

# Experimental Investigation of Recycled Plastic Aggregate in Concrete

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**ABSTRACT:** Plastic is one of the major environmental concerns in our country now days. This article studies how to recycle the plastics as construction materials without affecting its strength and properties. In this study, the natural aggregate was replaced by recycled plastic aggregate and it was used in concrete. The main aim of the study is to investigate the strength & properties of concrete with addition of plastics in concrete.

In the experimental investigation, Natural aggregate was replaced by recycled aggregate in the proportion of 0%, 4%, 8%, 12%, 16%, and 20%. Polyethylene in different proportions from 0.3%, 0.6%, 0.9% to 1.2% of the volume of concrete. Upon various levels, the investigations determine the right level of Low density PP is better to utilize for getting the improved results than High Density PP.

**KEYWORDS:**-Plastic, Polyethylene, Recycling Aggregate, RAC.

## I. INTRODUCTION

Generation of plastic waste is one of the fastest growing areas. Because the usage of plastic are increasing day by day in domestic and industrial wise. In Tamilnadu per day 3,400 tons of plastics are generated in each city, 35 to 45 tons is plastic wastes and most of that are plastic bags. Each year 500 billion to trillion plastics are generated in world wide. It estimated that the rate of expansion is doubled every year. This wastes produced today will remain in the environment hundreds and perhaps thousands of years. As landfill areas are rapidly depleting the cost of solid waste disposal is rapidly increasing. One solution to this crisis lies in recycling wastes into useful processes. So these types of plastic wastes are used in construction process. Research into new and innovative use of waste materials being undertaken world-wide and innovative ideas that are expressed are worthy of this important subject. Many highway agencies, private organizations and individuals have completed or are in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability and performance of using waste plastics in highway construction.

These studies try to match societal need for safe and economic disposal of waste materials with the help of environmental friendly highway industries which needs better and cost-effective construction materials.

## II. PLASTIC MATERIALS

### 2.1 Plastics

Now days the plastics usage is high so the quantity plastic waste is high. This study to check the efficiency of concrete by using the plastic waste in it and to improve the strength of concrete using Portland cement.

#### Three types of plastics

The polypropylene plastics can be divided in to three types for depending of strength size shape and weight. The following polypropylene plastics are

1. High density polypropylene
2. Low density polypropylene
3. Polypropylene waste

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## Properties of plastics

Table.1 Properties

Properties	Values
Specific gravity	1.04
Density (g/cc)	0.945 - 0.962
Melting point	75 – 100

## III. EXPERIMENTAL INVESTIGATIONS

### 3.1 Test programme

- The project deals with the behavior of recycled waste plastic concrete in partial replacement of coarse aggregate.
- To find out the strength parameters such as compressive strength, split tensile strength and modulus of elasticity of concrete with partial replacement of coarse aggregate is the prime concern of this study.
- Thirty six cubes, thirty six cylinders, are tested under compression, split tensile and deflection test respectively. The M25 grade of concrete is used for this study
- The investigated parameters under this study were concrete strength and the percentage of replacement plastics for the coarse aggregate.

Further details of concrete specimens are as follows:

### 3.2 Details of Specimens

#### 3.2.1 Cube Specimens

A mould of internal dimensions of 150 X 150 X 150 mm is used for casting of cubes for compression strength for both conventional concrete and waste plastic concrete Specimens.

#### 3.2.2 Cylinder Specimens

A mould of internal dimensions of 150 mm diameter and 300 mm height are used for casting of cylinder for split tensile strength for both conventional concrete and waste plastic concrete Specimens.

## IV. RESULTS AND DISCUSSIONS

### 4.1 Compressive Strength

Compressive strengths were measured using a compression testing machine with a maximum capacity of 2000KN. For all tests, each value was taken as the average of two samples. The dimensions for the concrete cube should be in 150×150×150mm respectively. The ultimate compressive load and compressive strength of the conventional and plastic concrete cubes for 14 days and 28 days curing results are tabulated in Table 2 respectively.

The remarkable compressive strength was achieved by using polypropylene in both 14 and 28 days curing as compare to nominal concrete mix. The results achieved for Low density PP is better than high density PP is showed in fig.2 respectively.

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Table.2 Compressive strength results for concrete cubes

% of Plastics	Curing days		Compressive strength(N/mm <sup>2</sup> ) For HDP		Compressive strength(N/mm <sup>2</sup> ) For LDP	
	14days	28days	14days	28days	14days	28days
0	585	665	25.22	28.22	25.22	28.22
3	751	893	27.82	30.62	33.37	39.68
6	746	854	28.75	31.11	33.13	37.95
9	655	706	29.86	34.88	28.79	30.85
12	568	618	18.55	19.30	25.24	27.46
15	465	524	17.20	20.75	20.66	23.28

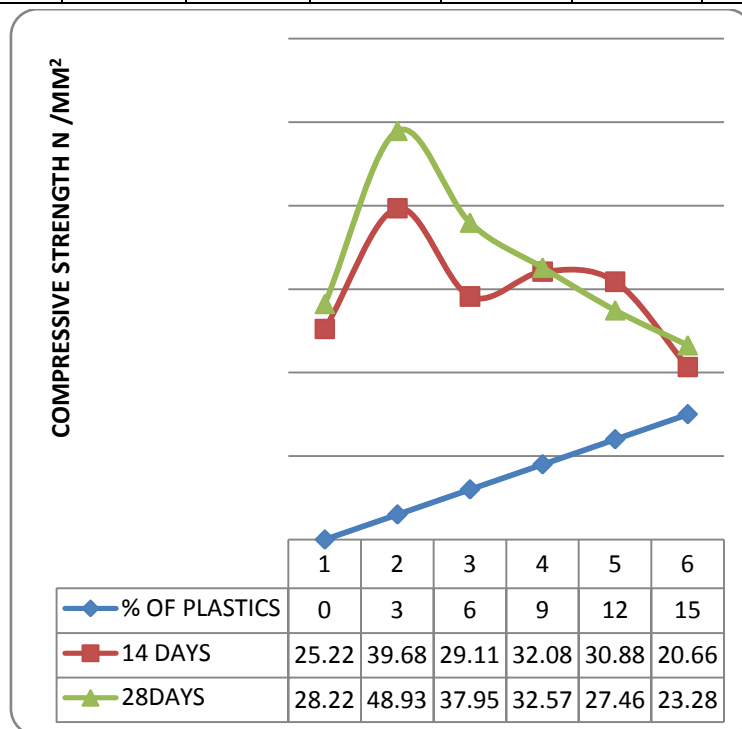


Fig.2.Compression Test – For Low Density PP

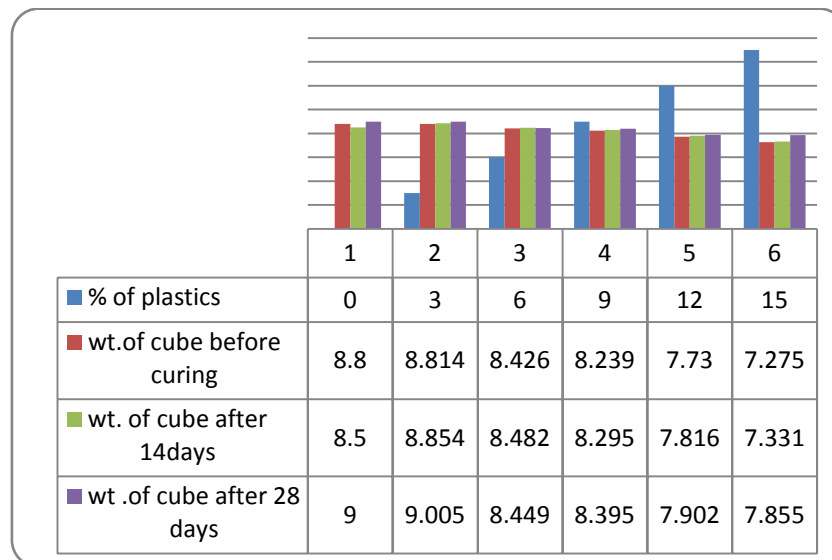
## 4.2 Self Weight Comparision

Based on the self weight comparison for each percentage level of plastics, the following figure was drawn based on the curing periods.

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**Fig.3. Self weight comparison**

### 4.2 Split Tensile strengths

Split Tensile strengths were measured using a compression testing machine with a maximum capacity of 2000kN. For all tests, each value was taken as the average of three samples. Test results for conventional concrete for both 14 and 28 days curing were tabulated in Table 5. The dimensions for the concrete cylinder should be in 150mm dia and 300mm length respectively. The split tensile strength for plastic cylinder for 14 and 28 days results are shown at the Fig .4 respectively.

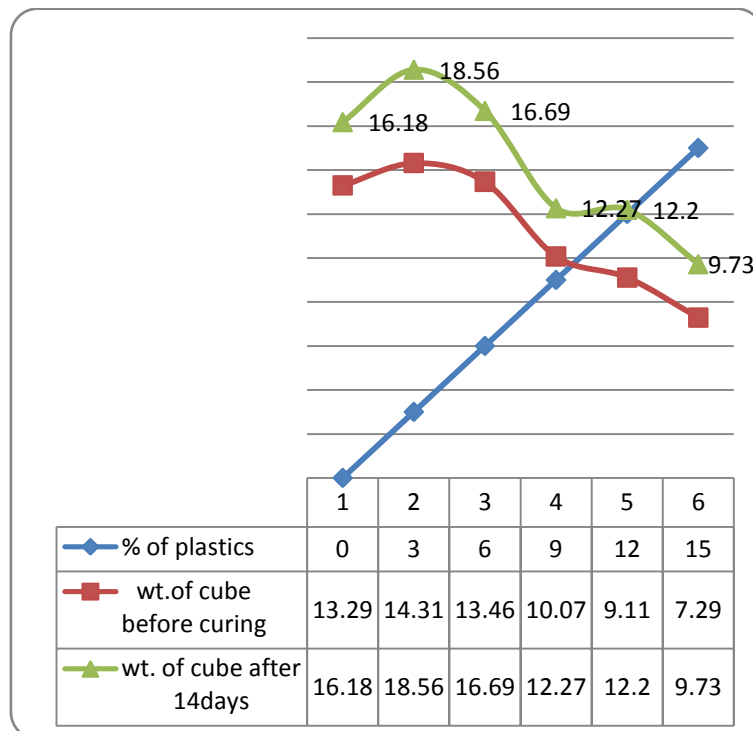
**Table.5 Split Tensile Strength**

% of Plastics	Curing days		Split tensile strength (N/mm <sup>2</sup> )	
	14 days	28 days	14 days	28 days
	0	58	70	3.27
3	59	72	3.39	4.08
6	63	80	3.56	4.27
9	48	58	2.72	3.31
12	39	47	2.23	2.65
15	36	49	2.06	2.80

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**Fig.4. Tensile strength for cylinder (HDPP)**

## V. CONCLUSION

The strength of the concrete such as compressive and tensile is increased up to 30% to 60%. The self-weight of the concrete is too low as compare to conventional concrete. The optimum percentage level was found out experimentally, while adding the plastics above 10% the concrete should be lose the compressive strength suddenly. Thus the usage of plastics was results in improving the strength of the concrete and its one of the fine way to reduce and recycle the waste plastics effectively.

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