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Strength Gain Analysis of Polypropylene Fiber Reinforced Concrete

Saman Khan[1], Roohul Abad Khan[2], Amadur Rahman Khan[3], Saiful Islam[4]

[1]Integral University, Lucknow, India
[2,4]King Khalid University, Abha, Saudi Arabia
[3]Aligarh Muslim University, Aligarh, India

ABSTRACT

The use of fiber in concrete is becoming a common practice in the concrete industry. The study undertakes the analysis of compressive and tensile strength of Polypropylene fiber reinforced concrete specimen. The strength was analyzed at 7 days and 28 days and compared with non-reinforced concrete specimen to determine the strength gain. The study concluded with significant strength gains in fiber reinforced concrete in terms of compression and split tensile strength.

Keywords: Fiber, Compressive And Tensile Strength, Polyproyplene Fiber Reinforced Concrete, Strength Gain

I. INTRODUCTION

Concrete serves as the base for human development in the modern age. Brittleness of concrete when subjected to tensile loads is well known; tensile strength of the concrete is approximately one tenth of its compressive strength. Reinforced concrete was introduced to overcome this drawback of concrete and has been successfully used worldwide. The reinforcement of concrete significantly increases its strength, but to produce a concrete with homogenous tensile properties and better micro-cracking behavior, fibers are advantageous [1,2,3,4,5]. The introduction of fibers in concrete has brought a solution to develop a concrete having enhanced flexural and tensile strength, which are a new form of composite material.

The fibers are incorporated into concrete to enhance its control crack system and mechanical properties such as toughness, impact resistance, ductility (post cracking), tensile strength etc. of basic matrix. The term fiber reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains discrete fibers of varying length that are uniformly distributed and randomly oriented. When fiber is added to a concrete mix, each and every individual fiber receives a coating of cement paste. Modification of synthetic fiber geometry includes monofilaments, fibrillated fibers, fiber mesh, wave cut fiber large end fibers etc. This increases bonding with cement matrices without increasing in its length and minimized chemical interaction between fibers and the cement matrices. Fiber can be used with admixture such as super plasticizer, air entraining, retarding, accelerating etc and all type of cement and concrete mixtures. A number of studies are done to study the effect of Polypropylene fiber Effect on concrete and soil. In present study polypropylene and steel fibres have been used. Polypropylene fibre having low modulus, light density, small monofilament diameter and not susceptible to corrosion and steel fibre increases its ductility, toughness, and impact resistance.

II. METHODS AND MATERIAL

Compressive strength of each concrete mix was determined usingand compared with standard concrete mix at 0% fibre and also inter compared with all mixes. Three specimens of each mix were tested to determine the average compressive strength of concrete mixes at 28 days. The specimens were tested under compression testing machine of 2000 KN capacity as per IS 516-1959[26].

Split tensile Strength of each concrete mix was determinedand compared with standard concrete mix at 0% fibre and comparison with all mixes. Three specimens for each mix were tested to determine the average split tensile strength of concrete mixes at 28 days. The specimens were tested as per IS: 5816-1999[29].

III. RESULTS AND DISCUSSION

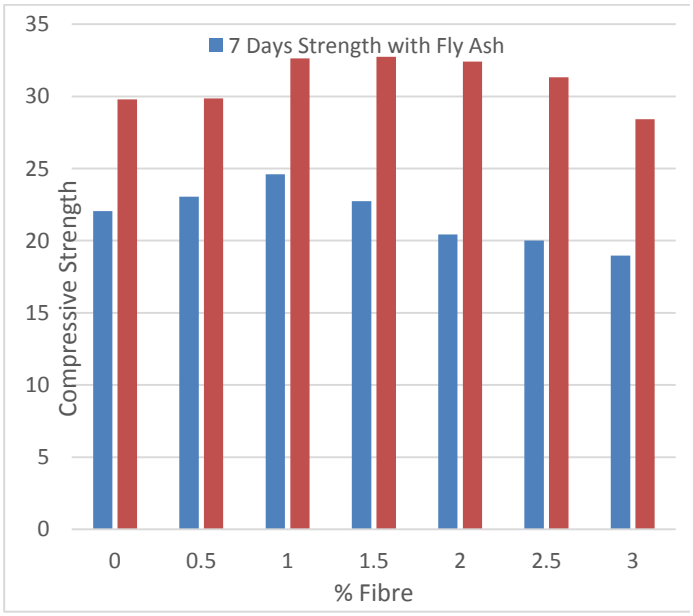

Figure 1 : Compressive strength at 7 and 28 Days with Fly Ash

The graph represents the 7 days and 28 days compressive strength of the specimen with Fly Ash. The lowest rate of gain of strength was depicted by the specimen with 2% fibre with 63 % of the strength gain while the specimen with 0.5% achieved the maximum strength within 7 days with 77 % strength gain.

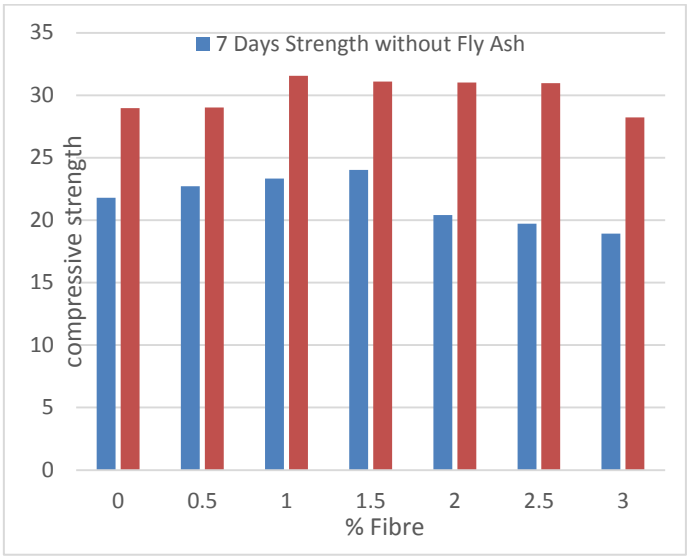

Figure 2 : Compressive strength at 7 and 28 days without Fly Ash

The graph represents the 7 days and 28 days compressive strength of the specimen without Fly Ash. The maximum rate of gain of strength 78% was achieved by specimen with 0.5 % fibre while the specimen with 2.5 % fibre content can gain only 63% of strength.

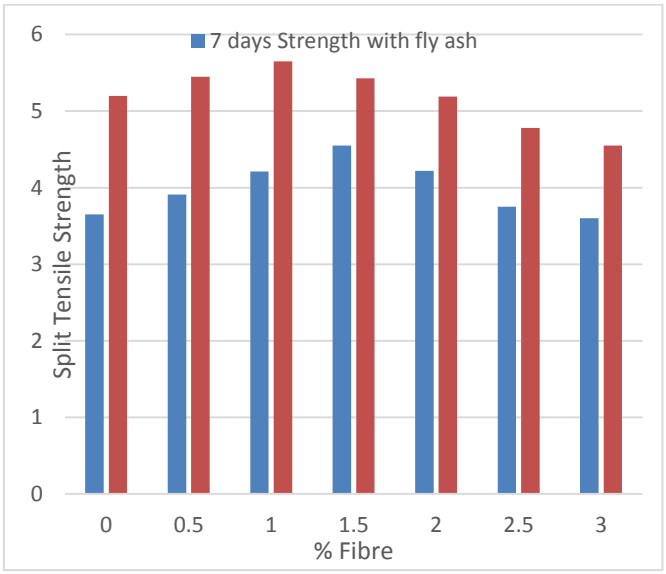

Figure 3 : Tensile Strength at 7 and 28 days with Fly Ash

The graph represents the 7 days and 28 days split tensile strength of the specimen with Fly Ash. The leas gain of strength was depicted by the specimen with no fibre at 70% gain of strength while specimen with 1.5 % fibre achieved maximum rate of gain of strength at 83 %.

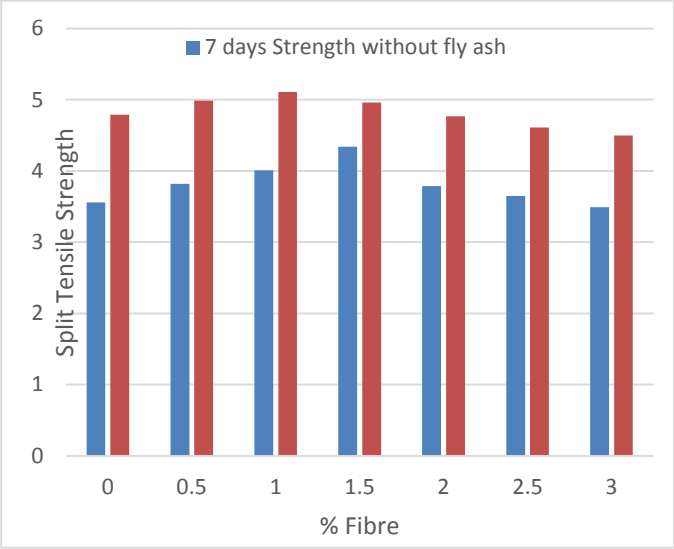

Figure 4 : Tensile Strength at 7 adn 28 days without Fly Ash

The graph represents the 7 days and 28 days split tensile strength of the specimen without Fly Ash. The specimen with 1.5 % fibre content depicted the maximum rate of gain of strength with 87.5 percent while specimen with no zero fibre content achieved the lowest gain of strength at 74 %.

IV. CONCLUSION

- When fibre are added to concrete mix it resulted in stiff mixes reducing the workability, hence the study concludes that plasticizer or super plasticizer should be used when dealing with fibre reinforced concrete.
- The compressive rate of gain of strength was maximum at 0.5 % fibre content with and without fly ash while the lowest was recorded at 2% and 2.5% for with and without fly ash specimens respectively.
- The lower fibre content in the specimen enhanced the cementitious properties while the higher fibre content i.e. more than 0.5 % hindered between the bonding of the concrete matrix resulting in lower rate of gain of strength.
- When the rate of gain of strength with respect to split tensile strength of concrete was analysed the results are more clear as the minimum rate of gain of strength was depicted by specimen with zero fibre content in both the cases.
- While the maximum rate of gain of strength was achieved at 1.5 % fibre content also corresponding to the maximum split tensile strength gained at 28 days for the same fibre content in both the cases.
- The split tensile rate of gain of strength was highest in the specimen without fly ash which may be due to the fact that the fibres may be hindering the rate of gain of strength.

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