A Study on Polypropylene Fiber Reinforced Concrete using Silica Fume as Partial Replacement for Cement

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Abstract— To enrich the properties of concrete and to study the performance of concrete polypropylene fiber and silica fume were used in this study. In this experimental work using of 2 different materials polypropylene fiber and silica fume fiber with different mix proportion of hybrid ratios to form the hybrid fiber reinforced concrete. silica fume and polypropylene fibers have altered properties and these properties will increases the flexural, tensile, impact strength of concrete. Shrinkage, Initial cracks can be resisted by using of polypropylene fibers. By this strength parameters also increases. In this work has been carried for M25 and M30 grade concrete according to IS 10262:2009 with five various proportions are added with concrete in gradients. The proportion of silica fume and polypropylene fiber is varying with different hybridization ratios i.e. 0%,0%, 1.0 %, 1.5% 2.0% and silica fume added by vol. of replacement of cement and polypropylene is added by the weight of cement. The tests were conducted on concrete such as slump cone test on fresh concrete, compressive test, flexural test, split tensile test and the modulus of elasticity on hardened concrete. These tests were done to analyze the hardened properties of concrete for 7& 28 days for compressive strength, 7 &28days for, split tensile strength, flexural strength. To evaluate the strength parameters different tests are conducted and results are tabulated. From experimental work and results it can be concluded addition of fiber gives maximum results in all the strength parameters compare to other different ratios.

Key words: Polypropylene Fiber, Silica Fume

I. INTRODUCTION

Now a day's Concrete is largely used material in all the sectors. Concrete require From the small construction to large structures like multi story buildings, irrigation structures, pavements, reservoirs, foundations, dams etc. For construction of all these structure it require huge amount of concrete material. Concrete is exposed to different environmental condition to with stand the environmental effects the properties of concrete have to increases with introducing admixture or fiber to concrete to increases the strength of concrete.

Conventional concrete have good compressive strength and it is very less or poor strength in tension as well as in flexural strength. So for increasing concrete tension as well as flexural strength it's required to add any innovative materials like fibers, admixture, and waste material having good pozzolana properties, construction chemical. Portland cement is normally use for making cement mortar and concrete in the world.

II. OBJECTIVES OF THE STUDY

- To know the optimum percentage of addition of fibers to concrete and finding maximum hybrid ratio.
- To determine workability of HFRC by the addition of fibers in concrete mix.
- To determine impact resistance properties on the HFRC and comparing with the conventional concrete.
- To produce polypropylene fiber reinforced concrete mixes of varying strengths and performances
- To study the effect of Cement replacement materials (CRMs**)** on the properties of polypropylene fiber reinforced concrete
- To Study the rheological properties of polypropylene fiber reinforced concrete

III. EXPERIMENTAL PROGRAM MATERIALS

For the experimental work the following materials are used.

- Cement
- Fine aggregate
- Coarse aggregate.
- Water
- Polypropylene fibers.
- Silica fume.

A. Polypropylene Fibers

Fig. 1: Polypropylene Fiber

Polypropylene fiber is composed of non-crystalline (amorphous) and crystalline regions. The fiber differs in size in different fractions such as micrometer to centimeters with respect to diameter. The manufacturing of this fiber have to two different types. First one is from rectangular cross section plastic film is extruded or from a circular section a wire is pulled procedure is followed .And appearance of this fiber in fibrillated bundles, mono filament. These fibers have different length 12mm, 24mm; 40mm cut length is available.

B. Silica Fume

Fig. 2: Silica Fume

Silica fume is also referred to as micro silica or condensed silica fume, but the term silica fume is generally accepted. It is by-product result from the reduction.

The specific gravity of silica fume is 2 to 2.4. The particles of silica fume are extremely fine, most of having diameter ranging from 0.03 to 0.3mm and it has very low bulk density: 200 to 300 kg/m$^{3.}$

IV. EXPERIMENTAL METHODOLOGY

To study the strength Concrete can be tested in fresh state as well as in hardened state with different mix proportion of fibers.

Tests on Concrete

A. Fresh Concrete

- Slump cone test.
- Compaction factor.

B. Hardened Concrete

- Compressive strength
- Split tensile strength
- Flexural strength
- Impact test

V. RESULT

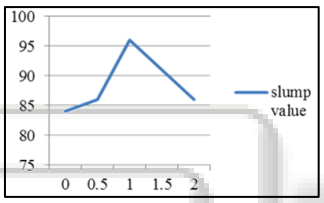

Fig. 3: Slump Value

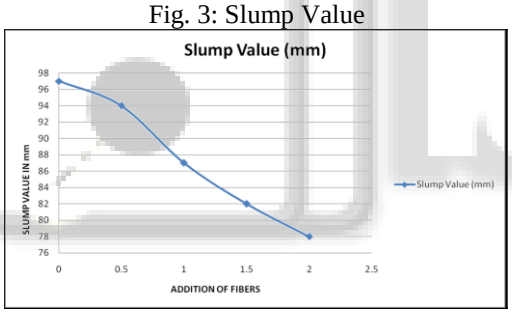

Fig. 4: Result

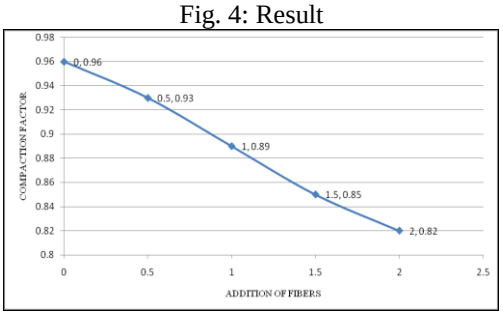

Fig. 5: Compaction Factor

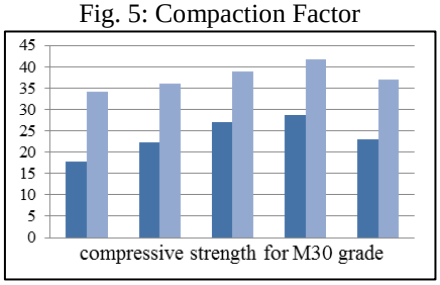

Fig. 6: Compressive Strength

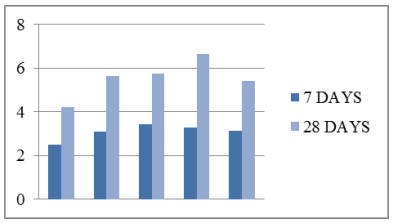

Fig. 7: Split tensile strength for M30 grade

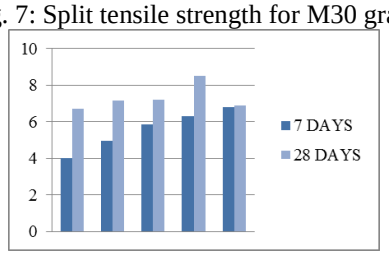

Fig. 8: Flexural strength for M30 grade

VI. CONCLUSION

From my experimental investigation I concluded the following points:

1) Addition of polypropylene caused a significant increase in % of water absorption
2) Mechanical properties of concrete improved by use of fibers
3) Increase in shear capacity when fibers are used
4) 84 to 85% of crack shrink is minimized by fiber use
5) The split tensile strength of concrete is gradually increased by use of silica fume content
6) The use of polypropylene fiber decreased the workability to some extent
7) compressive strength increased with use of silica fume content to 12 to 18% and PPF content 1 to 1.5%

VII. SCOPE FOR FURTHER STUDIES

1) In this experimentation M25 and M30 grade of concrete is tested further work can be carried by testing different grades of concrete i.e.M40,M50
2) In this project silica fume is replaced with cement other materials like metakolin, fly ash etc can be used
3) Studies can be carried on by varying silica fume and polypropylene fiber content
4) In this work only cubes, cylinders, and prisms were casted .further work can be carried by casting rectangular beams of various sizes
5) In this present work mix design was carried using IS:10262-2009 however similar work can be done using ACI method, British method ,fineness modulus method
6) In this work no plasticizer is used trials can be done by changing the % o superplasticizer

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