

STUDY ON PERFORMANCE OF CONCRETE BY USING ALCCOFINE AS A PARTIAL REPLACEMENT OF CEMENT

Sujana Palamani¹, K. Bala Gopi Krishna²

M.Tech Student¹ & Assistant Professor², Department Civil of Engineering,
Vignan's Foundation for Science - Technology & Research, Vadlamudi, Guntur, India.

Abstract - This paper presents the study of effect of performance of concrete using supplementary cementitious material i.e. Alccofine with M-40 grade of IS cube specimen. We partially replaced cement by weight of binder with alccofine replacement with percentages of 3%, 6%, 9% and 12%. Also, we've investigated strength in compression, split tensile strength and flexural capability for all various cases. The compressive strength of alccofine concrete increases at all stages fresh and hardened due to the presence of cementitious material that is alccofine. Compression is carried between the properties of the conventional and alccofine concrete.

Key Words: Alccofine, strength, supplementary cementitious material.

1. INTRODUCTION

One of the most often utilised materials in the construction sector is concrete. Concrete is poured into any desired shape. The concrete is utilised in numerous ways in depends on a structure's ability to support a load. Steel reinforcement is introduced into concrete to support axial and flexural loads. Although the simple cement concrete has weak tension properties, it exhibits good compressive strength and little crack resistance. Because of incorrect reinforcement alignment, the steel in reinforced concrete structures corrodes, leading to structural failure from insufficient cover.

In addition, The compressive strength can be increased by up to by adding various compounds that may be by products. Compared to typical concrete, there is a certain dosage that can help improve compressive strength and resistance to chemical attacks to a certain amount. Concrete is insufficient due to a lack of materials, particularly cements. There are many substitutes for cement, including fly ash, bottom ash, GGBS, and Metaoklin. Via partial and complete cement replacement in traditional concrete, these materials are tested in the lab for strength and other qualities. When compared to cement, the replacement exhibits various beneficial characteristics.

A controlled granulation process yields the substance alccofine. It is a slag with a high glass concentration and extremely small particle size. Although there is a decrease in water consumption, concrete still performs well and

workability is maintained up to 70% replacement. Alccofine is an excellent water redundant that may be used to enhance the parameters governing strength and other aspects of concrete. Alccofine is used as a cement substitute primarily for two conditions: to stabilise the supply of cement and to enhance the characteristics of concrete throughout its life cycle. Alccofine combined with fly ash use hence improves the mechanical qualities of concrete.

2. REVIEW OF LITERATURE

The Counto Microfine Products Ltd. Ambuja Cement Ltd. and Alcon Group Goa are partners in the CMPPL group. Goa is home to one of the largest dedicated manufacturing facilities for microfine materials in the world. In Kolkata, India, Alccofine was first introduced. Two cutting-edge products in the realm of concrete, Alccofine 1203 and Alccofine 1101, have been introduced by Ambuja Cement Company (ALC).

3. METHODOLOGY

The following methodology was used to investigate the behavior of Alccofine in workability and mechanical properties of concrete. M50 grade concrete mix design was determined in accordance with IS:10262-2019 for the inquiry at hand. Alccofine was used in place of cement in some places. Up to 3, 6, 9, and 12% of the cement's weight was added as alccofine. Concrete's mechanical and fresh characteristics were examined for the impact of alccofine. All aspects of the mix design employed a water/cement ratio of 0.45. At the conclusion of this investigation, a comparison between the qualities of conventional and alccofine was made.

4. EXPERIMENTAL PROGRAM

An experimental programme has been designed to deliver adequate data for determining the Alccofine-based concrete's quality. The behaviour of alccofine in the workability and mechanical qualities of the Alccofine-based concrete has been studied.

4.1 Materials Used

Cement For the study, KCP Ordinary Portland Cement (OPC) has been used.

4.2 Fine Aggregate

For the experimental purpose, aggregate from a nearby quarry that passes through an IS sieve measuring 4.75mm is gathered.

Table -1: Specifications of Cement

Specific gravity	3.0
Standard consistency	34
time of initialization	35 minutes
Last setting time	574 minutes
Soundness	1.72
Fineness	4.7

4.3 Coarse Aggregate:

The aggregates used are those that passed through a 4.75mm sieve. The chosen aggregate dimension is 20 mm, which is clear and devoid of surface dust and particles. At a nearby quarry, coarse aggregate was gathered.

Table 2 Specifications of Coarse Aggregate

Specific gravity	2.63
Water absorption	0.76%
Fineness	6.8
Crushing value	11.66%

Table 3 Specifications of Fine Aggregate

Specific gravity	2.75
Water absorption	0.43%
Fineness	2.7

4.4 Alccofine

Alccofine is a pozzolanic material that may be used to create concrete structures that are highly resilient. It is a specifically processed product made from high glass content, high reactivity slag that is obtained by the controlled granulation process. Utilized is alccofine 1203. It's taken from Ambuja Cements.

Table 4 Chemical properties of Alccofine

Cao	35.85%
SiO ₂	13.62%
Al ₂ O ₃	20.08%
MgO	2.43%

4.5 Micro structural studies of Alccofine

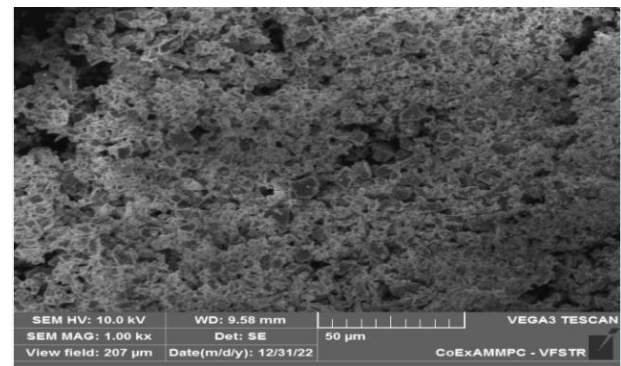
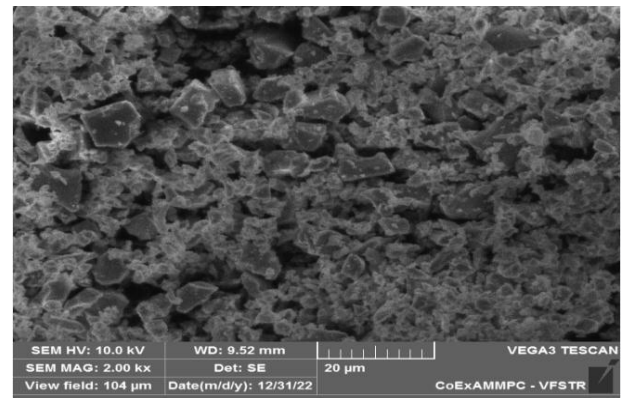


Figure-1.SEM images of Alccofine-1203

The basic working principle of SEM is Electron beams (primary electrons) striking a surface can either change direction elastically with no energy loss (elastic scattering) or some energy can be most initial electrons are halted as a result of being absorbed. and some backscattered (inelastic scattering). According to the SEM image, the particles of alccofine-1203 are extremely fine, have a glassy surface, are asymmetrical in shape, and have sharp edges.

5.MIX DESIGN

The mix design is determined by using IS 10262:2019 recommendations. M40 grade of concrete is selected for the present work.

Table 5 Mix Proportions for 1m³ M50 Concrete

Material	Weight (kg/m ³)
Cement	458
Fine aggregate	589
Coarse aggregate	1268
Water	187

6. EXPERIMENTAL PROCESS

Concrete samples were cast using the following moulds for a variety of research.

Table 6 Nomenclature

Alccofine	AF
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6.1 Fresh Properties of Concrete

Slump and Compaction factor tests was conducted by using slump cone and compaction ratio apparatus.

Table 7 Fresh properties of concrete by using slump cone and compaction factor ratio tests.

Specimen	Slump (mm)	Compaction factor
Conventional concrete	110	0.82
3%AF	122	0.84
6%AF	136	0.85
9%AF	142	0.88
12%AF	153	0.90

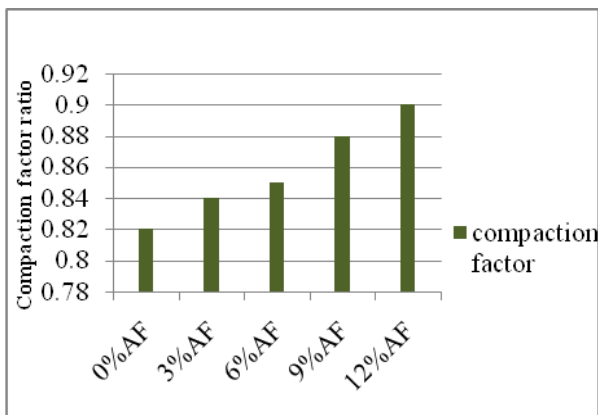
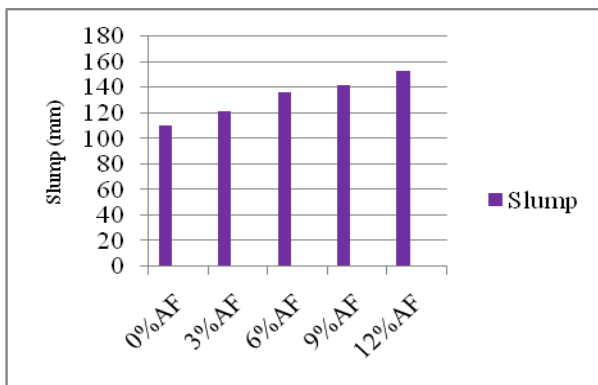


Figure- 2. Fresh State Properties of concrete Slump (mm) and Compaction factor ratio

6.2 Hardened State Properties of concrete

Strength in compression , split tensile strength, and flexural strength of hardened concrete were studied in this work.

6.2.1 Compressive strength

Three cubes were tested for strength in compression using a compression testing machine in accordance with IS 516 - 1959.

Table 8 Compressive Strength of Concrete

Specimen	Compressive strength (Mpa)		
	7 days	14 days	28 days
Conventional concrete	24.42	31.11	41.47
3%AF	26.65	34.44	44.02
6%AF	30.56	45.83	51.07
9%AF	23.42	41.13	42.87
12%AF	21.44	38.42	49.65

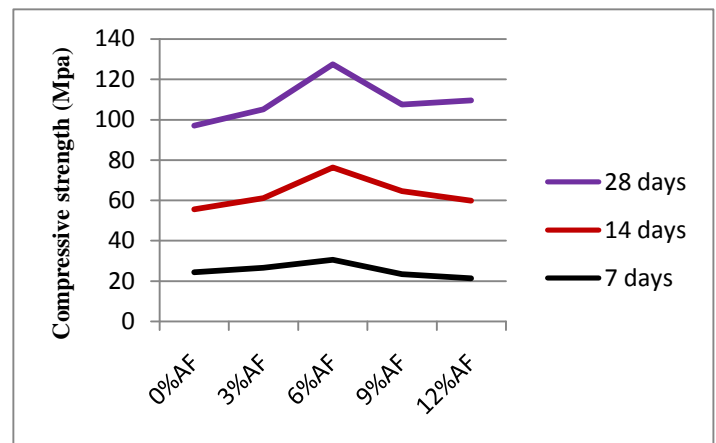


Figure-3. Compressive strength of concrete

6.2.2 Split tensile strength

The test procedure focuses on figuring out the splitting tensile strength of cylindrical concrete sample. By using this technique, a cylindrical specimen is compressed over its whole length.

Table 9 Split Tensile Strength of Concrete

Specimen	Split tensile strength (Mpa)		
	7 days	14 days	28 days
Conventional concrete	2.18	3.72	4.29
3%AF	2.93	4.12	4.70
6%AF	3.42	4.23	5.01
9%AF	3.95	4.82	5.47
12%AF	4.01	5.17	5.68

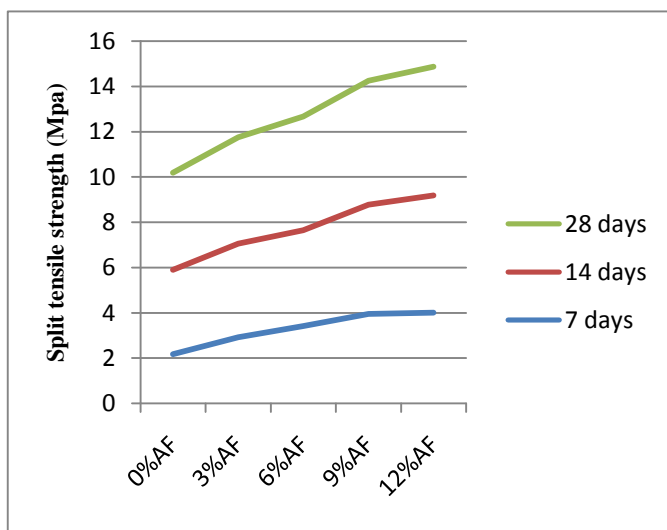


Figure-4. Split Tensile strength of concrete

6.2.3 Flexural strength

This test procedure uses a simple beam under a two-point force to assess the flexural strength of concrete. For the test, the two point bending test apparatus was utilised.

Table 10 Flexural Strength of Concrete

Specimen	Flexural strength of concrete (Mpa)	
	14 days	28 days
Conventional concrete	4.75	6.74
3%AF	5.24	7.19
6%AF	5.67	7.59
9%AF	6.11	6.94
12%AF	5.74	6.26

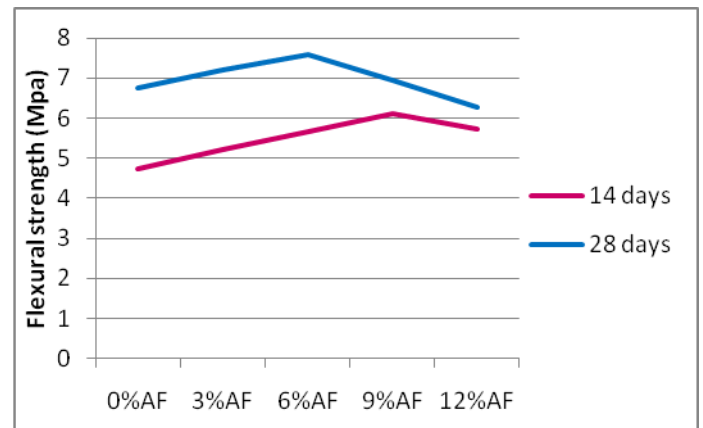


Figure-6. Flexural strength (Mpa)

7. Comparison of test results

Several concrete compositions' maximum values for strength in compression, split tensile strength, and flexural strength are compared in the 28-day strength test.

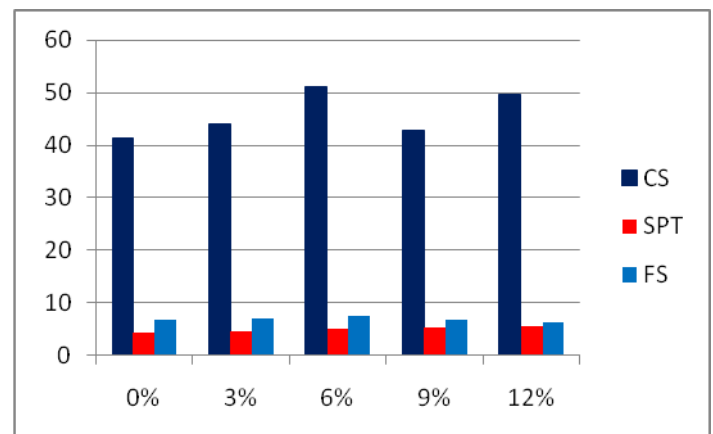


Figure-7. Comparison of results (Mpa)

8. CONCLUSIONS

The results indicate that adding Alccofine will enhance the mechanical and workability characteristics of Alccofine concrete. Workability increases on introduction of Alccofine to normal concrete.

Addition of Alccofine shows immense improvement in workability of Alccofine concrete. Strength in compression, split tensile strength and flexural strength shows maximum at 6% Partial replacement of Alccofine. It may be deduced that the ideal range for replacing cement with Alccofine is between 3% - 6%.

Alccofine has outstanding mixing behaviour in terms of workability and strength improvement. Alccofine's ultra-fine particle size produces a better and smoother surface finish, and it is easy to use and may be applied right to cement.

Employing this substance improves the properties of hardened concrete while lowering the cost of the concrete mix for high strength concrete compared to concrete without alccofine.

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