Use of Banana Fiber In Concrete

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Abstract- *Due to rapid industrialization & urbanization in the Country, lots of infrastructure developments are taking place. This process has in turn led questions to mankind to solve the problems generated by this growth. The problems defined are acute shortage of constructional materials, increased dumping of waste products. Hence in order to overcome the above said problems waste products should be employed as construction material. Cement used in cement concrete is replaced by banana fiber in known percentages and the optimum percentage at which higher strength is obtained is being calculated.*

Keywords- CSTR: Highly cost effective, Eco-friendly, Banana Fiber, Fiber property, Banana extraction, Waste materials.

I. INTRODUCTION

Most of the developing countries are very rich in agricultural and natural fiber. Except a few exceptions, a large part of agricultural waste is being used as a fuel. India alone produces more than 400 million tones of agricultural waste annually. It has got a very large percentage of the total world production of rice husk, jute, stalk, jute fiber, banana fiber and coconut fiber. All these natural fibers have excellent physical and mechanical properties and can be utilized more effectively in the development of building materials. Banana fiber is a very good source of cellulose. Banana production in India is the highest, and the area under it's cultivation is second largest, among all fruit crops grown in India.

Banana Fiber is environmentally friendly like jute Fiber. Fiber is extracted from the leaf sheath or pseudo stem of the banana

Fig. 1. Photo of banana fiber.

II. .SOURCES

Fiber can be obtained from whole banana plant. After the fruit is obtained, the plant is thrown away giving rise to increase in waste. By using a good Fiber extractor machine, a large amount of Fiber can be obtained which will give rise to additional income. Banana Fiber is a best Fiber with relatively good mechanical properties due to its high alpha cellulose and low lignin percentage. Specific agricultural plants that are producing high biomass after harvesting are found to be suitable substitutes for specific fiber based industries Banana is one of the greatest applicable examples, due to them growing fast and having high biomass. It is a huge herb with a pure adventitious root system.

III. PROCESS OF GENERATION OF BANANA FIBRE

To process banana fibers, they are extracted from banana tree trunks. Longitudinal slices, prepared from stems, are then fed to a fiber extracting machine, also known as a mechanical decorticator. The decorticator consists of two feed rollers and a beater. The beater receives the slices as they pass between the scrapper and the squeezing rollers. Next, the pulp gets alienated and fibers are pulled out and air-dried

Fig. 2 Process Of Generation Of banana fiber.

IV. CHARACTERISTICS OF BANANA FIBERS

Banana fibers has its own physical and chemical characteristics and many other properties that make it a fine quality fiber.

Appearance of banana fiber is similar to that of bamboo fiber and its fineness is also better, A chemical composition of banana fiber is cellulose, hemicelluloses and lignin, It is highly strong fiber, It has similar elongation

It is light in weight, It has strong moisture absorption quality. It absorbs as well as release moisture very fast. It is biodegradable and has no negative effect on environment and thus can be categorized as eco friendly fiber, Its average fineness is 2400 Nm, It has somewhat shiny appearance depending upon the extraction and spinning process.

V. PROPERTIES OF BANANA FIBERS

Fineness	17.15
Moisture regain	13.00%
Elongation	6.54
Aloco-ben Extractives	1.70%
Total cellulose	81.80%
Alpha Cellulose	61.50%
Residual Gum	41.90%
Lignin	15.00%

Table no. 1

VI. OBJECTIVES

1. To Experimentally Investigate The Effect Of banana fiber On Workability Of Concrete.
2. To Experimentally Investigate The Effect Of banana fiber On Density Of Concrete.
3. To Experimentally Investigate The Effect Of banana fiber On Flexural Strength Of Concrete.

VII. METHODOLOGY

Material specification :-

Cement:- the cement use in this work is 53 grade of ordinary Portland cement as per is:12269-1987.Fine aggregate:- locally available natural river sand passed through 4.75 IS sieve. Coarse aggregate:- crushed aggregate available from local sources with the maximum size of 40 mm. Water:- potable tap water is used for the experimentation.

Banana fiber :- Banana fiber use as cement in replacement of 0%,0.25%,0.50% & 0.75% in by weight of cement. And length also change 50 mm, 75mm, 100mm.

VIII. BANANA FIBERS CHEMICAL TREATMENT

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 possible reaction of the fiber and Sodium Hydroxide (NaOH) is represented in Equation

$$Fiber–OH + NaOH \rightarrow Fiber–O–Na+ + H2O$$

The banana fibers were cleaned and immersed in 6% NaOH solution for 2 h at room temperature as shown in Figure, 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 [8].

Fig.3 Submerging banana fibers in NaOH solution.

IX. QUANTITY OF MATERIALS

Total Quantity Of Materials Required For One Set Of Cube, Cylinder And Beam For Each Percentage. For M20 Grade (1:1.5:3) Of Concrete.

Replace-ment Of banana fiber (%)	Specimen To be casting	Length Of Banana Fiber (mm)	Cement (Kg)	Sand (Kg)	Aggre-gate 3/4" (Kg)	Aggre-gate 1/2" (Kg)	Banana Fiber (gm)
0	3 beam	0	18.654	32.90	32.906	32.906	0
0.25	50 mm	50	18.606	32.90	32.906	32.906	46.62
	75 mm	75	18.606	32.90	32.906	32.906	46.62
	100 mm	100	18.606	32.90	32.906	32.906	46.62
0.50	50 mm	50	18.558	32.90	32.906	32.906	93.24
	75 mm	75	18.558	32.90	32.906	32.906	93.24
	100 mm	100	18.558	32.90	32.906	32.906	93.24
0.75	50 mm	50	18.513	32.90	32.906	32.906	139.86
	75 mm	75	18.513	32.90	32.906	32.906	139.86
	100 mm	100	18.513	32.90	32.906	32.906	139.86

Table no. 2

X. RESULT OF TEST ON MODIFIED CONCRETE

10.1. Compaction Factor Test

Replacement of banana fiber %	Length Of banana Fiber (mm)	Compaction factor (%)	Avg. Compaction factor (%)
0	-	98.08	98.08
0.25	50	98.00	97.8
	75	97.90	
	100	97.50	
0.50	50	96.90	96.59
	75	96.67	
	100	96.21	
0.75	50	96.01	95.92
	75	95.90	
	100	95.85	

Table no. 3

Discussion:-

The maximum value of compaction factor of concrete is 97.80 % of 0.25% replacement of banana fiber. The minimum value of compaction factor of concrete is 95.92 % of 0.75% replacement of banana fiber. As increase in the % replacement of banana fiber at 0.25% then decrease in compaction factor at the rate of 0.28% . As increase in the % replacement of banana fiber above 0.25% to 0.50% then decrease in the compaction factor at the rate of 0.49%. As increase in the % replacement of banana fiber above 0.50% then decrease in the compaction factor at the rate of 0.67%. It indicates that above 0.25% replacement of banana fiber then gradually decreases in the value of compaction factor of fresh concrete.

10.2 Density

Replacement of banana fiber %	Length Of banana fiber (mm)	Density Of Concrete (Kg/m^3)	Avg. Density (Kg/m^3)
0	-	2604.62	2612.18
		2613.62	
		2618.31	
0.25	50	2542.71	2544.00
	75	2540.45	
	100	2548.80	
0.50	50	2502.64	2503.29
	75	2504.24	
	100	2503.00	
0.75	50	2474.94	2465.65
	75	2456.00	
	100	2466.01	

Table no. 4

Discussion:-

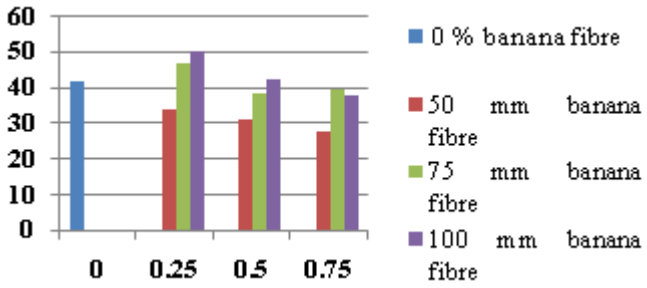
The maximum value of density of concrete is 2612.18 Kg/m3 of 0% replacement of banana fiber. The minimum value of density of concrete is 2565.65 Kg/m3 of 0.75% replacement of banana fiber. As increase in the % replacement of banana fiber from 0% up to 0.25% gradually decrease in density of concrete at the rate of 2.61%. As increase in the % replacement of banana fiber from 0.25% up to 0.50% gradually decrease in density of concrete at the rate of 1.56%.As increase in the % replacement of banana fiber from 0.50% up to 0.75% gradually decrease in density of concrete at the rate of 1.44%.It indicates that above 0.25% replacement of banana fiber then gradually decreases in the value of density of concrete of hardened concrete.

10.3 Flexural Strength Of Concrete

Flexural strength of concrete beam specimen tested after 28 days of curing

Replacement of banana Fiber %	Length Of banana Fiber (mm)	Load At Failure (KN)	Strength At 28 Days (N/mm²)	Avg. Strength At 28 Days (N/mm²)
0	-	24.00	42.66	41.77
		23.00	40.88	
		23.50	41.77	
0.25	50	20.00	31.11	34.07
		21.00	37.33	
		20.00	33.77	
	75	27.00	48.00	47.11
		26.50	47.11	
		26.00	46.22	
	100	29.00	51.55	50.66
		29.50	52.44	
		27.00	48.00	
0.50	50	18.00	32.00	31.11
		17.00	30.22	
		17.50	31.11	
	75	22.50	40.00	38.51
		21.50	38.22	
		21.00	37.33	
	100	24.50	43.55	42.36
		23.00	40.88	
		24.00	42.66	
0.75	50	17.20	25.99	27.86
		17.00	27.20	
		18.00	30.40	
	75	20.00	35.55	39.40
		21.00	37.33	
		20.50	45.33	
	100	22.50	38.00	38.14
		23.00	38.84	
		23.50	37.60	

Table no. 5



X axis- Replacement of banana fiber material in %
Y axis- Flexural strength of concrete Beam (N/mm2)

Discussion:

The maximum value of flexural strength of concrete is 50.66 N/mm2 of 0.25 % replacement and 100mm length of banana fiber. The minimum value of flexural strength of concrete is 27.86 N/mm2 of % 0.75 % replacement and 50 mm length of banana fiber. As increase in the % replacement of banana fiber length 50mm of 0.25% decrease in flexural strength of concrete at the rate of 18.43%.As increase in the length of banana fiber above 50 mm up to 100mm then gradually increase in flexural strength of concrete at the rate of 32.74 %.As increase in the % replacement of banana fiber of above 0.50% then suddenly decrease in flexural strength of concrete at the rate of 5.85%.It indicates that the acceptable limit of flexural strength of concrete of % replacement of banana fiber in between 0.25% to 0.50% of length 100 mm only.

XI. CONCLUSION

The test conducted on material like coarse aggregate, river sand, cement and banana fiber material having all the results within acceptable limit as per IS code.

The fresh concrete mix using banana fiber material are gives the increase in workability as increase in % replacement of banana fiber material so from this by using banana fiber in concrete, the concrete mix should be more workable than conventional concrete mix.

The test result of this experimental study on density of concrete is reduction in density as increase in % replacement of banana fiber. Due to this self weight (dead load) of the concrete structure is reduce. Therefore design of concrete structure becomes economical.

Flexural strength of concrete with replacement of banana fiber gives the satisfactory result up to a 0.50%. When a replacement of banana fiber in concrete increases above 0.50% then the gradual reduction in flexural strength of beam is to be noted.

The use of banana fiber in concrete is relatively new development in the world of concrete technology and this research must prove that the replacement of banana fiber in concrete is possible as steel fiber.

"Use of banana fiber in concrete" can be conveniently used as an alternative research to the convectional concrete in the construction industry.

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