International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 04 | Apr-2018 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY ON POLYPROPYLENE FIBER REINFORCEDCONCRETE

Amsa M[1], Ariyannan P[2],

[1]*PG Structural Engineering ,JCET, Dharmapuri, Tamilnadu ,India*
[2] *Assistant Professor, Structural Engineering JCET, Dharmapuri, Tamilnadu ,India*

Abstract - *This paper reports of a comprehensive study on the durability properties of concrete containing polypropylene fiber. Properties studied include unit weight and workability of fresh concrete. Compressive strength, tensile strength and flexural strength of hardened concrete. Fiber volume fraction was 0%, 0.2%, 0.3% and 0.5% in volume basis. The addition of polypropylene increases with the decreases the workability of concrete. The positive interactions between polypropylene fibers lead to the lowest drying shrinkage of fibrous concrete. Polypropylene fiber with 12-mm length and four volume fractions of 0%, 0.2%, 0.3% and 0.5% are used. The results show that incorporating polypropylene fibers improves mechanical properties. It is shown that using 0.5% polypropylene fiber increases split tensile, and flexural strength. Silica fume is used as cement replacement material at 8% weight of cement. The presence of polypropylene fibers had caused delay in starting the degradation process by reducing permeability, reducing the amount of shrinkage and expansion of concrete that can significantly affect the lifespan of the structure. By adding a polypropylene with higher and lower grade of concrete and analysis the results of compressive strength, spilt tensile strength and flexural strength studies. Finally compare the results with higher grade of concrete to lower grade of concrete.*

Key Words: **Silica Fume, Polypropylene Fibre, Super Plastizer ,M_{20} , M_{60}**

1. INTRODUCTION

Plain concrete possesses a very low Tensile strength, Limited ductility and very little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. Cracks form a conduit for permeability of Water and Chloride Ions present in permeated water and cause Corrosion of Steel present inside Concrete, and over a period of time affects the durability of structure. It is a fact that addition of Fibers has had an excellent effect in preventing / controlling Micro Shrinkage Cracks as well as prevents ingress of Water into Concrete member and considerably preventing Corrosion of rebar's from occurring in the first place. This enhances Durability of Concrete and the Structure on the long run. In Coastal areas, Saline water ingress is more pronounced which accelerates Corrosion of Steel in Concrete through capillary action and presence of Fibers help in checking the same to a great extent. Fibers also enhance other Mechanical properties such as Tensile & Flexural Strengths, Impact & Abrasion Resistance and improve Seismic Resistance of Concrete by increase in Concrete's Energy absorption characteristics.

1.1ADVANTAGES OF HIGH-STRENGTH CONCRETE

The main advantages of high-strength concrete are the following:

1) Reduction in member size, resulting in an increasing in the usable floor space, a reduction in the quality of concrete, and a consequent reduction in construction time.

2) Reduction in the area of the formwork and the time required for stripping forms.

3) The ability to withstand large column loads with reasonable sizes of columns.

4) Provision of large spans, or elimination of a few columns or smaller beams for comparable spans, leading to a reduction in the story height from headroom considerations.

5) Reduction in axial shortening effects in columns.

6) Reduction in floor thickness and beam height.

7) Elimination of a few footing because of adoption of larger spans.

1.2POLYPROPYLENE FIBRE CONCRETE

Concrete is a brittle material with low tensile strength and low strain capacity that result in low resistance to cracking. To improve such properties, fiber reinforced concrete (FRC) has been developed. Fibers are intended to improve tensile strength, flexural strength, toughness and impact strength, to change failure mode by means of improving post-cracking ductility, and to control cracking. Tensile strength of the composite, related more to the stress at which matrix develops a macro-crack, will not differ much for most Conventional fiber reinforced cementations materials. Several fiber materials in various sizes and shapes have been developed for use in FRC. Among these fibers, the polypropylene has been one of the most successful commercial applications. The common forms of these fibers are smooth-monofilament and have triangular shape. Polypropylene fibers have some unique properties that make them suitable for reinforcement in concrete. The fibers

have a low density, are chemically inert and non corrosive. The primary objectives of this investigation were to determine the benefits of using polypropylene fiber reinforced concrete (PFRC).

Fig1. Polypropylene fiber

1.3 SILICA FUME

Silica fume is a very fine non-crystalline sio2, is a byproduct of Ferro-silicon industry. It is made at a temperature of approximately 2000°C. It size is about 0.1µm (20-25m2/gm). Compared to cement, the particle size of silica fume is 2 orders finer. It acts as an excellent pore-filling material. It can be used in proportions of 5-10% of cement content in a mix. Silica fume, also referred to as micro silica or condensed silica fume, is another material that is used as artificial pozzolanic admixture. It is a product resulting from reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. Silica fume rises as an oxidized vapour. It cools, condenses and is collected in cloth bags.

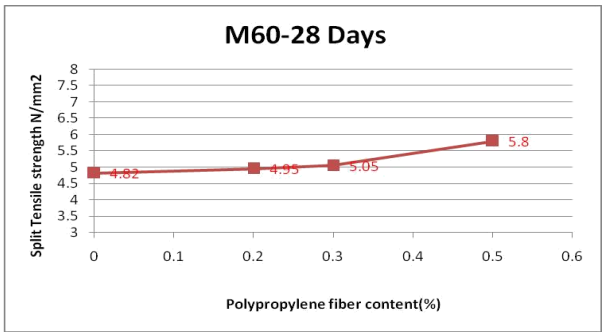
2. LITERATURE REVIEW

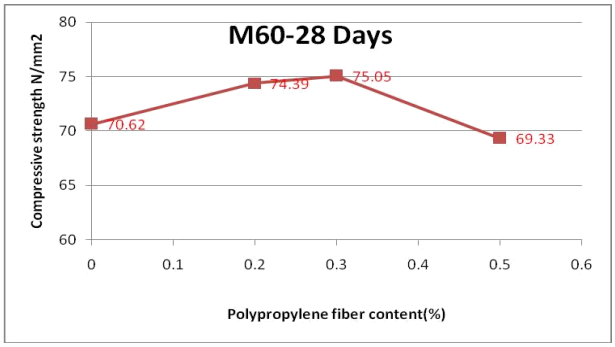
1. A.M.Alhozaimy .et. al: Polypropylene fibers have no statistically significant effects on the compressive strength and toughness of conventional concrete at the volume fractions used in this investigation. The presence of silica fume, however, increased the average compressive strength by 17% and 23% of plain and fibrous concretes. Polypropylene fibers have no effects on flexural strength at the volume fractions used in this study. Polypropylene fibers affect the flexural toughness significantly at 95% level of confidence. On the average, the addition of 0.1%, 0.2%, and 0.3% volume fraction of fibers increases the flexural toughness by 44%, 271% and 387%, respectively. Silica fume increases the flexural toughness by 48% and 79% in the case of plain and fibrous concretes, respectively. While pozzolans generally reduce the impact resistance of concrete, the positive interactions between polypropylene fibers and pozzolans (fibers are more effective in the presence of pozzolans) lead to enhanced impact resistance of fibrous concrete with pozzolans. The impact resistance at failure of conventional fibrous concrete was increased by 82%, 42% and 90% with the addition of fly ash, silica fume and slag, respectively.

2. Serkan Tapkın: The Marshall Tests and repeated load indirect tensile tests have shown that the addition of polypropylene fibers considerably alters the behavior of asphalt concrete. When the polypropylene fiber content increases, an increase in the Marshall Stability index has been observed reaching 58% for the specimens reinforced with 1% of polypropylene fibers. According to the test results, the addition of 1% of polypropylene fibers prolongs the fatigue life by 27%. Polypropylene fibers have a different specific gravity and size distribution, and because of this, there are some physical changes in the asphalt concrete and these changes can cause the behavioral differences. Besides, the polypropylene fiber-bitumen paste shows differences in elastic plastic and adhesive behaviors when compared with natural filler bitumen paste. The different elastic and permanent deformation response of fiber-reinforced specimens can be related to these reasons.

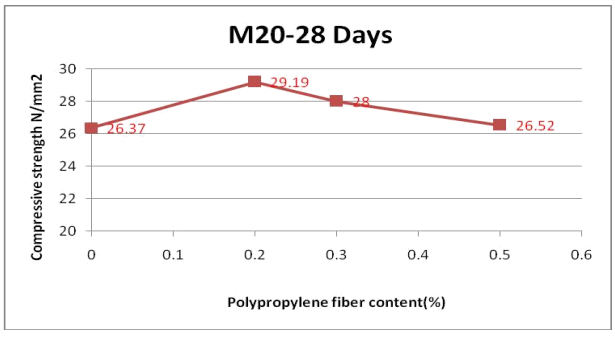
3. TEST RESULTS AND DISCUSSION

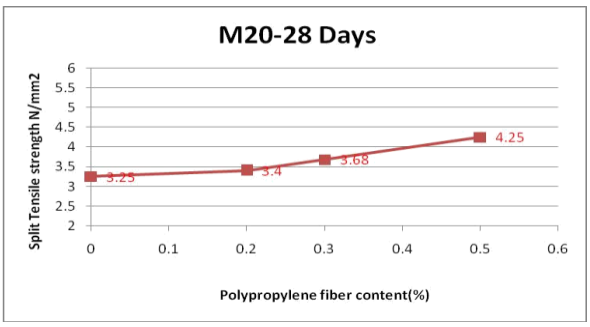
3.1 COMPRESSIVE STRENGTH CONCRETE



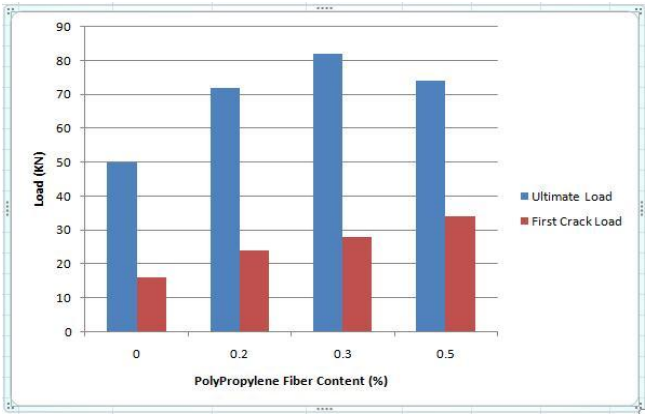


3.1 Spilt Tensile Strength Results (M20)

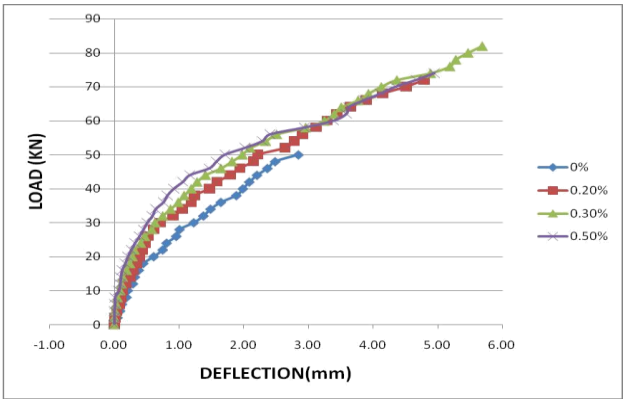




3.3 LOAD CARRYING CAPACITY



3.4 LOAD DEFLECTION BEHAVIOUR



3. CONCLUSIONS

- The use of polypropylene fibers, increase in bond strength especially for the mixtures with 8% silica fume.
- The slump flow of concrete is decreases, when use of 0.3% and 0.5% polypropylene fiber in concrete. Reduced slump flow for 0.3% and 0.5% of fiber usage is 100 mm, and 80 mm, respectively.
- Split tensile strength is increased as volume percentage of polypropylene fibers in increased. In 0.3% and 0.5% mix, the splitting tensile strength is increased by 8% and 20%, respectively for maximum volume percentage of the fibers (0.5%)
- Compressive strength decreased with the increase of Polypropylene Fiber content above 0.2%.
- The strength of specimen increases with the increase in silica fume content. The experimental result shows that silica fume can strengthens the transition zone and reduces crack initiation, and therefore, improves the failure strength of polypropylene fiber concretes.
- When silica fume is added into the non-fibrous and fibrous mixtures, the compressive strength, at the age of 28 days, was enhanced by 23% and 30%, respectively. On the other hand, adding of silica fume into the fibrous specimens led to an increased in compressive strength up to 30% at the age of 28 days.
- The load carrying capacity of 0.3% PF beam is higher than that of other beams.
- From the experimental works the comparisons the Beam-0.3% PF carries maximum load carrying capacity of 82 KN.

REFERENCES

[1] Alhozaimy A.M,, and Soroushiad P., “Mechanical Properties of Reinforced Concrete and Materials Polypropylene Fiber the Effects of Pozzolanic”, Cement & Concrete Composites, October 18 (1996), pp. 85-92.

[2] Serkan Tapkın., “The effect of polypropylene fibers on asphalt performance”, Building and Environment, February 2007, pp. 1065–1071.

[3] Okan Karahan,. and Cengiz Duran Atis., “The durability properties of polypropylene fiber reinforced fly ash concrete”, Materials and Design,February 2010, pp.1044–1049.

[4] Saeid Kakooei., Hazizan Md Akil ., and Morteza Jamshidi., “The effects of polypropylene fibers on the properties of reinforced concrete structures”, Construction and Building Materials, August 2011, pp.73–77.

[5] Alavi Nia .A ., M. Hedayatian ., and M. Nili., “An experimental and numerical study on how steel and polypropylene fibers affect the impact resistance in fiber-reinforced concrete”, International Journal of Impact Engineering, January 2012, pp.62-73.

[6] Songa S.P.,Hwangb S.,Sheub B.C ., “Strength properties of nylon- and polypropylene-fiber-reinforced concretes”, Cement and Concrete Research August 2003, pp.1546– 1550.