

Experimental Investigation on Blended Concrete with Alccofine

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ABSTRACT

Making concrete industry sustainable in the present scenario is very important, so as to reduce its adverse effects on environment. While choosing raw materials for construction it is necessary to go with eco-friendly materials. Alccofine (Ultra fine form of slag) which are by-product from steel industry possess cementitious properties can be used as replacement of cement, which are causing a lot of environmental pollution. The mechanical properties such as compressive, split tensile and flexural strengths of these mixes were computed for 7, 14 and 28 days. The results of Blended Concrete are compared with those of control concrete. It was observed that Blended Concrete mixes exhibited superior qualities like quick setting and enhanced workability, their mechanical properties were found to be higher than that of the conventional concrete. This goes to prove that the Alccofine as replacement for cement would enhance the properties of Blended Concrete.

Keywords

Alccofine, Blended Concrete, Cement, Compressive, Split tensile and Flexural strengths

INTRODUCTION

In present day, important aspect of construction is sustainability. As population is increasing, use of eco-friendly materials decide the future of human life. Other important thing is rapid urbanization and industrialization that have led to the increase in the demand of the construction resource. Hence more energy being consumed and also manufacture of raw materials for construction producing polluting elements in the form of gases and solids. Cement is the one of the most important aspects of the construction industry. Being widely produced due to its increasing demand, it is also responsible in the production of CO₂. The production of every single tone of cement releases equal amount of CO₂ in the atmosphere. Research works are being carried out for finding out the alternate cementing material which will replace cement partially or fully due to its ill effects on the environment.

MATERIALS

Cement:

In our investigation, 53 Grade cement as per IS 12269: 1987 is used for all type of mixes. The physical and chemical properties of the cement used are given in Table 1 and Table 2 respectively.

Table 1: Physical Properties of Cement

Properties	Content	Values per IS 12269 : 1987
Grade	53	53
Specific gravity	3.12	3.15
Fineness of cement	6.50%	< 10%
Normal Consistency	32%	30% - 35%
Initial Setting Time	50 min	> 30
Final Setting Time	420 min	< 600
Soundness	1.2 mm	< 10 mm

Table 2: Chemical composition of Cement

Chemicals	Content %
SiO ₂	21.3%
Al ₂ O ₃	4.5
Fe ₂ O ₃	4.0
MgO	2.4
CaO	63.1
Na ₂ O	0.1
K ₂ O	1.2
SO ₃	2.2

Alccofine:

Alccofine used in our investigation was manufactured by M/S Counto Microfine Products Pvt. Ltd., (CMPP), Alcon Organization, Goa, India. The physical and chemical properties of Alccofine can be found in Table 3 and Table 4 respectively.

Table 3: Physical Properties of Alccofine

Property	Values obtained
Fineness (cm ² /gm)	>12000
Specific Gravity	2.9
Bulk Density(Kg/m ³)	700-900
Particle Size Distribution in Microns	
D10	1.5
D50	5
D90	9

Table 4: Chemical composition of Alccofine

Chemicals	% Values
CaO	61-64 %
SO ₃	2-2.4 %
SiO ₂	21-23 %
Al ₂ O ₃	5-5.6 %
Fe ₂ O ₃	3.8-4.4 %
MgO	0.8-1.4 %

Coarse aggregate:

The coarse aggregate used in our investigation was rounded uncrushed gravel which is passed through a 20 mm sieve and was retained in 12 mm sieve obtained locally. The physical properties of coarse aggregate are shown in Table 5.

Table 5: Properties of Coarse Aggregate

Property	Values obtained
Specific Gravity	2.63
Fineness Modulus	7.22
Water Absorption	0.83%

Fine aggregate:

The fine aggregate used in our investigation was the locally available river bed sand. Its characteristics are listed down in Table 6.

Table 6: Properties of Fine Aggregate

Property	Values obtained
Specific Gravity	2.68
Fineness Modulus	2.7
Grade Zone	II
Water Absorption	0.20

Water:

Tap water available in our university campus was used in this investigation for the purpose of preparing the mixes.

MIX DESIGN

M30 Grade of concrete mix design was arrived at according to IS 10262-2009. The mix proportion arrived at for the experiments are shown in Table 7.

Table 7: Mix Proportion

Materials	Cement kg/m ³	Fine Aggregate kg/m ³	Coarse Aggregate kg/m ³	Water kg/m ³
Quantity	438	699.2	1109.8	197

Mix Proportion = 1: 1.59: 2.53 with water cement ratio (w/c) of 0.43.

RESULTS

Compressive Strength:

Most important property of concrete is Compressive strength carried out as per IS 1199: 1959 The tests were conducted on 7, 14 and 28 days on cube specimens of side 100mm. The strength in compression has a definite relationship with all other properties of concrete, i.e., these properties are improved with improvement in compressive strength. The height of the test specimen in relation to its lateral dimensions greatly influences the results.

Table 8: Compressive strength of Concrete

Alccofine	7 Days	14 Days	28 Days
0%	22.40	30.01	40.20
8%	36.66	40.03	41.00
10%	41.16	44.38	46.60
12%	39.24	42.20	45.68
14%	38.68	41.78	44.67
16%	37.20	40.75	43.76

From Table 8, the compressive strength achieved is 46.60MPa, which is well above the target strength. The strength of the concrete depends on the water cement ratio and porosity. With the use of alccofine as mineral admixture the compressive strength was increased compared to normal concrete.

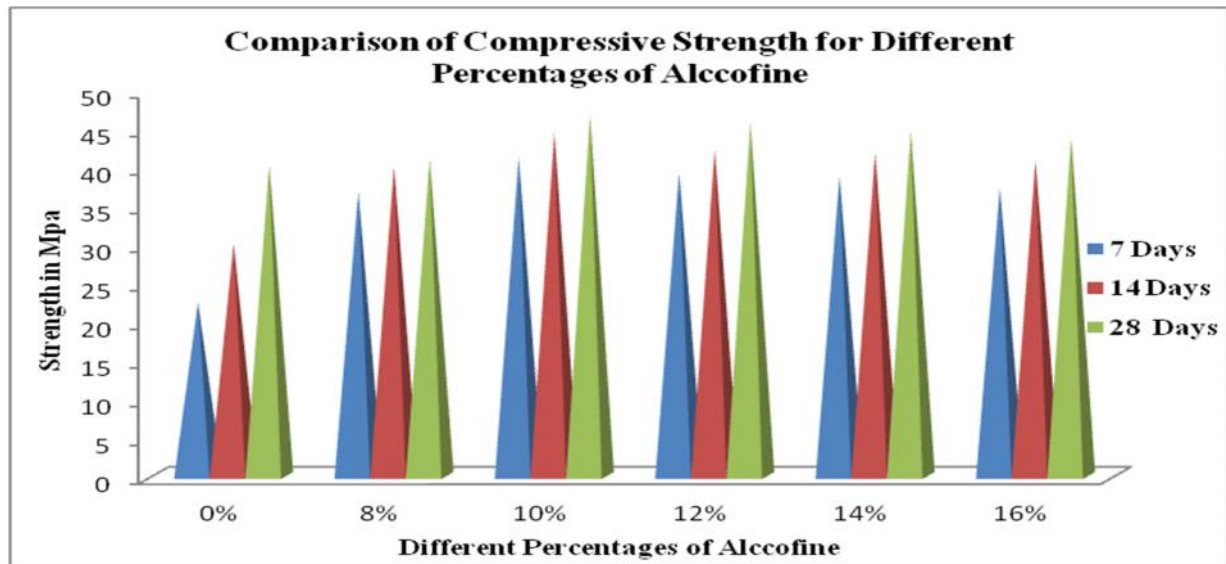


Fig. 1 Compressive strength of Concrete

From the Graph, high early strength is obtained at 7days of curing and the compressive strength increases upto 14days of curing and remains constant after that.

Split Tensile Strength:

The split tensile strength was tested on 100mm diameter 200 mm length cylinders. The tests were conducted on 7, 14 and 28 days and the test results are tabulated in the Table 9.

Table 9: Split tensile strength of Concrete

Alccofine	7 Days	14 Days	28 Days
0%	3.30	4.45	4.94
8%	4.54	5.45	6.22
10%	4.90	5.62	6.94
12%	4.86	5.50	6.36
14%	4.72	5.34	6.28
16%	4.68	5.26	6.12

As per ASTM678, the split tensile strength usually varies between 10-20% of compressive strength in normal strength concrete. But in high strength concrete the split tensile strength will be comparatively less. From Table 9, the average split tensile strength was about 12.45% of compressive strength at 28 days for concrete with 10% alccofine content.

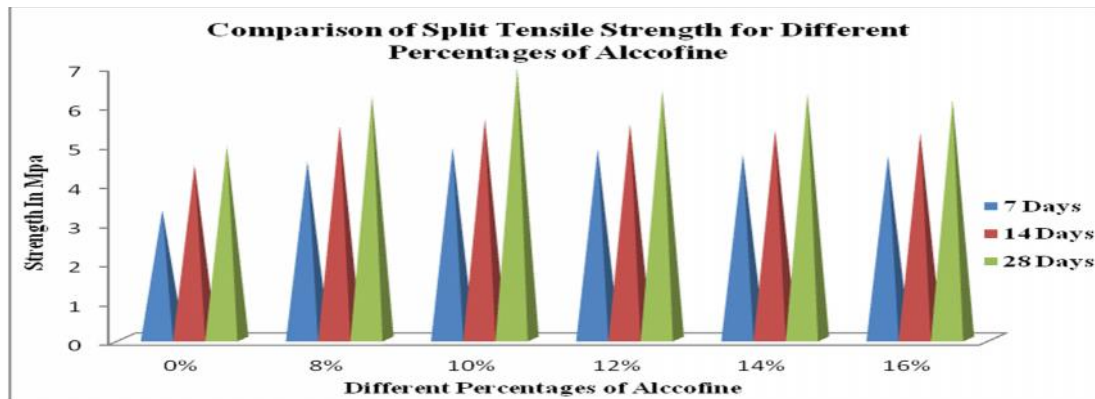


Fig. 2 Split Tensile Strength of Concrete

Flexural Strength:

A concrete beam of size (100×100×500 mm) is loaded through similar steel bearings placed at the third points on the top surface (2-point loading). Test details are as described in IS 516: 1959.

Table 11. Flexural strength at different ages

Alccofine	7 Days	14 Days	28 Days
0%	2.97	3.92	5.83
8%	3.12	4.08	6.92
10%	4.08	5.83	7.12
12%	3.92	4.92	6.97
14%	3.83	4.12	6.83
16%	3.12	3.92	6.12

As per ASTM C 78, the flexural strength usually varies between 10-20% of compressive strength in normal strength concrete. But in high strength concrete the flexural strength will be comparatively less. From table 7 the average flexural strength was about 12.80% of compressive strength at 28 days for concrete with 10% alccofine content.

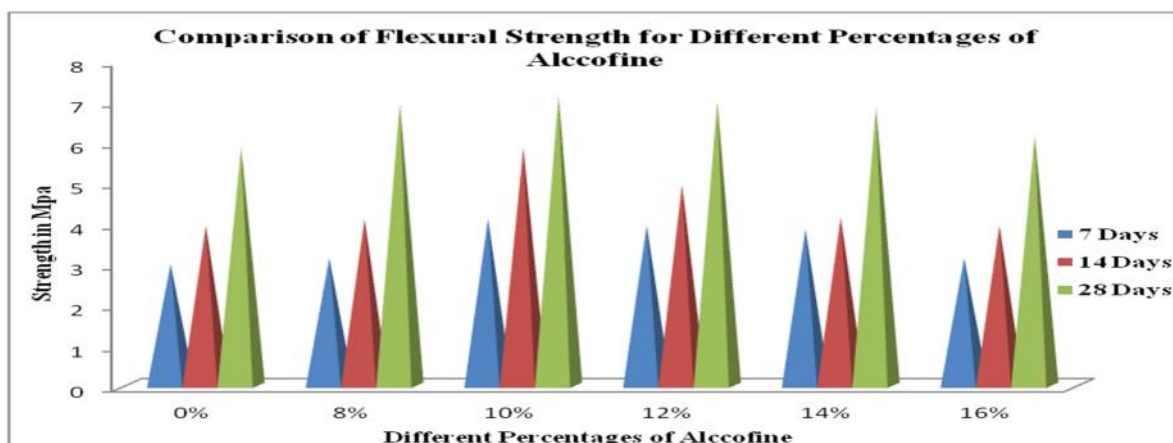


Fig. 3 Flexural strength of Concrete

CONCLUSION

Alccofine witnessed to improve the fresh and mechanical properties of concrete which can results in high performance as well as high strength concrete. The strength difference between alccofine concrete mix specimens and traditional concrete mix specimens became high distinct in the beginning age of curing itself. Compressive strength, Split tensile strength and Flexural strength variation for the replacement of cement to a level of 10% of Alccofine, indicate that an optimum replacement level. Alccofine made the concrete very resistive in all the mechanical properties.

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