AN EXPERIMENTAL STUDY AND BEHAVIOUR OF BANANA FIBER IN CONCRETE

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Abstract - The paper presents an experimental investigation conducted to study the effects of chemically treated banana fiber in concrete. Sustainable development of the built environment in developing countries is a major challenge in the 21st century. The use of local materials in construction of buildings is one of the potential ways to support sustainable development in both urban and rural areas. Banana fibers, which will be the focus of this study. Banana fibers are widely available worldwide as agricultural waste from Banana cultivation. Banana fibers are environmentally friendly and present important attributes, such as low density, light weight, low cost, high tensile strength, as well as being water and fire resistant. This kind of waste has a greater chance of being utilized for different application in construction and building materials. This focused on the use of banana fiber and its effect on the compressive and split tensile strength.

1.Introduction

In the present day scenario the society wants a major point in the environment protection and building safe structure due to this civil engineer today trend to use in various material to construct different types of building in last 15-20 years the various urban agricultural waste material are being used in buildings the usage of various waste material is one of the main application in construction industry as traditional and reciprocal material.

Banana fiber is obtained from the pseudo-stem of banana plant. It is the best fiber with perfect mechanical properties. It has the lower density than glass fiber. It has light weight and biodegradable. It is used for making handmade bags and covers. It is used to make products like filter paper, paper bags, greeting cards, lamp stands, pen stands, decorative papers, rope, mats and composite material etc. Waste of the banana fiber is not utilized properly and all of the banana fiber is at the waste. Germany currency are used in banana fiber and now in India it's also be used. There are many demands in banana fiber. In future, it is cheaper, lighter and environmental compared to other fibers. The fiber is extracted from pseudo-steam and is used for making many products. It is also used for building and construction materials and also in textile materials. Banana fiber is an environmentally friendly like a fiber and is demand in many countries like Japan, Germany, Australia and many. Banana is a fourth most important global food crop.

2. Materials

2.1.Cement

Cement is a binding material which possess very good and cohesive properties which make it possible to bond with other materials to form a compact mass. Ordinary Portland cement is the most commonly used cement for general engineering works. The specific gravity of all grades namely 33, 43 and 53 grades. In this project Ordinary Portland Cement of 53 grades is used for experimental work. Initial and final setting time of the cement was 30 minutes and 600 minutes.

2.2.Fine aggregate

The fine aggregate used was locally available river sand without any organic impurities and conforming to IS: 383 – 1970. The fine aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk density. A

concrete can be made from sand consisting of rounded grains as good as form that in which the grains or granular.

2.3 Coarse Aggregate

Coarse aggregate for structures consists of material within the range of 5mm to 150mm size. Rocks having water absorption value greater than 3% or specific gravity of less than 2.5 are not considered suitable for mass concrete. However, in practice mixes of same workability for round shaped aggregates required less water than angular shaped aggregates.

2.4 Water

Water is an important ingredient of concrete as it activity participates in the chemical reaction with cement and potable water available in laboratory with pH value of not less than 6.5 and not more than8.5 ,conforming to the requirement of IS 456 2000 were used for mixing concrete and curing the specimen. The water which is fit for drinking should be used for making concrete.

2.5 Banana Fiber

The Banana used for this work is from the local village, Tamil Nadu region. Uniform length of fibers was obtained by using cutting machine. Salient physical and mechanical properties of Banana were determined in their natural form.

Figure 1. Banana Fibers (BF)

Table 1. Composition of banana fiber

Constituents	Percentage
Cellulose	50%
Lignin	17%
Extractives	7%
Moisture	11%
Ashes	9%

2.5.1 Characteristics of Banana Fiber

- It has smaller elongation.
- It is light weight.
- Its average fineness is 2400Nm

2.5.2 Properties of Banana Fiber

- Density (kg/m3) – 1350
- Moisture content (%) - 11
- Tensile strength (M Pa) - 56
- Elongation at Break (%) - 2.6
- Young's modulus (M Pa) – 3.5
- Fineness – 17.15

3. Chemical Treatment For The Banana Fiber

Alkali treatment increases surface roughness resulting in better mechanical bonding and the amount of cellulose exposed on the fiber surface. This increases the number of possible reaction sites and allows better fiber wetting.

The banana fibers were cleaned and immersed in NaOH solution for 2h at room temperature and then thoroughly washed by immersion in a clean water tank to remove the non-reacted alkali until the fibers were alkali free. They were next rinsed under running water and filtered. The filtered fibers were then dried in an oven at 80 °C for 24 h.

Sodium Hydroxide (NaOH) treatment removes impurities from the fiber surface, Banana fiber sample were treated with three different conc. of NaOH to soften the fiber and make it suitable for spinning. The concentrations used were 1%, 2%, 3%, 6% weight/volume. Treatment was done with sample: liquor ratio of1:30. Standard procedure used in the institute is as follows. In the present study 200 grams of banana foreswore used per concentration. Since the NaOH used was1:30 total solution used in each case was 6 liters. For preparation of NaOH solution, 1% NaOH solution was

Fiber-OH + NaOH Fiber cell-O-Na+ + H2O + impurities

Figure 2. Banana Fiber treated in 1%, 2%, 3%and 6% of NaoH solution

4. Experimental Work

4.1 Measurement of Workability

The workability of a fresh concrete is a composite property which includes the diverse requirements of stability, mobility, placing of ability and finishing ability. There are different methods for measuring the workability. Each of them measures only particular aspects of it and there is no unique test which measures workability of concrete in its totality. The test measures the relative effort required to change a mass of concrete from definite shape to another by means of vibration.

4.1.1 Slump Cone Test

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in the laboratory or at the site of work. It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of conveniently as a control test and gives an indication of the uniformity of concrete from batch to batch.

Figure 3.Slump Cone Test

4.2 Compression Test on Concrete

Compression test is the most common test conducted on harden concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristics properties of concrete are qualitatively related to its compressive strength.

The compressive test is carried out on specimen cubical or cylindrical in shape. Sometimes, the compression strength of concrete is determined using parts of a beam tested in flexure. The end parts of beam are left intact after failure in flexure and since the beam is usually of square cross section, this part of the beam could be used to find out the compressive strength.

Figure 4. Compressive test on concrete

Table 2. Compression Test Results

Sl. No	Specimen	Compressive strength in N/mm^2		
		7^{th} day	14^{th} day	28^{th}day
1	1% NaoH BF	7.1	8.88	18.67
2	2% NaoH BF	5.77	8	17.33
3	3% NaoH BF	12.44	15.66	21.78
4	6% NaoH BF	8	13.33	20

4.3 Split Tensile Test on Concrete

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure. The tensile strength values for different types of mixes at 7, 14, 28 days are given.

Figure 5. Split tensile test

Table 3. Split Tensile Test Results

Sl.	Specimen	Split tensile strength in N/mm^2		
		7^{th} day	14^{th} day	28^{th}day
1	1% NaoH BF	3.39	4.52	6.5
2	2% NaoH BF	2.27	3.39	6
3	3% NaoH BF	4.52	6.22	9.05
4	4% NaoH BF	1.69	3.39	7.3

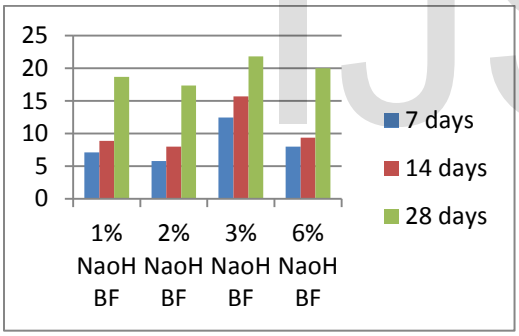
5. Result and Discussion

Various tests were conducted to know the characteristics of the concrete. The test was conducted to investigate the optimum percentage of different materials under which the concrete attains its maximum strength.

5.1 Compression Test on Concrete

The compressive strength of different types of mixes at 7 days, 14 day, 28 day are shown in graph1

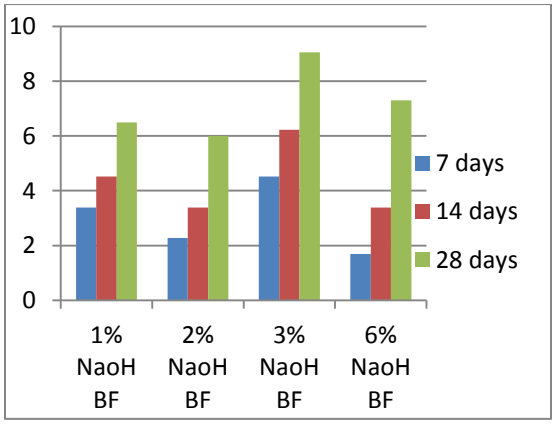
Graph 1. Compression Test Results



5.2 Split Tensile Test on Concrete

The flexural strength of different types of mixes at 7^{th} day, 14^{th} day, 28^{th} day are shown in graph 2.

Graph 2. Split Tensile Test Results



5.3 Discussions

1% of NaoH treated fiber gives better increased the compressive and flexural strength than the 2% NaoH treated fiber.

Sameway, 3% NaoH treated fiber give better compressive and flexural strength than 1% and 2% treated fiber.

We added the treated fiber from 1% to 6% and we concluded that the results 3%treated banana fiber gives more compressive and flexural strength than any other.

6. Conclusion

The study on the effect of banana fibers with different proportions can still be a promising work as there is always a need to overcome the problem of brittleness of concrete.

A new type of fiber reinforcement composite was experimentally investigated. The alkali treatment of banana fiber has improved the mechanical properties like tensile, flexural and impact strength of the fiber

Chemical treatment with NaOH proportion of 3% increases the compressive strength of the fiber up to 10-15% and removes the moisture content of the fiber.

The future scope of the project is extended by doing the experimental analysis on different proportion of coupling agents and the fiber content in the samples and performs the mechanical and thermal properties test on the specimen. And also implementation of eco-friendly fibers in the automotive parts like car panels, bumpers etc and also used for clothes,. Through implementing this fiber we can achieve lightweight and structural component in automotive parts, which in turn fuel efficiency is increased.

7. References

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