

# Development of High Performance Concrete using GGBS and Alccofine

Syed Nayaz<sup>1</sup>, Arun Kumar<sup>2</sup>, Suresh L<sup>3</sup>, Lohith K H<sup>4</sup>, G M Jagannatha<sup>5</sup>

<sup>1,2,3,4</sup>Department of Civil Engineering, STJ Institute of Technology,

<sup>5</sup> Associate Professor, Department of Civil Engineering,  
STJ Institute of Technology Ranibennur-581115, India

**Abstract** - Using alccofine1203 enhance early strength in concrete. The experimental work is carried out to evaluate mechanical properties such as compressive strength, split tensile strength and flexural strength for normal strength concrete and high strength concrete. Normal concrete and High strength concrete is made by replacing alccofine by weight of cement various percentage 10%, 15%.using constant water cement ratio 0.30 for M70 concrete respectively, super plasticizer are used for required degree of workability. Casting specimen is cured in atmospheric temperature and hardened properties for 7, and 28days.

**Key Words:** Normal strength1, High strength2, and Alccofine3.

## 1. INTRODUCTION

HPC is a material which is being used by infrastructure industry for long term performance strong , durable structures, better rheological, mechanical and durability properties than normal strength concrete. The general mix design guideline given by either American concrete institute (ACI-211-4R) ,departmental of environmental science (DOE Method), recommend that design of high-strength concrete mixtures is possible by keeping water binder ratio as much as possible to keep low as per the requirement. it is always better that high strengths are made possible by reducing porosity by keeping water binder ratio low ,maintaining homogeneity, and reducing shrinkage in the hydrated cement paste and the transition zone. ACI defined high-performance concrete as a concrete satisfying special requirement of long term performance and durability requirements that cannot always be achieved significantly by using conventional practices and normal mixing, placing, and curing methods.

Generally Mineral admixtures are used in order to improve mechanical properties of the mixture because of its compatibility with various type of cement along with Pozzolanic nature , self cementitious activity based performance. although , mineral admixtures help to decrease cost of the mixture by improving the workability of fresh concrete. Moreover, fresh concrete mixtures containing mineral admixtures are less prone to bleeding, segregation as well as help to produced cohesive concrete which ultimately increase the durability of the structure. The effect of mineral admixtures on the properties of mortar, fresh concrete along with hardened concrete mixtures was studied by many researchers. Moreover, there is relatively acute data on the microstructure of the binders subjected to various deleterious effects. Although there is no specific point of separation

between high-strength concrete and normal-strength concrete, as per the Indian Standard guideline suggest high-strength concrete as concrete with a compressive strength greater than fifty five N/mm<sup>2</sup>. For mix proportioning of HSC may or may not require special materials, but it definitely requires materials having highest quality and their optimum proportions. The utilization of HSC that consistently fulfil requirements for workability and strength development. it posses more durability as well as reduced permeability for better performance of the structure used as a modern construction material by infrastructure industry. It would be difficult to produce high-strength concrete mixtures with required workability without using chemical admixtures particularly high range water reducing admixture. For validation of strength to water/cement ratio for normal strength concrete and high strength concrete the target water/cement ratio can be in the range 0.2-0.5.

## 2. SYSTEM DEVELOPMENT FOR STUDY

High Performance concrete is prepared with help of the guideline give by ACI-211-4R and in accordance with IS-10262-2009 , by using various cementitious material like Fly Ash, Silica fume, Alccofine as a mineral admixture. various w/b ratio is used for achieving the different compressive strength of concrete and its relative workability. Concrete cubes of 100 mm size were made for concrete mix proportioned to replace 10%, 17%, and 17% cement with fly ash, Silica Fume and Alccofine respectively. To achieve different compressive strength of concrete wide range of concrete mixes with water to binder ratio (W/b) of 0.25, 0.3 and 0.35 were used.. The dosages of super plasticizer keep constant throughout the work as 0.1% by mass of total cementitious material. when concrete is in plastic state i.e. fresh concrete workability is measured in terms of slump and compacting factor. while harden concrete is tested for compressive strength with the help of compression testing machine.

### 3. DESIGN DATA CONSIDERED FOR PROPORTIONING

- a) Type of cement: OPC 53 grade, IS 8112.
- b) Nominal maximum size of aggregate: 12.5mm
- c) Exposure condition: Moderate
- d) Degree of supervision: Good
- e) Type of aggregate: Crushed angular
- f) Chemical admixture: S.P. 0.1% by mass of total cementitious material

#### Materials Test Data

- a) Cement used: OPC 53 grade.
- b) Specific gravity of
  - 1) Cement: 3.15
  - 2) Coarse aggregate: 2.89
  - 3) Fine aggregate: 2.83
- c) Water absorption:
  - 1) Coarse aggregate: 1.38%
  - 2) Fine aggregate: 1.15%
- d) Free moisture:
  - 1) Coarse aggregate: NIL
  - 2) Fine aggregate: NIL
- e) Sieve analysis:
  - 1) Coarse aggregate: Confirming to IS 383.
  - 2) Fine aggregate: confirming to Zone-I Confirming to IS 383

**Alccofine-** Alccofine 1203 is proprietary low calcium silicate based mineral additive Controlled granulation process results in unique particle size distribution. Alccofine has particle range 4 to 6 microns, average particle size is 4 micron.

**Table: 1.** Physical properties of Alccofine

property	unit	value
Average Particle Size	Micron	4 to 6
Fineness	Cm <sup>2</sup> / gm	12500
Specific Gravity	-----	2.86
Bulk Density	Kg / M <sup>3</sup>	600 to 700

Super-plasticizer-

**Table: 2.** Properties of Conplast-SP430

Appearance	Specific gravity	Alkali content	Air entrainment
Brown Liquid	1.2 at 200°C	>72.0g Na <sub>2</sub> O equivalent/liters of admixtures.	>2%

(1)

### 4. TESTS ON CONCRETE

**Table: 3.** Compressive Strength for M70 concrete

Serial. No.	Percentage of Alccofine 1203	Compressive strength for M70 concrete in (N/mm <sup>2</sup> )	
		7 days	28 days
1	00%	47.59	63.15
2	10%	53.81	68.47
3	15%	59.77	72.00

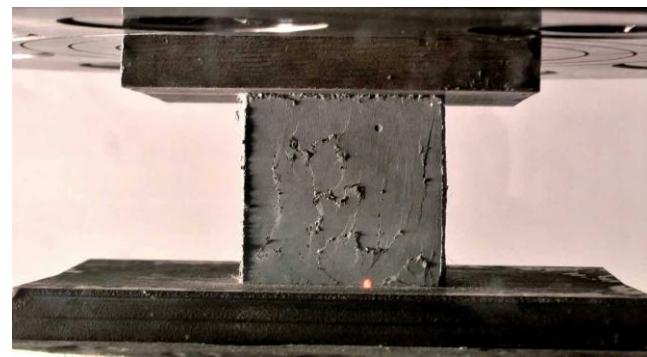


Fig. 1. Compressive strength test

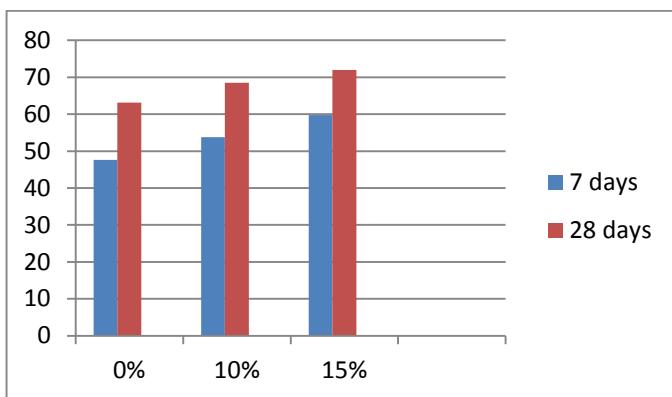
**Table: 4.** Split Tensile Strength for M70 concrete

Serial. No.	Percentage of Alccofine 1203	Compressive strength for M70 concrete in (N/mm <sup>2</sup> )	
		7 days	28 days
1	00%	4.30	11.50
2	10%	5.00	13.62
3	15%	9.30	19.00



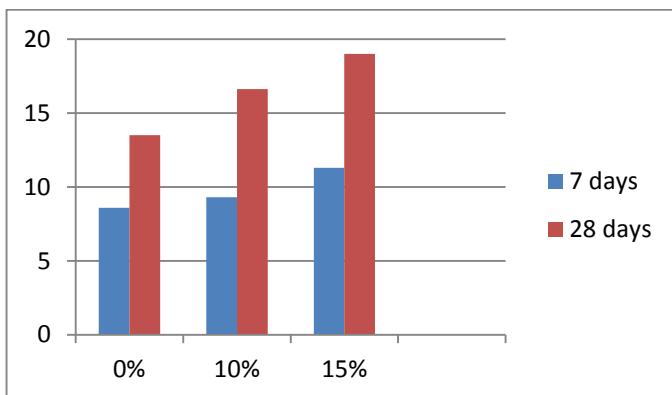
Fig. 2. Split tensile strength test

Chart. 1. Compressive strength for M70 concrete



Compressive test is a very significant test to know mechanical property of concrete. This test is conducted for various percentage of alccofine is replaced to the cement. Optimum percentage of alccofine for normal strength concrete and high strength concrete is 15% respectively.

Chart. 2. Split tensile strength for M70 concrete



Split tensile strength of concrete criteria is difficult measure directly. That's why, placing cylinder horizontally then applying the compressive load until the cylinder fail. It gives the strength indirectly to cylinder. Optimum strength is obtained at 11% and 10% for normal and high strength concrete respectively.

## CONCLUSIONS

- [1] Experimental work are carried out various percentage of Alccofine replaced to the cement in control mix from 10% and 15% and both the fresh and hardened properties
- [2] for normal strength and high strength compared. Using the alccofine as mineral admixture get early strength in concrete.
- [3] The fresh properties and hardened properties of concrete with alccofine are enhanced compared control mix.
- [4] The hardened properties like Compression strength and split tensile strength of concrete is obtained at 15%.
- [5] We observed in the above experimental work the alccofine increases the strength of normal strength of the concrete up to 11% for hardened properties then after decreases as increasing the alccofine. But in high strength concrete hardened properties increases at 10% then decreased for the increased percentage of alccofine.

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