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Influence of Polypropylene Fiber on Strength of Concrete

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ABSTRACT: *The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Researchers all over the world are attempting to develop high performance concretes by using fibers and other admixtures in concrete up to certain proportions. Hence, in this paper was interested in finding out the optimum quantity of polypropylene fibers required to achieve the maximum compressive strength for M25 grade concrete. From the exhaustive and extensive experimental work it was found that with increase in polypropylene fiber content in concrete there was a tremendous increase in compressive strength. Even at 2 % polypropylene fiber content compressive strength of 28 N/mm^2 was observed against compressive strength 25 N/mm^2 at 0 % hence increase of 12 % compressive strength was obtained.*

Keywords: *Polypropylene, Fiber, Strength, Fiber Reinforced, Concrete*

I. INTRODUCTION

The concrete is one of the most widely used construction material in developed and developing countries. The performance of concrete depends on its ingredients. It is well known that plain concrete is brittle and weak in tension. One of the objectionable characteristics of the concrete as a brittle material is its low tensile strength, and strain capacity. Therefore it requires reinforcement in order to be used as the most widely construction material. Conventionally, this reinforcement is in the form of continuous steel bars placed in the concrete structure in the appropriate positions to withstand the imposed tensile and shear stresses. Fibers, on the other hand, are generally short, discontinuous, and randomly distributed throughout the concrete member to produce a composite construction material known as fiber reinforced concrete (FRC).

The major advantage of fiber reinforcement concrete is to transform a brittle concrete into a pseudo ductile material. Adding fibers in concrete can arrest micro cracks which causes gradual failure. The fibers from cheap or waste materials may be used for manufacture of structural units with cement mortar composites have great potential for developing countries like Libya. Different fibers like steel, carbon, glass, synthetic organic and natural fibers has been incorporated in concrete and mechanical properties of such concrete is studied by many researchers. But still it is ongoing process to improve properties of concrete. Fiber reinforced concrete (FRC) is Portland cement concrete reinforced with more or less randomly distributed Fibers. In FRC, thousands of small Fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties in all directions.

Fiber reinforced concrete is cement- based composite material that has been developed in recent years. It has been successfully used in construction with its excellent flexural-tensile strength, resistance to spitting, impact resistance and excellent permeability and frost resistance. It is an effective way to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the concrete. Fiber is a small piece of reinforcing material possessing certain characteristics properties. They can be circular, triangular or flat in cross-section. The fire is often described by a convenient parameter called “aspect ratio”. The aspect ratio of the Fiber is the ratio of its length to its diameter. The principle reason for incorporating Fibers into a cement matrix is to increase the toughness and tensile strength and improve the cracking deformation characteristics of the resultant composite. For Fiber reinforced concrete to be a viable construction material, it must be able to compete economically with existing reinforcing system.

Polypropylene Fibers are one of the main types of Fiber used in the market, apart from steel Fibers. However, both types of Fibers vary significantly in their elastic and strength properties. For 40 years, steel Fibers have been commonly used in concrete flatwork and sprayed concrete applications. The emergence of polypropylene

Fibers has introduced to the world the possibility of having a high-performance and more cost-effective product in the market place. Polypropylene fibers also possess better durability as plastic does not rust. It also contributes to the ease in handling as it weight about one-fifth of an equivalent steel fiber.
Fiber–reinforced concrete is becoming an increasingly popular construction material due to its improved mechanical properties over unreinforced concrete and its ability to enhance the mechanical performance of conventionally reinforced concrete. Fiber reinforcement is one of the most important modification methods to alter the brittle nature of plain concrete. Fibers are generally used as resistance of cracking and strengthening of concrete. In this paper an experimental study is made on the utilization of plastic waste in concrete cubes with addition percentage ranging from 0% to 3% [1]. Polypropylene fiber is a synthetic fiber with low density, fine diameter and low modulus of elasticity. It has some special characteristics such as high strength, ductility and durability, abundant resources, low cost, and easily physical and chemical reformations according to certain demands. Thus it can be widely utilized in the field of concrete products [2]. In this study the influence of different amount of polypropylene fibers content on concrete properties were investigated by measuring compressive strength.

II. METHODOLOGY

2.1 Materials and Experimental Details

Concrete mixes containing ordinary Portland cement, desert sea sand, crushed coarse aggregate, water, and different percentage of polypropylene fiber content were studied. The used ordinary Portland cement satisfies the ASTM requirements. Locally desert sand was used, which had specific gravity of 2.68 and its grading fell within ASTM. Crushed coarse aggregate had specific gravity of 2.70. The sieve analysis of coarse aggregate is carried out according to ASTM. The fibrillated polypropylene fiber was used; the properties of this fiber are illustrated in Table (1). Three identical concrete mixes having different percentage of fiber content were used in this investigation. The same mix, which is obtained according to BS, was used through the all investigation. The water cement ratio (W/C) was 60%.

Table 1 Property of Polypropylene Fiber

No	Property	Description
1	Colour	Natural
2	Design	Monofilament Fiber
3	Fiber Length	6 mm
4	Diameter	18 micron nominal
5	Density	0.91 gm nominal
6	Absorption	Nil
7	Specific Surface Area	250 sq meters per KG
8	Melt Point	160 ^{0}C
9	Ignition Point	365 ^{0}C
10	Thermal Conductivity	Low
11	Electrical Conductivity	Low
12	Acid Resistance	High
13	Alkali Resistance	100%

2.2 Mix Proportion

Test specimens consisting 0f 150x150x150 mm cubes were casted. Aggregate and cement were first mixed, and water was progressively added until a homogeneous concrete was obtained. Then, the fibers were added, and concrete was mixed for at least 3 minutes in order to allow a sufficient time for fiber even distribution in the mixture. For each mixture three concrete cubes with dimensions of 150×150×150 mm were cast into molds consolidated by steel bar to decrease the amount of air bubbles. The specimens were remodeled after 24 hour and then placed in curing tank under laboratory conditions for 28 days for compressive concrete strength at age 28 days for compressive strength of concrete.

III. RESULTS AND DISCUSSION

3.1 Effect of Polypropylene Fiber on Workability of Concrete

Slump cone test was performed to determine the slump of the mixes. The slump values for various mixes are shown in Table 2 and fig 1, 2. It is evident from the fig 1 and 2 that as the percentage of fiber content increases slump values are decreasing. The reduction in the slump with the increase in the fiber will be attributed to presence of fiber which causes obstruction to the free flow of concrete.

Table 2 Results Obtained From Slump and Flow Test

Mixture	Fiber content %	Slump (mm)	Flow (mm)
M1	0	180	580
M2	1.0	185	560
M3	1.5	175	400
M4	2.0	75	370

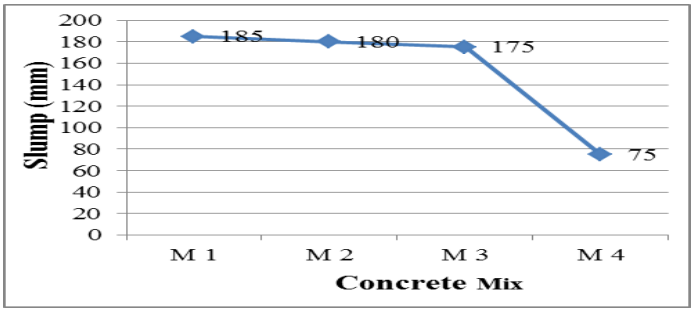

Figure 1 Line Chart Showing Results of Slump Test

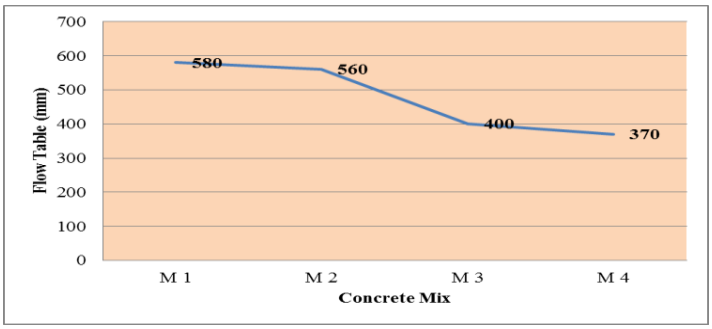

Figure 2 Line Chart Showing Results of Flow Test

3.2 Compressive Strength of Polypropylene Fiber On Concrete Mixes

The compressive strength values of the cube specimens at the age of 28 days are as shown in fig 3. It has been observed that the compressive strength of concrete for the cubes with polypropylene fiber 1%, 1.50% and 2% is more than that of cubes without polypropylene fiber 26 N/mm2 , 26.40 N/mm2 and 28 N/mm2 respectively compare with control mix without polypropylene fiber as compressive strength was 25 N/mm2. This may be due to the fact that the polypropylene fiber will effectively hold the micro cracks in concrete mass. The percentage increase in the compressive strength for the cubes with polypropylene fiber 1%, 1.5% and 2% compared to the cubes without polypropylene fiber are 4%, 5.6% and 12 % respectively.

It can be seen from the observations that the maximum percentage increase in compressive strength can be obtained for the cubes with polypropylene fiber 2%. Thus it is recommended to use polypropylene fiber 2% to get the maximum benefit in improving compressive strength. In a nutshell it can be concluded that the use of polypropylene fiber is an effective method to improve the compressive strength of concrete. To get the maximum benefit it is recommended to use polypropylene fiber 2%. More percentage of polypropylene fiber will have the workability problem & also air cavities are left in the system.

Table 3 Results Obtained From Compression Strength Test after 28 Days

Mixture	Fiber Content %	Compressive Strength (N/mm^2)
M1	0	25.00
M2	1.0	26.00
M3	1.5	26.40
M4	2.0	28.00

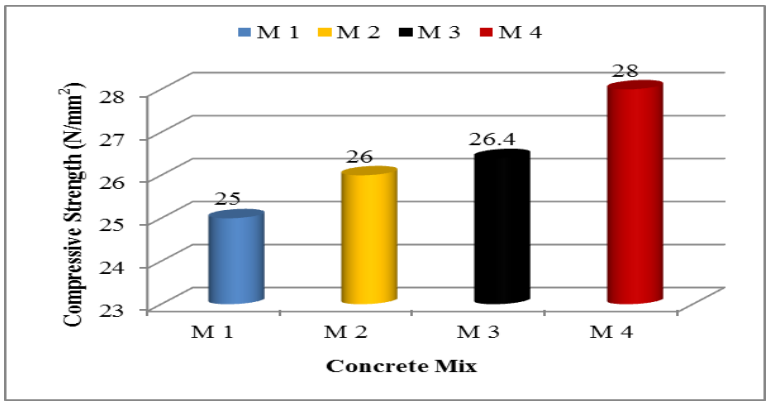

Figure 3 Line Chart Showing Results of Compressive Strength Test

IV. CONCLUSION

To study the effect of polypropylene fiber on compressive strength of concrete, the experimentation is conducted in the laboratory. Based on the experimentation conducted, on the cubes with different percentage of polypropylene fiber the following some conclusions were drawn.

1. The reduction of slump is noticed with increase in polypropylene fiber content, especially beyond 2 % dosage, the mix become fibrous which results in difficulty in handling.
2. The compressive strength tests reveal that, the strengths were increased proportionately with the increase in volume ratios of polypropylene fiber with reference to the control mix without fiber.
3. The percentage increase of compressive strength of polypropylene fiber concrete mixes compared to the mix without fiber is observed from 4 to 12 %.
4. The samples with polypropylene fiber content of 2 % showed optimum results in comparison with other samples in this study.

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REFERENCES

[1]. Salahaldein Alsadey (2016) "Effect of Polypropylene Fiber Reinforced on Properties of Concrete". Journal of Advance Research in Mechanical and Civil Engineering.
[2]. Shakir, A., and Maha, E., "Effect of polypropylene fibers on properties of mortar containing crushed brick as aggregate", Eng. And Tech., Vol. 26, No. 12, 2008, PP. 1508-1513.
[3]. ACI 544.1R (1996). State-of-the-Art Report on Fiber Reinforced Concrete, American Concrete Institute, Farmington Hills, Michigan.
[4]. ACI Committee 544. 1982. State-of-the-Report on Fiber Reinforced Concrete, (ACI 544.1R-82), Concrete International: Design and Construction. 4(5): 9-30, American Concrete Institute, Detroit, Michigan, USA.
[5]. ACI Committee 544. 1989. Measurement of Properties of Fiber Reinforced Concrete, (ACI 544.2R-889).
[6]. ASTM C 192/C 192M. 2002. ―Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory‖. ASTM International.
[7]. British Standard Institution, BS 1881: Part 102 (1983). "Methods for Determination of Slump".
[8]. British Standard Institution, BS 1881: Part 116 (1983). "Methods for Determination of Compressive Strength of Concrete Cube".
[9]. ACI Committee 544. 1982. State-of-the-Report on Fiber Reinforced Concrete, (ACI 544.1R-82), Concrete International: Design and Construction. 4(5): 9-30, American Concrete Institute, Detroit, Michigan, USA.
[10]. ACI Committee 544. 1989. Measurement of Properties of Fiber Reinforced Concrete, (ACI 544.2R-889).