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# A REVIEW OF COMPARISON STUDY ON MECHANICAL PROPERTIES BY USING POLYESTERS AND POLYPROPYLENE FIBER CONCRETE

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**Abstract:**
Concrete is a brittle composite material and concrete provides high compressive strength, [12] but at the same time its tensile and flexural strength is too low for polyester and polypropylene fiber to be used in its mix to increase its compressive, tensile, flexural strength and to make concrete durable and strong and long-lasting. [2] If the fiber ratio is high in concrete mix design it directly reduces its workability. Therefore, only 0.1 to 0.4 % of the volume of concrete can be used with fiber in the concrete mix. [7,13] Another advantage of using fiber is that it greatly controls shrinkage cracks in concrete, [1,8] In concrete fiber we can also use plastic waste as an environment-friendly option. [4,13]

**Keywords:**
Fiber Reinforce, Strength, Polyproline, Polyester, Composite materials, Concrete

**Introduction Polyester Fiber Reinforced Concrete**
Polyester fibers are mixed into concrete to amplify its mechanical properties and overall performance. [7,12] These fibers are made from synthetic polymers which are then added to the concrete mix to address specific shortcomings in traditional concrete. [3,13] This introduction aims to provide a detailed overview of the reasons for using polyester fibers in concrete. [1,6]
"Polyester fibers have caught and gained attention as a valuable addition to concrete due to their ability to significantly improve its mechanical characteristics. [5,7] By blending these synthetic fibers with concrete, the resulting composite material offers enhanced properties that address common challenges faced by conventional concrete. [3] This includes improved crack control, increased flexural and tensile strength, enhanced durability, better impact resistance, and greater ductility.[7] This paper gives a detailed view of the reasons behind incorporating polyester fibers into concrete. It explores the various ways in which these fibers contribute to optimizing the material's performance for a range of construction applications. [7]

Figure 1. Polyester Fiber [1]

Polypropylene fiber-reinforced concrete
Polypropylene fibers are incorporated into concrete to enhance its performance and durability. [8,10] These synthetic fibers offer specific advantages that make them a valuable addition to the concrete

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mix. [13] Here's an introductory statement that captures the reasons for using polypropylene fibers in concrete. [10]

"The utilization of polypropylene fibers in concrete has gathered significant interest due to their capacity to effectively enhance the properties of the material.[10] These synthetic fibers are introduced into the concrete mixture to address certain limitations of traditional ways of making concrete. [9] The incorporation of polypropylene fibers imparts improved crack resistance, heightened durability, enhanced flexural and tensile strength, and increased impact resistance to the resulting composite. [8] This paper provides an exploration of the rationale behind integrating polypropylene fibers into concrete and delves into the mechanisms through which these fibers bolster the overall performance and suitability of the material for diverse construction applications. [12]

Figure 2. Polypropylene Fiber [9]

**Mechanical Properties 1) Polyester fiber A) Compressive Strength**

Normal and polyester fiber concrete of M20 grade were studied as follows. [3] 21.11 N/mm2 compressive strength was obtained in normal concrete. [3] Here three different percentages of fiber were added in concrete as 0.2, 0.4, and 0.6% based on the volume of concrete, the highest strength of 25.77 N/mm2 was obtained with 0.4% fiber. [3] From this strength, it can be known that 0.4% fiber content in concrete is more suitable. [3] As the compressive strength of concrete increases, the lifespan of concrete is better and it can bear more loads. [3]

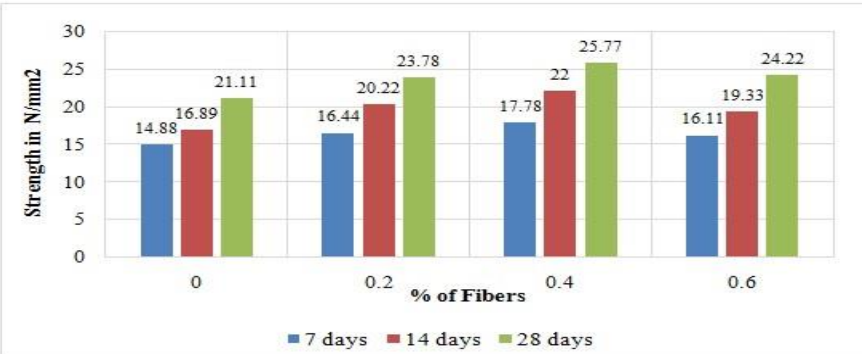


Figure 3 Comparison of Compressive Strength for Polyester Fiber 7, 14, and 28 days [3]

**B) Flexural Strength**

M20 grade of normal concrete achieves 8.63 N/mm2 flexural strength after 28 days and 0.4% fiber achieves a flexural strength of 10.98 N/mm2 when used in concrete and with this, it increases the traveling strength of concrete. [3]

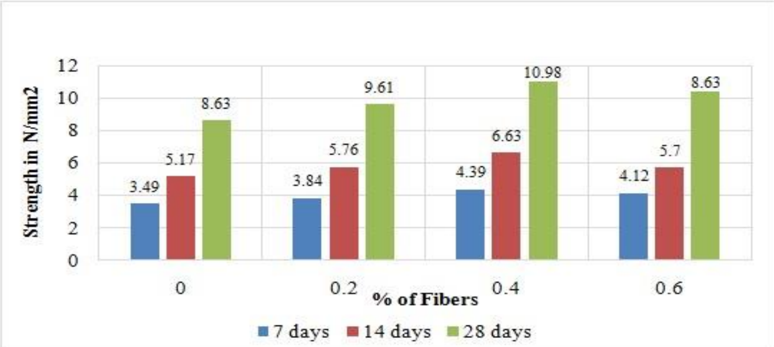


Figure 4 Comparison of Flexural Strength for Polyester Fiber 7, 14, and 28 days [3]

**C) Spilt Tensile Strength**

As normal concrete is fragile to withstand tensile load and if the tensile load of concrete is to be increased, it is necessary to add fiber to it. [3] For instance, 0.4% fiber was added to the concrete which attains 2.82 N/mm2 strength and normal concrete attains the strength of 2.20 N/mm2, hence it can be said from the below observation that Using 0.4% fiber increases the flexural strength of concrete. [3]

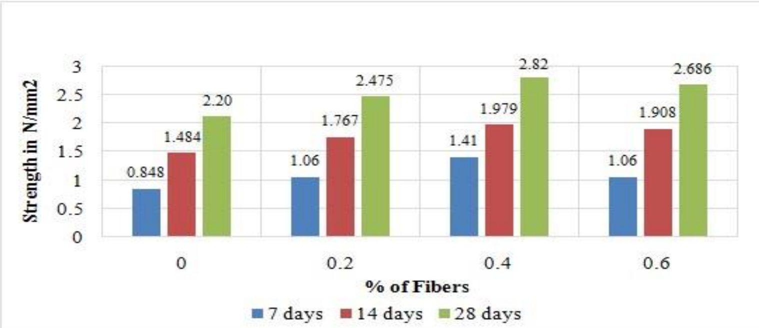


Figure 5 Comparison of Split Tensile Strength for Polyester Fiber 7, 14, and 28 days [3]

**2) Polypropylene Fiber A) Compressive Strength**

In general, the improvement in concrete strength was observed as the size of fiber addition in commonly used mixes is negligible.[10] 0.5, 1, 1.5, and 2 % M in this mixture were observed on different mixtures.[10] In this observation, 1.5 % fiber was added to the concrete as a result a minor increase in compressive strength was observed while comparing it to the concrete that has 0% fiber incorporation.[10]

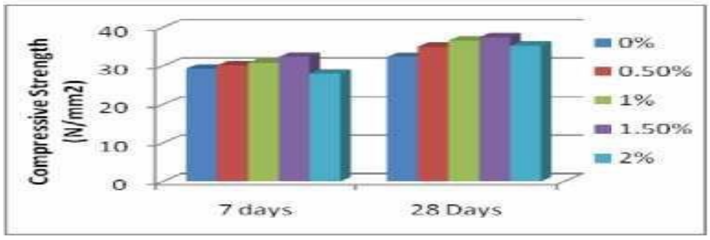


Figure 6 Comparison of Compressive Strength for Polypropylene Fiber 7, 14, and 28 days [10]

**B) Flexural Strength**

The flexural strength of the mix with the ratio of 0.5% and 2% increased by 16% and 36% respectively. [10] A minor increase remains for all of the fibers incorporated in concrete as per the ratio set while comparing it to normal mixes. [10] The amplification in flexural strength is achieved by strengthening the mechanical bond between the cement paste and fiber. [10] As the ratio of fiber increases in mix design, it greatly helps to reduce the widening of cracks more effectively, thus increasing flexural strength. [10]

 

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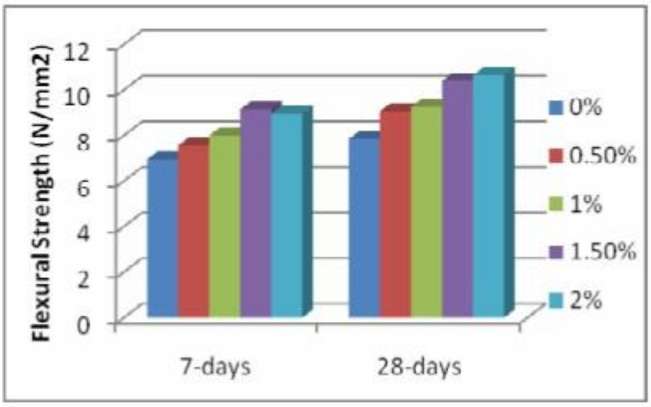


Figure 7 Comparison of Flexural Strength for Polypropylene Fiber 7, 14, and 28 days [10]

**C) Spilt Tensile Strength**

The split tensile strength varies from 3 MPa to 4.25 MPa for 7 days and 7.48 MPa to 9.2 MPa for 28 days.[10] Test results portray a maximum 23% increase in split tensile strength at 28 days.[10] The split tensile test does not give a perfect estimation of direct tensile strength but provides approximated strength due to mixed stress field and fiber adaptation but its non-functioning pattern gives a good idea about the ductility of the material.[10] Failure patterns of splitting tensile test indicate that samples after first cracking do not separate, unlike the concrete failure.[10] A great amount of damage zone is produced due to closely spaced micro-cracks surrounding a splitting plane.[10] The fiber bridging mechanism is the sole reason for such an enhanced ductile failure pattern.[10]

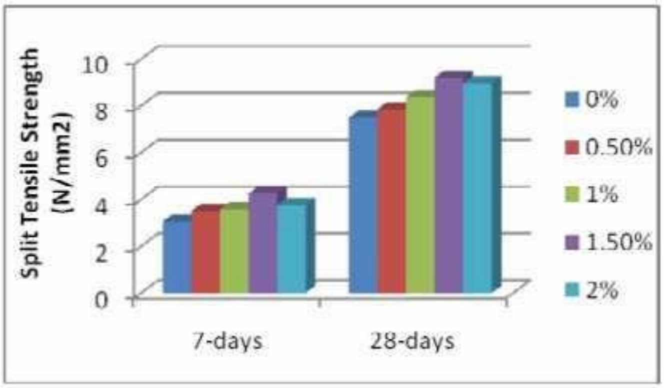


Figure 8 Comparison of Spilt Tensile Strength for Polypropylene Fiber 7, 14, and 28 days [10]

**Conclusions**

It is observed that the Slump value of concrete decreases as the fiber ratio increases, a decrease in a slump with the increase in fiber will be attributed to the presence of fiber which causes blockage to the free flow of concrete.[1] The higher initial cost of 8 to 11% is balanced by a reduction in maintenance and rehabilitation operations by using Fiber Reinforced Concrete.[1]

This study was to achieve high compressive, split tensile, and flexural strength and to point out how these parameters changed with the variation of some factors like water to cement ratio which directly results in low permeability and shrinkage reduction in concrete.[4] An economical approach can be achieved by improving strengths like compressive, split tensile, and flexural strengths which leads us to improvement in maintainability of structures.[1] The non-biodegradable waste can be limited by utilizing this waste in the concrete. [4] The durability of concrete and fracture parameters of concrete is highly improved due to the incorporation of fiber in concrete.[10] The compressive strength, split tensile strength, flexural strength, and modulus of elasticity increase with the addition of fiber content as compared with conventional concrete.[3]

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