

# An Experimental Study on Partial Replacement of Coarse Aggregate by Using Recycled Plastic Aggregate on Strength of Concrete

Bhavana Patil , Prof. S. D. Agrawal

**Abstract**— As one of the greatest inventions in 20th century, plastic has brought huge benefit in human life. Numerous plastic products are being consumed with the development of society. However, large amounts of plastic waste give much pressure on the environment due to the very low biodegradability of plastic. It is necessary to develop a rational approach for the waste disposal indicating both the economy and environmental protection. The productive use of waste material represents a means of alleviating some of the problems of solid waste management. The recycle of wastes is important from different points of view. The paper aims towards studying the effects of partial replacement of aggregates by plastic granules. Test samples will be casted for conventional concrete and then 6%, 12% and 18% of the aggregates will be replaced by plastic granules. Test samples will be tested for compression test, Split tensile test and flexure test. The test result of the conventional concrete will be compared with plastic imbedded concrete.

**Index Terms**— recycle aggregate, compression test, flexural test

## I. INTRODUCTION

Every year more than 500 billion plastic bags are used (nearly one million bag per minute). Hundreds of thousands of sea turtles, whales and other marine mammals die every year from eating discarded plastic bag for mistaken food. On land many animals suffer from similar fate to marine life. Collection, hauling and disposal of plastic bag waste creates an additional environmental impact. In a landfill or in environment, Plastic bags take up to 1000 year to degrade. Many researches were conducted to use industry by products such as fly ash, silica of concrete. Flume, glass cullet, coir fibers, e-plastic waste in concrete to improve the properties. (17%) is higher than for the plastic industry elsewhere in the world. India has a population of over 1 billion and a plastic consumption of 4 million tonnes. One third of the population is destitute and may not have the disposable income to consume much in the way of plastics or other goods. The virgin industry does not target this population to expand its markets. However, one third of the population is the middle class whose aspirations could be moulded to increase consumption. Plastic manufacturers create needs for this segment of population. The rising needs of the middle class, and abilities of plastics to satisfy them at a cheaper price as to other materials like glass and metal, has compared

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contributed to an increase in the consumption of plastics in the last few years.

## A. OBJECTIVE

To make a productive use of waste plastic which has harmful effect on environment to reduce the pressure on naturally available materials by replacing it with Recycled plastic aggregate

1. To study the physical characteristics of natural aggregate with Plastic recycled aggregate.
2. To study properties of wet concrete using recycled plastic aggregates as partial replacement of aggregates
3. o test compressive strength of cubes, cylinder & flexural strength of beams as per IS Code Specifications.

## B. SCOPE OF WORK

The project aims towards studying the effects of partial replacement of aggregates by plastic granules. Test samples will be casted for conventional concrete and then 6%, 12% and 18% of the aggregates will be replaced by plastic granules. Test samples will be tested for compression test, Split tensile test and flexure test. The test result of the conventional concrete will be compared with plastic imbedded concrete.

## II. RESULTS

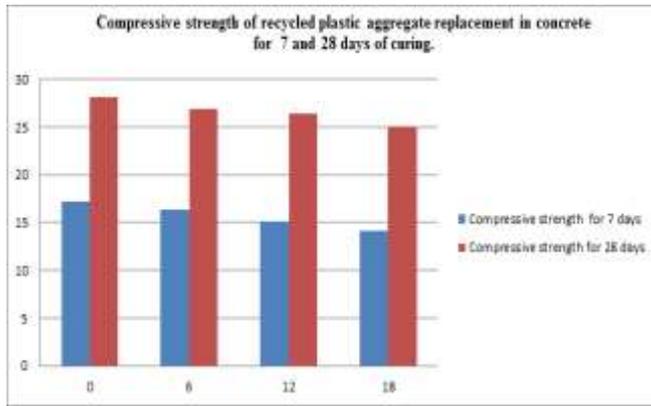
### Compressive strength

The cube specimen is of the size 15 x 15 x 15 cm. casted in Metal moulds. They are made in such a manner as to facilitate the removal of the moulded specimen without damage. Three specimens are casted for each of with and without replacement of plastic aggregate. In case of replacement it is done for 0%, 6%, 12% and 18% replacement of natural aggregate. And test compressive test are carried out for 7 and 28 days of curing for above all conditions.

### Results of Compressive strength of recycled plastic aggregate replacement in concrete for 7 and 28 days of curing.

| centage of recycled plastic aggregate (%) | Compressive strength of concrete with plastic aggregate for 7 days (N/mm <sup>2</sup> ) | Compressive strength of concrete with plastic aggregate for 28 days (N/mm <sup>2</sup> ) |
|---|---|--|
| 0   | 17.22   | 28.15  |
| 6   | 16.36   | 26.87  |
| 12  | 15.06   | 26.44  |
| 18  | 14.12   | 25.05  |

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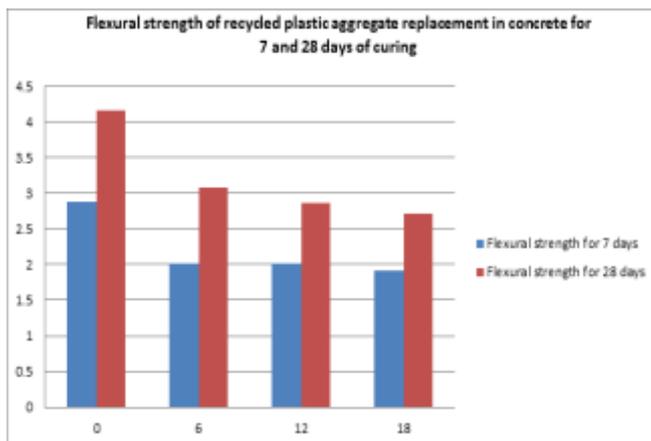


## Flexural strength

The beam specimen is of the size 15 x 15 x 70 cm. casted in Metal moulds. They are made in such a manner as to facilitate the removal of the moulded specimen without damage. Three specimens are casted for each of with and without replacement of plastic aggregate. In case of replacement it is done for 0%, 6%, 12% and 18% replacement of natural aggregate. And test flexural test are carried out for 7 and 28 days of curing for above all conditions.

## Flexural strength of recycled plastic aggregate replacement in concrete for 7 and 28 days of curing

| Percentage of recycled plastic aggregate (%) | Flexural strength of concrete with plastic aggregate for 7 days (N/mm <sup>2</sup> ) | Flexural strength of concrete with plastic aggregate for 28days (N/mm <sup>2</sup> ) |
|--|--|--|
| 0  | 2.88   | 4.16   |
| 6  | 2.01   | 3.08   |
| 12   | 2.02   | 2.86   |
| 18   | 1.91   | 2.71   |

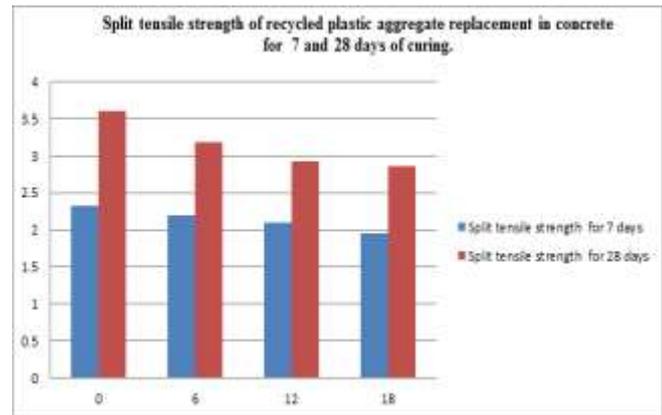


## Splitting tensile strength

The cylindrical specimen is of diameter 15cm and depth 30cm. casted in Metal moulds. They are made in such a manner as to facilitate the removal of the moulded specimen without damage. Three specimens are casted for each of with and without replacement of plastic aggregate. In case of replacement it is done for 0%, 6%, 12% and 18% replacement of natural aggregate. And test tensile test are carried out for 7 and 28 days of curing for above all conditions.

## Split tensile strength of recycled plastic aggregate replacement in concrete for 28 days of curing.

| Percentage of recycled plastic aggregate (%) | Split tensile strength of concrete with plastic aggregate at 7 days (N/mm <sup>2</sup> ) | Split tensile strength of concrete with plastic aggregate at 28 days (N/mm <sup>2</sup> ) |
|--|--|---|
| 0  | 2.32   | 3.6   |
| 6  | 2.19   | 3.19  |
| 12   | 2.10   | 2.93  |
| 18   | 1.95   | 2.86  |



## III. RESULT ANALYSIS

The Compressive strength of Plastic granules concrete decreases as we increases Plastic granules in concrete mix, for 28 days of strength it decreases slightly in range of 0-1%. This can get better results by adding fly ash small percentage as Fly ash delays the rate of strength gain. So we may get better results as the concrete ages.

The tensile strength of Plastic granules concrete affects drastically as we increases Plastic granules in concrete mix, for 28 days of strength it decreases from 0-40%.

After increasing percentages of plastic granular it even reduces more by more than 25%.

The Flexural strength of Plastic granules concrete decreases as we increases Plastic granules in concrete mix, for 28 days of strength it decreases suddenly up to 25%. After increasing percentages of plastic granular it even reduces more but only with small changes. Sudden change is only observed at initial stage only. The strength reduces because plastic granular do not absorb water which leads to improper curing.

## IV. CONCLUSION

The following conclusions are drawn from the results obtained from this experimental investigation. Material used for experiment is HDPE:

- 1) Fresh concrete becomes more workable when we increase the percentage of plastic as plastic do not absorb any water.
- 2) Compressive strength decreases slightly upto 10% after replacing by plastic granules 18% with compare to no replacement. Because of very less crushing value of plastic granules it seems to be decreased.
- 3) The flexural strength of concrete containing plastic aggregate with 18% replacement at 28 days is almost half

flexural strength of normal concrete. To be specific strength decreases by almost 40%. Also values shows that even by replacing small percentage of plastic granules to concrete causes drastic decrease in flexural strength.

4) Even though Compressive strength decreases after constantly increase in replacement of plastic granules it manages strength above 25 N/mm<sup>2</sup> for M25 concrete. But flexural strength and split tensile does not such nature.

5) Plastic Recycled aggregate concrete can be used for normal structural purposes with 5% to 10% replacement of natural aggregates.

From the above results it is clear that with this strength of concrete, this concrete can be used in P.C.C work which will save cost. If concrete as of M25 is to be manufactured, then 15% to 20% replacement of natural aggregate.

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