete

Mix	PROPORTION BY WEIGHT (kg/m ³)				
	Replacement Of Cement(%)	Cement	Sand	Coarse Aggregate	Alccofine(%)
CC	00	430	719	1243	00
MD ₁	5	408	719	1243	5
MD ₂	10	387	719	1243	10
MD ₃	15	365	719	1243	15

5. RESULTS

5.1 Workability-

The slump test were conducted according to May be: 1199-1959 to determine the usefulness of fresh concrete blend having different percentage of Alccofine as 0%, 5%, 10% and 15% by weight of concrete. During the whole research work the water to cement proportion was kept 0.44. The whole research work the water to cement proportion was kept 0.44. From the examination, it was concluded that adding Alccofine in concrete increases the functionality in concrete blend.

5.2 Compressive Strength-

Cube specimen of concrete were prepared incorporated with 0%, 5%, 10% and 15% of Alccofine of size 150x150x150 mm, cured and tested for 7, 14 and 28 days as per IS: 516-1959. The testing results were obtained are shown in Table 7 and graphical represented shown in Figure 1. From the above test results, it can be concluded that the highest compressive strength was achieved by replacement 15% of Cement with 15% of Alccofine in it and it is found out about 32.4 N/mm² compared with 25.1 N/mm² for the control

mix after 28 days of curing.

Table -7 Compressive Strength Test

Samples	Compressive Strength (N/mm ²)				
	Cement	Alccofine(%)	7 Days	14 Days	28 Days
CC	100	00	18.3	20.3	25.1
MD ₁	95	5	19.53	21.4	26.6
MD ₂	90	10	19.9	22.8	28.6
MD ₃	85	15	21.35	25.33	32.4

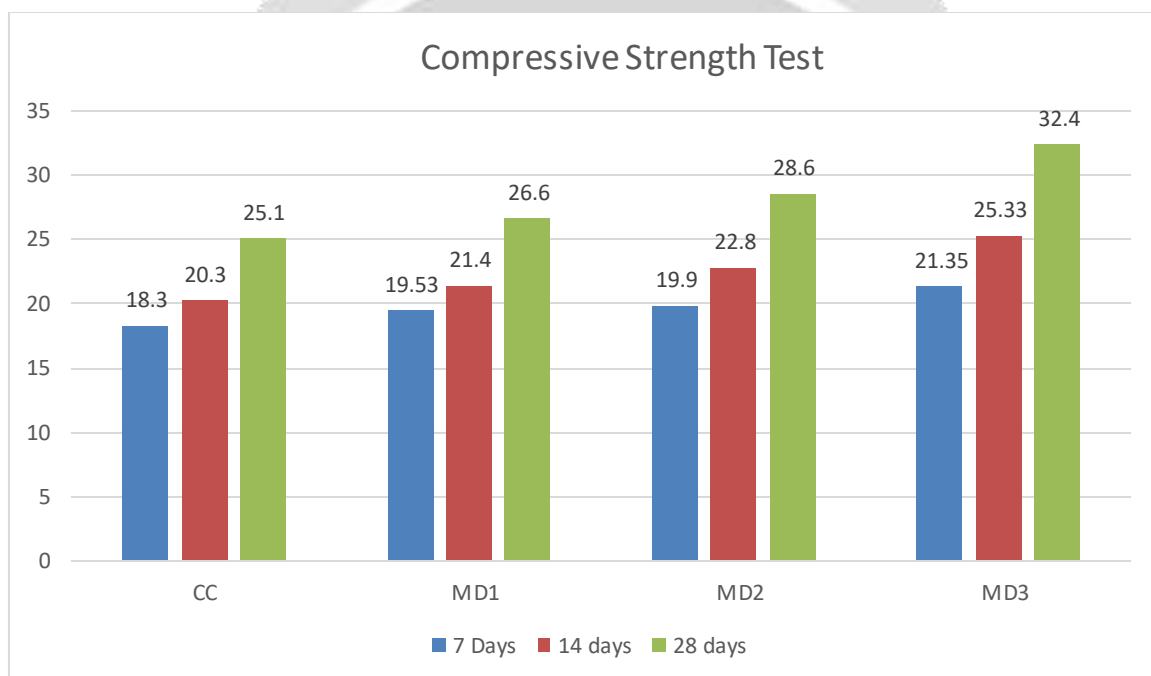


Fig 1. Compressive Strength Test

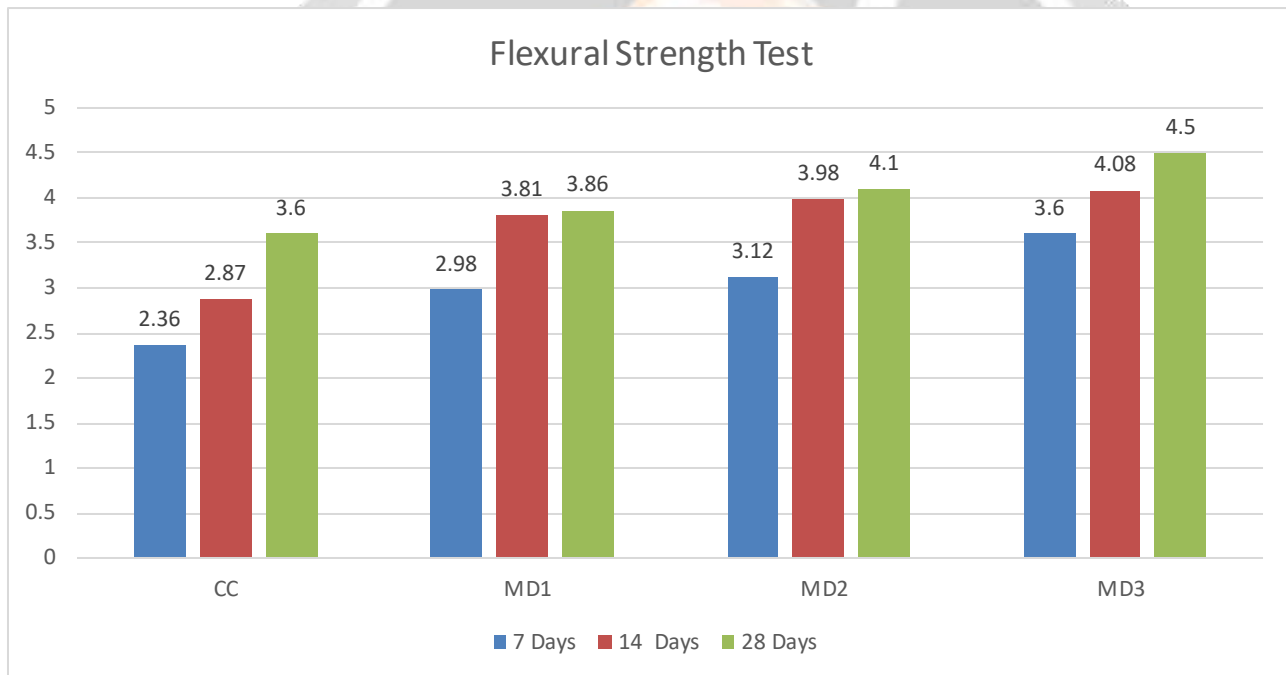
5.3 Flexural Strength

Standard beam of size 15cm x 15cm x 70cm were casted, cured, tested under one point loading to study the flexural strength of concrete is carried out as per 516:1959. Cubes were prepared, cured and tested for 7, 14 and 28 days.

After curing the test results were obtained are shown in Table 8 and graphical represented shown in Figure 2. From the above test results, it can be concluded that the flexural strength of concrete with 15% replacement of cement with Alccofine elevates the strength of concrete mix. it is found that strength about 4.5 N/mm² as compared to 3.6 N/mm² for the control mix after 28 days of curing..

Table-8 Flexural Strength Of Concrete

Samples	Flexural Strength (N/mm ²)				
	Cement	Alcofine(%)	7 Days	14 Days	28 Days
CC	100	00	2.36	2.87	3.6
MD ₁	95	5	2.98	3.81	3.86
MD ₂	90	10	3.12	3.98	4.1
MD ₃	85	15	3.6	4.08	4.5

**Fig 2- Flexural Strength Test**

6. CONCLUSION

From the experimental investigation carried out for present dissertation work, following salient conclusion can be drawn.

- ❖ This case study clearly shows that Compressive strength of the Alcofinated concrete were increased by 22.5% and the flexural strength also increased by 20% as compared to Conventional Concrete.

- ❖ It improves the strength and durability properties of concrete.
- ❖ It lowers water demand and admixture dosage.
- ❖ It improves package density of paste.
- ❖ Alccofine without superplasticizer affects the fluidity of concrete.
- ❖ It results in fast setting of concrete
- ❖ It leads to the formation of calcium silicate hydrate thereby enhancing strength of the concrete.
- ❖ The compressive strength of the concrete get increased when the cement is partially replaced with alccofine up to 15% and gradually decreases by increasing the percentage of alccofine.
- ❖ Optimum level of replacement of cement by alccofine is found to be 15%.
- ❖ It reduces the permeability of concrete is significantly.

7. FUTURE WORK

From the experimental study it is clear indicated that using Alccofine in concrete elevates the strength parameters. Following parameters will be study in future work-

- ❖ Study should be done in proportion zone i.e how much cement can be replaced by adding Alccofine.
- ❖ Trial of concrete mix should be done with Copper Slag.
- ❖ Trial of concrete mix should be done with seawater.
- ❖ Better admixture should be searched in order to enhance the strength

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