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PERFORMANCE OF CONCRETE USING PET BOTTLE SCRAP FINES

A.Ananthakumar[1]*, Dr.K.Sasiekalaa[2] , M.Deepika[3]
[*1] Assistant Professor , Department of Civil Engineering , MAMCET.
[2] Professor &Head , Department of Civil Engineering , MAMCET.
[3] Assistant Professor , Department of Civil Engineering , MAMCET.

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ABSTRACT
PET (Polyethylene tetra phthalate)bottles have increasingly become an indispensable part of a common man's life. With the phenomenal increase in plastic consumption the problems with plastic waste disposal have also aggravated. Our voracious appetite for PET bottles coupled with the undeniable behavioral propensity of increasingly over consuming discarding, littering and thereby polluting the natural environment makes it a lethal combination. Hence the need arises to route the waste plastic bottles to their optimum usage. That is why utilization of waste PET bottles has become an attractive alternative for disposal. This review paper reports the properties of concrete when waste PET bottles materials are used in a concrete. The waste plastic bottles are difficult to biodegrade and involves processes either to recycle or reuse. The construction industry is in require of finding cost effective materials for increasing the strength of concrete structures. To replace fine aggregate partially by the PET bottles scrap with 15%, 20%, 25% in concrete composites. Cube specimens were cast cured and tested for 7days, 14 days and 28 days compression strength. Reinforced beam specimens were cast cured and tested for 28 days flexural strength. And to study the optimum percentage of plastic scrap, which gives more strength when compared to conventional concrete.

1. INTRODUCTION

Concrete is the most widely used construction material due to its high compressive strength , long service life, and low cost etc, However, concrete has inbuilt disadvantages of low tensile strength and crack resistance also. To improve the weaknesses of the materials, number of studies on scrap concrete has been performed.The use of plastic scrap in concrete has increased in the last decade. Poly Ethylene terephthalate commonly abbreviated PET. It is the thermoplastic polymer resin of the polyester family and is used in scrap, PET is one of the most important and extensively used plastics in the world, especially for manufacturing beverage container, food and other liquid containers PET bottles are also recycled as-is (re-used) for various purposes PET bottles are filled with and left in the sun to allow disinfection by ultraviolet radiation. Most ofPET bottles used for beverage container are thrown away after single usage and disposal PET bottles are treated by landfill and burning, which is create serious environmental problems, Waste is one of the challenge to dispose and manage. It has one of the major environmental, economical and social issues. PET bottles in fiber form can be used to get better the mechanical properties of concrete. The Compressive strength and flexural strength behavior of concrete is discussed. The PET fibers addition and partial replacement of fine aggregate using PET bottle scrap in concrete is an innovative material that can be promote in construction field.

2. POLYMER WASTE

Shree RengaPolymersis a manufacture of Recycled polyester fiber from PET bottle flakes. The company is located in karur, a center place to **Tamil Nadu** catering to all leading spinning mills and Home textile industries.

Polymer recycling is a way to reduce environmental problems caused by polymeric waste accumulation generated from day to day applications of polymer materials such packaging and construction. The recycling of polymeric waste helps to conserve natural resource because the most of polymer material are made from oil and gas. This paper reviews the recent progress on recycling of polymeric waste form some traditional polymers and their systems (blends and composites) such as polyethylene (PE), Polypropylene (PP), and Polystyrene (PS), and introduces the mechanical and chemical recycling concepts. In addition, the effect of mechanical recycling on properties including the mechanical, thermal, rheological and

processing properties of the recycled materials is highlighted in the present paper.
Above these processes, we have to take decision to collect the different recycled polymer waste material for reuse in the concrete based on environmental issues.

3. OBJECTIVES OF INVESTIGATION

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

- To replace partially plastic scrap fines in fine aggregate in concrete composites.
- To investigate the structural behavior of concrete components.
- To investigate the mechanical behavior of the components by using PET scrap.
- To study the optimum percentage of plastic scrap fines, when compared to control concrete.

4. SCOPE OF INVESTIGATION

In this project, Low density polyethylene terephthalate is used as fines of scrap.
Partial replacement of Fine aggregate using the PET bottles scrap with 15%, 20%, 25% of cube and reinforced beam concrete for M20 grade concrete.

5. COLLECTION OF MATERIALS

The collected waste PET bottle Scrap are shown in Figure 1.

Figure 1 PET bottle Scrap fines

Cement

The cement used should confirm to IS specifications. There are several types of cements are available commercially in the market of which Portland cement is the most well-known & available everywhere. OPC 43 grade was used for this study.

Fine aggregate

Locally available river sand passing through 4.75mm sieve conforming to the recommendation of IS383-1970 is used.

Coarse aggregate

Coarse aggregates to be used for production of concrete must be strong, impermeable, durable & capable of producing a sufficient workable mix with minimum water cement ratio to achieve proper strength. Locally available coarse aggregate retaining on 4.75mm sieve. Nominal size of coarse aggregate is 20mm is used.

Water

The quality of mixing water for concrete has a visual effect on the resulting hardened concrete. Impurities in water may interfere with setting of cement & will adversely affect the strength and durability of concrete with steel slag..

Steel (as per IS: 1786 – 1985)

The reinforcing bar complies with all relevant Indian standards. Steel bar is a class N (normal ductility) reinforcing bar used in a range of application from reinforced concrete slabs to prefabricated beams, columns, cages and precast products.

Grade of steel = Fe 415
Main rod = 16mm diameter
Stirrups = 8mm diameter

6. CONCRETE MIX DESIGN

As per IS10262-1982 the concrete mix design prepared for M40 grade concrete the water cement ratio is taken as 0.5 from IS10262-1982 for maintain workability.

w/c ratio	Mix ratio		
	Cement	Fine aggregate	Coarse aggregate
0.5	1	1.8	2.8

Mix proportion of PET bottles Scrap fines

The mix proportion was done for various percentage of PET bottles scrap fines i.e., 15%, 20%, 25% replacement for fine aggregates. The mix proportion is shown in the Table 1.

Table 1Mix proportion of PET bottles Scrap fines

Replacement of PET bottles scrap fines (%)	15%	20%	25%
Water (kg/m^3)	191.6	191.6	191.6
Cement (kg/m^3)	383	383	383
Fine aggregate (kg/m^3)	620.46	585.99	551.52
PET bottles scrap fines(kg/m^3)	68.94	103.41	137.88
Coarse aggregate (kg/m^3)	1090.55	1090.55	1090.55

7. CASTING

Cube details

Twelve cubes are prepared with mix ratio of M_{20} with different percentage of partial replacement of fine aggregate by PET bottles scrap .The details are shown in Table 2,3.

Table 2 Cube Specimen Sizes

S.No	**Specimen**	**Size (mm)**
1	Cube	150mmx150mmx150mm

Table 3 Test specimen details

S.No	**Specimen name**	**Cube**
1	Conventional	3
2	PET bottles scrap fines with 15%, 20%, 25%	9

Figure 2 Cube casting

Beam details

Twenty one reinforced beams are prepared with mix ratio of M_{20} with different percentage of partial replacement of fine aggregate by PET bottles scrap. The details are shown in table 4,5.

Table 4 Beam specimen sizes

S.No	**Specimen name**	**Size (mm)**
1	Beam	750mmx200mmx200mm

Table 5 Test specimen details

S.No	**Specimen name**	**Beam**
1	Conventional	3
2	PET bottles scrap fines with 15%, 20%, 25%	9

Figure 3 Reinforced beam casting

8. RESULTS AND DISCUSSION

COMPRESSIVE STRENGTH TEST

The test set up and the failure pattern of specimen for compression test is shown in Figure 4 respectively.

Figure 4 Compression test set up

Table 6Compressive strength of cubes (basic PET bottles scrap fines test)

Percentage replacement of fine aggregate by PET bottles fines scrap	No of days	Compressive strength (N/mm^2)
0%	7	17.73
	14	19.34
	28	21.73
15%	7	21.62
	14	22.85
	28	26.43
20%	7	25.15
	14	27.24
	28	33.06
25%	7	22.22
	14	25.51
	28	30.88

The graph shown in Figure 5the variation of the compressive strength of specimen with different replacement percentage of fine aggregate by plastic PET bottles scrap fines.

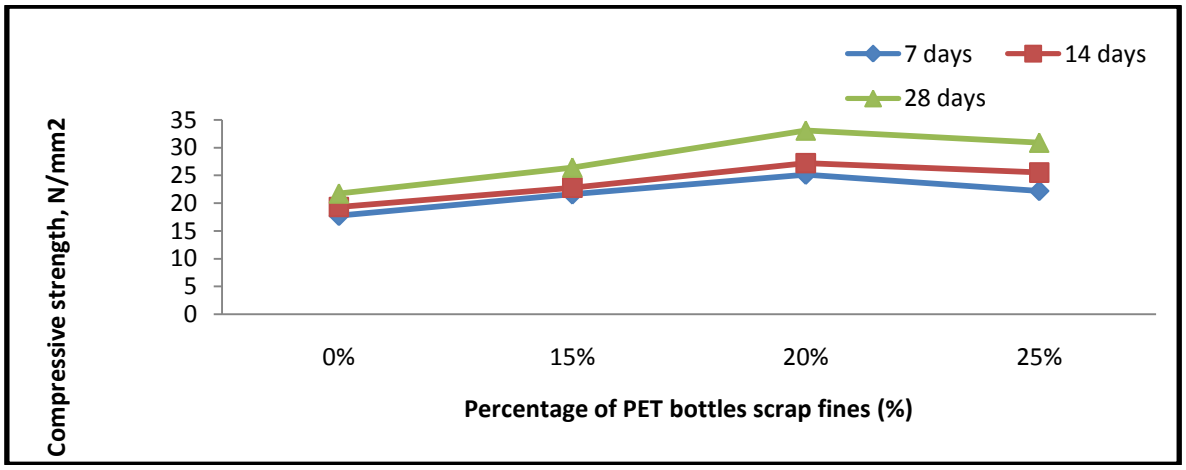

Figure 5 Compressive strength v_s PET bottles scrap fines (%)

FLEXURAL STRENGTH TEST

The test set up and the failure pattern of specimen for flexural test is shown in Figure 6 respectively.

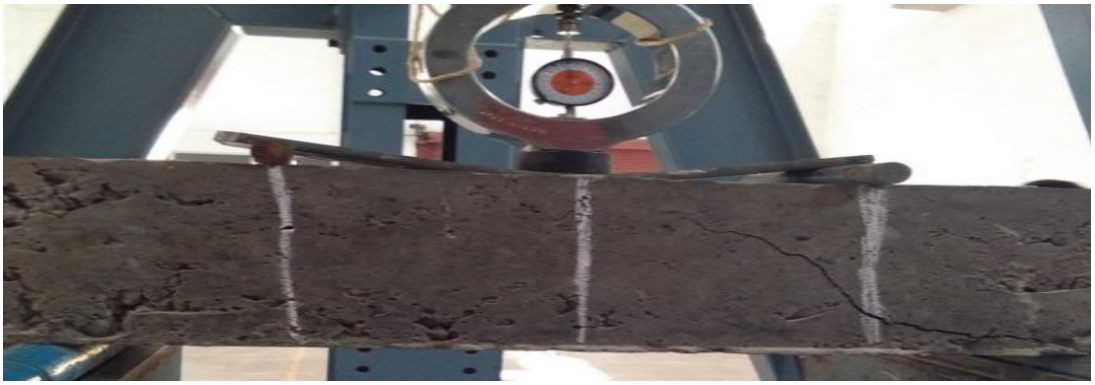

Figure6 Cracking of Specimens in loading frame

The graph shown in Figure 7 the variation of the flexural strength of specimen with different replacement percentage of fine aggregate by plastic PET bottles scrap fines.

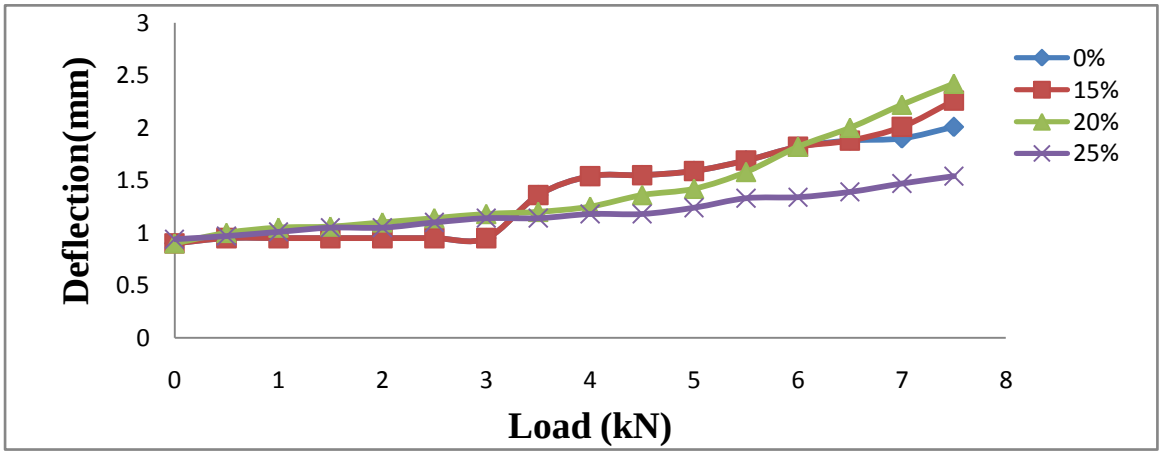

Figure 7Load(kN) Vs Deflection(mm)
(basicPET bottles scrap fines)

9. CONCLUSION

Over the range of plastic content and percentage of plastic scrap, the following results can be drawn in summary:

- Up to a certain amount of plastic content, the workability of concrete increases with increasing plastic content, beyond which it decreases with increasing plastic content.
- The compressive strength of the concrete to increases 52% with increasing upto 20% of the plastic scrap is used , if 25% of the plastic scrap is decreases in compressive strength compared 20% but not less than the 20 N/mm^2 (M_{20}).
- The flexural strength of the beam to increase with increasing 25% of the plastic scrap .
- Finally, use plastic scrap up to 25% of the concrete.

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