Use of Plastic Fiber in the Concrete

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Abstract-

Concrete is strong in compression however weak in tension. The tensile strength as well as ductile property of concrete could be improved by addition of fibers. Polyethylene Terephthalate (PET) fiber obtained from various industries were used. The mix f pet fiber plain concrete was design for a compressive strength of 26 MPa at 28 days curing time with a water cement ratio of 0.45. Cylindrical and beam specimens with 0.5%,1%, 1.5%, and 2% fibers volume were casted. This project mainly studied includes flexural strength, splitting tensile strength, compressive strength and bond strength. The test result show that the slump and compaction factor is reduced at higher percentages of fibers. But up to 1.5 to 2.0 % addition of fibers the slump and compaction factor is not hampered so much. It was observed that the concrete was good enough workable up to 1.5 to 2.0 % addition of fibers. also with the increase in fiber content bond strength will increases.

Keywords: Concrete, waste plastic bottles, fibers, cube and cylinder, compressive strengths, tensile strength, bond strength, flexural strength.

I. INTRODUCTION

Concrete is a basic material for civil engineering construction. All basic ingredients of concrete are natural. But the properties of concrete can be change by adding some plastic fiber. The concrete has many advantageous properties such as good compressive strength, durability, specific gravity and fire resistance but tensile strength of the concrete is very much low means it can be neglected. But tensile property of the concrete can be increase by addition of plastic fiber. Research conducted for this to utilization of plastic bottles of various brands like coca cola, Bislery etc

And mix them in the concrete by taking some aspect ratio. The use of plastic has increases substantially all over the world it leads to create large quantities of plastic-based waste. Plastic waste is the one of the challenge to dispose and manage as it is non biodegradable material which is harmful to our beautiful environment. The polyethylene teraphthelne (PET) bottles are recycled and used in concrete.

II. OBJECTIVES

The main objectives of this research proposal are to evaluate the possibility of using full water bottle and granulated plastic waste materials. The following were also proposed.

- 1. Check the compression strength of concrete block when plastic bottle can be used as core part of concrete block.
- 2. As partial substitute for the fine aggregate in concrete composites.
- 3. To investigate the mechanical behaviour of the components by using fibers.
- 4. To determine the percentage of plastic fiber which gives more strength when compared to control concrete.
- 5. It is counted as one of the foundation for green project through reduce land and air pollution

III. MIX MATERIALS

The material details are as follows:

A. Cement

For this research, locally available cement which is of the ordinary Portland cement type (53 grade) was used throughout the work. Specific gravity of cement was 3.09.

B. Fine Aggregate

Locally available fine aggregate used was 4.75 mm size confirming to zone II with specific gravity 2.67. The testing of sand was conducted as per IS: 383-1970.Water absorption and fineness modulus of fine aggregate was 1.35% and 2.806 respectively.

C. Coarse Aggregate

Coarse aggregate used was 20mm and less size with specific gravity 2.80. Testing of coarse aggregate was conducted as per IS: 383-1970. Water absorption and fineness modulus of coarse aggregate was Nil and 6.203 respectively.

D. Water

The water used was potable, colourless and odourless that is free from organic impurities of any type.

E. PET Bottle



PET Fiber

PET fiber is a waste material which is obtained from industries. we collect the pet bottle from the restaurants. They were cut after removing the top and bottom of the bottle. The length of fibers was kept 35 mm and the breadth was 1 mm. The aspect ratio (AR) of waste plastic fibers was 35 (AR-35). The plastic fibers used were having specific gravity 1.36, water absorption 0.00 %. The different fractions for two aspect ratios were used in this experimentation

IV. EXPERIMENTAL WORK AND TEST

A. Mix Design

Mix design carried out for M20 grade of concrete by IS 10262:2009, having mix proportion of 1:1.50:2.92 with water cement ratio of 0.40. The partial replacement of Fine aggregate by 0.5 % to 2.0 % of PET fiber. Chemical admixtures are not used in the work.

B. Compressive, Flexural and Split Tensile Strength

Concrete prepared with different percentage replacement of fine aggregate by 0.5 % to 2.0 and cured under normal condition as per recommendations of IS and were tested at 3,7 days and 28 days for determining the compressive, flexural and split tensile strength compared with the test results of conventional concrete.



Photo No. 1 Mixing of Concrete



Photo No. 2 Casting of Cube

V. TEST RESULTS

A. Compressive Strength

A cube compression test is performed on standard cubes of of size $150 \times 150 \times 150$ mm after 3, 7 and 28 days of immersion in water for curing. The compressive strength of specimen is calculated by the following formula:

 $f_{cu} = Pc /A$ WhereP_c = Failure load in compression, KN A = Loaded area of cube,

Tab.No.1Compressive Strength Test For Cube3 Days

Sr.	% Of	C/S	T 1	Compressi	Avg.
No	PET	Area	Load	ve	Compressie
	Fiber	mm^2	KN	Strength	Strength
•	11001			N/mm ²	N/mm ²
1			195	8.67	
2	0	22500	197	8.75	8.74
3			198	8.80	
4			201	8.93	
5	0.5	22500	203	9.02	9.02
6			205	9.11	
7			207	9.20	
8	1	22500	206	9.15	9.19
9			208	9.24	
10			214	9.51	
11	1.5	22500	213	9.46	9.50
12			215	9.55	
13			212	9.42	
14	2	22500	213	9.46	9.40
15		0	210	9.33	

Tab. No. 2 Compressive Strength Test for Cube 7 day

Sr. No	% Of PET Fiber	C/S Area mm ²	Load KN	Compressiv e Strength N/mm ²	Avg. Compressi ve Strength N/mm ²
1			398	17.68	
2	0	22500	400	17.77	17.77
3			402	17.86	
4			405	18.00	
5	0.5	22500	406	18.04	18.05
6			408	18.13	
7			410	18.22	
8	1	22500	412	18.31	18.32
9			415	18.44	
10			418	18.57	
11	1.5	22500	420	18.67	18.69
12			424	18.84	
13			415	18.44	
14	2	22500	412	18.31	18.32
15			410	18.22	

Days					
Sr. No.	% Of PET Fibe r	C/S Area mm ²	Loa d KN	Compressi ve Strength N/mm ²	Avg. Compres sive Strength N/mm ²
1			588	26.13	
2	0	22500	592	26.31	26.28
3			594	26.40	
4			596	26.48	
5	0.5	22500	598	26.57	26.57
6			600	26.67	
7			602	26.75	
8	1	22500	604	26.84	26.85
9			607	26.97	
10			610	27.24	
11	1.5	22500	613	27.30	27.32
12			617	27.42	
13			608	27.00	
14	2	22500	611	27.15	27.04
15			607	26.97	

 Tab. No. 3 Compressive Strength Test for Cube After 28

Graph 1 Graph for Compressive Strength of Cube



B. Spilt Tensile Strength

The cylindrical specimens of diameter 150 mm and length 300 mm were cast with PET bottle fibres of aspect ratio 25 in volume fraction 0.0%, 0.5%, 1.0%, 1.5%, and 2.0%. And the specimen loaded for ultimate compressive load under UTM for each mix. The split tensile strength test was carried out as per IS: 516-1979. This test was carried on specimens at the 28 days of curing. The split tensile stre416ngth of cylinder is calculate by the following formula: $ft = 2P / \pi D L$

Where,

f_t=split Tensile strength, MPa P=Load at failure, N L =Length of cylinder, mm D =Dia. Of cylinder, mm

Tab. No. 4 Spli	t Tensile Test	After 28 Days
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Sr. No.	% Of PET Fiber	Load at Failure (KN)	Tensile Strength (N/mm ²)	Average Tensile Strength
	1 1001			N/mm ²
1		302	4.27	
2	0	304	4.30	4.29
3		305	4.31	
4		306	4.33	
5	0.5	308	4.35	4.35
6		310	4.38	
7		315	4.45	
8	1	318	4.50	4.40
9		317	4.48	
10		320	4.52	
11	1.5	322	4.55	4.53
12		321	4.54	
13		315	4.45	
14	2	312	4.41	4.44
15		316	4.47	

Graph 2.Graph for Split Tensile Strength of Cylinder



C. Flexural Strength

Three beam section of size 150x150x750mm were casted and cured for 28 days. The flexural strength is determined by the

$$f_{cr} = P_f L / bd^2$$

Where,

 f_{cr} = Flexural strength, MPa P_f = Central load through two point loading system, N

L =Span of beam, mm

b = Width of beam, mm d = Depth of beam, mm

Sr. No.	% of PET Fiber	Load at Failure (KN)	Flexural Strength (N/mm^2) $0.7\sqrt{fck}$	Average Flexural Strength/ mm ²
1	0	15	3.34	
Z	0	18	3.90	3.53
3		15	3.30	
4		19	4.18	
5	0.5	18	3.96	4.18
6		20	4.4	
7		21	4.62	
8	1	23	5.06	4.84
9		22	4.84	
10		24	5.28	
11	1.5	25	5.50	5.64
12		28	6.16	
13		20	4.40	
14	2	18	3.96	4.18
15		19	4.18	

Tab. No. 5 Flexural Test on Beam After 28 Days

Graph 3 Graph for Flexure Strength of Beam

Flexure strength



VI. CONCLUSION

- 1. As we introduce PET bottle fibers in concrete, ^[12] they help to hold concrete ingredients united.
- 2. Indirect tensile strength test result demonstrate [13] that inclusion of 1.5% PET fiber volume fraction enhanced tensile strength a maximum.
- 3. From this experimental project work about 4 to ^[14] 5% compressive strength of concrete will be ^[15] increased.
- 4. From this experimental project work about 8 % split strength of concrete will be increased.
- From this experimental project work about 59 % Flexural strength of concrete will be increased.
- 6. It was observed during experimentations that normal concrete specimens were suddenly broken into two pieces either cubes or cylinders but PFRC specimens did not suddenly break and failure was ductile.

ACKNOWLEDGEMENT

Experimental work was carried out using the facilities in Civil Engineering Department laboratory of P.D.V.V.P. COE, Ahmednagar. I wish to thank Prof. S.N. Daule, my guide, Prof. P.B.Autade, ME Co-coordinator for their valuable Suggestions and authorities for their kind support. I also wish to thank the laboratory staff for their help and support during experimental work.

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