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Strength Analysis of Concrete by Using Plastic Waste

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Abstract: ***Industrial activities in India are related to major amounts of non-biodegradable solid waste, waste plastic being with the most important. Dumping of plastic waste in an environment is taken into considered to be a big problem because of its very low biodegradability and presence in large amounts. In modern time utilization of such, Industrial wastes from various plastics have been calculated as another substitution of a component of the conventional aggregates. Plastic recycling was taking place on a significant scale in an India. As much as 60 % of both industrial and urban plastic waste is recycled which obtained from various sources. In India plastic wastes is generated on large scale that have large economic value, as a result of this, recycling of waste plastics performs a most important role in offering employment. This study involved experiments and tests to optimize the effectiveness of reuse waste plastic in the manufacturing of concrete. Waste plastic was used as a partial replacement for sand by 0%, 1%, 2%, 3%, 4% and 5% with concrete mixtures. The concrete cubes had been tested at room temperature. These experiments consists performing slump & compressive strength. This investigation assured that utilization of waste plastic as a sand replacement aggregate in concrete provide a good process to decrease the rate of materials and crack some of the solid waste issues disposed by plastics.***

Keywords: PET bottles, Compressive strength, concrete, workability, M25 mix.

I. INTRODUCTION

The effective use of waste material shows a means of alleviating some of the issues of solid waste management. [10]. the use again of wastes is essential from several points of view. It allows saving and preserving natural resources that are not refill or reload, it reduces the pollutants of the surroundings and it additionally helps to save and recycle energy creation processes. Wastes and industrial by-products must be taken into consideration as potentially expensive resources merely pending to appropriate management and application. Plastic wastes are along with those wastes, their dumping has harmful effects at the environment because of their lengthy biodegradation phase, and hence one of the logical processes for decrease of their harmful effects is the application of those materials in different industries. Concrete plays major role in the beneficial utilize of those materials in construction. While some of those materials may be usefully included in concrete, together as part of the cementitious binder stage or as aggregates. Concrete includes several flaws and micro cracks. The rapid transmission of micro cracks in a carried out load is measured liable for the low tensile strength of concrete. It is reasonable to suppose that the tensile strength and flexural strength of concrete can be substantially augmented by introducing closely spaced fibers. The cementing materials, by using their overall performance in provisions of mechanical strength and durability control the market of construction materials. The addition of polymeric waste to concrete corresponds to a new viewpoint in research activities, integrating the regions of concrete technology and environmental technology. Industrial and domestic waste has an important proportion of polymeric materials in its establishment, which covered a big amount on landfills. Thus its recycling is exciting to investigate and improvement of technology for decreasing the issues as a result of this waste.

II. EXPERIMENTAL PROGRAM

A. Materials used

1) Cement: Ordinary Portland Cement of 43 grade used in this experimental analysis and cement properties that are used in this investigation are as follows in Table 1:

Table-1: Properties of Cement

S. No.	Properties	Results
1.	Standard consistency %	33%
2.	Initial setting time	46 min
3.	Final setting time	300 min
4.	Specific gravity	2.96
5.	Fineness	2%

2) *Fine aggregates:* Natural river sand used in this experimental analysis. That passes completely through 4.75 mm aperture size sieve and conforming to zone II. Properties of sand are as follows below in Table 2.

Table 2: Properties of Fine Aggregates

Sr. No.	Test	Result
1.	Zone	II
2.	Specific gravity	2.5
3.	Fineness Modulus	3.75
4.	Water Absorption	0.59%

3) *Coarse aggregates:* Coarse aggregates used in this study which is locally available and have 20 mm sieve size. Properties of coarse aggregates are described below in Table 3.

Table 3: Properties of Coarse Aggregates

Sr. No.	Test	Result
1.	Type	Crushed
2.	Maximum Size	20 mm
3.	Specific gravity	2.94
4.	Fineness Modulus	7.07
5.	Water Absorption	0.40%

4) *Plastic waste:* PET (polyethylene terephthalate) waste plastic used in this experimental analysis. For plastic waste used glucose bottles and water bottles which is locally available and this plastic used for packaging work. Properties of plastic waste are described below in Table 4.

Table 4: Properties of Waste Plastic Bottles (PET)

Sr. No.	Test	Results
1.	Specific gravity	1.34
2.	Water absorption	0.10
3.	Maximum size	4.75

5) *Water:* Potable water used in this investigation for mixing concrete mixture and curing of cubes.

B. Mix Proportions

Materials used for making Mix M25 grade of concrete and find out their relative quantity with the aim of producing a concrete of required strength , durability as economically as possible is termed concrete mix design. Table 5 shows the mix proportion of concrete.

Table 5: Mix Proportions of Concrete Materials

Percentage Plastic waste	Weight of CA. (kg/m^3)	Weight of Cement (kg/m^3)	Weight of F.A. (kg/m^3)	Weight of Plastic waste (kg/m^3)	Weight of Water(kg/m^3)
0%	1250	413	572	0	192
1%	1250	413	566.28	5.72	192
2%	1250	413	560.56	11.44	192
3%	1250	413	554.84	17.16	192
4%	1250	413	549.12	22.88	192
5%	1250	413	543.4	28.6	192

C. Experimental Results

In this experimental analysis the casted concrete cubes is related to various tests to obtain the strength and extra properties of the casted concrete. The major objective of the experimental analysis is to examine the developed strength attained by the concrete at various testing days from curing. Generally proper casting and curing of concrete will augment the strength of the concrete. For this project each test is carried out with 3 samples for every mix ratio and tested at required curing time. Then the average values are used for the investigations. The series of testing actions are detailed below:

1) *Slump Cone Test:* This experiment is executed to verify the workability of newly casted concrete. This test independently executed on newly casted concrete and the Fine aggregates replacing with waste plastic bottles to find the workability. The slump is very valuable in identifying variations in the consistency of a mix of given nominal proportions. Slump variations are shows in Table 6 and Figure 1.

Table 6: Slump value of Concrete Mix M25

% Replacement	Slump Value
0%	75 mm
1%	74 mm
2%	71 mm
3%	70 mm
4%	68 mm
5%	65 mm

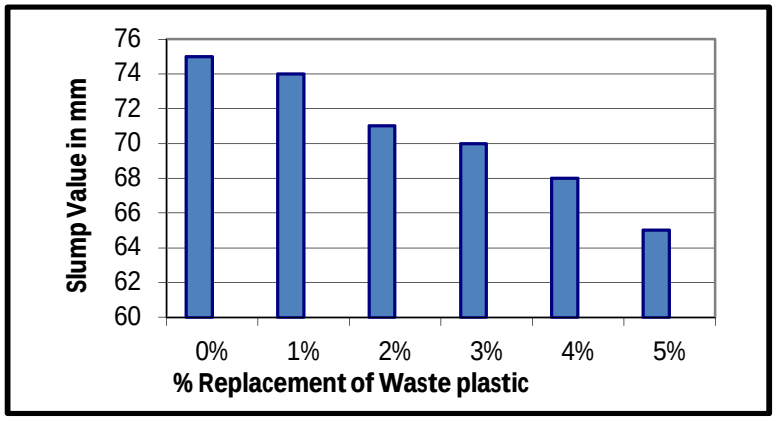

Figure 1: Slump Variations

2) *Compressive Strength Test:* Concrete is weak in tension and strong in compression so the concrete should be strong to attain high compression. In this study for each mix 3-samples have been tested and the average strength is compared with nominal mix of M25 Mix. Compressive strength test obtained the high amount of compressive load a concrete can put up with below facture limit. The outcomes of compressive strength at the age 7th day & 28th day are shown in table 7 and Figure 2.

Table 7: Compressive Strength on Concrete M25 Cubes

Percentage Replacement of Waste Plastic bottles	Compressive Strength (N/mm²)	
	7 Days	28 Days
0%	22.64	33.03
1%	23.28	33.98
2%	22.74	33.16
3%	21.99	31.87
4%	19.87	30.26
5%	18.16	28.73

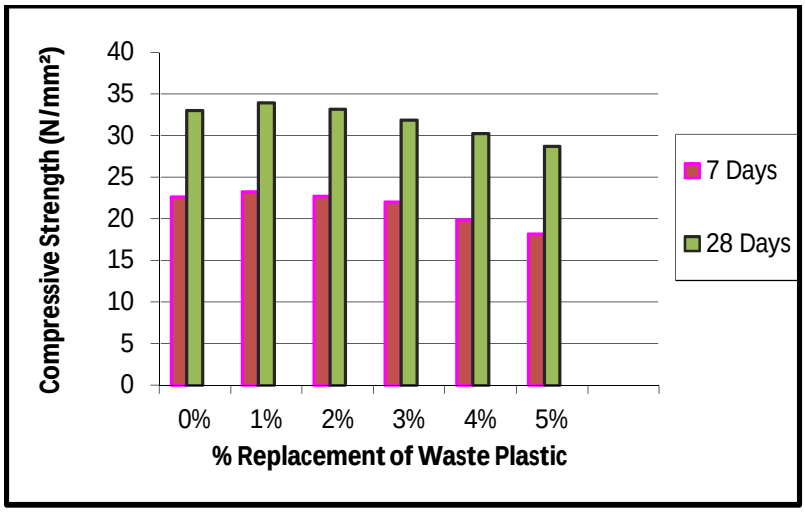

Figure.2: Compressive Strength of Concrete M25

3) *Waste Management:* In all over world plastic production has been increase day by day due to growing industry and rising population. Million tons of plastics wastes were generated day by day in all countries, so proper disposal of plastic is must necessary for protecting environment. To degrade waste plastic particles in the nature is a long time process, there also some other method for disposal of waste plastic but it causes environmental problem. In this Experimental study waste plastic is used in concrete in the form of replacement material of fine aggregates. For this study, M25 grade of concrete is prepared and the test are conducted for various substitute of fine aggregates using plastic waste as 0%, 1%, 2%, 3%, 4% & 5% in concrete ready with plastic waste of bottles .

4) *Cost Analysis:* This Experimental analysis for $1m^3$ of M25 grade of concrete with O.P.C. 43 grade made from conventional material and modified concrete made by substituting materials with 0% to 5% replacement of fine aggregates with plastic waste (PET bottles). Proportions of materials for mix 1:1.38:3.02 and cost of production for all concrete mix are given in Table 8.

Table 8: Total cost of Plastic Waste Concrete (Rs/m^3)

Sr. No.	Concrete Mix	Coarse Aggregates (Rs.)	Fine aggregates (Rs.)	Plastic waste (PET bottles) (Rs.)	Cement (Rs.)	Total cost for $1m^3$ concrete (Rs)
1.	0%	937.50	1144	0	2643.20	4724.7
2.	1%	937.50	1132.56	5.72	2643.20	4718.98
3.	2%	937.50	1121.12	11.44	2643.20	4713.26
4.	3%	937.50	1109.68	17.16	2643.20	4707.54
5.	4%	937.50	1098.24	22.88	2643.20	4701.82
6.	5%	937.50	1086.80	28.6	2643.20	4696.1

III. CONCLUSION

Based on the experimental investigation following assumptions are as follows

A. From this investigation, the Waste PET bottles would appear to be low cost material which would help to resolve solid waste disposal problem and preventing environmental pollution.

B. Results of the test conducted on material like Cement, Sand & Conventional aggregate are within the permissible limit as per IS codes.

C. The modified concrete mix, with mixing of plastic aggregate substitution of conventional fine aggregate up to 3% provides strength with in permissible limit.

D. Hence Concrete with waste PET bottles may be used as an successful plastic waste Management Practice in future.

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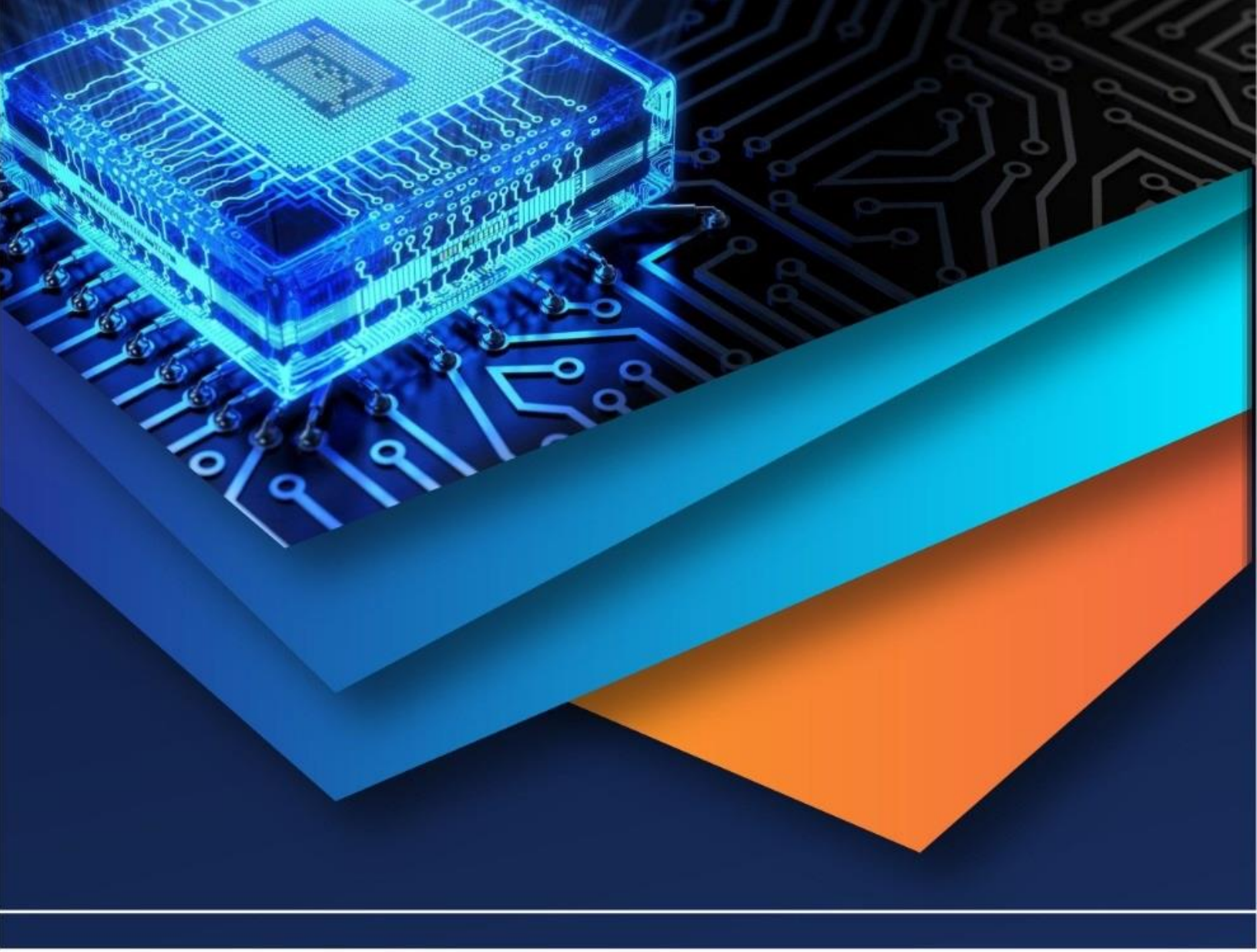

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