Research Paper Engineering

Experimental Study on Concrete Containing Recycled Plastics (LDPE)

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ABSTRACT

Due to rapid population growth and their consistent necessity the use of plastic articles is increasing regularly. This creates a large quantity of garbage every day which is unhealthy and pollutes the environment. In present scenario solid waste management is a challenge in our country. The present topic covers the use of recycled plastics Low density polythene as partial replacement of natural coarse aggregate in cement concrete mix. Complete replacement of natural coarse aggregate by recycled plastic aggregate Low density polythene (RPCA-LDPE) not realistic, therefore in this study partial replacement in various percentages were incorporated. For curbing the environmental pollution invention of this type of concrete is very much helpful to mankind, therefore getting inspired with this ideal the research work under consideration is taken up by authors. Intended percentages of recycled plastic aggregates Low density polythene (RPCA-LDPE) were from 0% to 30% with a increment of 10% in M20 Grade of concrete. It was observed that higher compressive strength was obtained with replacement of 20% natural coarse aggregate by recycled plastic aggregate Low density polythene (RPCA-LDPE) in concrete mix.

KEYWORDS : Recycled plastic granules, compressive strength, coarse aggregate, cement concrete.

1. INTRODUCTION

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 find their way into the drainage system and clog them. Often, these are burnt along the roadside, which produces fumes causing air pollution. Industrial wastes from polypropylene (PP) and low density polyethylene (LDPE) were studied as alternative replacements of a part of the conventional aggregates of concrete. Five replacement levels.0% ,10 %, 20 %, & 30 %, by volume of aggregates were used for the preparation of the concretes. Aggregate (PA) in concrete is acceptable there are for the making of concrete used coarse aggregate having size 20mm, natural river sand used for making a concrete and plastic aggregate used in crushed concrete from the tested cubes. Test carried out on these aggregate specific gravity and Bulk density, and sieve analysis. a mix design is produced in accordance with the properties obtained from test results. Concrete is then produced with replacement of 10%, 20%, and 30%, of plastic aggregate replacement of plastic aggregate with the same mix proportion. It can be utilized as constructional materials in cement concrete. It can be used as a coarse aggregate replacement in cement concrete also giving a eco-friendly solution for safe disposal of plastic waste.[4] Due to decrease in thermal conductivity of concrete by use of recycled plastic aggregate it can be used for thermal insulation work of buildings.[4]

2. OBJECTIVES:

1] To compare the compressive strength and Density of Recycled Plastics used as Coarse Aggregate for Constructional Concrete with the Conventional concrete

2] To know its applications in construction industry.

3] To reduce the pressure on naturally availability materials by replacing it with Recycled plastic aggregate

Fig-1 Waste plastics cut to required size

The aggregate thus obtained were a mixture of angular and round shape similar to that of crushed concrete aggregates. Obtained plastic granules were grinded in a grinding mill to a size 5 to 8 mm nominal as required for concrete as shown in fig-1 above.

Table-1 Physical properties of Plastic

Property	Detail
Plastic type	Grinded waste polythene plastic bags & High density polythene & other plastic articles
Plastic material	LDPE (Low density polythene),
Size (mm)	5 to 8 mm nominal size
Density(g/cm^3)	0.95
Melting point (°C)	120-130

Physical properties of grinded plastic to 5 to 8 mm nominal size is shown in table no-1. The density of plastic material is 0.95 g/cm^3 and melting point in the range of 120°C to 130°C.

3. EXPERIMENTAL PROCEDURES

3.1 Cement:

In this project work, cement used is ultra tech Cement which is PPC (Portland Pozzolana Cement) confirming to IS: 1489 part-1 (1991). This cement is Fly Ash based cement. The physical properties of cement obtained from the tests carried out are given in below table 2.

Table -2 Physical Properties of Cement

Sl. No	Material Properties	Cement Test Results
1.	Initial Setting Time	47 minutes
2.	Final Setting Time	330 minutes
3.	Standard Consistency Test	40%
4.	Specific Gravity	2.69
5.	Fineness	5%

3.3 Fine Aggregates:

Natural river sand which is locally available obtained from the Bheema river of Shahapur Taluk is used as fine aggregates. The physical properties of sand obtained from the tests carried out are given in below table 3.

Table 3 Physical Properties of Fine Aggregates

Sl. No	Material Properties	Natural River Sand
1.	Specific Gravity	2.60
2.	Water Absorption	2.3%
3.	Fineness modulus	2.7
4.	Zone	III
5.	Moisture Content	4.74%
6.	Bulk Density (Loose)	1.414 gm/ml
7.	Bulk Density (Compacted)	1.596 gm/ml
8.	Bulking of Sand	6.35%

3.4 Basalt Coarse Aggregates:

The Basalt coarse aggregates of 20mm down size obtained from the local stone crushers Gulbarga were used as coarse aggregates in cement concrete. The physical properties of coarse aggregates are given in below table 4.

Table 4 Physical Properties of Basalt Coarse Aggregates.

Sl. No	Material Properties	Basalt Coarse Aggregates
1.	Specific Gravity	3.0
2.	Bulk Density	1581.196 kg/m^3
3.	Water Absorption	0.54%
4.	Fineness Modulus	4.9
5.	Aggregate Impact Value	18.13%

3.4 Plastic Waste:

Waste scrap bag plastics, articles of Low density polythene (LDPE), materials were collected from landfills and other locations of nearby locality. These were cleaned and dried. The waste plastics articles were shaped and cut to required size.

3.5 Water: Clean Potable Water was used for the Mixing and Curing purpose of cement concrete. As per the IS: 456-2000 specifications.

4. METHODOLOGY

The mixing of various ingredients were done in a proper manner and a homogeneous mixture was obtained with proper coating of cement on the aggregates. Suitable numbers of cubes of concrete in suitable mould size (15cmx15cmx15cm) were made and cured for specified temperature and time. The compressive strength of various samples were tested by compression machine. Test results are tabulated below

5. RESULT AND DISSCUSION

The compressive strength of concrete cubes of various proportions cured for 7, 14 and 28 days are shown in table no-5.

Table-5 Compressive strength of Cubes of different proportions

Sample Series	Compressive Strength (N/mm^2)			
	3Days	7days	14Days	28 Days
C0	11.56	16.95	26.82	31.84
C10	11.10	17.96	20.10	25.12
C20	10.55	17.93	22.12	27.14
C30	8.11	15.96	19.92	24.12

The results of experimental investigations on use of recycled plastic aggregates as a partial replacement to natural coarse aggregate (NCA) in concrete were analyzed . Results as follows-

Use as Constructional Material: It was confirmed that plastic wastes can be disposed off by using it as constructional materials. It can be used as a coarse aggregate replacement in cement concrete.

Compressive Strength: The compressive strength of modified concrete with recycled plastic coarse aggregates Low density polythene (RPCA-LDPE) was compared with conventional concrete and it was observed that the compressive strength in comparison to conventional concrete C_0 series was achieved up to 78.54%, 85.69%, 76.49% for mix of waste plastic of 10%,20%,30% respectively. It shows that recycled plastic coarse aggregate Low density polythene (RPCA-LDPE) up to 30% as a replacement for natural coarse aggregate (NCA) can be used in light weight concrete structure successfully.

Cost Economy: By producing light weight concrete with use of recycled plastic coarse aggregate Low density polythene (RPCA-LDPE) there will be reduction in cost of raw materials and minimization of disposal of polymer waste.

Thermal conductivity: It was observed that thermal conductivity of concrete was reduced by use of plastic aggregates in concrete. This indicates that recycled plastics can be used for thermal insulation of buildings.

6. CONCLUSION.

Based on study and results of experimental investigations on use of recycled plastic aggregates as a partial replacement to natural coarse aggregate (NCA) in concrete the following conclusion can be drawn

1It can be utilized as constructional materials in cement concrete. It can be used as a coarse aggregate replacement in cement concrete also giving a eco-friendly solution for safe disposal of plastic waste.

The compressive strength of modified concrete with recycled plastic coarse aggregates low density polythene (RPCA-LDPE) was compared with conventional concrete and it was observed that the compressive strength in comparison to conventional concrete was achieved up to 79.54% , 85.69%, and 76.49% for mix of waste plastic of 10%,20%, and 30% respectively.

It shows that recycled plastic coarse aggregate low density polythene (RPCA-LDPE) up to 30% as a replacement for natural coarse aggregate (NCA) can be used in light weight concrete structure successfully.

However higher percentage more than 30% is not acceptable as the compressive strength is considerably reduced.

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