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Effect of Alccofine on Glass Fiber Reinforced Self Compacting Concrete

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Abstract – *Glass fiber reinforced self -compacting concrete is a newly developed concept in the field of construction industry. It has many advantages than conventional concrete.*
Self-compacting concrete can flow under its own weight to fully fill the formwork and passes through congested reinforcement. Self-compacting concrete is combined with alkali resistant glass fiber to form glass fiber reinforced self-compacting concrete. Alccofine is a pozzolanic material and it has high workability as well as strength characteristics. This thesis details the effect of alccofine on the glass fiber reinforced self-compacting concrete. Here different percentages of cement (5%, 10% and 15%) in the glass fiber reinforced self-compacting concrete is replaced with alccofine. Then fresh and strength properties are evaluated and compare with the normal glass fiber reinforced self-compacting concrete. With the addition of alccofine to the glass fiber reinforced self-compacting concrete enhances its properties.

Key Words: **Glass fiber reinforced self-compacting concrete, Alccofine, Fresh properties, Compressive strength.**

1. INTRODUCTION

1.1 Glass Fiber Reinforced Self Compacting Concrete

Self-Compacting Concrete (SCC) has been established in Japan to develop the durability and uniformity of concrete in 1988 by Okamura and Ozawa. Self-compacting concrete is combined with alkali resistant glass fiber (1% of binder) to form glass fiber reinforced self-compacting concrete. It is a revolutionary invention in the construction industry. Glass fibers can be defined as a small wire like reinforcement which are made of glass having high ductility. Addition of fiber into SCC improves tensile strength, ductility, impact, control of cracking. Glass fiber reinforced self-compacting concrete combines the advantages of SCC in its fresh state and that of fibers in its hardened state. Because of superior performance of SCC in its fresh state, addition of glass fiber will lead to a more uniform dispersion of fibers.

The primary objective of the study is to find the effect of alccofine on the glass fiber reinforced self-compacting concrete.

2. MATERIALS USED

The materials used in study are Cement, Coarse aggregate, Fine aggregate, Fly ash, Glass fiber, Alccofine, Super plasticizer, Water. The explanation of each material is given below.

Cement

The cement used in this study was Dalmia brand ordinary Portland cement of 53 grade. The specific gravity of cement is 3.15. The initial setting time and standard consistency are 45 min and 34% respectively.

Coarse Aggregate

Coarse aggregate used for the study is 12.5mm granite broken stones. The specific gravity of coarse aggregate is 2.8. Water absorption and bulk density (loose) are 1.2% and 1.41 kg/l respectively. Aggregates conforming to grading Zone II are used in this work.

Fine Aggregate

Aggregates used in the study was manufactured sand and conforming to Zone II. The specific gravity of fine aggregate is 2.68. The water absorption and bulk density (loose) are 1.88 % and 1.53 kg/l respectively.

Fly Ash

Fly ash (FYA) used in this study was collected from Alan hydraulic bricks, Angamali. The specific gravity of Fly ash is 2.1.

Glass Fiber

Glass fiber used is 12 mm length Cem-FIL anti-crack high dispersion.

Alccofine

Alccofine is a particularly processed product based on slag of high glass content with high reactivity obtained through the process of controlled granulation. Alccofine used is collected from Counto micro fine Pvt Ltd, Mumbai. The specific gravity of alccofine is 2.9.

Super Plasticizer (SP)

The super plasticizer used in this study is Master Glenium SKY 8233. It is an admixture based on modified poly carboxylic ether.

Water

Water used for mixing and curing shall be clean and free from oils, acids, alkalis, salts etc. Potable water is used for study.

3. MIX PROPORTION

Mix proportion was done based on Nan-su et al method and EFNARC guidelines. The mix design was carried out for M40 grade glass fiber reinforced self-compacting concrete (GFRSCC). Various mixes were prepared and tested to satisfying the EFNARC guidelines. Finally a mix is selected to fullfilling the fresh properties provided in the EFNARC guidelines.

Here different percentages of cement (5%, 10% and 15%) in the glass fiber reinforced self-compacting concrete is replaced with alccofine. The mix details are given below.

Table -1: Mix Ratio

Mix	GFRSCC
Cement (kg/m^3)	420
FYA (kg/m^3)	230
FA (kg/m^3)	857
CA (kg/m^3)	791
Glass Fiber (kg/m^3)	6.5
Water (kg/m^3)	258
SP (%)	0.3

Table -2: Combination of Mixes

Mix	Explanation
GFRSCC	Glass fiber Reinforced Self compacting concrete
GFRSCC1	GFRSCC + 5% Alccofine
GFRSCC2	GFRSCC + 10% Alccofine
GFRSCC3	GFRSCC + 15% Alccofine

4. EXPERIMENTAL WORKS

4.1 Fresh Properties

For determining the fresh properties of GFRSCC slump flow test, T500 test, V-funnel test, L-box test were conducted. The slump flow test gives good assessment of filling ability. This test is done to know the horizontal flow of concrete without segregation and bleeding. V-funnel test is used to find the filling ability of GFRSCC. L-box test is done to know the passing ability of GFRSCC.

According to EFNARC guidelines the acceptable range of slump flow diameter is between 650 to 800 mm. L-box ratio is in the range of 0.8 to 1. V-funnel time ranges from 8 to 12 seconds. T500 slump flow is in the range of 2 to 5 seconds.

4.2 Compressive Strength

For determining the hardened properties of GFRSCC compressive strength test was conducted. A cube of size 150mm × 150 mm× 150 mm was used for the test. Three specimens were casted for each mix and average of this three was taken as compressive strength. The test was carried out after 7 and 28 days of water curing.

5. RESULTS AND DISCUSSIONS

5.1 Fresh Properties

The fresh properties of different mixes are given in the following figures.

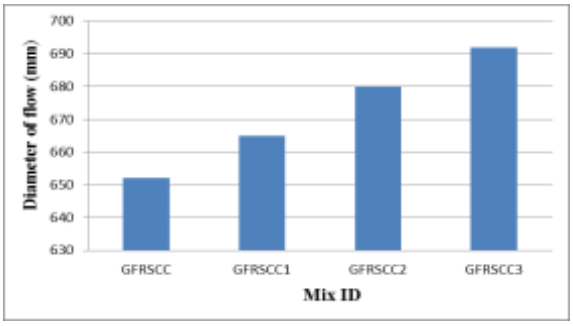

FIGURE -1: Comparison of slump flow diameter

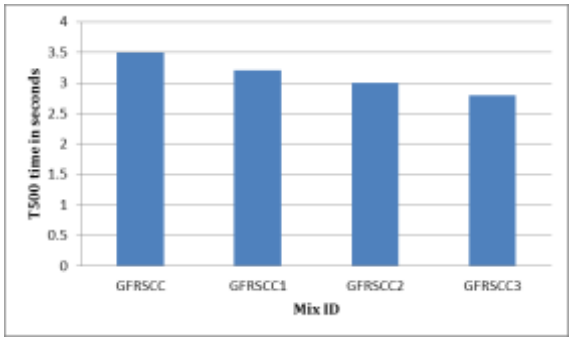

FIGURE-2: Comparison of T500 time

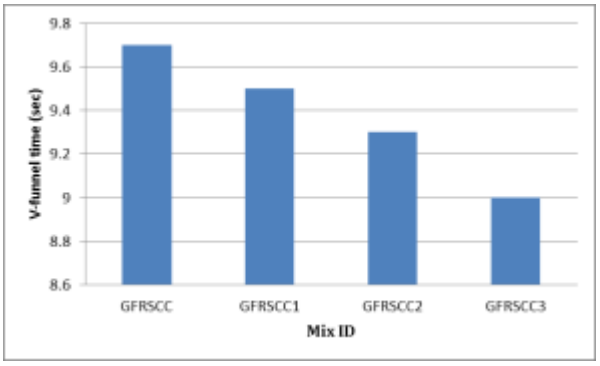

FIGURE-3: Comparison of V-funnel time

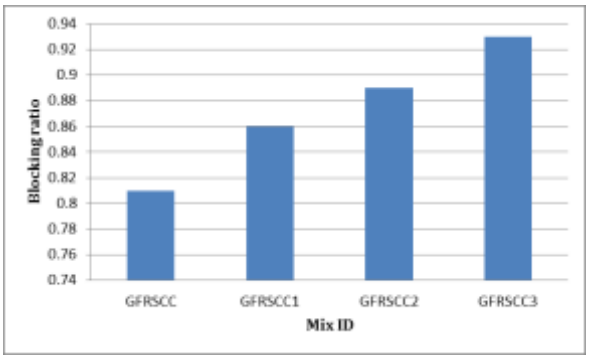

FIGURE-4: Comparison of passing ability

From the figures it is clear that the mix GFRSCC3 shows maximum slump flow diameter, lesser T500 time, lesser v-funnel time, higher passing ability. The fresh properties of GFRSCC is increases with increases of alccofine content. This is due to the ultra fine particle size of alccofine.

5.2 Compressive Strength

The graphical representation of compressive strength of different mixes are given in Figure 5.

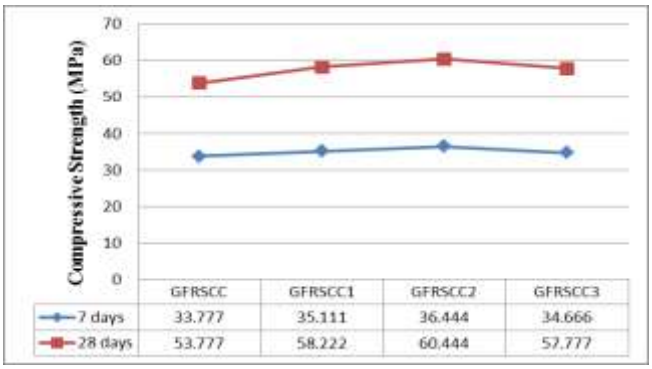

FIGURE-5: Comparison of compressive strength

From the test results, the compressive strength obtained for the GFRSCC1 is greater than the GFRSCC at 28 days. The compressive strength for 10% of alccofine (60.44MPa) is higher than the other replacement mixes. The result shows that for all ages, the alccofine ranging from 5%, 10% and 15% yields higher compressive strength when compared to GFRSCC. If the percentage level of alccofine is increased more than 10%, then it acts as a filler material only and the strength gradually decreases by increasing the percentage of alccofine.

6. CONCLUSIONS

The study was carried out to evaluate the influence of Alccofine in M40 grade GFRSCC. Experiments were conducted by replacing cement with Alccofine in various percentages i.e, 0%, 5%, 10% and 15% in GFRSCC. Test results indicated that GFRSCC mixes with Alccofine are suitable for improving the properties of concrete. The following conclusions were obtained from the study.

- Fresh properties of all mixes were verified by Slump flow test, L-box test and V-funnel test and results found satisfactory.
- The flowability of GFRSCC increases with increase of Alccofine content due to the increased fineness of Alccofine.
- The replacement level of alccofine ranging from 5%, 10% and 15% yields higher compressive strength than the normal mix.
- Compressive strength variation for the replacement of cement to a level of 10% alccofine indicate as an optimum replacement level.
- If the percentage level of alccofine is increased more than 10 %, it acts as a filler material only and the strength gradually decreases by increasing the percentage of alccofine.

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