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INFLUENCE OF POLYPROPLENE FIBER IN SELF COMPACTING CONCRETE –A REVIEW

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Abstract - *Concrete is a brittle material, with a low tensile and strain capacity. This behaviour of brittleness can be overcome by using randomly oriented short discrete fibers. Fibers not only limit the formation of cracks, but also control their growth and propagation. Fibers in concrete are acting as a localised reinforcement to the concrete mixture. Plastic shrinkage cracking which is formed in the early ages can be diminished by the inclusion of relatively small amount of fiber to the mixture. The fresh properties of SCC are restricted by the incorporation of polypropylene fiber to the mixture and workability can be restored by chemical admixtures. A review regarding its fresh, hard, spalling of concrete under fire exposure and durability property is summarized in this paper.*

Key Words: **Polyproplene Fibre, self compacting concrete , oriented discrete fibres , post–cracking ductility,Brittleness**

1.INTRODUCTION

The demand of Self Compacting Concrete (SCC) is growing rapidly since it is proved to be more economical, durable and also known as high performance concrete. Self flowing or self-filling property of self compacting concrete makes it distinguishable between the normal concrete. Brittleness nature of concrete under tensile loading is one of major drawback of concrete. But this mechanical property of concrete may be improved by randomly oriented discrete fibres which prevent or control propagation of cracks. The incorporation of fibres into concrete matrix improves several adequate mechanical properties, and reduces spalling of the reinforcement cover.

1.1 Fiber Reinforced Concrete (FRC)

Fiber property can be varing according to its length, aspect ratio, fiber type and configuration. Fibers are classified mainly as metallic, synthetic and natural fibers. Polypropylene fiber is one among the synthetic fiber which are commonly used and there are two types liked Strongcrete and Nokrack . Polypropylene fiber is obtained in 12 and 6mm length as in filament structure. There is an ability to arrest cracks. Particularly under flexural loading; fibre composites possess increased extensibility and tensile strength, both at first crack and at ultimate. There exist an ability of fiber to hold the matrix together even after extensive cracking. The net result is to impart to the fibre composite property such as post–cracking ductility which is not familiar in ordinary concrete.

The alteration from a brittle to a ductile type of material would increase considerably the energy absorption feature of the fibre and its ability to withstand repeatedly applied shock or impact loading. Fractured specimens of fiber-reinforced concrete shows that failure takes place primarily due to fiber pull-out or debonding. A fiber-reinforced concrete specimen does not break immediately after the origin of the first crack unlike plain concrete. This property is referred to as toughness and it is represented by the area under the load-deflection curve. In FRC crack density is increased, and the crack size is decreased.

2. LITERATURE REVIEW

2.1 Fresh state properties

Polypropylene (PP) fibers tend to reduce the flowability and passing ability but will increase viscosity and segregation resistance of SCC [1]. The slump reduction is noticed beyond 1.5% dosage; as the mix becomes fibrous and difficult in handle [2]. It is clearly seen that Flow ability (V-funnel test), Passing ability (J-Ring-Box), segregation resistance (VFunnel at T5 min), decreases when the presence of PP fiber increased [3]. Based on workability test results it can be assessed that polypropylene fiber addition up to 0.1% by volume of concrete meet the requirements of Flow ability, Passing ability, Segregation resistance of SCC as per EFNARC Guidelines[4] .

2.2 Hardened properties (compression, flexure and split)

Maximum compressive strength with use of polypropylene fibers in self compacting concrete can be achieve at 0.2 % use of polypropylene fiber as 3.80 % increase in compressive strength of self compacting concrete. When fiber percentage of 0 to 0.15 was provided, the compressive strength tends to increase when the fiber added up to 0.05 percent, and then decrease after 0.10 percent of polypropylene addition and better splitting tensile strength can be observed when the fiber added up to 0.10 percent, and then tend to decrease after that[5]. The inclusion of fiber will increase its flexural

strength. The reason is that, after matrix cracking, the fibers will carry the load that the concrete sustained until cracking by the interfacial bond between the fibers and the matrix. Therefore, the fibers resist the propagation of cracks and do not fail suddenly, which causes an increase in the load carrying capacity.

Ascending trend when the volume percentage of polypropylene fibers is increased and for the maximum increase of the fibers by 0.4% rupture modules is increased by about 22%[7]. Generally, it was seen that polypropylene fibers did not have an important impact on compressive strength and even, it inclined to decrease the concrete compressive strength with increasing fiber volumes. It is defined that there was a very little decrease in compressive and tensile strength of the samples including polypropylene fiber and this is connected to pores created by the polypropylene fibers [6]. According to the bending strength results, it was seen that polypropylene fibers did not contribute significantly to bending strengths. In the bending tests, it was seen that the breakings of non-fibrous samples were rapid and early, and as for the fiber reinforced samples, due to concrete gained a ductile structure, it was seen that the breaking became later and the concrete had a ductile fracture property [9].

2.3 Spalling of concrete

Spalling occurred on all specimens that did not contain PP fiber in the concrete mixture. However, spalling did not occur on specimens containing PP fibers above 0.05% by volume. A metal fabric showed beneficial effect on spalling resistance, but glass or carbon fiber fabrics do not show the same effect on the spalling resistance due to reduction of bond strength at high temperatures. The residual compressive strength was maintained at about 90% of its original strength, and this can be considered as an improved performance against fire damage [14]. In high performance self-compacting (HPSCC), the amount of PP fibers needs to be limited in order to keep the self-compacting properties, which may reduce the fire resistance. Fire spalling in HPSCC is illustrated, based on adding small particles of superabsorbent polymers (SAP) during mixing. The SAP end up as empty macrospores, similar to air voids, in the HPSCC matrix. The PP fibers-SAP voids system percolates at a lower fiber loading than the fibers alone, allowing maintenance of the self-compacting properties while reducing substantially the fire spalling [8].

2.4 Durability

Generally, SCC has lower porosity and sorptivity values compared to conventional concrete [9]. In wide-ranging Polypropylene fiber has very low water absorption this means the wet and dry properties of fiber are identical. Therefore, the addition of polypropylene fiber up to 0.15% in SCC reduced the rate of absorption of water in concrete. The increasing of PP fiber content up to 0.15 % does not affect the concrete in the acid solution. The weight reduction and lose of strength were also low compare to the plain SCC. The Polypropylene fiber has excellent chemical resistance & it resist most of the acids & alkalis due to its non-Polar structure. The non-Polar structure refers the bond between the atoms. The PP fiber content was increased up to 0.15%, it was not affected the concrete after sulphate curing. The fiber content increase, the resistance of penetration for sulphate solution also increased. There is no chemical interaction between fiber and paste matrix and good physical adhesion between them [10].

3. CONCLUSIONS

- In SCC when polypropylene fiber is increased ,the fresh state properties such as flowability (Slump Flow) and passing ability (J-Ring) is reduced.
- Smooth surface finish is not obtained when compared to nominal mixes. Mixing of fibers in dry state gives a homogeneous mixture.
- The compressive strength is obtainable for short fibers. However lesser proportion of longer fibers may also help to gain target strength.
- Polypropylene fibers added to the mixture did not have a prominent effect on the compressive strength of SCC and moreover, as the propylene fiber amount is increased in the mixture, the compressive strength of SCC tenses to decrease.
- With an addition of fiber has proved its performance analysis in split tensile strength. No structural failure can occur due to crushing; but it takes certain tensional forces resulting bulging. It will be more effective for strut and tie members.
- From the Sorptivity test result the incorporation of fiber up to 0.15% into SCC reduced the rate of absorption of water in concrete. SCC with fiber, the rate of water absorption was lower when compared to plain SCC because of the non-Polar structure of fiber.
- From the test results of acid attack and sulphate attack, the uniformly dispersed polypropylene fiber restricts the penetration of acids in the concrete. The loss of weight and compressive strength was decreased when the addition of fiber is up to 0.15% by volume of concrete compared to the plain SCC.

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