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Effect of Polypropylene Fiber on Concrete by Varying It's Percentage

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ABSTRACT
The reinforced polymer in civil engineering increase rapidly, the various experimental investigation for determination of properties of polypropylene fiber are discussed in paper work. this paper present the effect of polypropylene (PP) fiber on various properties of concrete such as compressive strength, tensile strength, workability and fractured properties with various content of fiber range of (0%, 0.5%, 1%, 1.5%) investigation was carried out to various type of effect such as compressive, spilt tensile, flexural shear strain, plastic shrinkage cracking by the curing period 7 & 28 days and that the addition in polypropylene fiber to concrete exhibit better performance. Furthermore, shrinkage cracking is reduced by 83 to 85% by addition of fibers in the range of 0.35 to 0.50%. Polypropylene fiber are hydrophobic, that is they do not absorb water. However, further investigation were highly recommended and should be carried out to understand more mechanical properties of fiber reinforced concrete.

1. INTRODUCTION

Reinforced concrete can be used to produce frames, columns, foundation, beams etc. Reinforcement material used should have excellent bonding characteristic, high tensile strength and good thermal compatibility. Reinforcement requires that there shall be smooth transmission of load from the concrete to the interface between concrete and reinforcement material and then on to reinforcement material. Thus the concrete and the material reinforced shall have the same .

The construction material is continuously evolving. The demand for high strength, crack, resistant and lighter concrete resulted in development of fiber reinforced concrete (2, 3, 4, 5, 6, 7). Fibers that are used are steel, nylon, asbestos, glass, carbon, sisal, jute, coir, polypropylene, kenaf.

The use of concrete as a structural material is limited to certain extent by deficiencies like brittleness, poor tensile strength and poor resistance to impact strength, fatigue, low ductility and low durability. It is also very much limited to receive dynamic stresses caused due to explosions. The brittleness is compensated in structural member by the introduction of reinforcement (or) pre-stressing steel in the tensile zone. However it does not improve the basic property of concrete. It is merely a method of using two materials for the required performance. The main problem of low tensile strength and the requirements of high strength still remain and it is to be improved by different types of reinforcing materials. Further concrete is also deficient in ductility, resistance to fatigue and impact. The importance of rendering requisite quantities in concrete is increasing with its varied and challenging applications in pre- cast and pre-fabricated building elements. The development in the requisite characteristics of concrete will solve the testing problems of structural engineers by the addition of fibers and admixtures. The role of fibers are essentially to arrest any advancing cracks by applying punching forces at the rack tips, thus delaying their propagation across the matrix. The ultimate cracking strain of the composite is thus increased to many times greater than that of unreinforced matrix. Admixtures like fly ash, silica fume, granulated blast furnace slag and metakaolin can be used for such purposes. 4 However addition of fibers and mineral admixtures posses certain problems regarding mixing, as fibers tends to form balls and workability tends to decrease during mixing.

II. METHODOLOGY

Materials :

➢ **Cement :-**

The cement used was Pozzolana Portland cement (PPC) with a specific gravity of 3.11. Initial and final setting times of the cement were 69 min and 195 min.

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➢ **Aggregate :-**

Good quality artificial sand was used as a fine aggregate . The material whose particles are of size as are retained on I.S Sieve (4.75mm) is termed as coarse aggregate. The size of coarse aggregate depends upon the nature of work. The coarse aggregate used in this experimental investigation are of 20mm size crushed angular in shape. The aggregates are free from dust before used in the concrete

➢ **Fiber :-**

Fibers vary in types, geometry, properties and availability in construction industry. Most common types of fibers are steel fibers, glass fibers, and polypropylene fibers. These usages may alter in concrete for different applications. The fibers are selected from their properties like, effectiveness, cost and availability. Special types of fibers such as carbon, natural fibers, mineral fibers, and asbestos fibers may use in harsh environment. These differences and usage of fibers depends on the requirement of behavior and properties for a concrete, allowing the increase the explicit effects and mechanical properties. fiber geometry varies from hooked end fibers, deformed fibers, deformed wires, fiber mesh, wave-cut fibers, large end fibers till different types and geometries.

Once the preparations are done for pouring, we proceed with the following:

1. Batching :-

We go through the process of measuring different concrete materials. These include cement, course aggregate (blue stone, etc.), sand and water. This process is known as batching.

2. Mixing : -

In the mixing process, the selected materials are mixed thoroughly to the required proportions. It's done until the resultant concrete paste has a uniform consistency and colour.

3. Transporting : -

Once the mixing process is complete, the concrete is transported to your site. the concrete is kept at the correct wetness and continually rotates to prevent it setting. At the site, the concrete is either poured directly into the cube.

4. Compaction & Levelling :-

Once the concrete has been evenly distributed into the cube, the process of compaction begins. The aim is to eliminate air bubbles to increate the strength of the concrete. Screeding is then done, which is essentially a levelling process using large, straight edges that scrape across and flatten the surface. It is at this point, the desired concrete finishing effect can be applied.

5. Curing : -

We then keep the concrete at an optimum moisture level for a certain time period, depending on the atmospheric conditions. This is required to complete the hydration process of the concrete, resulting in a high quality and long lasting concrete job and then take in to the water tank for curing purpose.

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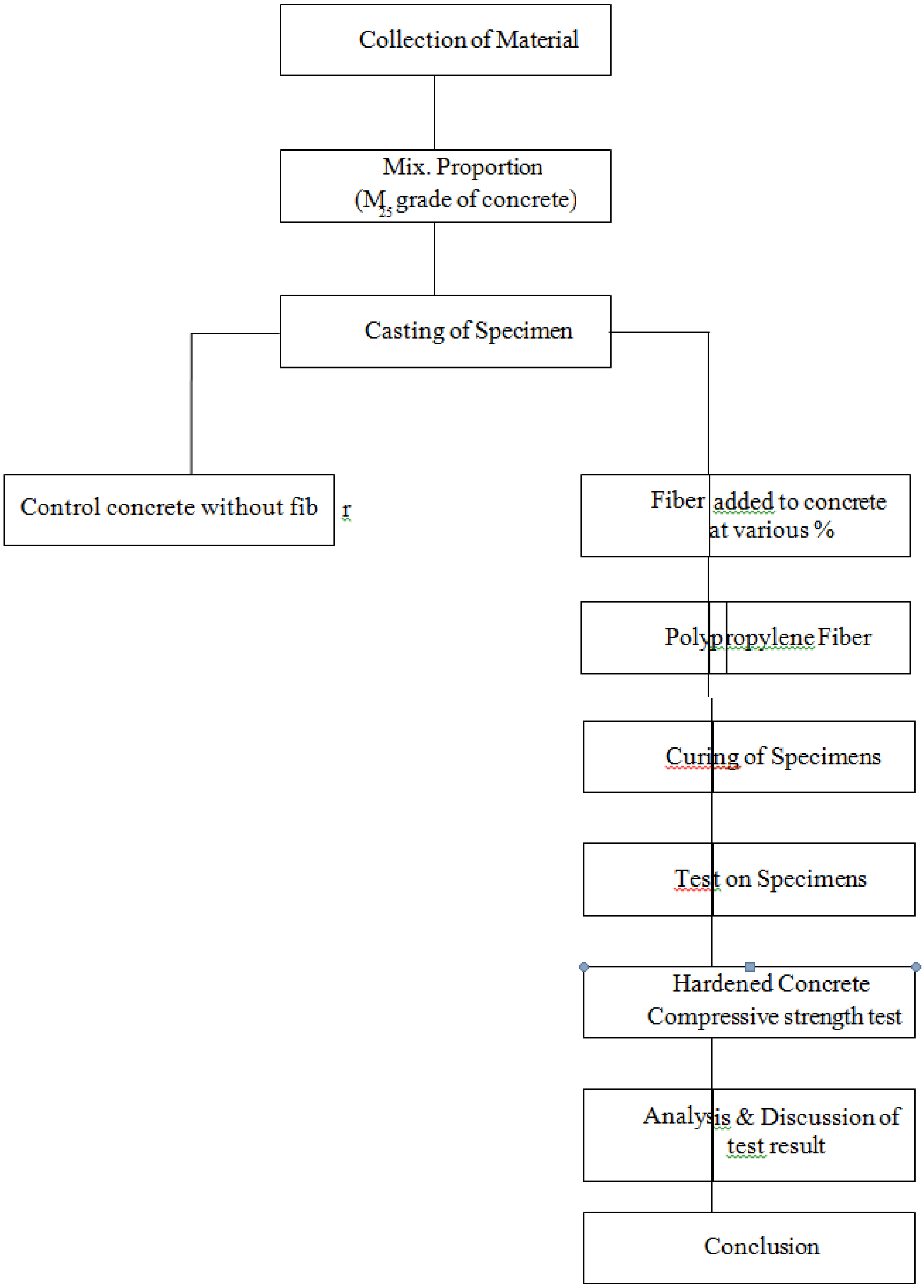

Fig no. 1.1 : flow chart of methodology

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III. EXECUTION OF WORK

1. MATERIAL SELECTION

For concrete ingredients are,

- Cement
- Aggregate
  - A) Fine aggregate
  - B) Coarse aggregate
- Water

1) CEMENT :

Ordinary Portland cement is hydraulic cement that hardens by interacting with water and forms a water resistance compound when it receives its final set. Compared with non-hydraulic cements such as gypsum and lime, which absorb water after hardening, Portland cement is highly durable and produces high compressive strengths in mortars and concretes.

The size of the cement particles has a strong influence on the reaction of cement with water. For a given weight of finely ground cement, the surface area of the particles is greater than that of the coarsely ground cement. Since there are different types of cement for various needs, it is necessary to study the percentage variation in the chemical composition of each type n order to interpret the reasons for variations in behavior. OPC-53 Grade con forming to IS: 12269-1987 was used.

2) AGGREGATES :

Aggregate are those parts of the concrete that constitute the bulk of the finished product. They comprise 60-80% of the volume of the concrete and have to be so graded that the entire mass of concrete acts as a relatively solid, homogenous, dense combination, with the smaller sizes acting as an inert filler of the voids that exist between the larger particles.

They are two types:

A. Coarse aggregate, such as gravel, crushed stone, or blast furnace slag.

B. Fine aggregate, such as natural or manufactured slag.

A) COARSE AGGREGATE :

Crushed granite coarse aggregate conforming to IS: 383-1987 was used. Coarse aggregate passing through 20mm, having the specific gravity and fines modulus vales 2.80-7.20 respectively were used. Properties of the coarse aggregates affect the final strength of the hardened concrete and its resistance to disintegration, weathering, and other destructive effects. The mineral coarse aggregate must be clean or organic impurities and must bond well with the cement gel. The common types are,

1. Natural crushed stone
2. Natural gravel
3. Artificial coarse aggregate

B) FINE AGGREGATE :

The fine aggregate conforming to zone-II as per IS: 383-1987 was used. Fine aggregate is smaller filler made of sand. A good fine aggregate should always be free of organic impurities, clay, or any deleterious materials or excessive filler of size smaller than N. For radiation-shielding concrete, fine steel shot and crushed iron ore are used as fine aggregate.

A fineness modulus (FM) in the range 2.5-3.2 is recommended for concrete, to facilitate workability. Lower values result in decreased workability and a higher water demand. The mixing water demand is dependent on the void ratio in the sand.

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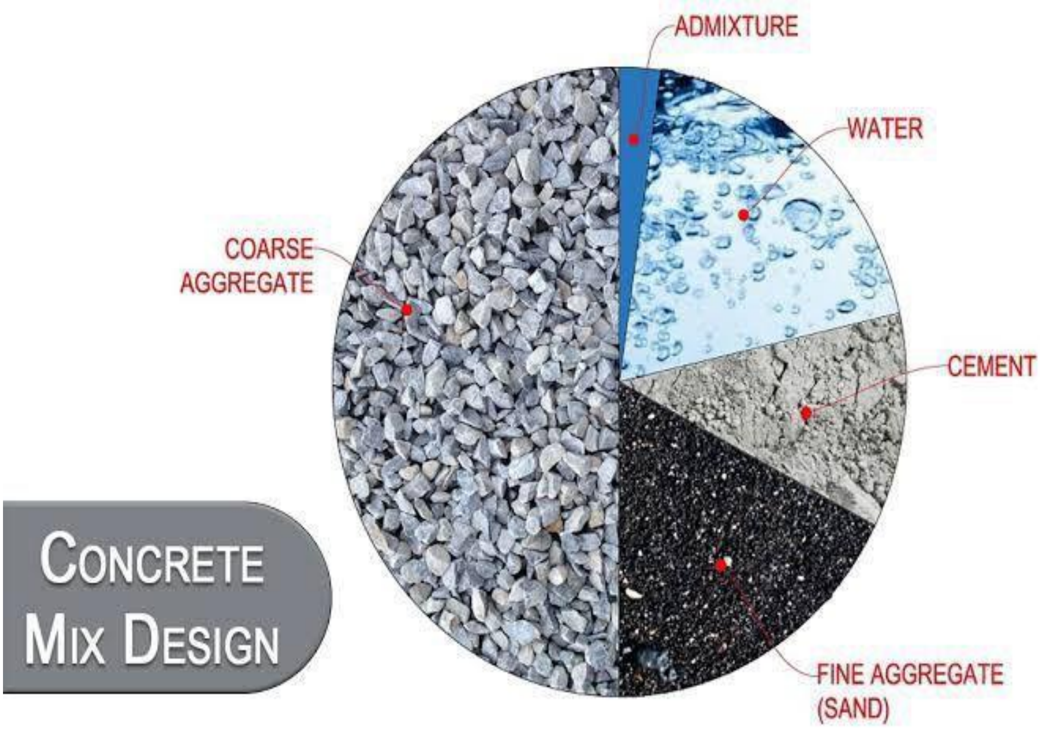

C) POLYPROPYLENE FIBER :

➢ Properties of Polypropylene Fibers:

The raw material of polypropylene is derived from monomeric C3H6 which is purely hydrocarbon. Its mode of polymerization, its high molecular weight and the way it is processed into fibers combine to give polypropylene fibersvery useful properties as explained below [9]:

➢ There is a sterically regular atomic arrangement in the polymer molecule and high crystallinity. Due to regular structure, it is known as isotactic polypropylene.

➢ Chemical inertness makes the fibers resistant to most chemicals. Any chemical that will not attack the concrete constituents will have no effect on the fiber either. On contact with more aggressive chemicals, the concrete will always deteriorate first.

➢ The hydrophobic surface not being wet by cement paste helps to prevent chopped fibers from balling effect during mixing like other fibers.

➢ The water demand is nil for polypropylene fibers.

➢ The orientation leaves the film weak in the lateral direction which facilitates fibrillations. The cement matrix can therefore penetrate in the mesh structure between the individual fibrils and create a mechanical bondbetween matrix and fiber.

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IV. RESULTS AND DISCUSSION

Table : Compressive strength of M25 grade concrete with and without polypropylene fiber

SR No	Mix	Polypropylene fiber (%)	Compressive Strength (Mpa)			
			At 7days	At 14 days	At 21 days	At 28 days
1.	CC	0	15	21.6	22.56	24
2.	PPF1	0.5	16.82	23.247	24.28	25.83
3.	PPF2	1	17.06	23.625	24.67	26.25
4.	PPF3	1.5	17.48	24.28	25.36	26.98

CC – Control concrete
PPF1 – 0.5 % polypropylene fiber added concrete PPF2 – 1 % polypropylene fiber added concrete PPF3 – 1.5 % polypropylene fiber added concrete

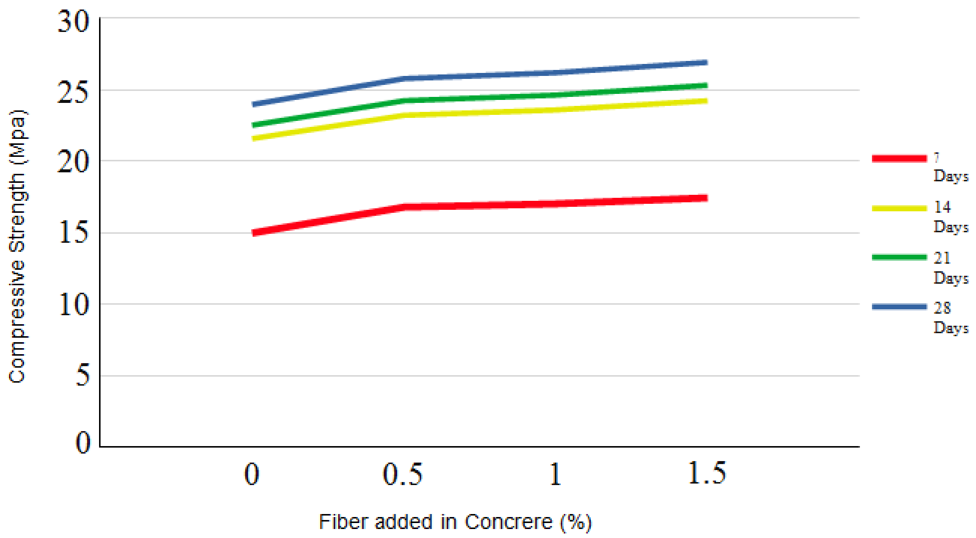

Fig : Strengths by varying its percentage

V. CONCLUSION

The primary objective of this study was to evaluate the optimal quantity of polypropylene fibers for improved physical and mechanical behaviour of concrete. The addition of marginal quantity of polypropylene fiber in the concrete mix showed positive effects on the compressive strengths of concrete. The optimum percentage of polypropylene to be added to the concrete mix to increase the compressive strength lies around 0.25%. Polypropylene fibers increased the 28 days compressive strength of concrete by about 9%. Polypropylene fiber addition greater than the optimum percentage (0.25%) showed a slight increase for 0.50% and then decreased for higher values. The flexural strength of concrete increases by as much as 65% when low percentage fractions (0.25%) are added. It recorded slight increase for 0.50% and then decreases when 0.75% and 1% are added. From this study, it is observed that the optimum dosage of polypropylene fiber is between 0.25% and 0.5% both for compressive strengths and for flexural strengths. Further researches should be carried out to know the exact dosage of polypropylene fibers that yields the most favourable strengths of concrete and to apply this methodology to different types of Portland cements.

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