

Influence of PET Waste on Mechanical Properties of Concrete

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Abstract: Recycling of plastic is one of the major issues in the today's world. In this paper, study is carried on properties on concrete using poly ethylene terephthalate waste fibers (PET). PET fibers are replaced with fine aggregate by 10,15,20,25 and 30%. Concrete is tested for fresh and hardened properties. Slump test is conducted to find out the workability of concrete. To check the mechanical properties of concrete compressive strength, flexural strength tests are conducted on concrete specimens.

Keywords: Recycled plastic, PET fibers, Fresh properties, mechanical properties, self compacting concrete.



Fig.1 PET fragments

I. INTRODUCTION

In recent years, due to increasing advantages of concrete a new era of development of different types of sustainable concrete is rising. In this development procedure some of the natural resources are getting depleted. Sand is one of the major constituent of concrete, normally used fine aggregate also. To reduce the usage of sand, it should be replaced by some other material that is abundantly available. This context leads to an idea of usage of plastic waste fibres in concrete.

Solid waste management is growing problem in day today's world. Some solid wastes can be recycled and some can be degradable. Plastic is one the material that cannot be degraded but can be recycled. Plastic is classified into different forms based their physical and chemical characteristics.

This study explains the behaviour of structural concrete when fine aggregate is replaced with plastic waste fibres at different compositions.

II. METHODOLOGY

A. Materials used

Portland cement of 53 grades is used as binding material, river sand as fine aggregate, coarse of 12mm size were taken. PET waste is taken from cool drink bottles are taken. Fibers were sleeved out of cool drink bottles using cutter and they are almost graded to the size of sand particles.

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B. Design of concrete mix

A total of six mixes were designed by replacing the fine aggregates (FA) with PET fibres in the proportion of 0, 10,15,20,25 and 30%.

Table 1: mix proportions of concrete (kg/m³)

mix no	Cement	FA	CA	water	PET %
Ref	470	920	760	160	0
1	470	828	760	160	10
2	470	782	760	160	15
3	470	736	760	160	20
4	470	690	760	160	25
5	470	644	760	160	30

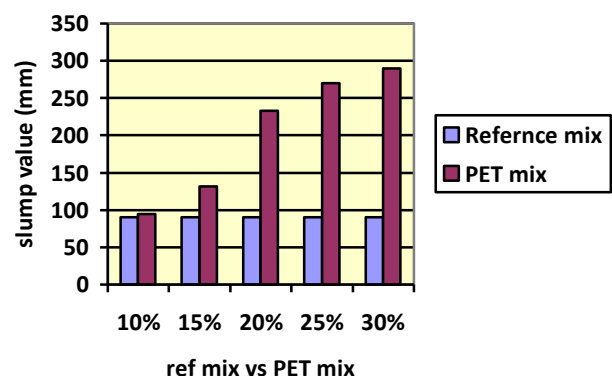
III. RESULTS

1) WORKABILITY :

I. Slump:

Workability of PET mixes was compared with Ref mix and comparison is given in fig.2 below

fig.2 comparison of slump values



Hardened properties of concrete:

I. Compressive strength:

To test the compressive strength of concrete cubes of standard size 150*150*150mm are casted and cured for 7 days and 28 days. Strength values of reference mix and replaced PET mix were compared in fig.3 and fig.4 below

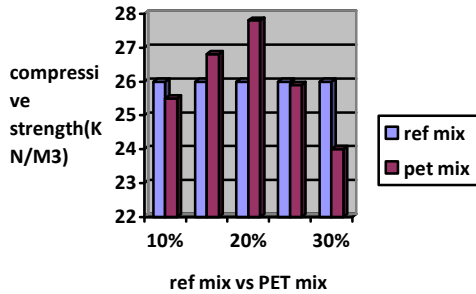


Fig: 3 comparisons of compressive strengths for 7 days

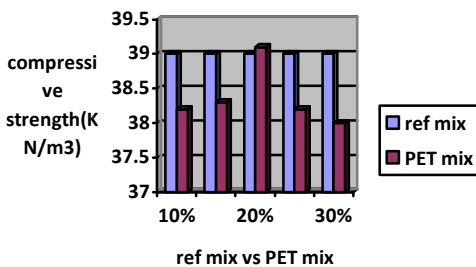


Fig: 4 comparisons of compressive strengths for 28 days

II. Flexural strength

To test the flexural strength, concrete beams were made with dimensions of 150*150*450mm. comparison of flexural strength values are given in fig.5 and fig.6 below

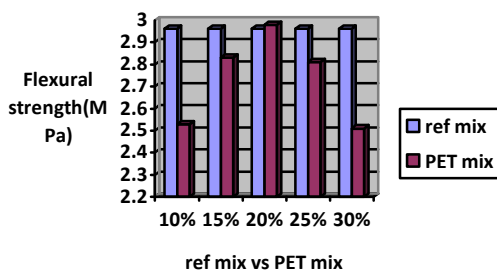


Fig: 5 comparisons of tensile strengths for 7 days

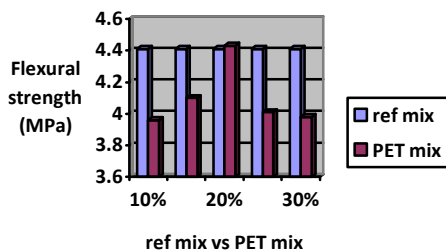


Fig: 6 comparisons of tensile strengths for 28 days

IV. CONCLUSIONS

From the experimental results following conclusions can be drawn

- Slump values are highly influenced by the increment in the proportion of the PET fibres. This is may be due to irregular arrangement of fibres.
- This can be concluded that concrete with high concentration of PET fibres cannot be used for reinforced structures.
- Compressive strength of concrete is gradually increased up to certain level and it has decreased gradually for both 7 and 28 days.
- Most nominal value for compressive strength is for the mix with 20% of PET fibres, at this concentration compressive strength values are high compared to the other proportions.
- Flexural strength values also show the same variations for PET mix with 20% PET fibres.
- At high concentrations of PET mix i.e., MIX no.5, compressive strength and flexural strength values low. This may be due to irregular distribution and non bonding characteristics of PET fibres.
- As per the results obtained MIX no.3 (concrete with 20% PET fibres) shows may be acceptable.

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