



## ANALYSIS ON COMPRESSIVE STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT WITH ALCCOFINE

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### ABSTRACT

The presence of Alccofine in the conventional concrete in optimum dosage can be expected to improve the compressive strength and provide resistance against chloride attack, sea water attack and accelerated corrosion attack. The main objective of this work focuses on the compressive strength of concrete with partial replacement of cement with Alccofine. The project focuses on the experimental investigation on concrete by replacing cement with Alccofine on varying percentage. 0%, 4%, 8%, 16%, 17%, 20%, 25%, 50%, 75% and 100% for 7 and 28 days. The design mix carried out throughout the experiment was M25. The increase in percentage of compressive strength for 7 days and 28 days curing was found to be maximum at 16% replacement exhibiting the value of 50.95 % and 60.95% when compared with conventional. Alccofine in various percentages improves the strength of concrete initial period. Alccofine acts as filler materials such that reduces permeability improving workability of fresh concrete. Overall it is a comparative study governing compressive strength as main point of contradiction.

**Keywords:** compressive strength, replacement, alccofine, conventional concrete, water binder ratio, ordinary portland cement, coarse aggregate, fine aggregate.

### 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 by-products 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.

### 2. RELATED WORK

Self-compacting concrete gets compacted due to its self-weight and is deaired almost completely while flowing in formwork. It reduces the problem of compacting and is easy to transport and less manpower needed. In order to investigate the properties and their differences, controlled concrete were made with various percentage of alccofine mix. Firstly conventional concrete without alccofine was prepared and then it was followed by (5%, 10%, and 15%) and also they tested fresh properties, like slump cone test to measure the workability and also harden properties like compressive strength test and flexural strength test. The specimens casted and then cured were tested on 7, 14, 28 days for compressive strength test and in 7 and 28 days for flexural strength test.

After testing the recorded values were compared for each proportion and conclusion was drawn out which said, "The addition of alccofine in SCC reduces problem of compacting and increases properties like filling and prevents segregation. Both fresh and harden properties with 10% of alccofine was found more efficient then compared to 5% and 15%.

The proportion of fly ash used was up to (0, 20, 25, 30, 35) % and alccofine proportions was (0, 4, 6, 8, 10, 12) %. They used ordinary Portland cement of 53 grade and also super plasticizers were added on required degree of workability. They first prepared specimens just with replacement of cement by varying % of flyash (C+F) and then went for specimens with just replacing cement by various % of alccofine (C+A). Laterally a mixture combining both fly ash and alccofine was prepared. Mix proportion was done as per IS 10262:2009. The specimens were molded and set into curing tank and were tested on 56 days. W/c ratio adopted was 0.4. The



maximum compressive strength on replacing cement with just alccofine was obtained at 7 % (44.81 Mpa) and with just flyash was obtained at 25%(45.7 Mpa).The compressive strength of specimens with alccofine flyash and cement was tested and the maximum value was found at 73% of cement , 7% of alccofine and 25% of fly ash. It was concluded that alccofine provides improvement in early age performance and fly ash improves the harden properties.

### 3. METHODOLOGY

To study the behaviour of coconuts shell with various volume fraction of steel fibre in concrete was studied through the following methodology.

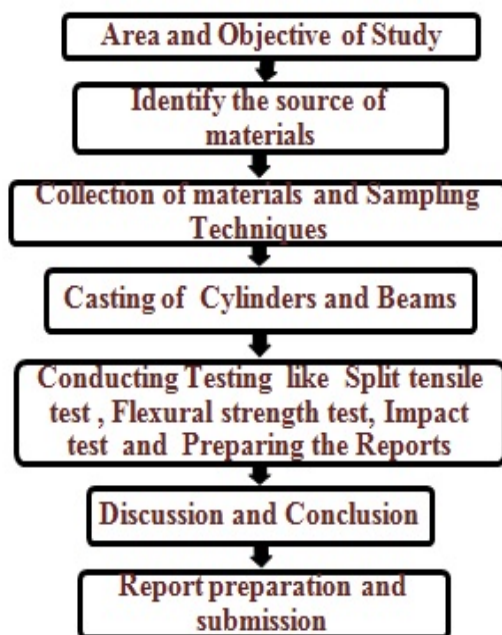


Figure-1. Methodology.

### 4. MATERIALS

#### a) Ordinary portland cement (OPC)

Cement is one of the important component in concrete. Use of high grade cement gives drastic improvement in strength. While compared to low grade cement, high grade cost ratio is slightly higher but they offer 10-20% reduction in cement consumption and improves the other properties of concrete. In this modern world as far construction industry is concerned high grade cement offers lower energy in production, economical and improves the technical aspects of cement. Finally blended cement remains a ecofriendly material. The lower grade cement33 usage graph was drastically reduced in the construction industry. As far as blended cement is concerned the percentage of the main ingredients are increased and some other extra adhesive components are used in cement. The properties of Ordinary Portland cement are listed in the Table-1 given below.

Table-1. Properties of ordinary portland cement.

Test	Result	As per IS 4031-1998
Consistency	53	—
Initial setting time	90 min	Not less than 30 min.
Final setting time	5 hours	Not more than 600 min.
Specific gravity	3.12	—

#### b) Aggregates

The aggregates used in concrete satisfies both plain cement and reinforced concrete. The aggregate are broadly classified in to two types i.e fine aggregate and coarse aggregate. The grading requirements for fine aggregates used in concrete are listed in ASTM specification C-33. At least 80 percent of the particles should be smaller than 3mm. The aggregate size used are classified based on the requirement. The coarse aggregate used in the concrete varies based on their structural application. In structural members the grain size is uniform mostly in coarse aggregate to increase its self weight. The properties of aggregates are listed in the Table-2 and Table-3 given below

Table-2. Properties of coarse aggregate.

Test	Result	As per IS 383-1970
Fineness modulus	5.2	5 to 7
Specific gravity	2.1	2.6

Table-3. Properties of fine aggregate.

Test	Result	As per IS 383-1970
Fineness modulus	2.78	Medium sand
Specific gravity	2.72	2.56

#### c) Water

Water is a main compound as far as concrete is concerned. It reacts with cement and initiates the binding in concrete. Water remains a important parameter in deciding the workability of concrete. The qualitative measures to be taken in to account for water to improve strength aspects of concrete in longer span. But the qualitative measures are not considered which results in several repair works in concrete towards their life period.The initial setting time of the test block made with a cement and the water proposed to be used shall not differ by  $\pm 30$  minutes.



#### d) Alccofine

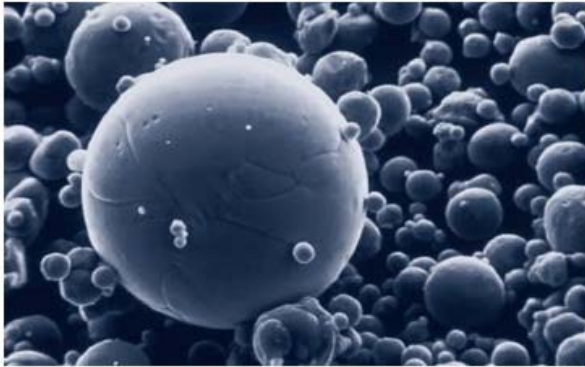


Figure-2. Nano particular form of alccofine.

Alccofine is a dense pore structure with some CaO components induced in it improves the secondary hydrated product as it increases the strength in shorter and longer time span. Alccofine have better particle size distribution compared to other Supplementary Cementations Materials which provides dense matrix pore structure resulting in to reduced water contains and batter workability. Alccofine has the lime contain 34% which provides more quantum of secondary hydrated product. This results in prolonged chemical reaction and responsible for reduced heat liberated by the hydration process. Alccofine has batter particle packing which results into increased rheology resulting in to improved flow ability. The study aims on the comparative study on the concrete cubes. M25 grades of concrete was made and used two different water cement ratio after conducting slump cone test, 0.4, 0.45 and 0.5. These include a control mixture containing 4,8,12,16,17,20,25,50,75 and 100% Alccofine as cement replacement. The specimens casted are undergone curing at atmospheric temperature. The specimen is tested for 7 and 28 days curing. A large number of cubes were cast and subjected to normal curing at atmospheric temperature. The compressive strength was determined 7 and 28 days.

Table-4. Properties of fine aggregate.

Constituent	Percentage by weight of sample (Alccofine)
SiO <sub>2</sub>	33.6
SO <sub>3</sub>	0.19
Al <sub>2</sub> O <sub>3</sub>	22.6
Fe <sub>2</sub> O <sub>3</sub>	2.2
MnO	0.62
MgO	8.00
CaO	31.0
Na <sub>2</sub> O	0.42
Chloride content	0.02
Sulphide Sulphur	1.1
Specific gravity	2.86

#### 5. RESULTS AND DISCUSSIONS

The specimens casted will be tested for Compressive Strength of plain cement concrete with replacement of cement by alccofine with various percentages in conventional concrete (Cubes 150x150x150mm)

##### a) Comparative study on compressive strength of Conventional concrete and concrete with various % of alccofine for 7 days curing

The compressive strength of concrete comparative study shows the strength increases maximum only upto 16% replacement of alccofine and after that strength drastically reduces. The maximum strength attained is 38.9 N/mm<sup>2</sup> and increase in percentage is 50.95.

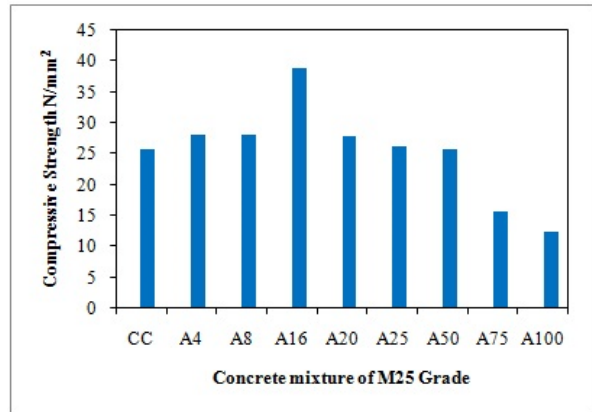


Figure-3. Compressive strength of concrete with various % of alccofine for 7 days curing.

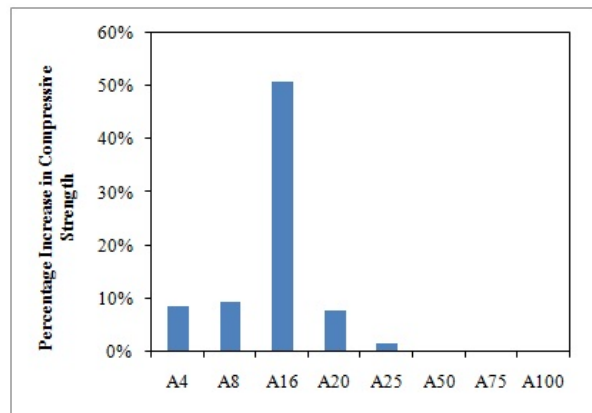


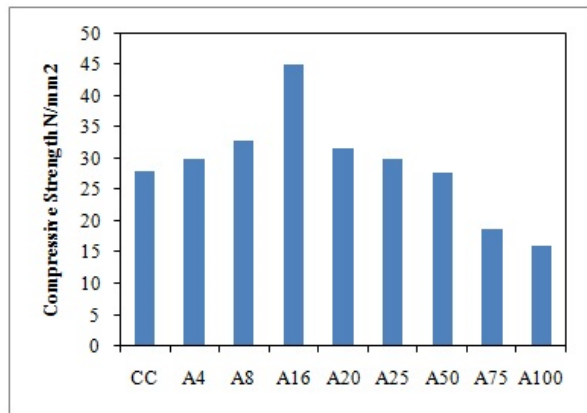
Figure-4. Comparative study on compressive strength of conventional concrete and concrete with various % of alccofine for 7 days curing.

##### b) Comparative study on compressive strength conventional concrete and concrete with various % of alccofine for 28 days curing

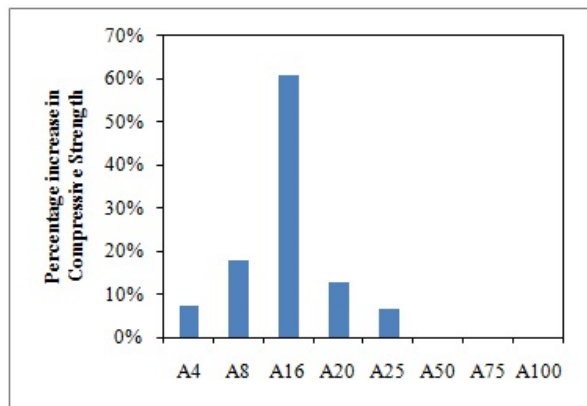
The compressive strength of concrete comparative study shows the strength increases maximum



only upto 16% replacement of alccofine and after that strength drastically reduces. The maximum strength attained is 45.1 N/mm<sup>2</sup> and increase in percentage is 60.95



**Figure-5.** Compressive strength of concrete with various % of alccofine for 28 days curing.



**Figure-6.** Comparative study on compressive strength of conventional concrete with various % of alccofine for 28 days curing.

## 6. CONCLUSIONS

The testing of concrete specimen shows the following results

- Undergoing compressive strength test, the maximum compressive strength of concrete when partially replaced by alccofine was found maximum to be at 16% for both 7 days and 28 days i.e. 38.9 N/mm<sup>2</sup> and 45.1 N/mm<sup>2</sup>.
- There was not a big nominal change when cement was replaced up to 10% but when it reached 16% the compressive value recorded was maximum, then on further addition of alccofine the compressive strength values goes on decreasing.

- The increase in percentage of compressive strength for 7 days and 28 days curing was found to be maximum at 16% replacement exhibiting the value of 50.95 % and 60.95% when compared with conventional.
- The minimum compressive strength value was seen when the cement was fully replaced by alccofine i.e at 100% was found to be 12.36 N/mm<sup>2</sup> and 16.2 N/mm<sup>2</sup> for 7 days and 28 days replacement.
- Alccofine when added in concrete mix exhibits nice permeability parameters which results in resistance against corrosion.
- CaO present in alccofine when combines with water under mix, provides high resistance against chemical and acid attacks.

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