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Comparative Study on Waste Plastic Incorporated Concrete Blocks with Ordinary Concrete Blocks

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Abstract - *Waste plastic materials are generated in large amount all over the world. Disposal of plastic waste is not eco-friendly as it is non-biodegradable. Usage of waste plastic aggregates in the construction of solid concrete blocks helps in recycling and reuse of plastic. Our project aims to test the suitability of plastic aggregates as a partial replacement for coarse aggregates in solid concrete blocks.*

Key Words: **plastic aggregates, partial replacement, coarse aggregates, solid concrete blocks, compressive strength, eco-friendly**

1. INTRODUCTION

The use of plastic as well as the problem created by its disposal is increasing now a day. Also the demands for construction of concrete buildings are rising up. In this context recycling of plastic and incorporating it as a constructional material is of prime importance. Using plastic aggregates as a partial replacement for coarse aggregate in concrete can provide a sustainable solution for the disposal of plastic waste. Plastic wastes that we made use of are polythene covers and Low Density Polyethylene (LDPE).

2. OBJECTIVES

2.1. To reuse the non-biodegradable materials like plastic
2.2. To study the effect of plastic aggregates on compressive strength of concrete blocks.
2.3. To compare strength as well as other properties of plastic incorporated blocks with ordinary concrete blocks.

3. LITERATURE REVIEW

Experimental analysis conducted by several investigators has shown that plastic incorporated concrete have desired strength and it is a viable solution for ecological problems created by plastic waste.

By referring many journals we concluded that the optimum percentage of the plastic aggregates for the partial replacement of coarse aggregates giving maximum compressive strength lies between 5 and 30 %.

Shibi Varghese et al. (2013) worked on concrete made with plastic aggregates. He had concluded that plastic coarse aggregates have low crushing values and will not be crushed as easily as the stone aggregates. That is why concrete cubes having lower amount of plastic coarse aggregates have less compressive strength than with optimum amount of plastic aggregates.

K.Ramadevi and Ms. R. Manju (2012), worked on fibre concrete and they got a result showing increase in compression strength and it reduce the weight of blocks.

Bakri et al. (2007) conducted a study on concrete made of HDPE plastic waste aggregate will give adequate strength to concrete and he found that concrete with HDPE plastic waste aggregate is suitable for non-structural usage.

Ben Davis and Dr. Kurtis (2007) worked on concrete with plastic fiber and the result shows a lower compressive strength and they have conclude that it may be because of the entrapped air by the presence of fiber.

4. MATERIALS

4.1 Cement

The cement used for our experiment is 53 grade OPC conforming to IS 12269 : 2013. The cement taken was fresh and without lumps. Following are the other properties which have been experimentally done in the laboratory:

Table -1: Properties of cement

Type and grade	Ordinary Portland Cement 53 grade
Specific gravity	3.125
Standard consistency	36 %
Initial setting time	65 min

4.2 Aggregates

The fine aggregates used for the experiment were manufactured sand and coarse aggregates used were crushed stone. The size, shape and other properties of aggregates should conform to IS: 383–1970. Following are the properties of both fine and coarse aggregates:

Table 2: Properties of aggregates

Aggregate	Fine aggregates	Coarse aggregates
Type	M sand	Crushed stone
Specific gravity	2.63	2.79
Crushing value	-	26.3%
Maximum Nominal size	-	12.5 mm

4.3 Plastic aggregates

The materials used to make plastic aggregate were waste polythene bags and low density polyethylene (LDPE) plastic. It was then sorted and separated from laminated plastics. These were cleaned to remove other impurities and were crushed into small fractions. It is then melted at 220^0C-250^0C temperature and allowed to cool by spreading on ground surface. The plastic boulders of size 100 to 120 mm were then crushed down to obtain the size of aggregates.

Table 3: Properties of plastic aggregates

Property	Experimental value
Specific gravity	0.9
Crushing value	1.5

4. METHODOLOGY

The coarse aggregates were partially replaced with plastic aggregates in varying proportions from 5% to 30%. The replacement was done by volumetric substitution. The raw materials in calculated proportions were thoroughly mixed in the concrete mixer. Concrete blocks conforming to IS 2185:2005 were prepared having a size of 300mm X 200mm X 150mm. The cast blocks were allowed for curing of 28 days and the curing was done by sprinkling water. After proper curing the concrete blocks was tested for compressive strength, water absorption, block density, weight and cost comparison with ordinary concrete blocks.

5. EXPERIMENTAL RESULTS

From the test results, it was found that optimum percentage of plastic aggregates for the partial replacement of coarse aggregates lies between 15% and 20%.

Table 4: compressive strength of concrete blocks

% of plastic aggregates added	Compressive strength(N/mm^2)
15	3.12
16	1.79
17	1.53
18	1.12
19	0.78

From the table it is clear that the optimum percentage substitution giving maximum compressive strength is 15%. The other test results are shown in table 5:

Table 5: Test results

Property	Plastic incorporated concrete block	Ordinary concrete block
weight	16.2 kg	19.8 kg
Block density	1800 kg/m^3	2200 kg/m^3
Water absorption	2.6%	4%

6. CONCLUSIONS

- Optimum percentage of substitution of coarse aggregates with plastic aggregates giving maximum compressive strength is 15%.
- Compressive strength of solid concrete blocks with plastic aggregate replacement is slightly lesser than that without replacement.
- The solid concrete blocks with plastic aggregates can be used as light weight concrete blocks since its weight is less than that of ordinary concrete blocks. Also water absorption and block density is found to be less for plastic incorporated concrete blocks.
- On comparing the cost of solid concrete blocks with plastic as partial replacement and without replacement, cost of former is lower than the latter when made in a large quantity.

- In future use of plastic aggregate is an effective way of plastic waste management. And it will add more employment.

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