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Impact on Strength of Concrete by Coconut Coir and Polypropylene Fibers

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Abstract: ***Plain concrete is tough in terms of compression and feeble in tension, which leads to development of cracks in structure. The internal micro cracks in concrete which are formed due to tensile stresses, can be minimized and prevented by the addition of fibers in concrete. This project aims at the enhancement of concrete properties with the intrusion of hybrid fibers, by controlling the effect of cracks. The dosages of fibers are 0%, 1%, 2%, 3%, 4% to the weight of cement. The hybrid fibers used in this work are the combination of synthetic fiber of polypropylene twines of 1 to 2 cm and natural fiber of coconut coir of length 2 to 3 cm. The specimen made up of hybrid fibers and conventional concrete are tested for engineering properties like compressive, split-tensile, flexure strength. A comparative study is done between hybrid concrete and conventional concrete.***

Keywords*: Coconut coir fiber, Compressive strength, Flexural strength, Polypropylene fiber, Split Tensile strength.*

I. INTRODUCTION

Some there might be need to make concrete structure complicated, super thin, and very thin pavements at whatever place rebars doesn't works, and make sure to ensure that cracks are small, in all these conditions fiber reinforced concrete is the satisfactory solution. As we understand concrete is vulnerable in tension, if a beam is loaded at top, then there could be push up at top which is known as compression and pull up at bottom, which is tension and it is the origin of 'cracks' which are formed due to shrinkage, thermal insulation and bleeding of water. one more basic hassle about concrete is that cracks begins to originate as soon as concrete get placed and hardens sooner as well. The cracks formation may be a key purpose of origination of concrete weak spot, predominantly in huge onsite execution main to successive rupture, collapse as well general lack of resilience. The weakness in tension be able to conquer via making the utilization of traditional reinforcement making a few extent with incorporation of adequate level of assured fibers.

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If there is no reinforcing within the concrete, then it will bring about notable damage. Fibers acts like micro reinforcement. If the cracks are subjected to the identical load and the structure doesn't fall apart, because it is held by means of fibers.

Fibers do not stop forming the cracks and doesn't make concrete strong, however it makes to hold together. They conserve cracks minute and it isn't always in reality visible to naked eye. A small crack is equal to long life of concrete as they keep chemicals from getting into the concrete by causing all time deterioration in reinforcing to corrode. In the midst of the quest for green production along with low-cost housing system meant same among rural and urban population, assorted proposals focusing on slicing down traditional building material outlay enclose be set ahead. One of the suggestion has been the sourcing, enhance in conjuction with utilization of substitute, advanced regional building substances. Benefits of natural fibers take account of squat charge, low mass, infinite, viable accessibility along with stumpy abrasive wear of handling equipments and turn out to be famous path in order to surmount environmental hassle in mainly growing nations.

From the superficial crust of a coconut, coir fibers are extricated. The Clinical and Universal name, clinical name is Cocasnucifera, coir belonging to plant family of Areca-ceae (palm), correspondingly. The coir fibers exist in 2 forms, namely brown fibers which are extracted from full-blown coconuts possessing properties like thickness, sturdy, encompass high abrasion resistance, more often used in engineering works. Whereas white fibers extracted from adolescent coconuts which are smoother and finer besides poorer in strength. Coir fibers are profitably available in 3 forms, particularly long, relatively short and mixed fibers, the usage relaying on the necessity. Polypropylene fibers are artificial acquired as a spinoff from industries of textiles, also characterized as low specific gravity and low price. Polypropylene fibers utilization improves the tensile and flexure strength through significant decline of thermal cracks along the cracks which are formed due to plastic shrinkage. These are chemically inert and non-corrosive.

The objective of this work is to conduct experiment on the utilization of coir fibers along with polypropylene as a enhancement of concrete. In this work coconut coir fibers of 2 to 3cm and 1 to 2cm pieces of polypropylene twines are used. This project deals with strength properties recited on fresh as well hardened concrete, through the accumulation of coconut coir and polypropylene fibers. Experiment tests has been conducted in the direction of investigating the fiber effects on strength properties of concrete.

II. METHODOLOGY

A. Materials Used

The raw supplies which were used in this work are stated below.

***a. Cement*:** 53 grade of ordinary Portland cement have been used for this work is procured form local cement traders, Hyderabad, Telangana. Table 1 shows the cement properties.

Table 1.physical properties of cement

Properties	Cement
Specific gravity	3.14
Normal consistency	29%
Initial setting time	92 min
Final setting time	195 min
Fineness	5.2%

b. Coarse Aggregate: Natural stone, crushed of 20mm size is used for this work is procured by local traders, Hyderabad, Telangana. Table 2 shows the cement properties.

Table 2. Physical properties of coarse aggregate

Properties	Coarse aggregate
Specific gravity	2.76
Water absorption	0.40%

c. Fine Aggregate: River sand of size less than 4.75mm used for this work is collected from local traders, Hyderabad, Telangana. Table 3 shows the fine aggregate's physical properties.

Table 3. Physical properties of fine aggregate

Properties	Fine aggregate
Specific gravity	2.65
Water absorption	1.46%

d. Coconut coir: Coconut coir utilized in this work is procured from local traders, Hyderabad, Telangana and cut into length of 2 to 3cm. Table 4 shows the physical properties of coconut coir.

Table 4. Physical properties of coconut coir

Properties	Coconut coir
Specific gravity	0.87
Length	2 to 3 cm
Diameter	0.29 to 0.83mm

Figure 1. Coconut coir

e. Polypropylene: Polypropylene used in this work is collected by local market, Hyderabad, Telangana have cut in to 1 to 2 cm length from polypropylene twines. Table 5 shows the polypropylene physical properties.

Table 5. Physical properties of polypropylene

Properties	Polypropylene
Specific gravity	0.91
Length	1 to 2 cm
Diameter	0.13mm

Figure 2. Polypropylene twine

Figure 3. Polypropylene of 1 to 2cm length

f. Water: For mixing and curing purpose normal portable water is collected from tube well.

B. Experimental Procedure

Concrete mix of M30 with 0.42 as water-cement ratio is followed in this work, for each mix 15 cube specimens of dimension 15x15x15 cm, 15 cylinders dimensioning of diameter 15cm and height 30cm and 10 beam specimens of dimensions 10x10x50 cm were moulded. For each mix workability is noted by means of slump cone and compaction factor, then placed into moulds and compacted so as to reduce voids. Overall 45 cubes, 45 cylinders and 30 beams were casted in this work. Demoulding has been done by completion 24 hours of casting and set up for curing. Curing is done for 7, 14 and 28days for cubes and cylinders and remaining curing is done for 7 and 28days.

C. Experimental Investigations

1. *Test on fresh concrete*

The experimental investigation carried out on concrete of fresh state are as follows

a. Slump test: Slump test provide quick means of measuring workability of concrete on site.

The experimental test was carried out confining of code IS: 1199-1959, and results are recorded.

Table 6. Slump values

S.No	Dosage of fiber	Slump(mm)
1	0%	120
2	1%	100
3	2%	90
4	3%	86
5	4%	82

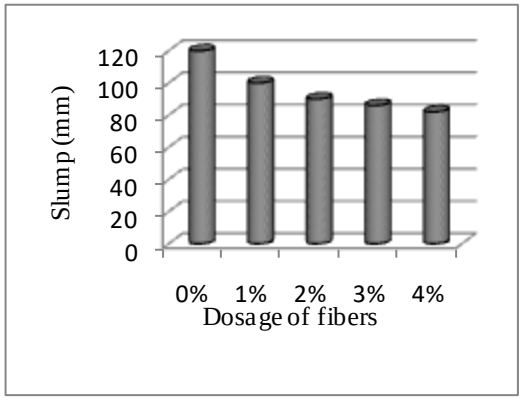

Figure 4. Variation of slump

The slump is falling in above graph with the addition of fibers, due to absorbency of water by coconut coir besides polypropylene fiber holds the concrete and raise the adhesion and cohesiveness thereby slowing down the settlement of aggregate.

b. Compaction factor: When concrete is made to fall from a certain height concrete gets compacted internally then lesser amount of external force is applied to compact leftover concrete. The experimental test was carried out as per code IS: 1199-1959 and results were recorded.

Table 7. Compaction factor

S.No	Dosage of fiber	Compaction factor
1	0%	0.88
2	1%	0.80
3	2%	0.84
4	3%	0.86
5	4%	0.90

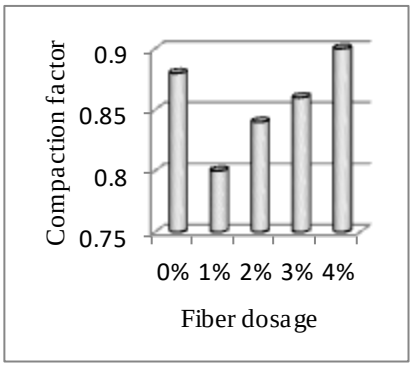

Figure 5. Variation of compaction factor

1. Test on concrete of hardened state

Experimental investigations carried out on concrete of hardened state are

a. Compressive Strength: The experiment program has been done on cube specimen in compression testing machine by making use of load of 0.140 g/cc/minute until the specimens fails following code IS:516- The average of 3 samples are considered and results are recorded.

Figure 6.Performing compressive strength

b. Split-tensile strength: The experimental work is executed on cylinder specimens in step with IS: 516-1959, Indian standard methods of tests for strength of concrete and the average of 3 specimens were noted.

Figure 7. tensile strength.

c. Flexure strength: The experimental test executed on beams following the code of IS: 516-1959 and the results are noted.

Figure 8.Flexure strength.

Figure 9. Orientation of fibers inside concrete.

III. EPERIMENTAL RESULTS

Table 8.Compressive strength

S. No	*Dosage of fiber*	*Strength at 7days (N/mm²)*	*Strength at 14days (N/mm²)*	*Strength at 28days (N/mm²)*
1	0%	22	32	35
2	1%	24	28	36
3	2%	25	29	37
4	3%	23	27	34
5	4%	21	25	30

It is noted that the strength slightly increased by addition of fibers to concrete, it may be due to high lignin as well low cellulose nature of coconut coir make it strong besides they creates extra interfacial transition region inside concrete which may have an effect on compressive strength.

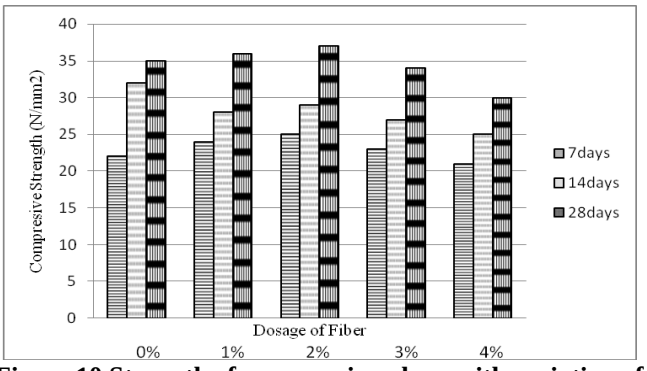

Figure 10.Strength of compression along with variation of fiber at 7, 14 and 28 days.

As represented in above graph, it is clearly visible that the strength of compression is improved by addition of fibers up to 2% beyond that, the strength is going on decreasing ,as the critical fiber volume for strengthening had reached ,it is likely to result in numerous cracks.

Table 9.Tensile strength

S. No	*Dosage of fiber*	*Strength at 7days (N/mm²)*	*Strength at 14days (N/mm²)*	*Strength at 28days (N/mm²)*
1	0%	2.51	3.06	4.88
2	1%	2.83	.63	6.5
3	2%	2.81	4.51	6.7
4	3%	2.60	4.36	5.6
5	4%	2.7	4.48	6.12

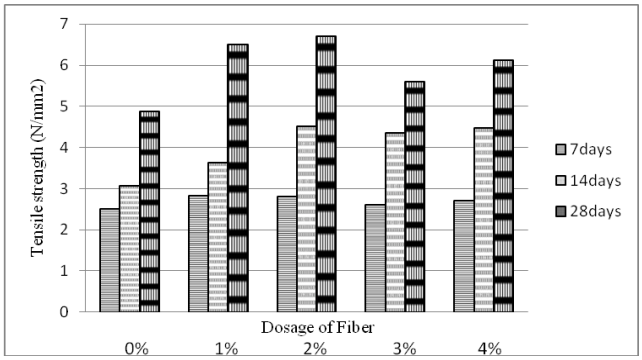

Figure 11.Strength of compression along with variation of fiber at 7,14 and 28 days.

From the graph, results are drawn as there is enhancement of tensile strength by adding fibers up to optimum level with respective to control concrete, there by resulted as slight declination beyond the optimum level.

Table 9.Tensile strength

S. No	*Dosage of fiber*	*Strength at 7days (N/mm²)*	*Strength at 28days (N/mm²)*
1	0%	2.16	3.55
2	1%	2.38	3.62
3	2%	2.52	3.89
4	3%	2.95	5.23
5	4%	3.36	5.12

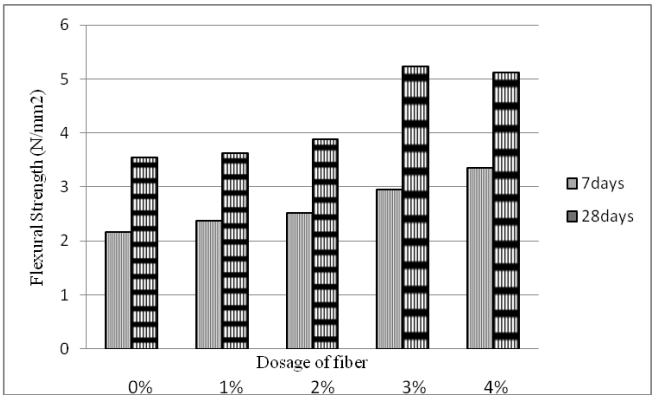

Figure 11.Strength of compression along with variation of fiber at 7,14 and 28 days.

With reference of above graph, it states that flexure strength increased by addition of fibers up to the optimum dosage of 3%, beyond that the strength slightly decreased, this may be cause of water absorbed by fibers that weakens the bonding act.

IV. CONCLUSION

This paper reported experimental consequences of strength properties of concrete by inclusion of coir and polypropylene fibers. Thus, the following conclusions has been stated based on results.

1. The workability decreases with enhance of dosage of fibers by 32%.
2. The compressive strength increased by 5.7% with increase of fiber dosage than conventional concrete up to optimum dosage of 2%, beyond the optimum dosage strength started decreasing by 2.8%.
3. Split-tensile strength is slightly inclined by 37%, as volume of fibers reaches up to optimum dosage of 2% comparing with control concrete, beyond that there is a slight decrease by 14 % with optimum dosage.
4. The flexure strength increased by 47% with increase of fiber dosage than conventional concrete up to optimum dosage of 3%, beyond the optimum dosage strength started decreasing.

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