

Effects of Coir Fibers on Workability and Strength Properties of Concrete

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ABSTRACT

This study aimed toward analyzing length and content of coir fiber on workability and strength of concrete. For this purpose, different fractions of coir fibers of length as 10 mm, 20 mm and 30mm are used with varying proportions as 0.15%, 20%, 0.25%, 0.3% and 0.35% by the volume of concrete. One mix of control concrete and 15 mixes of concrete with inclusion of coir fibers were prepared. The experiments were conducted to check the workability, compressive and tensile strength of concrete. It was observed from conducted research, that the workability is decreased with increasing the content of coir fibers. On the basis of conducted research, the inclusion of 0.25% of coir fibers of length 20mm is optimum. With inclusion of 0.25% of coir fibers of length 20mm, compressive and tensile strength is improved as compared to control mix.

Keywords

Coir Fibers, Workability, Compressive And Tensile Strength Of Concrete

1. Introduction

In the concrete possesses less tensile strength less ductile which is due to presence of unsoundness and low robustness. The tensile strength and ductility of concrete can be increased by adding the natural artificial fibers [1],[2], [3], [4]. The coir fibers are natural available material like hair in coconut trees [5]. The inclusion of fibers of fibers in concrete is to improve the tensile strength which reduce the tensile cracks of composite material [6]. Coir fiber is used as reinforcement in concrete of highest toughness than the other natural fibers [7], [8]. Coir fibers are strong in tensile strength with low thermal conductivity and bulk density [9]. The coir fibers are of very low cost and its dispose off method is costly [10]. The inclusion of fiber in concrete able to absorb tension force when fibers are used as reinforcement [11], [12]. Coconut fibers are available in huge quantities in Nigeria, Asia, Africa and other regions of the world. 500,000 tons coir fibers are produced from 12 million coconut trees in world every year [13], [14], [15].

Concrete has low tensile strength only 10% of its compressive strength [16]. Due to low tensile strength of conventional concrete, microcracks develop because of drying shrinkage and other volume changes in concrete [17]. To improve the strength properties especially tensile strength, in this study Coir Fibers are included in concrete.

2. Materials and Research Methodology

2.1 Materials

2.1.1 Cement

Lucky, OPC is used in experimental work.

2.1.2 Aggregate

Bhoalri sand passed from 4.75 mm sieve is used in this research as shown in Figure 3.2

2.1.3 Coarse Aggregate

Crushed aggregates maximum size of 19mm is used. These aggregates were washed properly to use in concrete

2.1.4 Aggregate

10, 20 and 30 mm length of coir fibers are used in this study. 2



Figure 1 : Coir fibers



Figure 2 : Coir fibers in equal length

2.1.5 Super plasticizer (HRWR) Aggregate

A poly-carboxylic ether EN934-2:2000 based super plasticizer commercially named as Master Polyheed 993 from BASF Chemicals Karachi.

2.2 Mix proportioning of concrete

One Control concrete mix and 15 modified mixes with coir fibers are prepared. Table 1 shows the details of different ingredients of concrete.

Table 1 : Mix of different ingredients of concrete

Mix ID	Cement Kg/m ³	Coir fibers Kg/m ³	Length fiber (mm)	Fiber volume Vf (%)	FA Kg/m ³	CA Kg/m ³	Water Kg/m ³	W/C	Slump (mm)	SP (%)
B1	346	--	--	--	692	1038	190	0.55	48	2
B2	346	2.1	10	0.15	692	1038	190	0.55	42	2.5
B3	346	2.8	10	0.2	692	1038	190	0.55	35	3
B4	346	3.5	10	0.25	692	1038	190	0.55	27	3
B5	346	4.2	10	0.30	692	1038	190	0.55	41	3.5
B6	346	4.9	10	0.35	692	1038	190	0.55	30	3.5
B7	346	2.1	20	0.15	692	1038	190	0.55	45	2.5
B8	346	2.8	20	0.2	692	1038	190	0.55	38	3
B9	346	3.5	20	0.25	692	1038	190	0.55	30	3
B10	346	4.2	20	0.30	692	1038	190	0.55	46	3.5
B11	346	4.9	20	0.35	692	1038	190	0.55	36	3.5
B12	346	2.1	30	0.15	692	1038	190	0.55	49	2.5
B13	346	2.8	30	0.2	692	1038	190	0.55	45	3
B14	346	3.5	30	0.25	692	1038	190	0.55	37	3
B15	346	4.2	30	0.30	692	1038	190	0.55	50	3.5
B16	346	4.9	30	0.35	692	1038	190	0.55	41	3.5

2.3 Method

The workability of control and modified mixes conducted as per ASTM-C-14. The procedure for compressive and tensile strength of concrete was carried out accordance with ASTM-C-39 and ASTM-C-496 respectively

3. Results and Discussion

3.1 Workability

Figure 3 shows the comparison of results of slump for CFRC, fiber length of 10mm and 20mm and 30 mm.

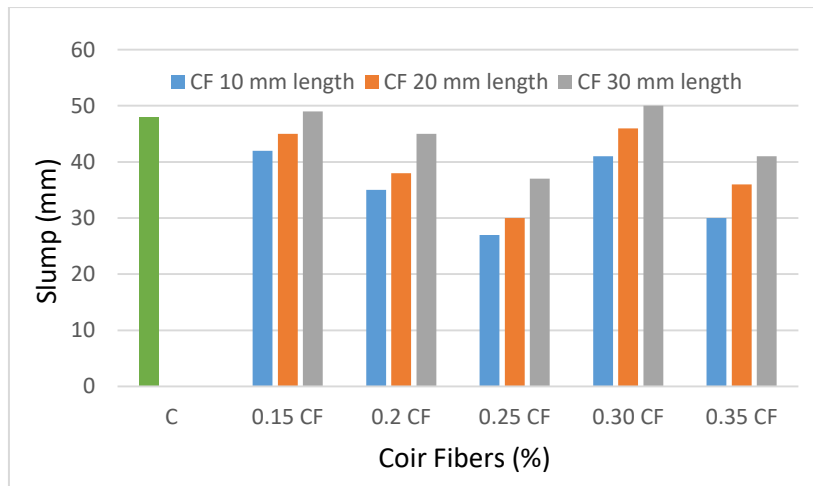


Figure 3: Comparison of workability of CFRC for CF of length 10mm, 20mm and 30 mm length

Figure 3 shows that with increasing the quantity of fibers workability decreases. As the length of fibers increased workability is increased. The workability of 30 mm length is more than of concrete prepared with 20mm and 10 mm length. The workability of coir fiber concrete is decreased because the coir fibers are water absorbing material. To obtain the designed workability superplasticizer is used. As the quantity of coir fibers increased more quantity of super plasticizer has been used to maintain the desired workability.

3.2 Compressive strength

The compressive strength of control and concrete prepared with different length of coir fibers are shown in Figure 4.

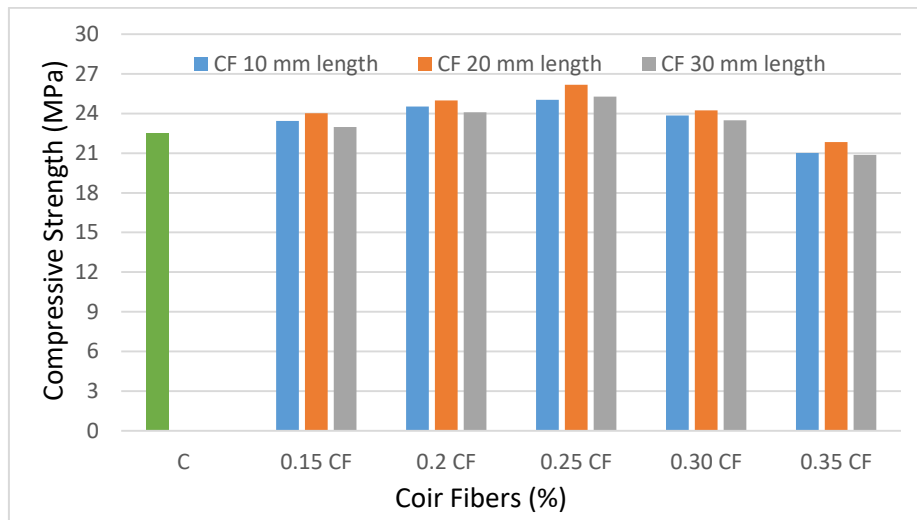


Figure 4 : Comparison of compressive strength of CFRC

It is clear from above figure 4, that Compressive strength of CFRC is increased from 0.15% to 0.25%. on further inclusion of coir fibers compressive strength decreased. The maximum compressive strength of 26.17 MPa is achieved at 0.25% addition of coir fiber of 20 mm length by volume fraction of concrete which is 16.31% more than control mix, further an increase in amount of coir fibers the compressive strength of CFRC did not increase. The compressive strength of 20 mm length of coir fibers is more than that of coir fibers length of 10 and 20mm length.

3.3 Tensile strength

The comparison of results of tensile strength for CFRC, fiber length of 10mm and 20mm and 30 mm length are shown in Figure 5.

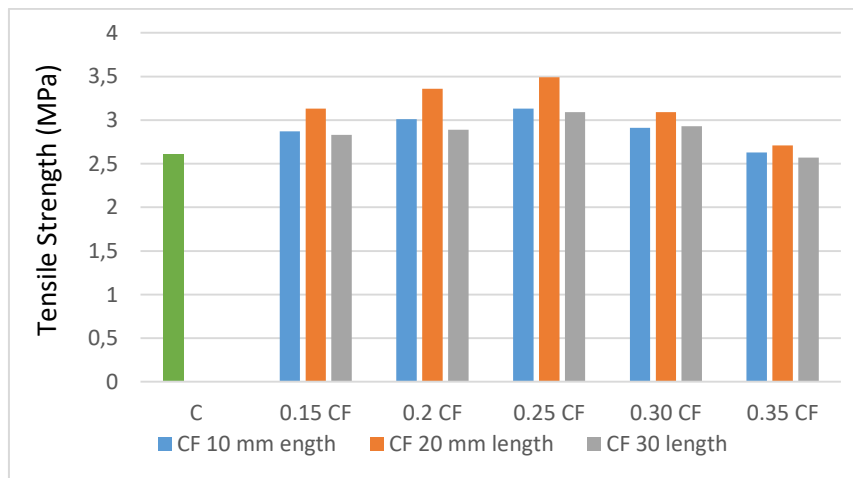


Figure 5 : Comparison of tensile strength of CFRC

It is clear from above figure that tensile strength of CFRC is increased from 0.15% to 0.25%. On further inclusion of coir fibers tensile strength decreases. The maximum tensile strength of 3.49 MPa is achieved at 0.25% addition of coir fiber of 20 mm length by volume fraction of concrete which is 33.72% more as compared to plain mix. The tensile strength of concrete with inclusion of 20 mm length coir fibers are more than that of coir fibers length of 10 and 20mm length.

4. Conclusion

This On the basis of conducted research, it can be concluded that:

- 1) As the quantity of coir fibers are increased, the quantity of super plasticizer is increased to obtain desired workability. As the length of coir fibers increased the workability of concrete is increased.
- 2) Compressive strength of CFRC is improved with inclusion of coir fibers from (0.15% to 0.25%). The highest compressive strength of 26.17 MPa is observed at 0.25% inclusion of coir fibers of 20 mm length by volume fraction of concrete which is 16.31% more than control mix.
- 3) Tensile strength of CFRC is improved with inclusion of coir fibers from (0.15% to 0.25%). The highest tensile strength of 3.49 MPa is observed at 0.25% inclusion of coir fiber of 20 mm length by volume fraction of concrete which is 33.72% more than control mix, further an increase in amount of coir fibers the tensile strength of CFRC did not increase.
- 4) On the basis of conducted research 0.25% addition of coir fibers of length 20mm by volume fraction of concrete is optimum. On 0.25% addition of coir fibers of length 20mm compressive and tensile strength is improved as control mix.

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