Investigation on the effect of using banana fiber in normal C-25 Grade concrete

Gizachew Markos Makebo[1], Elsaye Berhanu Basa[2]

[1]MSc, Department of Civil Engineering Wolaita Sodo University, Wolaita Sodo, Ethiopia
[2]MSc, Department of Civil Engineering Wolaita Sodo University, Wolaita Sodo, Ethiopia

ABSTRACT

Concrete is relatively brittle, and its tensile strength is typically only about one tenths of its compressive strength. Regular concrete is therefore normally reinforced with steel reinforcing bars but due high cost of steel bars Fibers used in concrete production. A Fiber is a small piece of reinforcing material possessing certain characteristics properties. Addition of fibers to concrete influences its mechanical properties which significantly depend on the type and percentage of fiber. The property of fiber reinforced concrete is influenced mainly by the physical and mechanical properties of the fiber. The objective of this study was to evaluate the workability, unit weight, compressive strength of concrete and tensile strength after 7th and 28th days curing. The study considered 0%, 0.5%, 1%, 1.5% and 2% Banana fiber in concrete production for and determination its effect on fresh and hardened concrete. Mechanical properties of waste banana fibered concrete, compression and flexural strength test with different percentage of BF range from 0 to 2% showed a good result. Increase for 0.5, 1 and 1.5% and then again decrease at 2% usage of fiber. Workability of the fresh mix decreased from its control mix due to addition of banana fiber in concrete production. Incorporation of BF in concrete was decreased the compressive strength of sample. But, the impact of 0.5% of BF compressive strength is not more significant that the result is not far more from strength of concrete control.

Keyword: *Compressive strengths, Fiber reinforced concrete, Flexural strength, Banana Fiber, Workability*

1. INTRODUCTION

Concrete, in the broadest sense, is any product or mass made by use of a cementing medium. This medium is a product of reaction between hydraulic cement and water. This medium cover a wide range of products: several types of cement containing pozzalana, fly ash, blast furnace slag, a „regulated set" additive, Sulphur, admixtures, fibers, and so on. The cementing medium, i.e. the products of hydration of cement, is the essential building material, with the aggregates fulfilling the role of a cheap, or cheaper, dilutant [1].

Fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Some types of fibers produce greater impact, abrasion, and shatter resistance in concrete. Larger steel or synthetic fibers can replace rebar or steel completely in certain situations. Fiber reinforced concrete has all but completely replaced bar in underground construction industry such as tunnel segments where almost all tunnel linings are fiber reinforced in lieu of using rebar. Indeed, some fibers actually reduce the compressive strength of concrete [2].

A Fiber is a small piece of reinforcing material possessing certain characteristics properties. Addition of fibers to concrete influences its mechanical properties which significantly depend on the type and percentage of fiber. The property of fiber reinforced concrete is influenced mainly by the physical and mechanical properties of the fiber. A good fiber should have good adhesion within the matrix and adaptable elasticity modulus. It must be compatible with the binder, which shouldn't be attacked or destroyed in the long term. It should be short, fine and flexible to permit mixing, transporting and placing and also strong enough to withstand the mixing process [3].

Fibers have been used as reinforcement since ancient times. Historically, horsehair was used in mortal and straw in mud bricks. In the early 1900s, asbestos fibers were used in concrete. In the 1950s, the concept of composite materials came into being and fiber reinforced concrete was one of the topics of interest. Once the health risks associated with asbestos were discovered, there was a need to find a replacement for the substance in concrete and other building materials. By the 1960s, steel, glass (GFRC), and synthetic fibers such as polypropylene fibers were used in concrete [4].

Fiber reinforced concrete is a composite material containing fiber in the cement matrix in an orderly manner or randomly distributed manner. Its properties would obviously depend upon the efficient transfer of stress between matrix and the fibers, which is largely depend on the type of fiber, fiber geometry, fiber content and distribution of the fibers. Fiber reinforced concrete (FRC) has been recognized for a long as a material with potential which extends the versatility of concrete as a construction material, by providing an effective method of overcoming its intrinsic brittleness [5].

Based on investigation focused on the influence of curing types and its period on fiber reinforced concrete, the increase of the fiber content from 1 to 6 volume% increased the tensile strength by 92% and the compressive strength by 72%. From the investigation of the different curing regimes and the curing period, it was observed that the 7 days strength of the steam-cured specimens was almost the same as the 90 days strength of the specimens cured under normal conditions [6]. Concrete is relatively brittle, and its tensile strength is typically only about one tenths of its compressive strength. Regular concrete is therefore normally reinforced with steel reinforcing bars. So the study focused on the effect of using banana fiber in concrete production.

1.1 Objective of the study

The objectives of the study

- To determine the effect of banana fiber on workability of fresh Concrete
- To determine its effect on compressive strength of concrete
- To determine the its effect on properties on Hardened concrete
- To determine its optimum percentage of banana fiber in C-25 concrete production

2. RESULTS AND DISCUSSION

2.1 The effect of banana fiber on workability of fresh concrete

The addition of fiber reduced the workability of the fresh concrete. This is attributed to the fact that the fibers absorb some of the water in the concrete mix making the mix be of less flow. But human hair absorbs the least water from the mix. Probably, this is attributed to the presence of keratin in hair which makes the hair absorbs very little water.

As a result, since the slump of the study found in the range of 30-38 mm, BF concrete is good in plastic and cohesive properties. As a result it was found that Banana fibered concrete will be good to minimize segregation of fresh concrete during placing and consolidation.

Table 1: The Effect of BF on workability of fresh concrete.

Material type	Fiber content	Slump test result(mm)
Banana fiber	0	40
	1	38
	2	36
	3	35

From the experiment it was realized that there was a variation on the consistency and workability of the concrete mix depending on the fiber percentage used in the mix. The slumps of the concrete containing BFC have shown reduction as the fiber content increases. But the slump result record different result for different percentage of fiber used, for 0.5% it decrease by 18.9% from the control, for 1% fiber used there I also a declination of slump from the control by 21.6%, for 1.5% it a declination by 32.4% and for the 2% fiber used a 35.1% declination of slump was recorded. From this it's easy to understand as the fiber percentage increase the slump or workability decrease concurrently.

2.2 Effect on Compressive strength

Compressive strength test of samples was done at the age of 7 and 28. The 7th age results indicate on the following table. Compressive strength value (7^{th} day) shown the following table.

Table 2: the Effect of BF on 7^{th} day compressive strength of concrete

Fiber	Banana fiber content (%)	Average max load(ton)	Compressive strength in (Mpa)
Control	0	51.5	23.1

Banana fiber	0.5	54.6	24.5
	1	55.7	24.6
	1.5	56.8	25.0
	2	53.7	24.5

The Banana fiber concrete at the age of 7days result shows that addition of this fiber resulted in rise of concrete compressive strength compared with the control mix. As the banana fiber percentages increases the corresponding compressive strength increase to some extent and again reduce as the fiber percentage increase in excess. From 0.5% to 1.5% shows continuous increase in compressive strength but in the 2% addition of fiber there was a reduction in compressive strength when compare with 1.5% of fiber used. This shows that increasing the fiber percentage beyond this, resulted with reduction of compressive strength of fibered concrete.

2.2.1 Compressive strength value (28th day)

Table 3: the Effect of BF on 28th day compressive strength of concrete

Fiber	Banana fiber content (%)	Average max load(ton)	Compressive strength in (Mpa)
Control	0	76.8	34.0
Banana fiber	0.5	81.60	36.1
	1	81.90	36.25
	1.5	84	37
	2	81.30	36

The results of BFC concrete at the age of 28 days was shown the same result of increasing for 0.5, 1 and 1.5% and reduce the result at 2% of BFC concrete. But all percentages of fibers used were rise of concrete compressive strength compared with the control mix

2.3 Its effect on harden concrete properties

a) Unit weight of hardened concrete

The average unit weight value after 28 days represented as follows

Table 4: the Effect of BF on Unit weight of hardened concrete

Sample	Banana fiber (%)	Density (kg/m^3)
1	0% of BF	2480
2	0.5% of BF	2448.65
3	1% of BF	2435.25
4	1.5% of BF	2422.35
5	2% of BF	2385.85

From the above table the 28 days curing result showed that there was a significant reduction on unit weight of concrete.

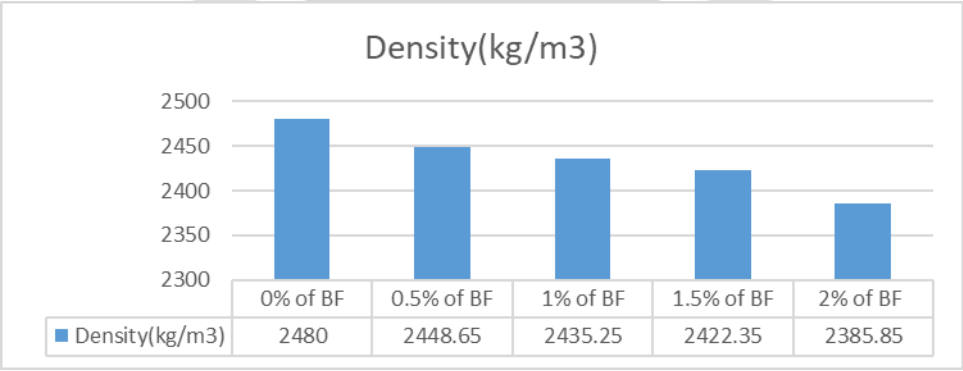

Chart 1: The effect of BF on Unit Weight

2.4 Effect on Flexural tensile strength

The flexural tensile strength value of concrete as a result of 0%, 0.5%, 1%, 1.5%, 2% as a result of 7th and 28th day as follows in the following table.

Table 5: the Effect of BF on Flexural tensile strength

Sample	Result of 7th day			Result of 28th day		
	Average load(KN)	Modulus of Rapture (MPa)	Variation from control (%)	Average load(KN)	Modulus of Rapture (MPa)	Variation from control (%)
1	18.64	5.60	0.00	28.31	8.64	0.00
2	22.24	7.43	16.86	28.84	8.38	3.21
3	16.42	4.95	-11.44	26.22	7.61	8.64
4	13.35	3.98	-27.45	20.66	6.01	28.45

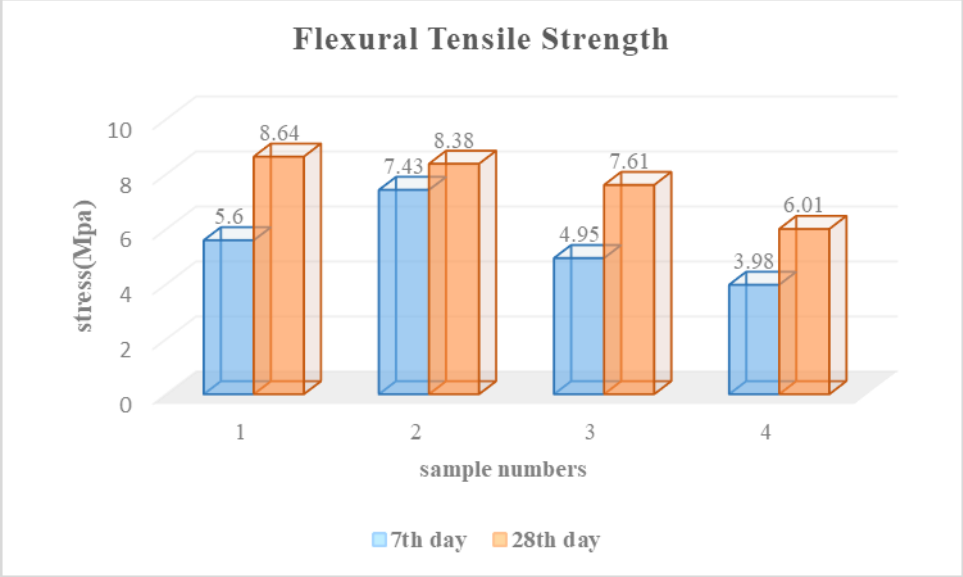

Chart 2: The effect of BF on Flexural Tensile Strength

3. CONCLUSIONS

Based on the analysis of data and discussion that has been carried out, it was shown that banana fibers can be used as concrete reinforcing material. After the completion of testing and analysis based on the objectives outlined for this study, the following conclusions can be derived:

- Mechanical properties of waste banana fibered concrete, compression and flexural strength test with different percentage of BF range from 0 to 2% showed a good result. Increase for 0.5, 1 and 1.5% and then again decrease at 2% usage of fiber.
- Workability of the fresh mix decreased from its control mix due to addition of banana fiber in concrete production.
- Incorporation of BF in concrete was decreased the compressive strength of sample. But, the impact of 0.5% of BF compressive strength is not more significant that the result is not far more from strength of concrete control. And, it has moderate to strong positive linear relation with both flexural and split tensile strength.

4. REFERENCES

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