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Experimental Study on Partial Replacement of Aggregate by using Plastic Waste

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Abstract: *A substantial growth in the consumption of plastic is observed all over the world in recent years that has led to dumping of huge quantities of plastic related wastes in the environment. Recycling of plastic waste to produce construction material like concrete appears as one of the best solutions for the disposal of plastic waste. This paper involves a partial replacement of waste plastic as fine aggregates from 5% to 25% with 5% increment. The main objective of this study is to reduce the wastage of plastic and to improve the eco-friendly environment. Many investigations were taken for plastic so far, that has led to current research for using pulverized plastic which passes through 2.36 mm sieve and retained in 1.18 mm sieve in concreting material. The investigation was done and the mechanical properties of concrete were discussed in the present study. The experiment was done with M30 grade concrete for a curing of 7 days, 14 days and 28 days from which its compressive strength, tensile strength, flexural strength were taken and compared with the conventional concrete. The compressive strength has increased for 5%, 10 %, 15 % and gradual decrement is obtained for 20% and 25% of partial replacement. The tensile strength and flexural strength has been increased for all percentage of waste plastic replacements.*

Keywords: Recycling Pulverized Plastic Compressive Strength Tensile Strength and Flexural Strength.

I. INTRODUCTION

Concrete is the second most widely used material on the planet, after water. The manufacturing of concrete generates about 4.5 percent of the world's human-induced carbon dioxide emissions. Replacing even a small portion of concrete with irradiated plastic could thus help reduce the global carbon footprint. The plastic industry is amongst the fastest growing markets; this is attributable to its use in a variety of sectors. In India, about 80% of the total plastic consumption is discarded as waste, at least 40% of which is uncollected. Plastic is an organic hydrocarbon-based material, its high calorific value can be used for incineration or in other high temperature processes. But, burning of plastics releases varieties of poisonous gases which contaminates the air. However, the versatile behavior of plastic (it is lightweight, flexible, strong, moisture-resistant, and cheap) can make it a replacement of aggregates in making concrete.

II. LITERATURE REVIEW

T. Bragadeeshwaran, A.S. Kiruthika Devi, D. Manju Shree, R Pakya Sree in 2021 performed a study on Partial Replacement of Coarse Aggregate with Waste Plastic in Concrete. They used high strength of concrete w/c 0.35 and the percentage of waste plastic replaced by 3, 6, 9, 12, 15 and 18% of cement, coarse aggregate in concrete. They concluded that the use of waste plastic in cement-based composite can significantly reduce cost of construction through full or partial replacement of aggregates. The use of waste plastics in constructions will grossly reduce rate of solid waste accumulation in the environment and income will be generated from its utilization.

Elango A and Ashok Kumar A in 2018 performed study concrete with plastic fine aggregates. They used OPC 53 grade, River sand and crushed aggregates. They used plastic in place of fine aggregates in proportion of 10%, 20% and 30%. They test mechanical and durability properties on their concrete samples. They found the decrease in strength of concrete. But found that the concrete shows good results against acid attacks and increase in elasticity. So, they

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concluded that the plastic aggregate concrete can be used in place where we need less compressive strength but more durability.

Lhakpa Wangmo Thingh Tamanget. al. in 2017 performed experiment on Plastics in Concrete as Coarse Aggregate. They performed the testing of mechanical properties of concrete containing Plastic aggregates. They use plastic aggregates in proportion of 10%, 15%, and 20%. They found marginal reduction in strength and suggested the optimum result as 15% replacement.

III. MATERIAL USED AND THEIR PROPERTIES

Cement: Ordinary Portland Cement (43 grade) with 29% normal consistency conforming to IS: 8112-1989 is used. The specific gravity and fineness modulus of cement are 3.15. Coarse Aggregate: Natural crushed stone conforming to the IS 383-2016 is used. The shape of coarse aggregate is angular, water absorption capacity is 0.5%, fineness modulus is 4.50 and specific gravity is 2.68. Fine Aggregate: Uncrushed natural river sand is used as fine aggregate. In accordance with IS 383-2016 tests were conducted and concluded that the fine aggregate falls in Zone-II. The water absorption capacity is 1%, fineness modulus is 2.60 and specific gravity is 2.62. Water: Water is an important ingredient of concrete as it is actively participates in chemical reactions with cement therefore clean potable water conforming to IS 456-2000 is used for the preparation of concrete mixture. Plastic: Studies have revealed that waste plastics have great potential for use in concrete as its addition in small doses, about 6-12%, by weight of aggregates helps in substantially improving the strength of concrete. The waste plastic used in this study conforms to the size passing 2.36 mm sieve and retained on 600-micron sieve

IV. METHODOLOGY

The methodology adopted for this experimental study is as under:

Literature study was carried out based on data available on use of waste plastic in concrete.

b) Waste plastic was collected, cleaned, dried and shredded.

c) Test related to properties of cement and aggregates are performed.

d) Proportion of plastic coarse aggregates (PCA) in different mixes is selected based on available literature.

e) Mix design for different proportions of concrete is prepared and tests are conducted to obtain the mechanical properties of different mixes.

f) Based on the literature survey and optimum quantities of plastic, the following combinations are adopted.

Fig1 . Paving block Testing

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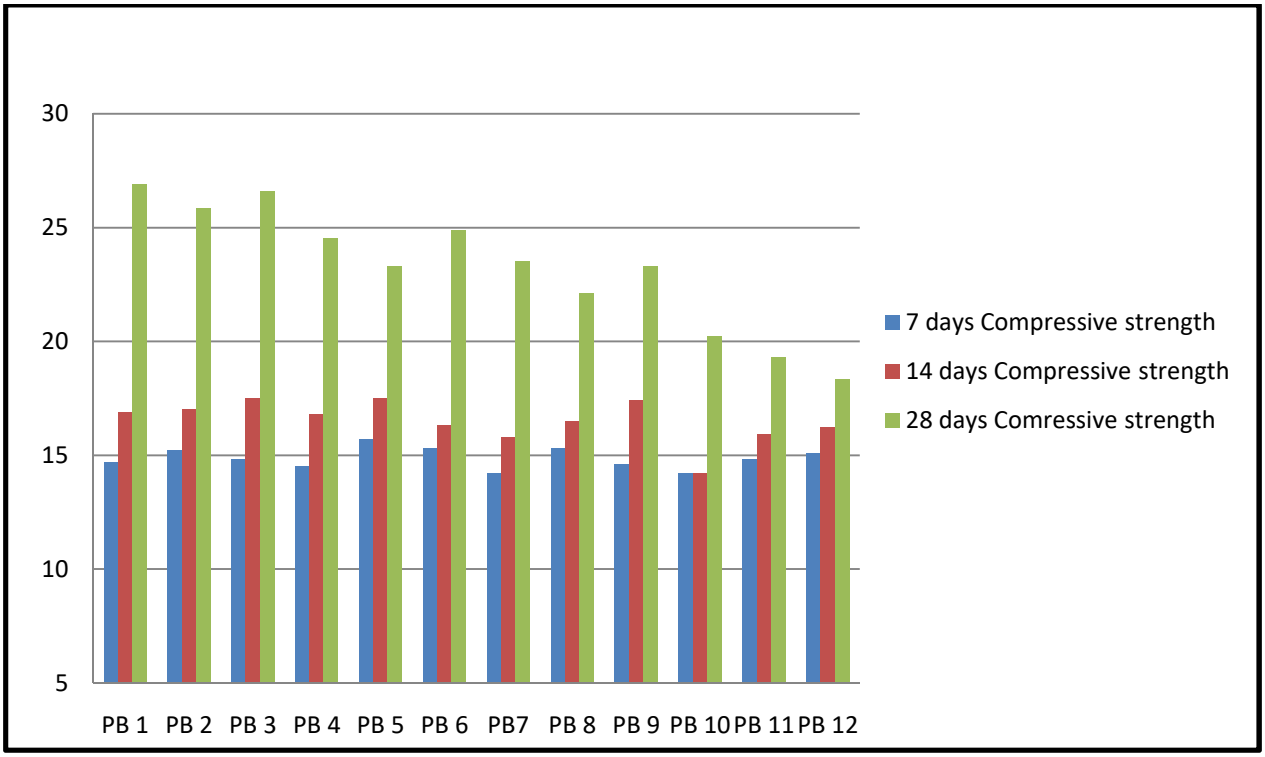

Fig2. bar chart of compressive strength result of different sample

V. RESULT

Sr. No.	Sample	Compressive Strength in N/mm^2		
		7 days	14 days	28 days
0 % replacement of plastic waste				
1.	PB 1	14.68	16.9	26.9
2.	PB 2	15.2	17	25.85
3.	PB 3	14.82	17.5	26.5
10% replacement of plastic waste				
1.	PB 4	14.5	16.78	24.5
2.	PB 5	15.7	17.5	23.3
3.	PB 6	15.3	16.32	24.9
20% replacement of plastic waste				
1.	PB 7	14.2	15.78	23.5
2.	PB 8	15.3	16.5	22.1
3.	PB 9	14.6	17.4	23.3
30% replacement of plastic waste				
1.	PB 10	14.2	14.2	20.2
2.	PB 11	14.8	15.9	19.32
3.	PB 12	15.1	16.2	20.1

From the above table, it is clear that average compressive strength for conventional paving block is N/mm^2 and for plastic paving block after 7 days, 14 days check and result similarly compressive strength after 28 days curing for the samples.

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Paver blocks using 0%, 10%, 20%, 30% of plastic coarse aggregate are casted. From the test results, it is concluded that the compressive strength value of concrete mix increases gradually up to 20% replacement of plastic coarse aggregate and decreases at 30% replacement of plastic waste in concrete.

VI. CONCLUSION

Plastic is very hard polluted ingredient in the nature so used in the paving block to reduce the pollution in the area. The strength of the plastic paver block is similar to that of concrete block. These blocks are used in the park, or on the footpath of the road. The utilization of waste plastic is manufacturing of paver block. Paving block has productive way of disposal of plastic waste.

Paver block is casted using partial replacement of coarse aggregate in this experiment. Here we used M20 concrete mix for casting paving block. Paver blocks using 0%, 10%, 20%, 30% of plastic coarse aggregate are casted. From the test results, it is concluded that the compressive strength value of concrete mix increases gradually up to 20% replacement of plastic coarse aggregate and decreases at 30% replacement of plastic waste in concrete. It is observed that, if the plastic increases in concrete then compressive strength are decreases.

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