ISSN 2321 3361 © 2018 IJESC

Research Article Volume 8 Issue No.7

Behaviour of HVFA Concrete by Replacing Copper Slag by Sand in Addition to Glass Fibers

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Abstract:
High Volume Fly Ash concrete system addresses all the major sustainability issues. It is recommended over the ordinary concrete as it considerably saves cement and also prevents environmental pollution. The use of fibres improves specific material properties of the concrete, impact resistance, flexural strength, toughness, fatigue resistance, and ductility. In this paper an attempt is made to study the mechanical properties of High Volume Fly-Ash Concrete by replacing sand by copper slag by 20, 30 and 40% in addition with glass fibres at 1, 2, and 3% of cement and with 50% fly ash replacement with cement. It is found that fibre additions have increased its Flexural strength characteristics considerably over the ordinary cement concrete. The major parameter that affected strength was total binders and water-binder ratio.

Keywords: High volume flyash, Copper slag, Glass fibers, 28 days strength

1. INTRODUCTION

Throughout the world concrete is the most widely used material in thre various field. Concrete basically contains ingradients such as cement, sand, crushed quarry stones and water for hydration of cement. the crushed stones and the sand are the natural sources which act as a filler material in the concrete along with cement which acts as a binding material which enhance strength for the concrete. Since the demand for concrete as a construction material is more, the demand for portland cement also more. Its been investigated that production of cement increased from 1.5 billion tons in 1995 to 2.2 billion tons in 2010 and also 3% increase in the production of cement every year. One ton cement production will liberate one ton of CO2 to the atmosphere. Among all gases, the CO2 contibutes about 60 to 65% of g;obal warming. But cement is one of the nost energy intensive construction material.The structures which are built in corrosive environment start to deteriorate after 20 to 30 years, when it is designed for more than that. Further the climate change due to global warming is also taken into account wheile we talk about service life of a structure. Since portland cement is an unavoidable component, inorder to address the global warming issues many investigations are being done till today to reduce the use of portland cement.

Copper slag is obtained by the process called smelting which is a byproduct of copper extraction. The impurities becomes slag during smelting process and is quenched in water which produces angular granules considered as a waste material. The slag contains mostly ron oxides and silicon oxides.

The Glass fiber consist of high strength alkali resistant glass fiber embedded in a concrete matrix. In general fibers are the load carrying members and can incorporated into a matrix either in continuous or chopped lengths. Hence the glass fibers got good behaviour under tensile forces, bending and shear forces, and secondary loading effects like creep and thermal response and moisture movement.

1.1 MATERIALS USED

Fine aggregate: Locally available river sand conforming to Grading zone III of IS 383 –1970.

Coarse aggregate: Locally available crushed blue granite stones conforming to graded aggregate of nominal size 12.5 mm as per IS 383 – 1970.

Fly Ash: Fly ash class F obtained from Baikampady Industrial area which confines as per IS 3812-2000.

Copper Slag: Copper Slag is replaced by sand obtianed from Blastech Ltd, Mumbai.

Glass Fibres: Chopped Glass fibers of 6mm are used obtained from Manjeshwara Chemicals Ltd.

Water: Potable water.

Physical Proporties	Proporties of fly ash
Specific gravity	2.15
Initial getting time	120 minutes
Final setting time	280 minutes
Fineness specific surface m2/Kg min	320
Lime ractivity Avg Compressive strength	4

Physical properties of Flyash

2 METHADOLOGY

This investigations explains the process and experimental works out to achieve objectives of the study. The observation in this research will be concentrated on determining the optimum percentage addition of copper slag and glass fibers in concrete. In addition, to study how well the copper slag and glass fibers improves the properties in concrete.

2.1 Mix Design and Experimental Work

2.1 Mix design

An integral part of concrete mix proportioning is the preparation of trial mixes and effect adjustments to such trials

to strike a balance between the requirements of placement, that is, workability and strength, concomitantly satisfying durability requirements. As per IS 10262, the method is adopted for finding the proportion of M25 grade concrete.

Water	Cement	Fine aggregate	Course aggregate	W/C
160ml	360kg/m^3	683.6kg/m^3	1187.1kg/m^3	0.46

2.2 EXPERIMENTAL WORK

Strength test	Compression test	Split tensile test	Flexural test
Sample type	Cube	Cylinder	Beam
Sample size	150*150*150	150*300	100*100*500
Days of testing	7, 21 and 28	7 and 28	28
Total no. of samples for one series	9	6	3

The cubes of above mentioned sizes are used for casting purpose. Cubes, cylinders, and beams were casted. The casted cubes are tested forv 7,21 and 28 days. The Mix proportion is given below in the table.

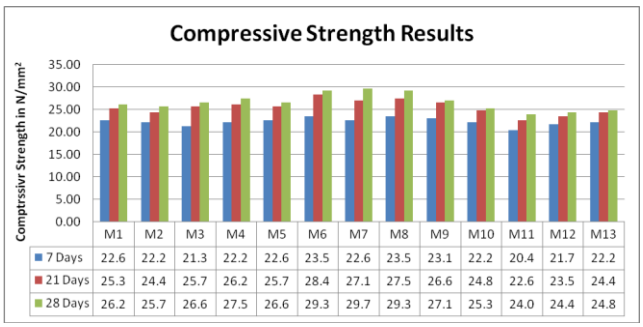
MIX	PROPORTIONS
1	50%FA + 0%CS + 0%GF
2	50%FA + 20%CS + 0%GF
3	50%FA + 20%CS + 1%GF
4	50%FA + 20%CS + 2%GF
5	50%FA + 20%CS + 3%GF
6	50%FA + 30%CS + 0%GF
7	50%FA + 30%CS + 1%GF
8	50%FA + 30%CS + 2%GF
9	50%FA + 30%CS + 3%GF
10	50%FA + 40%CS + 0%GF
11	50%FA + 40%CS + 1%GF
12	50%FA + 40%CS + 2%GF
13	50%FA + 40%CS + 3%GF

3 RESULTS AND DISCUSSIONS

3.1 Effect of addition of the copper slag and Glass fiber on the compressive strength of the high volume fly ash concrete

There compressive strength of the high volume fly ash mix with copper slag and the glass fibers has shown the greater value of compressive strength as compared to the mix without copper slag and glass fiber. We can see that for the Mix M1 the compressive strength is 26.22 N/mm2at the end of 28 days but for the mix M7 the strength is 29.78 N/mm2. Similar trend was observed for the mix M3 to M9.

The High volume fly ash concrete can be made with the replacement of the copper slag and glass fiber up to M7 mix, which give higher compressive strength as compared to the standard mix. That is the copper slag can be replaces the sand up to 30% and glass fiber content can be used up to the 1%. The optimum content high volume fly ash concrete is the concrete made with replacement of the copper slag of 30% and the glass fiber of 1%.

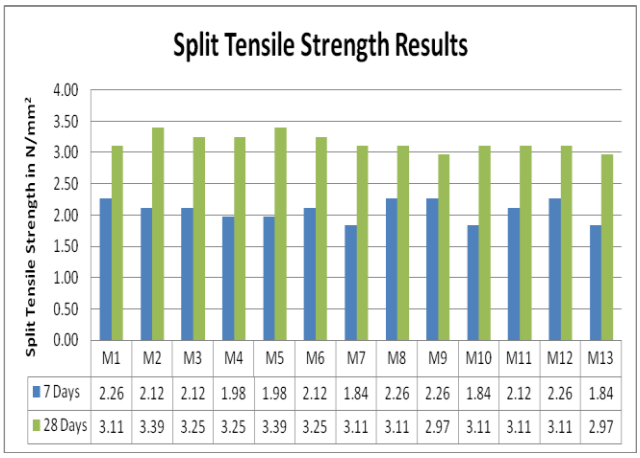


Compressive Strength Results

3.2 Effect of addition of the copper slag and Glass fiber on the Split tensile strength of the high volume fly ash concrete

From the result it can be seen that the split tensile strength of the High volume fly ash concrete with glass fiber and the copper slag is improved as compared with the mix without copper slag and glass fiber. For the M1 mix the split tensile strength is 3.25 N/mm2, for the mix with glass fiber and copper slag is 3.39 N/mm2.

It can be also seen that Mix M2 to M6 the split strength is compared with the standard mix but as the percentage of the copper slag and glass fiber increased the split tensile strength reduces. Maximum value of the split tensile strength is obtained for the mix M5, 50%Fly Ash + 20%Copper Slag + 3%Glass Fiber is 3.39 N/mm2. As the percentage of copper slag is increases the split tensile strength reduces. From the result it can be seen that the optimum dose of copper and glass fiber for High volume fly ash concrete is 20% and 3% respectively.



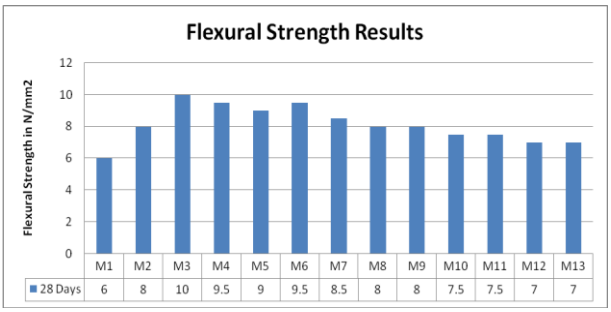
Split tensile strength results

3.3 Effect of addition of the copper slag and Glass fiber on the flexural strength of the high volume fly ash concrete

The concrete cube mould of the standard dimension are prepared and cured for the 28 and the flexural test is conducted. From the result it can be seen that the flexural strength of the high volume fly as concrete is more than the high volume fly ash with copper slag and the glass fiber. The flexural strength of the high volume fly ash concrete is 6 N/mm2 and with glass fiber of 1% and copper slag of 20% is 10 N/mm2.

Also it can be seen that flexural strength of the concrete reduces as the percentage of the copper slag increases. The maximum flexural strength id obtained for the mix of M3 i.e. 50%Fly Ash + 20%Copper Slag + 1%Glass Fiber. It can also

be seen that the flexural strength is increases up to 40% of the replacement. It can be seen that as the glass fiber increases the flexural strength reduces. The flexural strength is maximum for the 1% addition of the glass fiber. Optimum content of copper slag and glass fiber is 20% and 1% glass fiber respectively.



Flexural strength results

4 CONCLUSIONS

From the results and discussions, the following conclusions were made

- The high volume fly ash concrete with 50% of flyash, copper slag and the glass fiber showing superior mechanical properties
- The addition of the copper slag up to 30% increases the compressive strength. The maximum compressive strength is obtained for the mix 50%Fine Aggregate + 30%Copper slag + 1%Glass Fiber.
- Maximum value of the split tensile strength is obtained for the mix M5, 50%Fly Ash + 20%Copper Slag + 3%Glass Fiber. The mix with more than 20% of the copper slag show lower split tensile strength
- The maximum flexural strength is obtained for the mix with 50% Fly Ash + 20% Copper Slag + 1% Glass Fiber. If the glass fiber content increase more than 1% the compressive strength reduces.
- When you add glass fibers more than 1%, the the Flexural strength decreases by 0.5N/mm2.
- The use of the byproduct such as fly ash and copper slag will reduces the environmental pollution and make the concrete more economical.

REFERENCE

[1] “Experimental Investigation on High volume Fly ash concrete by Incorporating Foundry sand as Fine aggregate” By Prof. Swapnil B. Cholekar and Subrahmanyam Raikar (2014)

[2] “Study of Compressive Strength of High Volume Fly Ash Concrete with Varying Proportion of Fly Ash and Silica Fume” By Srila Dey (2016).

[3] “Strength study of high volume fly ash concrete with fibres” By JO JACOB RAJU and JINO JOHN (2014).

[4] Kulkarni “The Effect of Addition of Carbon Fibers on Mechanical Properties of High Strength Concrete” By S. M. Kinayekar1, Dr. V. D. Gundakalle, Kishor Kulkarni (2014)

[5] “Experimental Study On Concrete Using Copper Slag as Replacement Material of Fine Aggregate” By Lakshmi Narayani P and Ramya G (2011).

[6] “Strength and Behaviour of High Volume Fly Ash concrete” By Mini Soman and Shobha.K (2014).