Improvement of Properties of Concrete by Using Fibers

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Abstract: ***Concrete made with Portland cement has certain limits. It is relatively strong in compression but weak in tension and tends to be brittle. The weakness in tension can be overcome by the use of conventional rod reinforcement and to some extent by the inclusion of a sufficient volume of certain fibers. The use of fibers also alters the behavior of the fiber-matrix composite after it has cracked, thereby improving its toughness. This leaflet aims to provide information on the properties of the more commonly available fibers and their uses to produce concrete with certain characteristics. Some new developments are discussed.***

Keywords: Polypropylene fiber, natural fiber (bagasse) compression test, flexure test, test result, result analysis, future scope and conclusion

1. Introduction

Civil structures made of steel reinforced concrete normally suffer from corrosion of the steel by the salt, which results in the failure of those structures. Constant maintenance and repairing is needed to enhance the life cycle of those civil structures. There are many ways to minimize the failure of the concrete structures made of steel reinforce concrete. Steel reinforcement only increases the toughness and tensile strength and improves the cracking and deformation characteristics. Fiber-Reinforced Concrete (FRC) is not only increasing the tensile strength but also help to improve the mechanical properties of concrete. For prove we have taken here two type of fiber polypropylene and natural fiber (sugarcane waste) called as Bagasse. And we have done the comparative study between fibers. Which is most economical in terms of cost, strength, properties, and all the structural parameters. And main focus on natural fiber what we have used here that is sugarcane waste (bagasse).to get it into a construction sector and can be used as fiber so we can reduced the pollution to our nearby areas and make use of it in effective way.

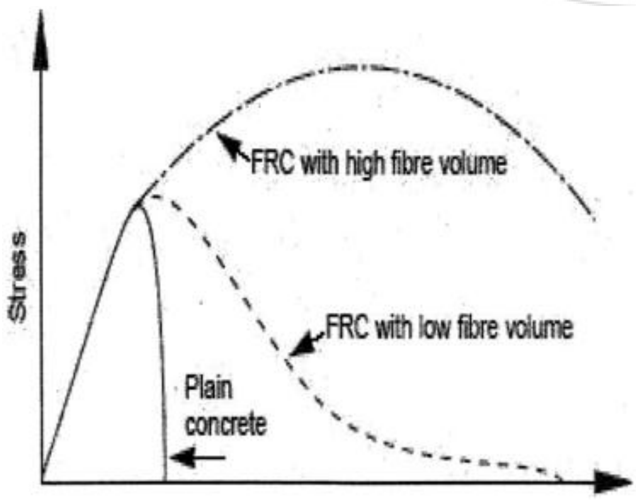


Figure 1: Typical curves for fiber reinforced concrete (M. L. Gambhir)

2. Type of Fibers to be Considered

2.1 Polypropylene

Polypropylene fiber was first used to reinforce concrete in the 1960s. Polypropylene is a synthetic hydrocarbon polymer, the fiber of which is made using extrusion processes by hot-drawing the material through a die. Polypropylene fibers are produced as continuous mono-filaments, with circular cross section that can be chopped to required lengths, or fibrillated films or tapes of rectangular cross section. Polypropylene fibers are hydrophobic and therefore have the disadvantages of poor bond characteristics with cement matrix, a low melting point, high combustibility and a relatively low modulus of elasticity. Long polypropylene fibers can prove difficult to mix due to their flexibility and tendency to wraparound the leading edges of mixer blades. Polypropylene fibers are tough but have low tensile strength and modulus of elasticity;

Figure 2.1: Polypropylene Fibers (Google image)

2.2 Natural Fibers

Utilization of natural fibers as a form of concrete reinforcement is of particular interest to less develop regions where conventional construction materials are not readily

available are too expensive. Sisal-fiber reinforced concrete has been used for making roof tiles, corrugated sheet sheets, pipes, silos and tanks. Here we have taken sugarcane waste as a natural fiber.

Figure 2.2: Natural Fibers (Google)

3. Test Results

Table 3.1: Compression test for 0% fiber

Material	*S.S.D Mix*	*Mois-ture*	*Absor-btion*	*Corrected Mix*	*Mix for- 0.026M^3*
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	365			365	9.49
Fly ash	85			85	2.21
Crushed Sand	826	_	3.81	794.53	20.66
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.5
Admixure	3.6			3.6	0.094
Fiber- 0%				0	0

Testing of Cubes- 7 Days

Sr No.	*Wt. of cube (KG)*	*Load (KN)*	*Strength (MPa)*	*Av. Strength (Mpa)*
1	8.846	860	38.22	
2	8.75	850	37.78	37.18
3	8.746	800	35.55	

Testing of Cubes-28 Days

Sr No.	*Wt. of cube (KG)*	*Load (KN)*	*Strength (MPa)*	*Av. Strength (Mpa)*
1	8.079	1070	47.55	
2	8.926	1060	47.11	49.92
3	8.830	1240	55.11	

Table 3.2: Compression test for 0.2% Polypropylene fiber (PPF)

Material	*S.S.D Mix*	*Moisture*	*Absor-btion*	*Corrected Mix*	*Mix for- 0.026M^3*
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	365			365	9.49
Fly ash	85			85	2.21
Crushed Sand	826	_	3.81	794.53	20.66
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.5
Admixure	3.6			3.6	0.094
Fiber- 0%				0.09	0.0234

Testing Of Cubes- 7 Days

Sr No.	*Wt. of cube (KG)*	*Load (KN)*	*Strength (MPa)*	*Av. Strength (Mpa)*
1	8.814	800	35.55	
2	8.814	950	42.22	38.37
3	8.836	840	37.33	

Testing Of Cubes-28 Days

Sr. No.	*Wt. of cube (KG)*	*Load (KN)*	*Strength (MPa)*	*Av. Strength (Mpa)*
1	8.996	1640	72.88	
2	8.895	1500	66.67	50.51
3	8.78	1450	64.44	

Table 3.3: Compression test 0.4% Polypropylene fiber (PPF)

Material	*S.S.D Mix*	*Mois-ture*	*Absor-btion*	*Corrected Mix*	*Mix for- 0.026M*^{3}
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	365			365	9.49
Fly ash	85			85	2.21
Crushed Sand	826	_	3.81	794.53	21.26
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.1
Admixure	3.6			3.6	0.094
Fiber- 0.4%				1.8	0.047

Table 3.4: Compression test for 2% polypropylene fiber (PPF)

Material	*S.S.D Mix*	*Mois-ture*	*Absor-btion*	*Corrected Mix*	*Mix for- 0.026M*^{3}
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	475			475	12.35
Fly ash	0			0	0
Crushed Sand	826	_	3.81	794.53	20.66
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.5
Admixure	3.6			3.6	0.094
BAGGASS 2%				0.9	0.2375

Testing Of Cubes - 7 Days

Sr No.	Wt. of cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.75	730	32.44	
2	8.83	740	32.89	33.92
3	8.898	820	36.44	

Testing Of Cubes-28 Days

Sr No.	Wt. of cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.846	1190	52.89	
2	9.042	1340	59.55	56.74
3	8.744	1300	57.78	

Testing Of Cubes - 7 Days

Sr No.	Wt. of cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.860	1100	48.88	
2	8.915	1200	53.33	51.10
3	8.870	1150	51.11	

Testing Of Cubes-28 Days

Sr No.	WTof cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.955	1370	60.88	
2	8.932	1280	56.88	57.03
3	8.910	1200	53.33	

Table 3.5: Compression test for 0.2% Natural fiber (BAGASSE)

Material	S.S.D Mix	Mois-ture	Absor-btion	Corrected Mix	Mix for- 0.026M^3
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	475			475	12.35
Fly ash	0			0	0
Crushed Sand	826	_	3.81	794.53	20.66
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.5
Admixure	3.6			3.6	0.094
BAGGASS 2%				0.9	0.02375

Table 3.6: Compression test for 0.4% Natural fiber (BAGASSE)

Material	S.S.D Mix	Moisture	Absorption	Corrected Mix	Mix for- 0.026M^3
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	475			475	12.35
Fly ash	0			0	0
Crushed Sand	826	_	3.81	794.53	20.66
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.5
Admixure	3.6			3.6	0.094
BAGASS 0.4%				0.9	0.04748

Testing Of Cubes- 7 Days

Sr No.	Wt. of cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.710	960	39.63	
2	8.840	1000	41.35	40.70
3	8.990	980	41.13	

Testing Of Cubes- 7 Days

Sr No.	Wt. of cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.840	890	42.25	
2	8.715	920	43.68	44.15
3	8.790	980	46.53	

Testing Of Cubes-28 Days

Sr No.	Wt. of cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.785	1050	44.21	
2	8.807	1130	41.09	42.55
3	8.830	1170	42.36	

Testing of Cubes-28 Days

Sr No.	Wt. of cube (KG)	Load (KN)	Strength (MPa)	Av. Strength (Mpa)
1	8.840	940	44.63	
2	8.715	980	46.53	46.94
3	8.790	1050	49.83	

Table 3.7: Compression test for 2% Natural fiber (BAGASSE)

Material	S.S.D Mix	Mois-ture	Absor-btion	Corrected Mix	Mix for- 0.026M^3
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	475			475	12.35
Fly ash	0			0	0
Crushed Sand	826	_	3.81	794.53	20.66
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.5
Admixure	3.6			3.6	0.094
BAGGASS 2%				0.9	0.2375

Table 3.8: Flexure Test for 2% Natural fiber

Material	S.S.D Mix	Mois-ture	Absor-btion	Corrected Mix	Mix for- 0.026M^3
	(Kg)	%	%	FOR 1M^3	
W/C	0.37				
Cement	475			475	12.35
Fly ash	0			0	0
Crushed Sand	826	_	3.81	794.53	20.66
10MM AGG	425	-	1.24	419.73	10.91
20MM AGG	643	-	1.24	635.03	16.51
Water	167			211.71	5.5
Admixure	3.6			3.6	0.094
BAGGASS 2%				0.9	0.2375

Testing Of Cubes-28 Days

Sr. No.	*Load (KN)*	*Strength (MPA)*
1	32.20	58.37

Testing Of Cubes- 7 Days

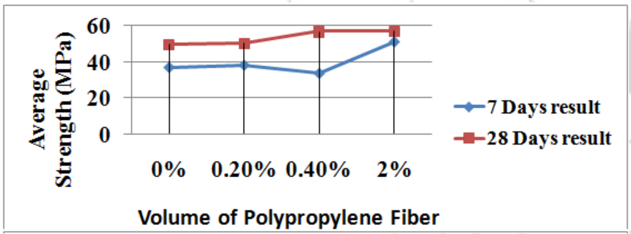
Sr. No.	*Wt. of cube (KG)*	*Load (KN)*	*Strength (MPa)*	*Av. Strength (Mpa)*
1	8.710	850	42.22	
2	8.840	1000	44.44	43.40
3	8.990	980	43.55	

Testing Of Cubes-28 Days

Sr No.	*Wt. of cube (KG)*	*Load (KN)*	*Strength (MPa)*	*Av. Strength (Mpa)*
1	8.785	1250	55.55	
2	8.807	1300	57.77	57.77
3	8.830	1350	60.0	

4. Result Analysis

4.1 Compressive Strength Analysis of Polypropylene Fiber Reinforced Concrete



4.2 Compressive Strength Analysis of Natural Fiber Reinforced Concrete

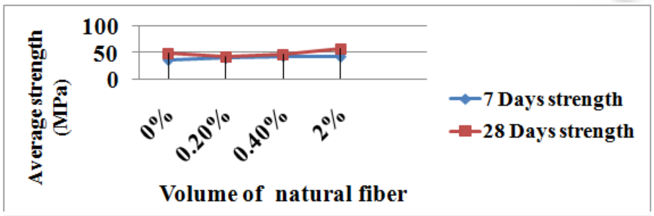


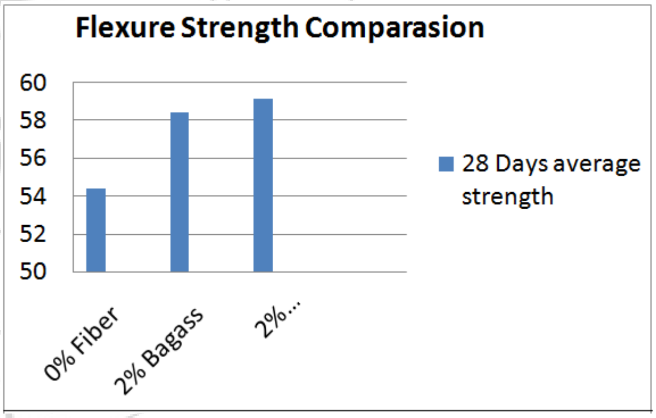
Table 3.9: Flexure test for 2% Polypropylene fiber (PPF)

Material	*S.S.D Mix*	*Mois-ture*	*Absor-btion*	*Corrected Mix*	*Mix for-0.026M³*
	(Kg)	%	%	FOR 1M³	
W/C	0.37				
Cement	365			365	12.41
Fly ash	85			85	2.89
Crushed Sand	826	_	0.8	819.39	20.66
10MM AGG	425	-	1.24	419.73	14.27
20MM AGG	643	-	1.24	635.03	21.59
Water	167			187.85	6.4
Admixure	3.6			3.6	0.122
PPF 2%				0.9	0.2375

Testing of Cubes-28 Days

Sr. No.	*Load (KN)*	*Strength (MPA)*
1	32.20	59.09

4.3 Flexure Strength Comparison



5. Conclusion

I. Polypropylene Fiber Reinforced Concrete

1. We are concluding that the early compressive strength can be achieved by using 0.2% of polypropylene fibers and maximum compressive strength can be achieved by using 2% of polypropylene fibers.
2. We are concluding that the both early flexural strength and maximum flexural strength can be achieved by using 2% of polypropylene fibers.

II. Natural Fiber Reinforced Concrete

1. W may conclude that the early compressive strength and flexural strength can be achieved by using 2% of steel fibers.

2. Strength of natural fiber reinforced concrete decreases if volume fraction of fibres is increased beyond 2%.

III. Economy Considerations

1. We may conclude that cost of concrete mix is increased by 10% using 2% natural fibers and by 1% using 0.4% polypropylene fibers.
2. Use of PPF could be advised over natural fibres in the applications where tensile and flexural properties of concrete are focused
3. Use of natural fibers is recommended for light structures or where tensile n flexure strength is not more important.

6. Future Scope & Limitations

1. We can use combination of two or more fibers to improve various mechanical properties of concrete.
2. Natural fibers which we have used here that is sugarcane waste (bagasse) is a waste product causing pollution to the nearby society so we can use that waste as fiber and we can control the pollution and can use it in construction industry in efficient way.
3. We can minimize the disposal problem of sugarcane waste.

References

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