2nd International Conference on Current Research Trends in Engineering and Technology
© 2018 IJSRSET | Volume 4 | Issue 5 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Performance and Analysis of Brass Coated Micro Steel Fibre on Alccofine 1203 Based Concrete

Saggu Arshdeep Singh[1], V. R. Panchal[2], Jay Bhavsar[3] and Vatsal Patel[4]

[1]Postgraduate Student, Civil Engineering Department (Structural Engineering), Chandubhai S Patel Institute of Technology, Charotar University of Science and Technology, Changa, Gujarat

[2] Professor and Head, Civil Engineering Department (Structural Engineering), Chandubhai S Patel Institute of Technology, Charotar University of Science and Technology, Changa, Gujarat

[3] Assistant Professor, Civil Engineering Department (Structural Engineering), Chandubhai S Patel Institute of Technology, Charotar University of Science and Technology, Changa, Gujarat

[4] Associate Professor, Civil Engineering Department, A. D. Patel Institute of Technology, New Vallabh Vidhyanagar,

ABSTRACT

Concrete has gained more attention due to increased construction activities in terms of construction of buildings, highways and other special structures. It is necessary to enhance its cementitious characteristics by means of strength. It is also reasonable to produce concrete using admixtures such as Brass Coated Micro Steel fibre, Alccofine, etc. as partial replacement of cement. Alccofine based concrete will enhance properties by giving excellent resistance against corrosion as well as filling up the voids in cement. Brass Coated Micro Steel Fibre and Alccofine based Concrete will make the concrete more stable and alter its mechanical property. The experimental work is carried out on M40 grade concrete by replacing cement with 5%, 10% and 15% of Alccofine 1203 and by adding 1%, 1.5% and 2% of Brass Coated Micro Steel Fibre. From the experimental study, it is observed that the compressive strength, split tensile strength and flexural strength increase by 65.55%, 40.48% and 32.21% respectively in comparison with control mix.

Keywords : Alccofine 1203, Brass Coated Micro Steel Fibre, Flexural Strength, Compressive Strength, Split Tensile Strength.

I. INTRODUCTION

Concrete is the second thing which comes after water in terms of utility. Numerous surveys show that concrete needs to get alterations in its properties to have longer life span. In order to construct a stronger structure, it must have high quality ingredients which can boost performance of concrete to certain levels [1].

Many structures are in need of alterations in terms of strength and durability for better life span where materials like Alccofine 1203 and Brass coated micro steel fibres will help. Today, there are numerous admixtures categorized as minerals and chemicals. The changes of the mix design and addition of proper proportions of admixtures will shield concrete from nature's act. As an example, structures are facing problems like acid attack or else which creates deterioration in concrete's molecular bonding which results in damage to structure. Materials used like alccofine 1203 and brass coated micro steel fibres have good availability and will help concrete in terms of

compressive and flexural strength including its durability which will be economical to engineers for different types of construction [2].

There are numerous types of admixtures like ground granulated blast furnace slag, fly ash, silica fume and rice husk ash which can be used in order to improve different properties of concrete for categorized constructions [3].

II. MATERIALS AND PROPERTIES

M40 grade concrete is produced using materials with properties discussed below:

(i) Cement

In this study, cement used is Coromandel king of 53 grade of ordinary Portland cement. Specific gravity and standard consistency are found to be 3.15 and 28 %, respectively as per IS 12269-1987 [4].

(ii) Alccofine 1203

Alccofine 1203 is an additional cementitious material which is used in high performance concrete. Alccofine 1203 is microfine slag with high glass content and reactivity. Alccofine improves alkanity of concrete. It is one type of GGBS (Ground Granulated Blast Furnace Slag), which is modified by various chemicals which gives greater workability and makes dense pores in cement. Alccofine 1203 is a mineral additive with low calcium silicate. Due to pozzolanic reactivity, it results intensified hydration processes, including latent hydraulic property. Alccofine 1203 develops better packing density of paste composition. In short, it improves strength of concrete parameters at all ages. Tables I and II show physical and chemical properties of Alccofine 1203 [5].

TABLE I- PHYSICAL PROPERTIES OF ALCCOFINE 1203

Fineness (cm^2/gm)	>12000
Specific Gravity	2.8 ± 0.2
Bulk Density (kg/m^3)	690
Particle Size Distribution D10	1.5 Micron
Particle Size Distribution D50	4.3 Micron
Particle Size Distribution D90	8.9 Micron

TABLE II- CHEMICAL PROPERTIES OF ALCCOFINE 1203

Constituent	Ratio
SiO_2	35.1 %
Al_2O_3	21.9 %
Fe_2O_3	0.8 %
CaO	33.8 %
SO_3	0.08 %
MgO	6.6 %

(iii) Fine Aggregate

Locally available sand passed through 4.75mm sieve having a specific gravity of 2.1 and fineness modulus 3.04 is used as fine aggregates. Bulk density is found to be 1094 kg/m^3 in loose state and 1162 kg/m^3 in compacted state with a water absorption rate of 1.583%.

(iv) Coarse Aggregate

Coarse aggregates of 20 mm ware used having specific gravity 2.6 and fineness modulus 7.18.

(v) Water

Potable water free from all types of acids, organic and inorganic impurities, is used for proper mixing and curing of concrete.

(vi) Brass Coated Micro Steel Fibres (13mm)

Brass Coated Micro Steel Fibre as shown in Figure 1 used in High Performance densified concrete

has more maximum content of carbon. They are available in different diameters & length sizes. Addition of brass coated micro steel fibres into the concrete improves the crack resistance of the concrete. Tables III and IV show physical and chemical properties of brass coated micro steel fibres [6].

Figure 1: Brass Coated Micro Steel Fibre (13 mm)

TABLE III- PHYSICAL PROPERTIES OF BRASS COATED MICRO STEEL FIBRES

Items	Technical Data
Diameter	0.2mm
Ultimate Tensile Strength	2800 N/mm^2
Length	13 mm (± 10%)
Surface Finish	Brass Coated
Aspect Ratio	65

TABLE IV- CHEMICAL PROPERTIES OF BRASS COATED MICRO STEEL FIBRES

Constituent	Standard Value	Test Results
%C	0.72 - 0.80	0.76
% Mn	0.50 – 0.80	0.65
% Si	0.10 – 0.30	0.19
% S (Max)	0.035	0.015
% P (Max)	0.035	0.03
% Ni (Max)	0.20	0.12
% Cr (Max)	0.15	0.11
% Mo (Max)	0.05	0.01
% Cu (Max)	0.25	0.19
Al	0.01	-

III. EXPERIMENTAL WORK

The concrete of M40 grade is produced by following steps discussed below:

(I) Mix Proportion

The mix proportion shown in Table V is found for a M40 grade concrete with the slump of 50mm-70mm as per IS: 10262-2009 [7].

TABLE V- MIX PROPORTION

Material	Weight (kg/m^3)
Cement	450
Water	186
Fine Aggregate	461.95
Coarse Aggregate	1081.97
w/c ratio	0.40

(II) Casting and Curing

Casting is done by adding Alccofine 1203 and Brass coated micro steel fibres for high performance concrete in different proportions as shown in Table VI. Cubes of size (150mm × 150mm × 150mm), cylinder of size 150mm diameter and 300mm of height and beams of (150mm × 150mm × 700mm) are casted and cured in water for 7 and 28 days.

TABLE VI- MIX DESIGN

Mix Proportion*	Usage of Alccofine 1203 (%)	Usage of Brass Coated Micro Steel Fibre (%)
0A0FC(Control)	0	0
5A1FC	5	1
5A1.5FC		1.5
5A2FC		2
10A1FC	10	1
10A1.5FC		1.5

10A2FC		2
15A1FC	15	1
15A1.5FC		1.5
15A2FC		2

*0A0FC- Control Mix

*5A1FC- 5% of Alccofine 1203 & 1% of Brass Coated Micro Steel Fibres based concrete

*5A1.5FC- 5% of Alccofine 1203 & 1.5% of Brass Coated Micro Steel Fibres based concrete

*5A2FC- 5% of Alccofine 1203 & 2% of Brass Coated Micro Steel Fibres based concrete

*10A1FC- 10% of Alccofine 1203 & 1% of Brass Coated Micro Steel Fibres based concrete

*10A1.5FC- 10% of Alccofine 1203 & 1.5% of Brass Coated Micro Steel Fibres based concrete

*10A2FC- 10% of Alccofine 1203 & 2% of Brass Coated Micro Steel Fibres based concrete

*15A1FC- 15% of Alccofine 1203 & 1% of Brass Coated Micro Steel Fibres based concrete

*15A1.5FC- 15% of Alccofine 1203 & 1.5% of Brass Coated Micro Steel Fibres based concrete

*15A2FC- 15% of Alccofine 1203 & 2% of Brass Coated Micro Steel Fibres based concrete

IV. TESTS

Compression test, Split tensile strength and Flexural test are performed to find mechanical properties as mentioned below:

(I) Compression Test

Compression test is carried out on cube specimens. of sizes (150mm × 150mm × 150mm). After filling concrete into moulds, layers are tamped by tamping rod by three equal layers of 25 blows. Moulds are vibrated properly in order to avoid the air voids in concrete. Specimens are tested on compression testing machine after 7 and 28 days of curing. Load is given gradually at the rate of 5.2kN per second till specimens fail.

(II) Flexural Test

Flexural test is carried on beams sizes (150mm × 150mm × 700mm) tested on two point loading flexural testing machine as per IS: 516-1959 and flexural strength at failure is noted [8].

(III) Split Tensile Strength

Split tensile test is carried out on (300mm length and 150mm diameter) moulds. Cylinders are not in position of resisting direct tension loadings, as concrete gets cracks when applied to tensile forces so it is necessary for determining tensile strength [9].

V. RESULTS AND DISCUSSION

The results of compression test, split tensile test and flexural strength obtained after 7 and 28 days are discussed below:

(I) Compression Test

Figures 2 and 3 show compressive strength for mix of 10A2FC and 15A2FC which gives 38.97MPa and 44.44MPa with compare to control concrete respectively which is 23.80MPa and 28.75MPa for 7 and 28 days.

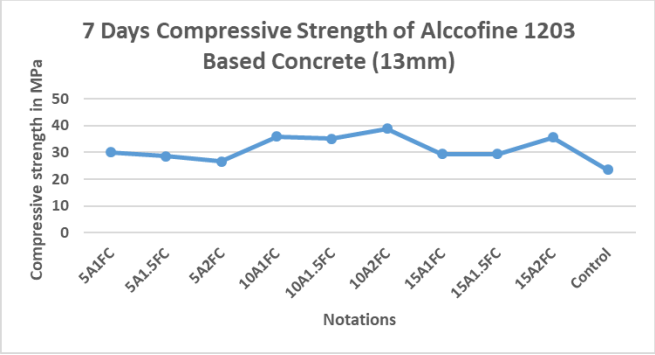

Figure 2: Compressive Test at 7 days

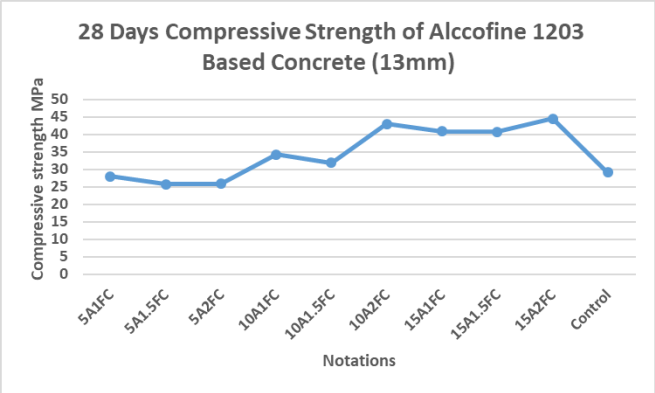

Figure 3: Compressive Test at 28 days

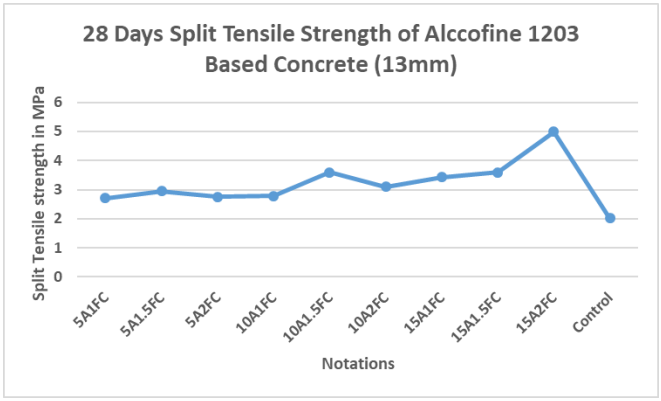

Figure 5: Split Tensile Strength at 28 days

(II) Split Tensile Test

From Figures 4 and 5, it shows results of split tensile strength for mix of 10A2FC & 15A2FC which gives 2.12MPa and 4.99MPa for 28 days of curing as compared to control concrete respectively which is 1.44MPa and 2.02MPa. The increase in strength could be due to usage of fibres which leads to good split tensile strength.

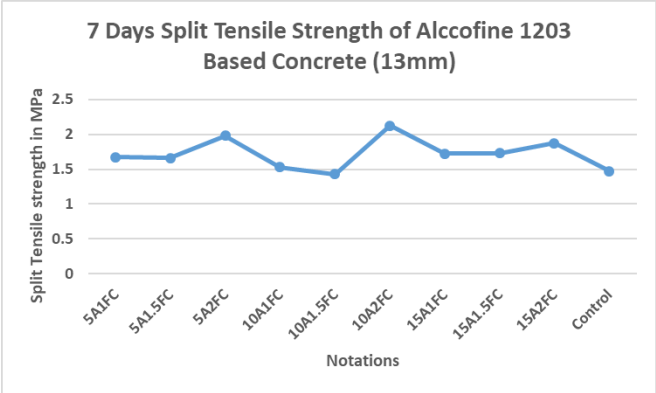

Figure 4: Split Tensile Strength at 7 days

(III) Flexural Test

Figure 6 shows flexural strength results. In flexural strength, 15A2FC gives strength which is 5.68MPa as compared to control concrete which is 1.82MPa. Curing helps fibres to builds connections between surfaces which further helps in the preventions of cracks to extent at very micro levels. These fibres give energy absorption capacity to the specimens as well as post fracture stress capability is good as it absorbs impact loads [10][11]. This could be the reason of increase in flexural strength.

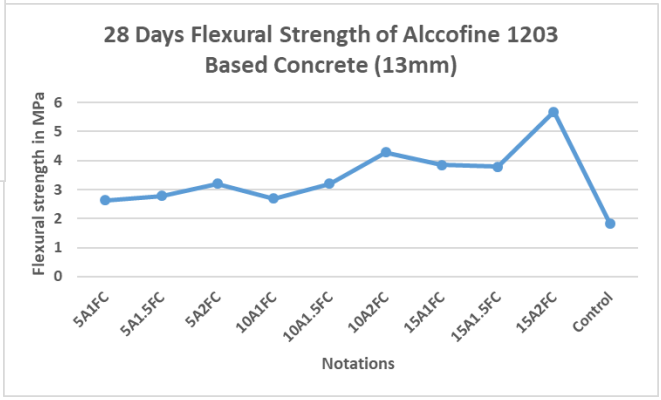

Figure 6: Flexural Strength at 28 days

VI. CONCLUSIONS

The following conclusions are made based on study:

- The optimum mix obtained from the study is 15A2FC.
- At 7 and 28 days, there is an increase in compressive strength by 60.55% and 65.55% in 10A2FC and 15A2FC mix, respectively as compared to control concrete mixture for M40 grade of concrete which is 23.80MPa and 28.75MPa
- At 7 and 28 days, there is an increase in split tensile strength by 69.33% and 40.48% in 10A2FC and 15A2FC mix compared to control concrete mixture respectively as 1.44MPa and 2.02MPa.
- In the 15A2FC mix, flexural strength increases by 32.21%, in contrast to control concrete which is 1.82MPa for 28 days.

REFERENCES

[1] P. S Mangat and Kribanadan Gurusamy, (1986), "Chloride Diffusion in Steel Fibre Reinforced Marine Concrete", Volume 17, pp 385-396.

[2] P. Rossi, P. Acker, Y. Malier, (1987), "Effects of Steel Fibres at Two Different Stages: The Material and The Structure", Materials and Structures, Volume 20, pp 436-439.

[3] D. H. Lim and B.H. Oh , (1999), "Experimental and theoretical investigation on the shear of steel fibre reinforced concrete beams", Engineering Structures Volume 21, pp 937–944.

[4] Yining Ding and Wolfgang Kusterle, (2000), "Compressive stress strain relationship of steel fibre-reinforced concrete at early age", Cement and Concrete Research, Volume 30, pp 1573-1579.

[5] Burcu Akcay and Mehmet Ali Tasdemir, (2012), "Mechanical behaviour and fibre dispersion of hybrid steel fibre reinforced self-compacting concrete", Construction and Building Materials, Volume 28, pp 287–293.

[6] IS 516, (1959), "Method of Test for Strength of Concrete" , Bureau of Indian Standards.

[7] IS 5816, (1999)," Method of Testing Splitting Tensile Strength of Concrete" , Bureau of Indian Standards.

[8] Vatsal Patel and Niraj Shah, (2013), "A survey of high performance concrete developments in civil engineering field", Open Journal of Civil Engineering, Volume 3, pp 69-79.

[9] IS 12269, (1987), "53 Grade Ordinary Portland Cement", Bureau of Indian Standards.

[10] Devinder Sharma, Sanjay Sharma and Ajay Goyal, (2016), "Utilization of Waste Foundry Slag and Alccofine for Developing High Strength Concrete", International Journal of Electrochemical. Science, Volume 11, pp 3190 – 3205.

[11] IS 10262, (2009), "Guidelines for Concrete Mix Design Proportioning", Bureau of Indian Standards.