Analysis of Workability and Compressive Strength of the Fiber Reinforced Concrete by using Jute Fiber

Bal Gopal Guru[1], Sangeeta Swain[2], Swapna Seth[3], Madhusudan Sahu[4]

[1]*Assistant Professor in Civil Engineering Department, VIT, Bargarh, Odisha, India*
[2, 3, 4] *Students of Civil Engineering Department, VIT, Bargarh, Odisha, India*

***Abstract*— In day to day life people always look for ecofriendly and economic construction material. The main objective of this study is to analyses the compressive strength of concrete by using just fiber. . The type of fibers currently been used include steel, carbon, polymers, glass and natural fibers. Natural fibers have the potential to be used as reinforcement to sceptical the innate scarcities in cementitious materia Substantial researches are being done for usage of reinforcing fibers like jute, akwara, sisal, bamboo, sugarcane bagasse, coconut husk in cement composites typically in case of building materials. Jute fiber is natural resources which overcome this demand. In this analysis some amount of Jute fiber (0.5%, 1% and 1.5%) are added on the concrete. Different cubes were casted and gone through compressive strength test on 3rd, 7th and 28th day. On 7th day of casted 1.5% OJFRC possessed the least compressive strength; the addition of 0.5% jute gave the best result.**

***Keywords*— Jute Fibre, FRC, Compressive strength.**

I. INTRODUCTION

It is a great challenge for the engineers in the field of design to produce ecofriendly, high specific strength and economic, material and structure. The type of fibers currently used includes steel, carbon, polymers, glass and natural fibers. Consequential researches are done for manipulation of rain forcing fibers like jute, sisal, akwara, bamboo, sugarcane,bagasse, coconut husk in cement composing of building material. Jute is one of the best natural fibers. The spectacled materials with light weight, high strength to weight ratio and rigidity properties have come a long way in supplant the recurrent materials like metals, wood etc. the jute fiber is an important fiber which constitute of bundled ultimate cells, each containing spirally oriented micro fibrils bound together. Jute composites could be an ideal solution for mocking woods. The jute coin boards proving superior over operation plywood boards find imaginable in railway coaches for sleeper berth backing, for building interiors, doors and windows, besides in transportation sector as backing for seat and backrest for buses.. Typical jute composites boards do not prove well on the ground due to its moisture consumption and screw holding strength. The use of jute fiber mats in consolidation with polymer films potentially offers a squeal and simple means of manufacturing composites through film stacking, heating and press-consolidation etc. in this experiment jute after treatment with alkali was added in concrete in different percentage and compressive strength was determined after 3rd, 7th and 28th day of casting . This was conducted to determine the appropriate percentage of jute fiber addition in concrete to give maximum amount of compressive strength.

II. LITRETURE REVIEW

Vipul Kumar (2015) has studied a various engineering characteristics of Cement Composites when reinforced with jute fiber and has done a series of experiments such as Test for compressive strength, Test for workability and Test for Consistency with different volume fraction of jute fiber. He conclude that with the increase in fiber-cement ratio there was a decrease in the slump and increase in workability. The compressive strength was higher than the plain concrete cube. The difference in initial setting time and final setting time increased with increased ratio of fiber-cement ratio.

Rahul R Kshatriya et al. (2016) worked on the tensile, compressive, mechanical properties of jute fibre without modification and after modification with 0.5% alkali and 0.5% latex polymer which was modified by taking quantity of jute as 1% of cement. This modification of jute fibre improved the tensile strength of Jute fiber. He compared these properties by taking tests on plain, with and without modification of jute fibre casting cube, cylinder and beams after curing of 7 days. He concluded that there is considerable increase in strength of concrete by adding treated jute in concrete.

T. Sai Vijaya Krishna et al. aimed to study the behaviour of concrete as a reinforcing material for improving the mechanical properties of concrete. They conducted several experiments on jute fibers, jute cement mortar and jute fiber reinforced concrete. They casted 24 mortat specimens, 144 concrete specimens i.e. 48 prisms and 48 cylinders each consisting ordinary concrete, 0.5%, 1% and 2% jute fiber reinforced concrete to test their compressive, flexural and split tensile strengths respectively for different curing periods like 7, 28, 56 and 90 days. They conclude that the JFRC specimens with 1% jute content, cured up to 56 days resulted in significant improvement of mechanical properties such as compressive strength, flexural strength and split tensile strengths with respect to ordinary concrete.

III. MATERIALS

In this experiment Pozzolana Portland cement (PPC) of Panther Company is used.

AGGREGATE

(a). Fine aggregate

The river Sand was used as Fine aggregate 2mm size of Sand was used in this experiment for casting.

(b). Course of aggregate

The aggregate passing through 20mm sieve and retaining in 10mm sieve were used in this experiment.

(c). Water

Fresh edible water was used for mixing the W/C ratio was found out by consistency test. i.e. 32% of cement.

(d). Jute Fiber

Jute fibred to be used for rain forcing concrete was in raw form obtained the local market. Then the fibers were cut into pieces of 6cm length each and were soaked in 0.5% (w/r) NaOH solution at atmospheric temperatures maintaining a fiber to liquor ratio of 1:30. They were kept immersed in the alkali solution for 24 hrs. The alkali treated fibers were then washed several times with distilled water to remove the excess alkali from the fiber surface. The final Ph was maintained at 7. The jute fibers were the air dried at room temperature for 24 hrs. Hence the jute fiber was ready to use.

Figure-1 Raw jute fibre

From the view of polar chemical nature and the structure of natural fibre it appears that such fibres can interact with polar nature of cement concrete which justifies the reinforcing action of jute in cement concrete. But due to the polar character of natural fibre i.e. jute, it shows hydrophilic character. Such hydrophilicity may lead to depletion of water from the wet concrete mix as well as it may degrade in due course of time as a result of microbial attack. This degradation may prove to be a drawback of jute fibre. In order to overcome such shortcomings jute fibres needed suitable physicochemical modification before incorporation in concrete mix. This microbial degradation of jute fibre can be either delayed or prevented after modification of jute with alkali and other chemical constituent.

IV. METHODOLOGY

In this experiment different tests were conducted on the main ingredients used various tests that were conducted are as follows:-

(a). Cement test:-

- Consistency test
- Setting time
- Compressive strength

(b). Test on aggregate :-

- Sieve analysis of aggregate
- Loss angeles abrasion test

(c). Treatment of Jute Fiber:

To prevent or delay the microbial degradation and other shortcomings the jute should to be treated with alkali and other chemical constituents.

First of all the fibres were cut into pieces of 6cm length each. After that these jute fibre pieces were soaked in 0.5% (w/v) NaOH solution at ambient temperature maintaining a fibre to liquor ratio of 1:30. They were kept immersed in the alkali solution for 24 hrs. The alkali treated fibres were then washed several times with distilled water to remove the excess alkali from the fibre surface. The final pH was maintained at 7.0. The jute fibres were then air dried at room temperature for 24hrs followed by oven drying at 55oC for 24 hrs.

After all the tests had been conducted, cubes were casted using using different percentages of jute for testing the compressive strength .

(d). *Casting of cubes having 0% jute fiber*

Cement, fine aggregates and course aggregates were taken according to M25 mix design i.e. in the ratio of 1:1:2. Water cement ratio was taken as 32% of cement. All these ingredients were thoroughly mixed with water, properly compacted by using table vibrator and then poured in the mould having dimensions 15cm*15cm*15cm. Similarly 9 cubes of same mixture were moulded. The next day the cubes were unmoulded and were kept in the curing tank for curing. on the 3rd day of casting 3 cubes were taken out from the curing tank and were left for few minutes to dry. After drying they were weighed and their compressive strength were tested simultaneously by using the compression testing machine.

Similarly the compressive test after 7th and 28th day was determined.

(e). Moulding of jute reinforced concrete

After the treatment of raw jute, jute reinforced concrete cubes were casted.

In the 1st case jute was taken in 0.5% of cement. According to M25 mix design i.e. – 1:1:2 ratio cement, fine aggregate, course aggregate were taken. W/C ratio was taken as 32% of cement. All these ingredients were thoroughly mixed and poured in the mould. Similarly a cubes of same mixture ratio were moulded. The next day the cubes were unmoulded and were kept in curing tank for curing. On the 3rd day of casting 3 cubes were taken out from the curing tank and left for few minute to dry. After drying they were weighted and their compressive strength was tested simultaneously by using the compression testing machine. Similarly other cubes were tested on 7th and 28th day by following the same procedure.

Figure-2 Concrete mixing

In the 2nd case jute was taken as1% of cement and 9 cubes were casted. Similarly for 1.5% of cement, another 9 cubes were casted and their compressive strength were tested on the 3rd, 7th and 28th days.

V. RESULT AND DISCUSSION

The results obtained after conducting the Los Angeles Abrasion Test which has been shown in the table below:

Table No. 1: LOS ANGELES ABRASION TEST VALUES

SL.No.	Wt of sample (kg)	Wt of retained material(kg)	Loss(kg)	% loss	Average
1	2	0.130	1.87	93.6	93.55
2	2	0.128	1.872	93.5	

Table No. 2: .COMPRESSIVE STRENGTH AFTER 3 DAYS:

SL.No.	Load(KN)	Area(mm^2)	Compressive strength(N/mm^2)	Average(KN/mm^2)
1	15	4900	3.06	7.82
2	50	4900	10.20	
3	50	4900	10.20	

Table No.3: COMPRESSIVE STRENGTH AFTER 7 DAYS:

SL.No.	Load(KN)	Area(mm^2)	Compressive strength(N/mm^2)	Average(KN/mm^2)
1	70	4900	14.28	16.66
2	85	4900	17.34	
3	90	4900	18.36	

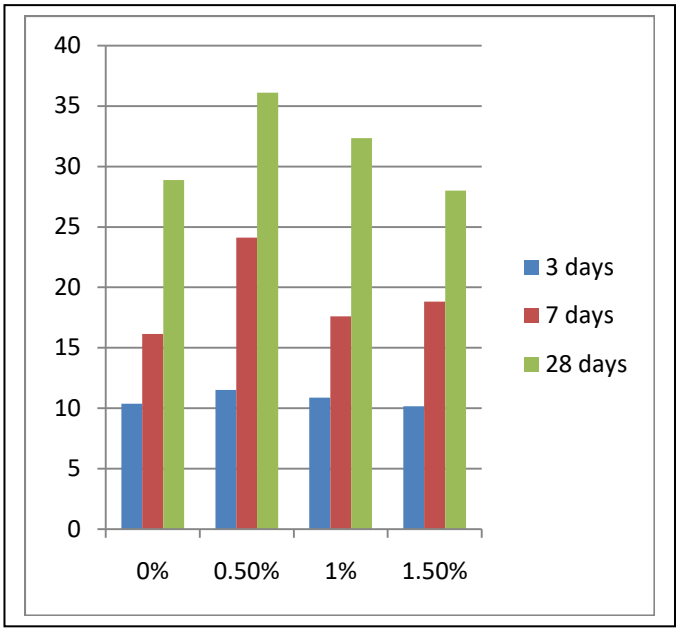
Table No.4: COMPRESSIVE STRENGTH AFTER 28 DAYS:

SL.No.	Load(KN)	Area(mm^2)	Compressive strength(N/mm^2)	Average (KN/mm^2)
1	100	4900	20.41	24.49
2	140	4900	28.57	
3	120	4900	24.49	

Table No.5: COMPRESSIVE STRENTH OF ALL DAYS

Days / Percentage	3 days	7 days	28 days
0%	10.37 KN	16.14 KN	28.89 KN
0.5%	11.51 KN	24.11 KN	36.11 KN
1%	10.88 KN	17.60 KN	32.35 KN
1.5%	10.156 KN	18.82 KN	28.02 KN

Concrete having 0% jute fiber i.e. plain concrete results in a compressive strength which nearly equal to the characteristic strength i.e. 25N/mm2. It more than the characteristic strength by 3.89N/mm2. N. When jute was added upto 0.5% of cement, the compressive strength obtained after 28 days was 36.11N/mm2 which is much more than the characteristic strength as well as the strength obtained by plain concrete.



Graph- CUMULATIVE GRAPH OF JUTE FIBRE

The compressive strength after 3rd and 7th day in case of 0.5% jute addition is more than that of the plain concrete. The average compressive strength obtained after 28days after adding 1%jute of cement is more than that of plain concrete but less than that of 0.5% addition of jute. In case of 3rd and 7th day also the compressive strength of 1% JFRC is more than plain concrete but less than 0.5% JFRC. After the percentage of jute by 0.5% i.e. adding 1.5% jute it resulted in lesser compressive strength than that of other percentages and even than the plain concrete after 3rd day. It's compressive strength after 7th day is more than 1% but less than 0.5% and plain concrete.

VI. CONCLUSION

After conducting compressive strength test on different % of IFRC, it has been seen that 0.5% IFRC gives the maximum compressive strength among all other % on all the 3 days of testing.

1% of IFRC process quite less compressive strength than 0.5% of IFRC where as it possess more compressive strength than 1.5% of IFRC except on 7th day of casted 1.5% of IFRC possessed the least compressive strength.

Therefore the addition of jute in concrete should not exceed 1% and addition of 0.5% jute gives the best result. It increases the strength to a great extent.

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