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Experimental Study on Partial Replacement of Aggregate by using Plastic Waste

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Abstract: *Safe disposal of waste plastic is a serious environmental concern which needs to be mitigate. Being a non-biodegradable material, it does not decay over time and even if dumped in landfills, finds its way back in the environment through air and water erosion, can choke the drains and drainage channels, can be eaten by unsuspecting grazing animals causing them illness and death, can contaminate the construction fill, etc. The use of plastic shall be refused as much as possible. This paper investigates the effect to fusing waste plastic materials on the concrete. Waste plastic used in this study were collected from home which are almost available in our homes. The plastic can be used as filler material in concrete as well as it can be used to improve the mechanical properties of concrete. Concrete is a composite material which comprises Cement, Coarse Aggregate, Fine Aggregate, Water and Admixtures. In this project, M25 grade of concrete with W/C 0.46 is adopted and the percentage of waste plastic added as 0%, 2%, 4%, 6%, 8% and 10% to study the strength of concrete. High compressive strength was found with 8% of waste plastic added in the concrete.*

Keywords: Waste plastic, Concrete, OPC, Aggregate

I. INTRODUCTION

Aggregates are natural materials of great demand, and they are the most mined materials. They are directly used for construction or as constituents of ready-mixed concrete or asphalt products, and they appear as an index of the economic activity of a country. Distance between quarries and demand points controls the price of high place-value products such as aggregates. Their potential exploitation depends on factors such as geology, environmental and heritage protection laws, or even on social rejection near populated areas. These factors are forcing quarries to move away from demand areas and make the aggregates to be transported for longer distances, with associated economic, environmental, and safety issues. To mitigate this issue, this work has focused on the usage of waste materials that were also adversely affecting the environment. Some of these are already in use such as Iron slag, Crusher Dust, etc. and many others are under research. Hence, usage of these waste materials helping in dual role by minimizing the usage of raw material of concrete and by using the waste materials that are affecting the environment. Its beneficial properties which include (i) Low density extreme versatility; (ii) Lighter weight without sacrificing strength; (iii) Durability and longevity; (iv) Resistance to chemicals, water, and impact; (v) Unique ability to combine with other materials and (vi) Highly weatherable and low maintenance.

II. LITERATURE REVIEW

S. Vanitha et al. in 2015 performed studies on use of waste plastic in Concrete Blocks. Paver Blocks and Solid Blocks of size 200 mm X 150 mm X 60 mm and 200 mm X 100mm X 65 mm were casted for M20 grade of concrete and tested for 7, 14 and 28 days strength. Plastic was added to a proportion of 2%, 4%, 6%, 8% and 10% in equal replacement of aggregates. They found the optimum result for paver block at 4% replacement of aggregates with plastic aggregates. And 2% of plastic in case of solid blocks.

Daniel Yaw Osei in 2014 performed experiments on plastics aggregate in concrete. He replaces the coarse aggregates in concrete of ratio 1:2:4 by 25%, 50%, 75% and 100% with plastic. He found that there was reduction in strength of

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concrete as well as density of concrete. They suggested that replacement of aggregates more than 36% is not suitable for structural concrete. They also suggested plastic as a medium for production of light weight concrete.

T.Subramani and V.K.Pugal in 2015 performed an experiments on plastic waste as coarse aggregates in concrete. They prepared the concrete with 5%, 10% and 15% replacement of aggregates in concrete with plastic. They found the optimum results at 10% replacement of aggregates with plastic. Further increase in plastic content decreases the strength of concrete.

Amalu.R.Get. al. in 2016 performed the study the use of waste plastic as fine aggregate in concrete. They use plastic as substitute of fine aggregates in proportion of 10%, 15%, 20% and 25%. They found reduction in strength of concrete but support the use of plastic in non-structural concrete for the reason it shows higher workability and reduce environmental waste.

Manhal A Jibrael and Farah Peter in 2016 studies the Strength and Behaviour of Concrete Contains Waste Plastic. They replace fine aggregates in concrete with plastic bottles and plastic bags in varying proportions from 0% to 5%. They concluded the results to use the plastic in concrete for nonstructural purposes as it reduces the strength in both cases.

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:

a) 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.

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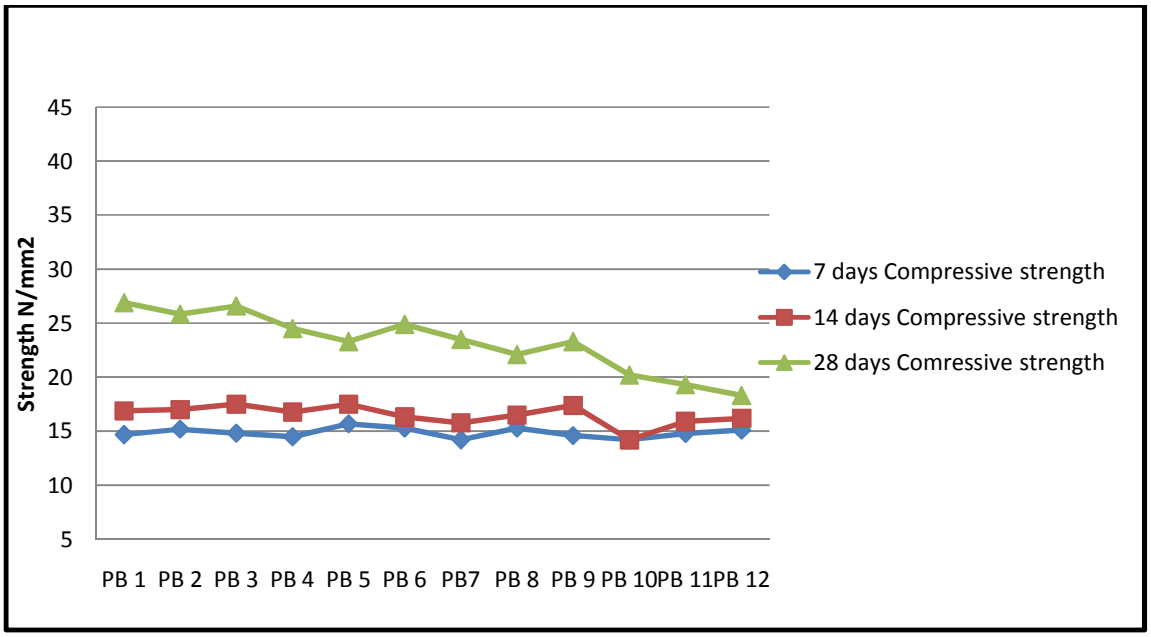

Fig1 . Line chart of comparative result of different sample

Fig2. Paving block Testing

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

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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.

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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