Performance of Pet Fibre Renforced Concrete using Recycled Polyethylene Terephthalate Waste Plastic

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Abstract— In general, the trend of annual consumption of all type of plastics is increase tremendously all over the world has been growing in phenomenal way. Waste plastic bottle are large amount of solid waste disposal, Polyethylene Terephthalate (PET) is usually used for carbonated quencher and various types of plastic bottles. With the phenomenal day by day increase in plastic consumption the problems with plastic waste disposal have also inflame. The PET fibers used in this study were obtained manually from waste water bottles. M30 grade of concrete we are studied as alternative replacements of a part of the conventional aggregates of concrete. The results showed a good performance of the continuous PET fiber reinforcement than that of the short. PET bottle waste is used as reinforcement for concrete and the flexural strength of hardened concrete at 7days, 14days, & 28days was tested and compared with conventional concrete and steel reinforced concrete.

Key words: Fiber-reinforced concrete, Recycled PET fibers, Concrete, PET Bottle waste

I. INTRODUCTION

The waste plastic is urban and rural areas is large and day by day increase with time. waste composition is different In each country. Concrete is the most widely used construction material in the world due to its high compressive strength, service life is long and low cost. Over the last decades the growing problem of recycling waste plastic materials has generated the need for these materials to be widely investigated. Therefore, it is necessary to find alternatives about recycling and reusing the waste plastics materials. Many investigations have been done about structural materials using plastic elements as reinforcement. Waste plastics materials have been used as components in cement pastes, mortar and concrete fines aggregates, coarse aggregate, lightweight aggregate.

The worldwide production of PET exceeds 6.8 million tons/year and shows a dramatic increase in the Asian region due to recent increasing demands in China and India. This is increasing at a rate of 2.5 to 4.1% annually. PET bottles in fiber form can be used to get better the mechanical properties of concrete. The compressive strength, tensile strength and flexural strength behavior of concrete is discussed. The PET fibers addition in concrete is an innovative material that can be promote in construction field.

A. Definition of Plastic:

A material which contains one or more number of polymers having large molecular weight." Solid in its finished state will be processing into finished articles is known as Plastic. Polyethylene Terephthalate (PET) is the most commonly used thermoplastic polymers. PET is used predominantly in the form of bottles for storing carbonated and non-carbonated drinks. Recycling is one of the ways to reduce the environmental impact of the waste plastic bottles.

Look at the global issue of environmental pollution by post-consumer PET waste, research efforts have been focused on consuming this waste on massive scale in efficient and environmental friendly manner. Researchers planned to use PET waste in form of concrete ingredient as the concrete is second most sought material by human life after water.

II. MATERIAL

A. Cement:

Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens

Properties of cement	
Specific gravity	3.12
Normal Consistency	33%
Initial Setting time	95 min
Final Setting time	240 min
Fineness	2.7%

Table 1:

B. Coarse aggregate:

Coarse aggregate shall comply with the requirement of IS 383 as for as possible crushed Aggregate shall be used for ensuring adequate durability. 10mm Course Aggregate size are use in production of block.

C. Fine aggregate:

The sand used for the experimental program was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.

Specific gravity	2.53
Water absorption (%)	1.2
Bulk density (Kg/m)	1718.52
Fineness modulus	2.61
Silt Content (%)	0.61

Table 2:

III. PET BOTTLES IN FIBER FORM

PET bottles fiber were used for reinforcing concrete specimens. The waste PET bottles were made available from local area of Nagpur city- These bottles were shredded into fiber form with the help of scissors. The sizes of fibers were

fixed to L mm wide and 15 mm long. The physical properties of these fibers were found cut are as below.

Shape	Dimensions (mm)	Length (mm)	Aspect Ratio
Straight Rectangular	Th.=t=0.2463 Width=b=2 A=b×t=2×0.2463=0.4926 A=π/4×D =0.4926=π×D/4 D=0.7921	15	25

Table 3:

IV. Design Mix

The concrete grade M30 was decided to use for investigation. The normal concrete mix is designed in accordance with the Indian Standard Code - IS10262-2009 guidelines assuming good degree of quality control and moderate exposure conditions. The normal concrete mix (NC) proportion for per cubic meter of concrete is shown in table. For making the concrete mixes containing PET fibers (PFRC), the amount of PET fibers is calculated in percentage by weight of cement.

V. Mix Proportions for Per Meter Cube for Normal Concrete (M30)

Recycled Plastic Aggregate (RPA) in concrete is acceptable there are for the making of concrete used coarse aggregate having size 150mm×150mm×150mm were cast in compression test mould with PET bottle fiber. A preliminary study on compressive strength, tensile and flexural strength using different proportion of PET fiber, in the present study concrete cube to take the material quantity for 9 Nos cube each proportion material required. After the casting the cube remove from the mould after 24hrs and than put the curing tank for curing of 7days, 14 days and 28 days after the curing completed .remove from curing tank and dry to normal atmosphere atleast 2hrs for the surface dry then to check it for compression testing machine get the result.

VI. Compressiove Strength Test

Plastic Aggregate in %	7^{th}days strength	Avg. strength	14^{th}days strength	Avg. strength	28^{th}days strength	Avg. strength
00.00	25.90 24.70 25.30	25.30	30.90 29.80 32.10	30.94	41.60 43.00 41.80	42.13
10.00	24.90 25.00 25.60	25.16	28.90 31.00 29.50	29.80	41.00 42.30 42.90	42.06
20.00	24.90 25.60 24.00	24.83	28.00 29.90 28.80	28.90	40.70 41.60 40.40	40.90
30.00	24.90 24.30 23.30	24.17	27.00 26.80 24.40	26.06	39.80 40.70 39.10	39.87

TABLE 4:

VII. Conclusion

Following are the conclusions can be made based upon the Experimental studies made in this project:-

1) Plastics can be used in a concrete mix. This contributes to reducing the unit weight of the concrete. This is useful in application requiring nonbearing lightweight concrete, such as concrete panel.
2) Waste plastic bottle fibers could be consider for the reinforcement of concrete; further studies could elucidate if these fibers used as structural material for construction
3) As we introduce PET bottle 9 block in concrete, they help to hold concrete.
4) By using the PET fiber in concrete mix to reduces the weight of cube up 15%.
5) The results indicate that for same mix proportion and same super plasticizer dose with same aspect ratio of fiber but increase in fiber content (%) wet density as well as dry density is reduced
6) Introduction of plastics in concrete tends to make concrete ductile. Hence increasing the ability of concrete to significantly deform before failure. This characteristic maims the concrete useful in situation where it will be subjected to harsh weather such as expansion and contraction, or freeze and thaw.

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