



Investigation Report on Strength Properties of Concrete by Partial Replacement of Coarse Aggregate with Waste Plastic Bottle Caps

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ABSTRACT

In construction industry the most widely used material is Concrete. To make environment eco-friendly, waste plastic bottle caps were used such that to reduce environment damage. Partial replacement of aggregates with bottle caps in concrete may leads to good results based on the proportions. Due to a lot of wastage of bottle caps environment gets polluted. In Olden days due to lack of knowledge, bottle caps are thrown away. Now-a-days while the technology is improving there on wastage of bottle caps are decreasing. Now-a-days there is rapid increasing of environmental awareness to reduce the problems on plastic to environment. Huge quantity of waste is generated from bus stands, railway stations, canteens, schools, colleges etc. As we know plastic is non degradable, it may help to reuse or recycle. Now-a-days In Civil engineering point of view as we know that to resist the loads of a structure the effective materials such as low cost, less environmental damage are used. In laboratory with the replaced concrete some tests were done. In concrete, the aggregates are replaced by bottle caps based on the percentages and that replaced concrete is studied.

Keywords: Concrete, Bottle caps, Waste Plastic, Aggregates.

1. INTRODUCTION:

In INDIA due to rapid development of civil engineering projects economical products are to be taken and choosen. By choosing those economical products there may be chance of reducing the environmental pollutions. There is a chance to reduce a lot of problems caused by environment. By using plastic as a construction material, the road side animals will not suffer with any diseases. In fastest growing construction industrial areas the economical products are to be used because to see their mechanical properties. As we know the main key in civil engineering point of view is concrete. Generally more than 350 million metric cube concrete is used in INDIA every year. The usage of concrete in civil projects are increasing day by day due to increasing of projects. As per IS 10269-2009 mix design code, mix design is done. After mix design the specimens were casted and testing has done on that specimen. Mechanical properties like compressive, split tensile and flexural strengths are done and the test results are compared with the standard results. Now-a-days, in construction industry the main factor considering is satisfying all the stages of people i.e., sustainability. Aim of my experiment work is to identify the properties of a standard specimens and the replaced specimens. Generally plastic is the main problem which takes more time to biodegrade and that presents in bulk quantity. In municipal solid waste, the main problem is plastic. Day-by-day the usage of plastic in the society is more. The motto of this paper is to study the behaviour of the M40 grade concrete.

1.1 Purpose of the study:

- To reduce the environmental pollution caused by the waste plastic.
- To bring awareness among people about the usage of plastic.
- To establish a new modified and replaced concrete properties.

1.2 Objectives of the Project:

- To find the strength properties of partially replaced concrete.
- To decrease the industrial waste.
- To make society eco-friendly.

2. METHODOLOGY:

We have used ordinary Portland cement of 43 grade cement conforming to IS 8112-1989 and we have used 20 mm coarse aggregate for the work, and the specific gravity of aggregate is 2.93, on the basis of Indian Standards specifications (IS 383-1970). In this test, we have preferred to use the local available sand conforming to zone 2 with specific gravity of coarse aggregate is 2.62 was used. The test was conducted as per Indian standard specification IS 383-1970 and the fine aggregate size is less than 4.75 mm is to be considered as suitable for our project.

Plastic Bottle Caps (PBC):

Waste plastic bottle caps collected from our college canteen, Gudlavalluru Engineering College. While day to day college life most of the students usages soft drinks in college canteen, so we came with an idea is to collect all used waste bottles when students are used. We kept dustbins in all corner of canteen to collect bottles. In this we only focused on bottle caps only for this study. These bottle caps are replaced with coarse aggregate and gives good strength also so our idea was implemented. And also we done a lot of work on increasing awareness of Waste Plastic Bottles Caps usage.



Fig 1: cut pieces of waste plastic bottles caps.



Fig 2: Waste plastic bottles caps in concrete cube

2.2 Casting of Specimen

According to IS 10262 (1982), the concrete mix design which was taken for the project. Under the Indian standards value, the material were tested for their physical properties and the ratio 1:1.5:3 the concrete mix property and 0.5 is the ratio of water/concrete, For the easy removing of moulds, after the casting oil is applied to surface of the moulds and the screw fitted moulds. For the compression strength test, 150mm*150mm*150mm casted concrete cubes are used. For split tensile strength the concrete cylinder are casted of 150*300mm. For flexural strength, the concrete beams was casted of 150*150*700mm. Based on the proportion of mix, in different proportion replacing coarse aggregate with waste plastic bottle caps. Fig (i) shows bottle caps added to concrete and fig 2 shows mixing of concrete with bottle caps.

3. EXPERIMENTAL WORK:

Tests Done:

1. Specific Gravity test on cement, Fine aggregate and coarse aggregate
2. Workability test on wet concrete
3. Compressive strength on dry concrete specimen
4. Split tensile strength on dry concrete
5. Flexural strength on dry concrete specimen

Relative density, or specific gravity, is the ratio of the density (mass of a unit volume) of a substance to the density of a given reference material. Specific gravity for liquids is nearly always measured with respect to water.

Specific gravity of cement =3.12

Specific gravity of Fine Aggregate= 2.64

Specific Gravity of Coarse Aggregate= 2.7

Workability of concrete with plastic bottle caps (WPBC):

Table 1: workability of concrete with plastic bottle caps

S. No	Test Series	Slump in mm
1	Normal concrete	110
2	WPBC (5% replacement)	109
3	WPBC (10% replacement)	107
4	WPBC (15% replacement)	104
5	WPBC (20% replacement)	101

4. RESULTS AND DISCUSSION:

4.1 Compressive strength:

The purpose of conducting compression test is to know the Hardened and strength capacity of material. With the help of these values can measures of the concrete ability to resist all types of loads when it carries. In my experiment at the age of 7 days of curing 9.84% of strength increased with modified concrete with comparison of conventional concrete at waste plastic of 10% replacement of bottle caps. At age of 28 days of curing 5.68% of strength increased with modified concrete with comparison of conventional concrete at waste plastic of 10% replacement of bottle caps. Below table shows the values of Compressive strengths at different percentages of bottle caps at 7 days and 28 days.

Table 2: Compression strength values.

Bottle caps (%)	Compressive strength (N/mm ²)	Compressive strength (N/mm ²)
	Avg strength at 7 days	Avg strength at 28 days
0	23.42	32.52
5	24.50	37.39
10	25.52	40.22
15	21.90	39.50
20	21.18	25.34

4.2 Split tensile strength:

The purpose of conducting Split Tensile Strength test is to know the tensile capacity why because the concrete is weak in tension and strength capacity of material. With the help of these values can measures of the concrete ability to resist all types of tensile loads when it carries.

In my experiment at age of 7 days of curing 9.90% increased with strength modified concrete with comparison of conventional concrete at waste plastic of 15% replacement of bottle caps. At age of 28 days of curing 5.37% increased with strength modified concrete with comparison of conventional concrete at waste plastic of 10% replacement of bottle caps. Below table shows the values of Split tensile strengths at different percentages of bottle caps at 7 days and 28 days.

Table 3: Split tensile strength values.

Bottle caps (%)	Split tensile strength (N/mm ²)	Split tensile strength (N/mm ²)
	Avg strength at 7 days	Avg strength at 28 days
0	1.20	2.09
5	1.44	2.54
10	1.34	2.44
15	1.40	2.96
20	1.21	2.20

4.3 Flexural strength:

We observed here is the increase of WPBC from 0%, 5%, 10%, 15% & 20% the change of flexural strength is very predominant. Finally the increased value 9.77% is observed at a age of 7 days with 10% replacement of bottle caps. And also the increased value 1.98% is observed at at age of 28 days with 20% replacement of bottle caps. Here shown that the various values of flexural strengths at 7 days and 28 days with replacement of WPBC in different proportions.

Table 4: Flexural strength values.

Bottle caps (%)	Flexural strength (N/mm ²)	Flexural strength (N/mm ²)
	Avg strength at 7 days	Avg strength at 28 days
0	2.66	4.62
5	3.28	4.98
10	4.98	5.44
15	4.60	5.20
20	3.68	4.46

5. CONCLUSION:

- We observed in compressive strength major difference with WPBC (Waste Plastic Bottle Caps), when replaced with 10% of bottle caps with coarse aggregates the compressive strength value observed is 9.84% and 5.68% at age of 7 days and 28 days with modified concrete and conventional concrete.
- We observed in Split tensile strength major difference with WPBC (Waste Plastic Bottle Caps), when replaced with 15% and 10% of bottle caps with coarse aggregates the compressive strength value observed is 9.90% and 5.37% at age of 7 days and 28 days with modified concrete and conventional concrete.
- We observed in Flexural strength major difference with WPBC (Waste Plastic Bottle Caps), when replaced with 10% of bottle caps with coarse aggregates the compressive strength value observed is 9.77% and 1.97% at age of 7 days and 28 days with modified concrete and conventional concrete.
- The experimental work indicates the major change of results for replacement of waste bottle caps with aggregates in concrete upto 10% and 15%.
- Usage of waste plastic bottle caps in now a days construction activities is gives grate result of save environment.

6. REFERENCES:

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