Research Paper Engineering

Investigation of Compressive Strength in Recycled Plastics Granules (Hdpe) Concrete By Replacement With Coarse Aggregates

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ABSTRACT

The project aims at use of recycled plastic I;e high density poly Ethylene (HDPE) in concrete as a partial replacement of Coarse aggregate to obtain light weight concrete. The waste plastic of HDPE is collected from Hyderabad and mixed with PPC and sand in varying proportions (0%,10%,20%,30%). The compressive strength for each variant is to be determined in laboratory. The rapid industrialization and urbanization in the country leads lot of infrastructure development. This process leads to several problems like shortage of construction materials, increased productivity of wastes and other products. As disasterious effects of waste plastic on the environment is noticed by the authors as its huge quantity pollutes the environment, therefore authors have taken up this study. This paper deals with the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete. Usually M20 concrete is used for most constructional works. Waste Plastics were incrementally added in 0%, 10%, 20%, 30%, to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement and waste plastics to determine their physical properties. Cubes of concrete were cast and tested after curing them for 3, 7, 14 and 28 days for compressive strength. The result shows that the compressive strength of M20 concrete with waste plastics HDPE is highest at the replacement of 20% for cube strength but still it is less than the normal concrete. Hereafter increment in percentage of it is decreasing the strength.

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

1. INTRODUCTION

There is a acute problem of disposal of wastes and it has become expansive due to over loaded landfills in present scenario. The threat due to non-biodegradable materials like waste plastics, scrap tyres etc. may contaminate the soil and ground water. The problem of disposal can be solved to some extent by reusing these wastes after recycling and it will also give a solution to environmental pollution as well. Re-use of waste plastic after recycling is economical as it is available at lower cost for mixing with other variants like bitumen, concrete etc. In order to modify the properties of concrete with the use of waste plastic materials such as High density polyhene (HDPE), have been investigated to be used in concrete in order to modify it and to improve the properties of it and reduce the cost. This will give a way for green construction and a eco- friendly environment.

In this research work recycled plastic granules were used as a partial replacement to natural coarse aggregate (NCA) of concrete. Intended percentages of recycled plastic granules were in varying percentages from 0% to 30% with a increment of 10%. (0%, 10%, 20%,30%) . The compressive strength of each sample was determined and compared with conventional concrete mix. A pilot study was conducted to determine the suitability of PCA for structural concrete. A percentage replacement of 22% NCA with PCA was found to be of superior concrete compressive strength. [(1)] From the above discussion it is identified that the use of plastic can be possible to improve the properties of concrete which can act as a one of the plastic disposal method.[(2)]

2. OBJECTIVES: The objectives of this research work are listed below-

1. To reduce the pressure on naturally availability materials by replacing it with Recycled plastic aggregate

2. To compare the physical characteristics of natural aggregate with Plastic recycled aggregate.

3. To produce lightweight polymer concrete for multi-purpose use

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	HDPE (High density polythene),
Size (mm)	5 to 8 mm nominal size
Density(g/cm³)	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/cm³ 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	II
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 plastics, articles of High density polythene (HDPE), 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: It is a important ingredient which actively plays a part in the chemical reactions. It should be a potable water free from organic matter and pH value should be between 6 to 7. Hence the water available in the material testing laboratory of KCT Engineering college is suitable hence it is used.

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 DISCUSSION

Table-5 Compressive strength of Cubes of different proportions

Sample Series	Compressive Strength (N/mm²)			
	3Days	7days	14days	28days
C0	12.56	17.95	27.82	32.82
C10	12.10	17.96	21.10	26.11
C20	11.55	19.93	23.12	28.10
C30	10.11	18.96	20.92	25.10

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

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 High density polythene (RPCA-HDPE) was compared with conventional concrete and it was observed that the compres-

sive strength in comparison to conventional concrete was achieved up to 79.55%, 85.61%, 76.47% for mix of waste plastic of 10% , 20%,30% respectively. It shows that recycled plastic coarse aggregate High density polythene (RPCA-HDPE) 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.

Cost Economy: By producing light weight concrete with use of recycled plastic coarse aggregate High density polythene (RPCA-HDPE) 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 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 high density polythene (RPCA-HDPE) was compared with conventional concrete and it was observed that the compressive strength in comparison to conventional concrete was achieved up to 79.55%, 85.61%, 76.47% for mix of waste plastic of 10%,20%, and 30% respectively.

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