

Polymer Concrete by Using Waste Plastic Granules

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ABSTRACT: Concrete is a material which widely used in construction industry. The generation of plastic wastages is increasing day to day causing serious problems to the environment. In this research, the waste plastic particles are used in the concrete by partial replacement of fine aggregates in concrete. The main purpose of this study is to investigate the properties of concrete such as compressive, tensile as well as flexural strengths in the partial replacement of aggregate. The results indicate that the use of waste plastic particles in the concrete results the formations of light weight concrete. The properties such as compressive strength are reduced as well as tensile and flexural strength is increases with the addition of plastic in concrete.

KEYWORDS: Concrete, natural sand, solid plastic waste, environmental problems, compressive, partial replacement.

I. INTRODUCTION

In case of rapid increase of amount of industrialization in world, the amount of waste products such as waste plastic also increases rapidly. These waste plastic will remain in the environment for hundreds of years. The utilization of these waste plastic in concrete may decrease the environmental problems up to certain extent [1]. It is possible to dispose of these wastages in mass concrete such as in heavy mass concreting in PCC, in pavements where the strength of concrete is not a major criteria under consideration. Due to which we can utilize large quantities of plastic waste particles by mixing it in the concrete mass as additive. The changed lifestyle and endlessly increasing population has resulted in a significant rise in the quantity of post-consumer plastic waste. The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950's to nearly 100 million tons in recent times, resulting in a rapid increase in the amount of plastic waste generation [3]. Out of these waste, a major part is recycled but the majority of post-consumer plastic wastes, like shampoo sachets, carry-bags, nitro packs, milk and water pouches etc. though recyclable, remains comparatively untouched as they are difficult to separate from household garbage. The disposal of post-consumer plastic waste by land filling poses significant environmental hazards as it results in reduction in soil fertility, emission of toxic gases, reduction in water percolation, pollution of ground water due to leaching of chemicals from these waste products, health hazard to animals and birds consuming the wastes, poor drainage due to land filling, etc [7]. Disposal of waste plastic consumer bags from the domestic has become a major problem to the agencies in the town and cities. The waste Plastic bags available in the domestic waste mainly consist of Low density polyethylene (LDPE). Plastic bags dumped in the Dustbins and their way into the drainage system and blockage them.

When plastic bags burn which produces hazardous fumes causing air pollution. Industrial wastes from Low density polyethylene (LDPE) and polyethylene terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Three replacement levels are 5%, 10% & 15% by volume of aggregates were used for the preparation of the concretes. The results of this research suggest that LDPE and PET can be used as concrete aggregates for certain structural applications.

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Properties of aggregate

Plastic characteristics that make it a good material in concrete production and other building activities include: - a) Not easily biodegradable/ durability - This property shows that plastic can be used as an inert matter in cement matrix. b) Versatility - Plastic can be used in many areas in the industry. It is capable of being used in many different situations. This makes it an economically attractive choice. c) Lightness - Plastic is very light in terms of weight. d) Hardness - Plastic is made up of strongly bond together particles that make it hard to break. e) Low linear dilation coefficient f) Good chemical resistance g) High heat resistance.

Properties of Plastic Aggregates

Physical Properties	CA	PA
Specific Gravity	2.68	0.833
Bulk Density(kg/cm ³)	1600	1700
Water Absorption (%)	0.49	0.22
Free Moisture (%)	NIL	2
Fineness Modulus	4.65	2.2

Fig. Preparation of Plastic Aggregate



II. EXPERIMENTAL PROGRAMME

The main objective of this methodology is to compare the properties of concrete with the utilization of plastic particles used as partial replacement as fine aggregate and without any plastic. The various tests which are carried out for polymer modified concrete are followed by a brief description about mix design (M25) and curing procedure.

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III. EXPERIMENTAL RESULTS

The M25 grade of concrete mix is design as per IS 10262 :(2009) on Conmixer Software. Fresh concrete is test for workability by using slump cone & compaction factor test & harden concrete is test for compression test, Split tensile test & flexural test for 7,14 & 28 days of curing the results are shown below.

Results

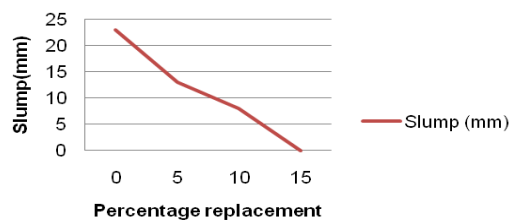
(A) Fresh concrete test:

(1) **Slump test:** fresh concrete was test under slump for different proportions as 0%, 5%, 10% & 15% replacement of fine aggregate with waste plastic granules, the results of the test shown in below graph Slump vs Percentage replacement .

Slump test (BS 1881: Part 102)

% Replacement	Slump (mm)
0	23
5	13
10	8
15	0

Slump Vs % replacement

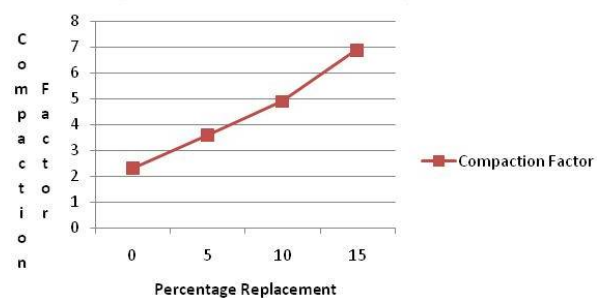


(2) **Compaction factor test:** fresh concrete was test under Compaction factor apparatus for different proportions as 0%, 5%, 10% & 15% replacement of fine aggregate with waste plastic granules, the results of the test shown in below graph Compaction factor vs Percentage replacement.

Compaction factor test

% Replacement	Compaction Factor
0	2.3
5	3.6
10	4.9
15	6.9

Compaction Factor Vs % replacement



(B) Harden concrete test:

(1) **Compression test:** Harden concrete cubes was tested under CTM for different proportions as 0%, 5%, 10% & 15% replacement of fine aggregate with waste plastic granules, the results of the test shown in below graph Decrease in compressive strength vs Percentage replacement

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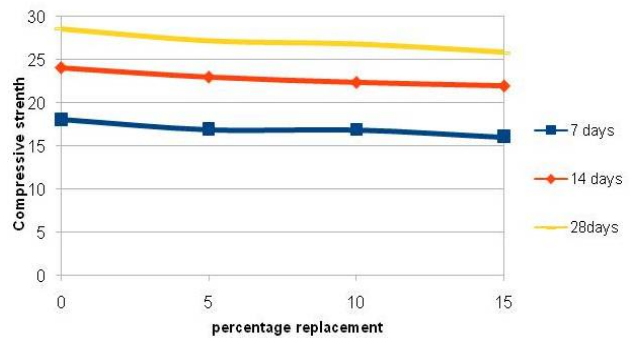
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Compressive strength

Percentage replacement	Compressive Strength		
	7 days	14 days	28 days
0	18.04	24.03	28.52
5	16.89	22.94	27.13
10	16.86	22.32	26.76
15	16.04	21.91	25.81

Compressive strength Vs % replacement

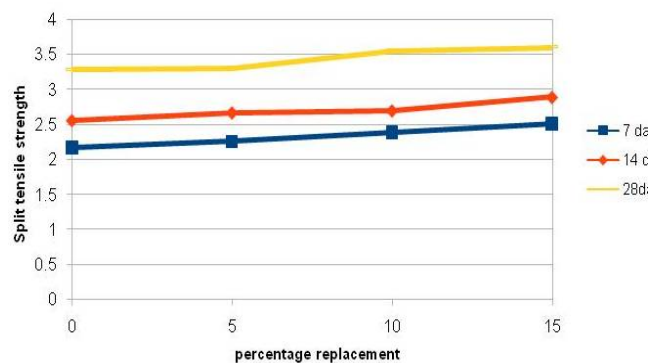


(2) **Split Tensile test:** Harden concrete cylinders were tested under CTM for different proportions as 0%, 5%, 10% & 15% replacement of fine aggregate with waste plastic granules, the results of the test shown in below graph Increase in Split tensile strength vs Percentage replacement

Split Tensile strength

Percentage replacement	Split Tensile Strength		
	7 days	14 days	28 days
0	2.16	2.56	3.29
5	2.25	2.67	3.31
10	2.38	2.7	3.56
15	2.51	2.89	3.6

Split tensile Vs % replacement



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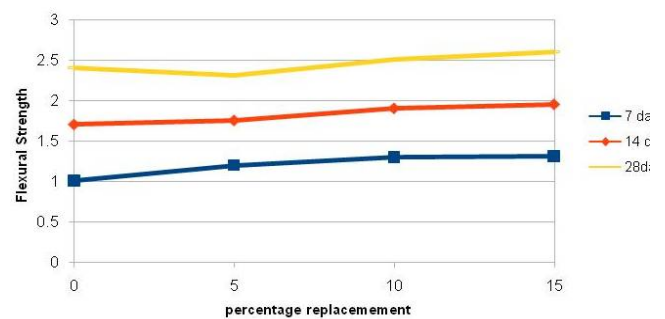
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(3) **Flexure test:** Harden concrete beams were tested under Flexural test machine for different proportions as 0%, 5%, 10% & 15% replacement of fine aggregate with waste plastic granules, the results of the test shown in below graph Increase in Flexural strength vs Percentage replacement.

Flexural strength

Percentage replacement	Flexural Strength		
	7 days	14 days	28 days
0	1.01	1.705	2.4
5	1.2	1.755	2.31
10	1.3	1.905	2.51
15	1.31	1.955	2.6

Flexural Strength Vs % Replacement



Discussion

1. The slump is decrease by for 5% replacement is 43.5%, 10% replacement is 65.2 %, 15% replacement 100 %.
2. The Compaction factor is increase by for 5% replacement is 36.11%, 10% replacement is 53.06 %, 15% replacement 66.67%.
3. The percentage compressive strength decrease in concrete for 5% replacement is 4.87%, 10% replacement is 6.2 %, 15% replacement 9.5 %.
4. The percentage Split tensile strength Increase in concrete for 5% replacement is 0.6%, 10% replacement is 7.58 %, 15% replacement 8.61 %.
5. The percentage flexural strength Increase in concrete for 5% replacement is 2.1%, 10% replacement is 4.4 %, 15% replacement 7.7 %.

IV. CONCLUSION

1. For given water content, the use of plastics in the mix lowers the compressive strength and increase the tensile strength and flexural strength.
2. This type of concrete can be used for rigid pavement as its flexural strength increases.
3. The workability is decrease as the percentage of replacement is increase.
4. The use of admixture is necessary as workability is decrease with increase in replacement of fine aggregates.
5. Plastics can be used to replace some of the aggregates in a concrete mixture. This contributes to reducing the unit weight of the concrete. This can be very applicable when requiring light weight concrete.
6. The effect of water cement ratio on strength development is not predominant in case of plastic concrete.

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