

Sustainable Concrete by Partial Replacement of Cement with Alccofine

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Abstract - In the present paper, the effect of Alccofine on properties of concrete has been studied. The main aim of this study is to evaluate the strength or we can say high performance of concrete containing supplementary cementitious materials (SCM) such as Alccofine. Concrete is third most widely used material in world and cement is major ingredient of it. One ton cement production cause emission of one ton of CO₂ gas which is harmful to environment. ALCCOFINE is a new generation supplementary cementitious material(SCM) with a built in high tech content which can be used as cement replacement. In this thesis ,it is proposed to study the Alccofine based high performance concrete with various proportions. M30 grade of concrete is planned to study by their mechanical properties such as compressive strength compared with conventional concrete. Cement is replaced with Alccofine with percentage varying from 5% and 20% at an interval 5%. For all the tests ,standard experiments are followed to determine the properties as per Indian standards. The results presented and discussed.

Key words: Alccofine 1203, sustainability, compressive strength

1.INTRODUCTION

The most important construction materials are cement based materials and it is most likely that they will continue to have the same importance in the future. The construction and the engineering materials must meet new and higher demands. As far as productivity, economy, quality and environment is concerned, they have to compete with other construction materials too like plastic, steel and wood. The durability of concrete means it should have resistance to weathering action, chemical attack or any other process of deterioration. Durable concrete will retain its original form quality, and serviceability when exposed to environment. These materials include traditional Portland cement and other cementitious materials, such as Alccofine. Alccofine is either combined at the cement works or at the concrete mixer when the concrete is being produced. Cementitious materials for concrete are fine mineral powders. When this material is mixed with water, they react chemically to form a strong rigid mass that binds aggregate particles together to make concrete. Alccofine is a new generation, micro fine material of particle size and is much finer than other

hydraulic materials like cement, fly ash, silica etc. being manufactured in India. Alccofine has unique characteristics to enhance “performance of concrete in hardened stages due to its optimized size distribution.

2. METHODOLOGY

• Material Collection

Cement, Alccofine, fine aggregate (sand), coarse aggregate, and potable water are collected. All materials are selected as per relevant Indian Standards.

• Testing of Materials

Basic tests are carried out to know the properties of materials:

Materials	Specific gravity	Fineness/sieve analysis	Soundness of cement	Bulking of sand
Alccofine	2.85	5-7 micron	-	-
Cement	31.5	6%	6mm	-
Fine aggregate	2.79	3.06%	-	10%
Coarse aggregate	2.75	7.80%	-	-

• **Mix Design**

M30 grade concrete mix is designed as per IS 456-2000. A control mix with 0% Alccofine is prepared. The water–cement ratio is kept constant for all mixes. Replacement of Cement with Alccofine Cement is partially replaced with Alccofine by weight at different percentages:

- 0% (control mix)
- 5% 10% 15% 20%

• **Preparation of Concrete**

For each mix, cement and Alccofine are mixed first. Then sand and coarse aggregate are added. Finally, water is added and mixed well to get uniform concrete.

• **Casting of Specimens**

Concrete is poured into 150 mm × 150 mm × 150 mm cube moulds in three layers. Each layer is compacted properly. The surface is levelled and moulds are kept undisturbed for 24 hours.

• **Curing**

After 24 hours, the cubes are removed from the moulds and cured in clean water. Curing is done for 7, 14, and 28 days.

• **Testing of Concrete**

Compressive strength test is conducted on cubes at 7, 14, and 28 days.

3. MATERIALS USED

Cement : It is mainly used as a binder material in concrete which is used for construction that sets, hardens to other materials bind together. OPC (ordinary Portland



cement) of 53 grade is used conforming to IS: 12269-1987.

The tests on cement are carried out as per Indian Standards.

Alccofine: It is a low calcium silicate material which improves the workability and compressive strength due to granulation and high glass content. ALCCOFINE1203 is a specially processed product based on high glass content with high reactivity obtained through the process of controlled granulation. The raw materials are composed primary of low calcium silicates.



Fine Aggregate: Fine Aggregate (FA) sand of particle size less than 4.75 mm size & confirming to zone-II as per IS 383:2016 code is used. Good river bank sand in the absence of any earthy matter and organic matter. Particles are angular in shape passing 4.75mm and retaining on 150 micron standard sieve. The river sand is used as fine aggregate conforming to the requirements of IS: 383-2016.



Coarse Aggregate: Is obtained by crushing various types of granites, schist, crystalline and lime stone and good quality sand stones.

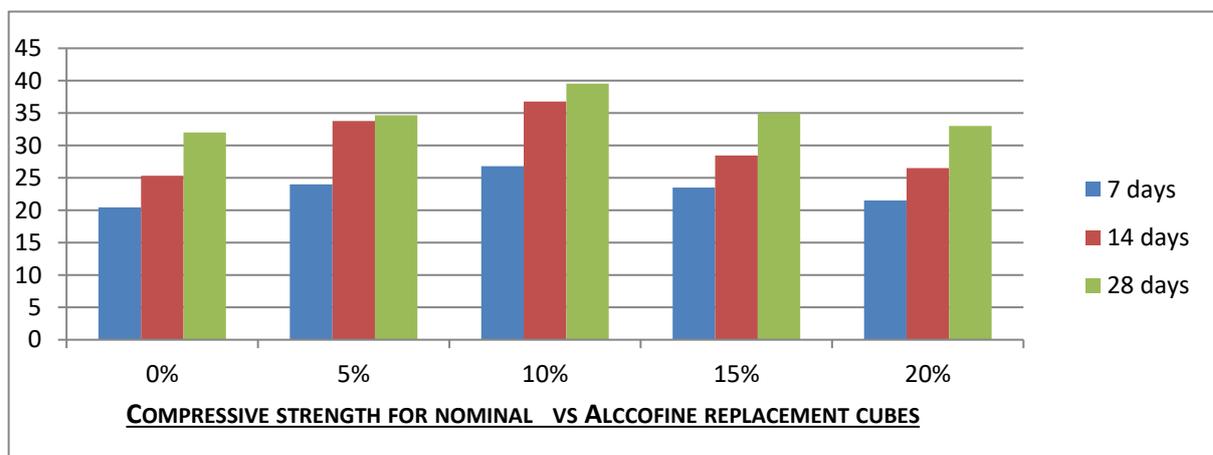
Concrete made with sand stone aggregate give trouble due

to cracking because of high Degree of shrinkage. Uniformly well graded coarse aggregate of 20 mm size conforming to IS383:2016 code is used.

Water: The water used for preparing concrete mix and for curing should be clean and free from hazardous impurities such as salts, acids, alkali, oil and organic materials confirming to IS 456:2000 code. The pH of the water used should be in the range of 6–8.

S.NO	Percentage of "Alccofine"	No. of Curing Days	Minimum Compressive Strength (MPa)	Compressive Strength in (MPa)
		7	22.00	21.44
1	0%	14	25.00	25.33
		28	30.00	32.00
		7	22.00	24.00
2	5%	14	27.00	33.77
		28	33.00	34.66
		7	23.50	26.50
3	10%	14	29.50	36.78
		28	35.50	39.55
		7	21.50	23.50
4	15%	14	26.50	28.46
		28	32.50	35.00
		7	20.50	21.50
5	20%	14	25.50	26.50
		28	31.00	33.00

Compression Test Results:



CONCLUSION

- From the experimental results, A15 mix gives higher compressive strength than all other mixes (A0, A5, A10 and A20). It shows that the addition of Alccofine in concrete increases the compressive strength by 20 to 30%.
- The strength development of Alccofine based concrete is greater than all other concrete at all age of curing.
- If the percentage level of Alccofine is increased beyond that level it acts as a filler material and yields good workability to the concrete.
- Alccofine replaced at 15% levels has contributed to the higher strength values.
- Alccofine Replacement at 15% was found to be an optimal dosage for hydration and strength gain in accordance with codal provisions.
However, the 10% and 20% partial replacements act as filler material during the concrete's bonding.
- By increasing the percentage of Alccofine in concrete as replacement of cement, the value of cementing efficiency increases.
- It is concluded that the Alccofine 1203 is good replacement cementitious material for cement to certain extent that up to 15%. It is good against durability aspects also.
- Also further more research required to standardize the use of Alccofine in concrete in practice.

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