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Research paper

A study of design Mix concrete properties by using natural additives

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Abstract

Originally, Concrete mix contains cement, sand and coarse aggregate is a general proportion. But it contains short falls of properties which affects the strength of concrete which is used for construction.Now-a-days the technology is enhanced to overcome the short falls and to improve the strength of concrete by using natural & artificial additives like organic & inorganic.The present study on plain concrete by using organic additives like coconut fiber & bagasse is mixed with cement, sand & coarse aggregate in terms of different percentages of additives to impact the strength of concrete ability.The additives like coconut fiber is mixed in proportion in terms of percentage 0.5, 1.0, 1.5 and bagasse percentage is also taken as 0.5, 1.0, and 1.5 to find out the compressive strength of concrete. Total Number of Cubes for both additives of each percentage tested 9 Cubes as per IS 456:2000 to find out the Characteristic strength of Plain concrete for 7days, 21 days and 28 days.The aim of this study is to check the concrete strength compared separately for both natural additives like bagasse & Coconut fiber.

Keywords: *Plain Cement; Coconut Fiber; Bagasse; Compressive Strength.*

1. Introduction

The PCC is a brittle proposition. It attains a low tensile strength, less ductility and poor in resistance to internal micro cracks which is present in concrete. Generally, structural cracks develop before stress application with respect to shrinkage and other natural reasons. Due to stress the additional cracks are impart inelastic deformation in concrete. The usage of natural fiber will help us to arrest the cracks in concrete and strengthen the properties in static and dynamic ways. The other fiber materials like Nylon, Polypropylene, recycled plastic, Polymeric, Polyester fibers also help in this scenario. In this study, the natural additive likes coconut shell and bagasse used as a percentage propitiation which helps to improve its structural performance for this paper

The natural fibers are compared with natural organic materials like coconut and bagasse has a good source of eco-friendly, feasible and with less production cost.

The generation of waste fiber called natural product, used as a supplement instead of coarse aggregate in concrete. The tattered out coconut shell is generated as a waste which is helpful for our study to improve the strength standards. The bulk density for coconut shell is in the range of 500 to 600kg/m3 and the bagasse bulk density is 200kg/m3.

Even we can add reinforcement for good binding nature but which is uneconomical and it shows aggressiveness due to weathering action. So, we are concentrating on natural additives.The main objective of this study is to optimize the volume fraction of selected aspect ratio with natural fibers and improves the strength parameters.

2. Literature review

The concept of using fibers in a brittle matrix was first recorded with the ancient Egyptians who used the hair of animals and straw as reinforcement for mud bricks and walls in housing. The dates back to1500 B.C. (Balaguruet al, 1992).

Ronald F.Zollo (1997) presented an overview regarding the history and development for fiber reinforced concrete 30 years ago. According to this report, in the early 1960's, the works on fiber reinforced concrete had been started.

Researchers like Gosh et al (1989) studied tensile strength of SFRC and reported as inclusion of suitable short steel fibers increases the tensile strength of concrete even in low volume fractions. Optimum aspect ratio was found as 80 and the maximum increase in tensile strength was obtained as 33.14% at a fiber content of 0.7% by volume. Also it was reported that cylinder split tensile strength gave more uniform and consistent results than the modulus of rupture test and direct tension test.

As of now so much research proposals has been done. Based on these workouts we have chosen our proposal with different natural additive.

3. Materials

In this experimental study we used mix proportion with natural additives like cement, aggregates like fine and coarse, coconut fiber, bagasse were used.

3.1. Cement

53 Grade Ordinary Portland cement (Brand- Bharathi Cement) conforming to IS 455: 1989. Test results on cement are given in Table 1.

Table 1: Properties of Cement

Property	Value
Fineness (%)	6.1
Specific Gravity	3.2
Soundness (mm)	2
Consistency (%)	29.2
Initial Setting Time (minute)	36
Final Setting Time (minute)	200

3.2. Fine aggregate

Clean and dry river sand which is available locally used. Grain size analysis has been done for sand using sieves passing through IS 4.75 mm sieve [IS: 383:1970] and retained in 600 micron sieve used for study. The test result on FA is presented in Table 2.

Table 2: Properties of FA

Property	Value
Sp. Gravity	2.65
FM	3
Zone	III

3.3. Coarse aggregate

Crushed granite stone coarse aggregate which is available in local area of size 12mm is used. Test results on coarse aggregate are given in Table 3.

Table 3: Properties of CA

Properties	Value
Sp. Gravity	2.93
FM	6.98
Bulk density (grm/cm^3)	1.7
Impact strength (%)	25.3

3.4. Coconut fiber

The tattered out coconut shell is generated as a waste which is taken in our study to improve the strength standards. The bulk density for coconut shell is in the range of 500 to 600kg/m3

3.5. Bagasse

The bagasse is produced from sugar cane pulp which is used for our study. The bulk density of bagasse is 200kg/m3.

3.6. Water

Portable drinking water used for mixing and curing.

3.7. Mix design

A design mix has been adopted as per IS10262:2009 for M40 grade concrete. Mix proportion is in Table 4. Material consumption details are shown in Table 5.

Table 4: Mix Proportion

Particulars	Value
Cement (Kg) per Cube	1.36
FA (Kg) per Cube	2.21
CA (Kg) per Cube	4.42
Water (ml) per Cube	600
w/c	0.43
Ratio (C:FA:CA)	1:1.63:3.25

Table 5: Quantity of Fiber Used

Mix		Coconut fiber			Bagasse		
% of material		0.5	1.0	1.5	0.5	1.0	1.5
	7 days	3	3	3	3	3	3
No. of Cubes	21 days	3	3	3	3	3	3
	28 days	3	3	3	3	3	3

4. Experimental methodology

4.1. Compressive testing machine

The concrete cubes are tested under compressive tesing machine of capacity 200KN as per IS 516-1959. The standred cube size is of 150 mm × 150 mm × 150 mm. The test results are shown in Table 6.

Table 6: Compressive Strength Results

No. of days	100 %	Compressive Strength 28 days (Mpa)	
7 days		10.81	
21days	M40	19.93	
28 days		40.50	
Compressive strength for M40 Grade with additives in %			
Material	%	Coconut fiber	Bagasse
	0.5	15.40	10.73
7 days	1.0	19.88	13.49
	1.5	22.96	18.50
	0.5	28.29	6.92
21 days	1.0	27.80	2.67
	1.5	26.23	2.96
	0.5	28.24	10.80
28 days	1.0	28.65	3.35
	1.5	39.85	1.68

5. Results and discussions

In this study the slump is also tested for above Mix proportion with additives. When the fiber is mixed with concrete mix the slump test results is going low due to moister content absorbed by organic fiber. The results are shown in below Table-7.

Table 7: Slump Values of Fiber

Types of fiber	Slump in mm for fiber-cement ratio of %		
	0.5%	1.0%	1.5%
Coconut fiber	70	45	50
Bagasse	74	65	56

The compressive strength results of M40 grade with different mix proportions of additives are shown in terms of graphs

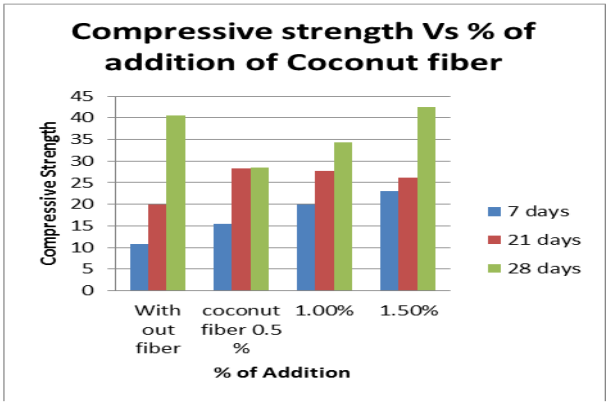

Fig. 1: Compressive Strength for Different percentage of Coconut Fiber.

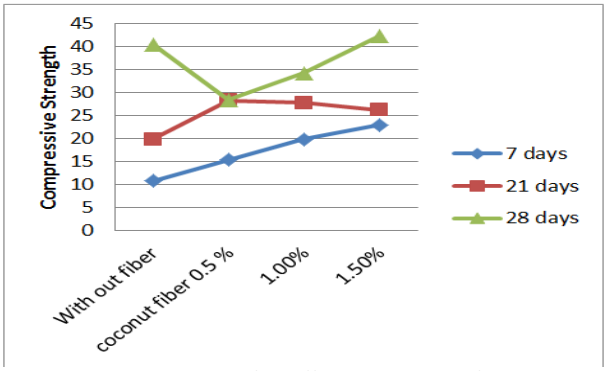

Fig. 2: Compressive Strength for Different Percentage of Coconut Fiber.

The Figure 1 & Figure 2 explains about the compressive strength of design mix with Coconut fiber and without additives in terms of percentages to find out the strength for 7, 21, 28 days.

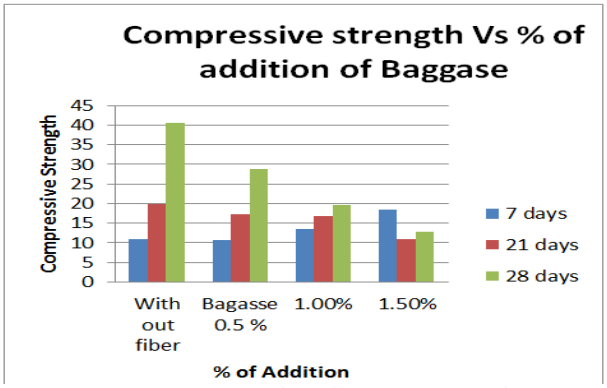

Fig. 3: Compressive Strength for Different Percentage of Bagasse.

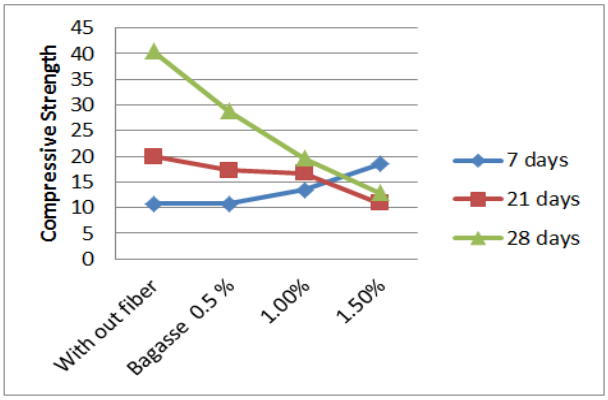

Fig. 4: Compressive Strength for Different percentage of Baggase.

The Figure 3 & Figure 4 explains about the compressive strength of design mix with Bagasse and without additives in terms of percentages to find out the strength for 7, 21, 28 days.

6. Conclusion

The strength charectersics of concrete enchanced with using organic additives like Coconut and Bagasse fiber has been done.
The addition of 1.5% Coconut fibers with cement ratio increased the compressive strength compare to 0.5% and 1.0% of additive with respective to design mix concrete.
The addition of 0.5% Baggase with cement ratio increased the compressive strength compare to 1.0% and 1.5% of additive with respective to design mix concrete.
The comparison of 1.5% Coconut fiber increases the strength of design mix but, 1.5% of Baggase fiber losses its strength.
In this study, the results give an idea about compressive strength improvement with additive of Coconut fiber compared to Bagasse fiber.

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