

Experimental Study on the Mechanical Properties of Concrete Incorporating PET Fibers

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Abstract— The aim of this study is to evaluate the mechanical properties of PET fiber reinforced concrete using alccofine. In this study PET fiber are used with 0%, 0.5%, 1.5% and 3% by weight of cement with Alccofine (GGBS) percentage of 0%, 3%, 6% and 9% which replacing cement for M30 grade concrete. All of the mixes are tested to find the compressive strength test and flexural strength test for 7 days 28 days. The results from all of the tests are to be compared with control concrete mix.

Key words: Polyethylene terephthalate, PET Fiber, Alccofine 1203, Compressive Strength, Flexural Strength

I. INTRODUCTION

Among different waste fractions, plastic waste deserves special attention on account non-biodegradable property which is creating a lot of problems in the environment. In India approximately 40 million tons of solid waste is produced annually. This is increasing at a rate of 1.5 to 2% every year. Plastics constitute 12.3% of total waste produced most of which is from discarded water bottles. The PET bottles cannot be disposed-off by dumping or burning, as they produce uncontrolled fire or contaminate the soil and vegetation. Polyethylene terephthalate (PET) is one of the most used materials in the packaging of several kinds of products. The packages made with PET are light, transparent, and with high resistance to impact, they do not interact chemically with the contents, and they are not toxic. Hence an attempt on the utilization of waste Poly-ethylene Terephthalate (PET) bottle grinding flakes is done and its mechanical behaviour is investigated.

II. MATERIAL

- Cement: ordinary Portland cement 53 grade and binani cement having specific gravity 3.15.
- Fine Aggregate: locally available river sand from Bodeli conforming in Indian standard (IS 383) specific gravity 2.8.
- Coarse Aggregate: Locally available quarry stone in good strength passing through 12.5 mm and retain in 10mm sieve, specific gravity 2.67.
- Water: Ordinary portable water without acidity and Alkanet available in well or pump.
- PET fiber: PET flakes from plastic waste recycling plant.
- Alccofine 1203: For mixes other than control concrete, Alccofine is used as admixture. The Chemical and physical properties of Alccofine are as below. Its application standards are relevant to IS12089-1987.

Properties	
Molecular formula	(C10H8O10)n
Molar mass	Variable
Density	1.38 g/cm ³ (20 °C)
Melting point	> 250 °C, 260 °C

Boiling point	> 350 °C (decomposes)
Young's modulus (E)	2800–3100MPa
Tensile strength(σt)	55–75 MPa
Elastic limit	50–150%
Water absorption (ASTM)	0.16

Table I: Properties of Pet Fiber

Fineness (cm²/gm)	>12000
Specific Gravity	2.9
Bulk Density(Kg/m³)	700-900
Particle Size Distribution	
d10	1.5 micron
d50	5 micron
d90	9 micron

Table II: Properties of Alccofine

III. EXPERIMENTAL PROGRAM

A. Workability Test

The workability is defined as the ease with which a freshly mixed concrete can be properly compacted and also that it can be transported, placed, and finished. Workability of a concrete is a composite property with at least two main components, as follows: “Consistency”- indicates the mobility or flow ability of freshly mixed concrete “Cohesiveness”- indicates the water-holding capacity (the opposite of bleeding) and the coarse aggregate-holding capacity (the opposite of segregation).concrete works. Also, the eco-friendly benefits of using openly dumped plastic bottle waste in concrete, resulting in reducing. Based on the above results, it can be observed that reduction in 28-days compressive strength of concrete can controlled with use of certain strength admixtures.

B. Compressive Strength Test

150 mm × 150 mm × 150 mm concrete cubes are cast. Specimens with ordinary Portland cement (OPC) and OPC replaced with and Alccofine the specimens are removing from the mould and subjected to water curing. After curing, the specimens are tested for compressive strength using a calibrated compression testing machine

C. Flexure Strength Test

Concrete specimen of size 50 cm*10cm*10 cm is cast in metal mould. The metal should be of sufficient. Test specimens are stored in water before testing. The bearing surface of support and rollers are wiped, cleared and any loose sand or other material is removed. The specimen is placed in machine in such a manner that the load is applied to the appear most surface as cast mould along 2-lines apart at 133 mm. The flexural strength of specimen is expressed as modulus of rupture (fb).

IV. RESULT AND DISCUSSION

A. Workability Test

Slump cone test, compression test and flexure test are carried out for every batches of and the results are recorded.

BATCH NO.	SLUMP (mm)
P0 A0	96
P0.5 A0	62
P1.5 A0	50
P3.0 A0	35
P0 A3	101
P0.5 A3	70
P1.5 A3	55
P3.0 A3	47
P0 A6	105
P0.5 A6	76
P1.5 A6	69
P3.0 A6	52
P0 A9	111
P0.5 A9	82
P1.5 A9	74
P3.0 A9	57

Table III. Result of Slump Cone Test

B. Compressive Strength Test

The results of compressive strength were presented in fig 1 and 2. The test has carried out conforming to IS 516-1959 to obtain compressive strength of concrete at the age of 7 and 28 days.

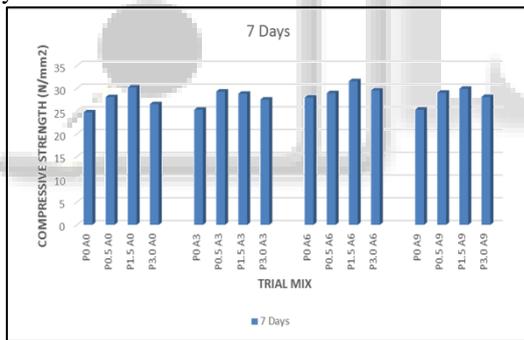


Fig. 1: Compressive Strength for 7 Days

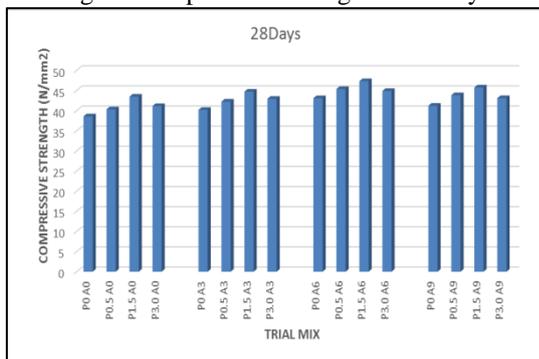


Fig. 2: Compressive Strength for 28 Days

C. Flexural Strength Test

The results of flexural strength were presented in Fig 3 and 4. The test has carried out conforming to IS 516-1959 to obtain compressive strength of concrete at the age of 7 and 28 days.

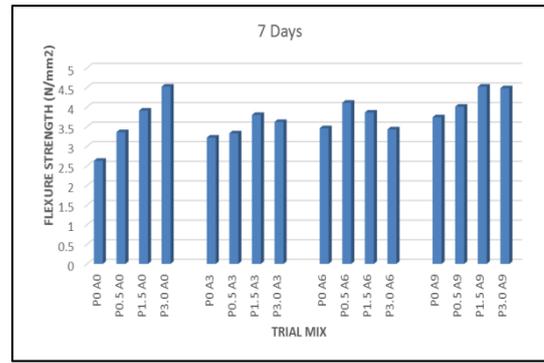


Fig. 3 Flexure Strength for 7 Days

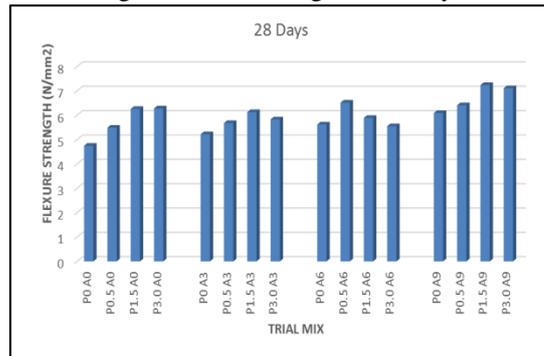


Fig. 4 Flexure Strength for 28 Days

V. CONCLUSION

- Workability of concrete is decreases with increasing in fiber content. Maximum workability is achieved with 0% PET fiber and 9% alccofine.
- Compression test result it can be clearly seen that with increasing in fiber content compressive strength increases up to 1.5% and then compressive strength decreases. Compressive strength is increases with increasing in alccofine up to 6% and it is decreases. Maximum compressive strength is achieved with 1.5% PET fiber and 6% alccofine.
- Flexure strength increases with increase in both PET fiber and alccofine. Maximum flexural strength is achieved with 1.5% fiber and 9% alccofine.
- PET fiber 0.5% and alccofine 6% gives maximum compressive strength which is 22.65% more in comparison with control mix. And for this strength only 3.84% cost increasing.
- PET fiber 1.5% and alccofine 9% gives maximum flexure strength which is 52% more in comparison with control mix. And for this strength only 5.75% cost increasing.

REFERENCES

- [1] Ms. K. Ramadevi, ms. R. Manju “Experimental Investigation on the Properties of Concrete with Plastic Pet (Bottle) Fibres as Fine Aggregates” www.ijetae.com (issn 2250-2459, volume 2, issue 6) June 2012, India.
- [2] Dora foti “Preliminary Analysis of Concrete Reinforced with Waste Bottles Pet Fibers” (construction & building material) Aug 2010, Italy.

- [3] L. R. Bandodkar, a. A. Gaonkar, n. D. Gaonkar, & y. P. Gauns, s. S. Aldonkar, p. P. Savoikar “Pulverised Pet Bottles As Partial Replacement For Sand” (International journal of earth sciences and engineering) oct 2011, Goa, India.
- [4] N. Shamskia “Pulverised Pet Bottles as Partial Replacement for Sand” (journal of structural engineering and geotechnics) June 2012, Iran.
- [5] Liliana ávila córdoba, gonzalomartínez-barrera, carlos barrera díaz, fernando ureña nuñez, alejandro loza yañez “Effects On Mechanical Properties Of Recycled PET In Cement - Based Composites” (hindawi publishing corporation international journal of polymer science) volume 2013. Mexico, March 2013.
- [6] Yatin Patel, Dr. B. K. Shah, Prof. P. J. Patel “Effect Of Alccofine On Self Compacting Concrete”
- [7] M.S. Pawar, A.C. Saoji “Effects on Mechanical Properties of Recycled PET in Cement - Based Composites” (The International Journal of Engineering and Science (IJES)), India (2013).
- [8] Khadake S.N.*, Konapure C.G. “An Experimental Study of Steel Fiber Reinforced Concrete with Fly Ash for M35 Grade” (International Journal of Engineering Research and Applications (IJERA)), India 2013.
- [9] IS 12269: 2013 for checking the properties of cement test.
- [10] IS - 383 (1989) for checking of properties of coarse aggregate.
- [11] IS - 2386 (part 1) (1963) for checking of properties of fine aggregate.
- [12] IS 10262: 2000 for mix design of concrete.
- [13] IS: 516-1959, Indian standard code of practice-methods of test for strength of concrete, bureau of Indian standards, New Delhi, India.