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EXPERIMENTAL STUDY ON CONCRETE BY USING WASTE PLASTIC BOTTLE CAPS AS PARTIAL REPLACEMENT OF COARSE AGGREGATE

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INTRODUCTION

Concrete is most widely used construction material in the word. To solve environmental issue like deposition of waste product, recycling or reuse of waste product, bottle caps were used to make eco friendly concrete. A standard proportionate mixing of bottle caps in concrete in replacement of aggregate gives best results. Due to growing environmental awareness, the world is increasingly turning to researching properties of waste and finding solutions on using its valuable component parts so that those might be used as secondary raw material in other branches. Green building is an increasingly important global concern and a critical way to conserve natural resources and reduce the amount of materials going to our landfills. Large quantities of waste are generated from empty cans and bottle caps of juices and soft drinks. This is an environmental issue as plastic waste is difficult to biodegrade and involves processes either to recycle or reuse. Today the construction industry is in need of finding effective materials for increasing the strength of concrete structures with low cost, and with less environmental damage. This research is aimed at addressing such issues by investigating the possibility of using waste bottle caps to partially substitute for coarse aggregate in concrete production. The compressive strength, split tensile strength and flexural strength properties at different percentages replacement of coarse aggregate with waste bottle caps were investigated in the laboratory. By replacing coarse aggregate with 0%, 5%,8%, 10% ,12% and 15% of the waste plastic bottle caps in concrete is studied

MATERIAL USED:

The material in this study for the preparation of specimens Ara,

- Ordinary Portland cement (33 grade)
- Coarse aggregate (20mm size) > Fine aggregate
- Water
- Bottle cap

METHODOLOGY

Material Collection
↓
Material Test
↓
Mix Design
↓
Optimization of Plastic Bottle caps
↓
Casting and Testing Analysis of specimens
↓
Analysis of test results
↓
Conclusion & Suggestion for future study

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Observations:

Calculations of Mix Proportion

S.No	Age of Specimen	Replacement For Coarse **Aggregate**	Dia. of Specimen (mm)	Depth (mm)	MaximumLoad (N)
1	7	5	150	300	270
2	7	10	150	300	210
3	7	15	150	300	165

MIX DESIGN

MIX DESIGN (for trial Mix 1 with admixture)

1) Grade : M25
2) Type of Cement : OPC 33 Grade
3) Max. Nominal size : 20mm
4) Min. Cement content : 320 Kg/M^3
5) Max. Water Cement Ratio : 0.50
6) Exposure Condition : Severe
7) Method of Concrete Placing : Normal
8) Degree of Supervision : Good
9) Type of Aggregate : Crushed Angular Aggregate
10) Max. Cement Content : 450 Kg/ M^3
11) Chemical Admixture : Not Used
12) Workability : 70 mm

Test Data For Material:-

1) Cement : OPC 33Grade
2) Sp. gravity of Cement : 3.67
3) Chemical Admixture : Not Used
4) Sp. gravity of Coarse Aggregate : 2.89
5) Sp. gravity of Fine Aggregate : 2.65

Sieve Analysis:-

a) Coarse Aggregate : 20mm was confirming to table II of IS 383
b) Fine Aggregate : Zone II was confirming to table II of IS 383

Target Strength for Mix Proportioning:-

f_{ck} = f_{ck} + 1.65 S (Ref Table I Clauses 3.2.1.2, IS 10262 : 2009)
= 25 + 1.65 X 4
= 31.6 N/mm^2

Selection of Water Cement Ratio:-

Max .W/c Cement Ratio = 0.50 (Ref Table 5 (Clause 6.1.2, 8.2.4.1 and 9.1.2) IS 456: 2000
Based on Experience w/c Cement Ratio as 0.50
Based on Experience w/c Cement Ratio as 0.50
$0.40 < 0.50$
Hence Ok

Selection on water content:-

Max. Water Content = 186 Lit (Ref Table2 (Clauses 4.2. A-5 and B-5) IS 10262: 2009)

(For 25mm to 50 mm Slump)

Selection of cement Content:-

Water cement ratio = 0.50
Cement content = 450 Kg/ M^3
Minimum Cement Content = 300Kg/M^3
(Ref Table Clause 6.1.2, 8.2.4.1 and 9.1.2) IS 456: 2000
450 Kg/M^3 > 300 Kg/ M^3
So take 450 Kg/M^3

Proportion of volume of Coarse and Fine Aggregate:-

Water Cement Ratio = 0.50
Volume of Coarse Aggregate = 0.62 Kg/M^3
Volume of Fine Aggregate = 1- 0.62 Kg/M^3
= 0.38 Kg/M^3

Mix Calculation:-

1) Volume Concrete = 1 M^3
2) Volume of Cement = Mass of cement / Sp. gravity of cement x 1/1000
= 450/ 3.67 x 1/1000
= 0.123 M^3
3) Volume of Water = Mass of water / Sp. gravity of water x 1/1000
= 197/ 1 x 1/1000
= 0.197 M^3
3) Volume of all in Aggregate = a - (b + c)
= 1 - (b + c)

COMPRESSION STRENGTH

Cube Size = 150mm x 150mm x 150mm
Area = 2.50 x 10^3 mm^2 = 2500 mm^2
Compressive Strength = Load /Area

RESULTS

1) Normal Cube

Size of Cube (mm)	Compressive Strength (N/mm^2)	Curing Period (Days)
150mm x 150mmx150mm	14.8	7 Days
150mm x 150mm x150mm	20	14 Days
150mm x 150mm x150mm	22.2	28 Days

2) 5% Bottle cap Replacement in aggregate

Size of Cube (mm)	Compressive Strength (N/mm^2)	Curing Period (Days)
150mm x 150mmx150mm	17.3	7 Days
150mm x 150mm x150mm	14.2	14 Days
150mm x 150mm x150mm	19.3	28 Days

3) 8% Bottle cap Replacement in aggregate

Size of Cube (mm)	Compressive Strength (N/mm^2)	Curing Period (Days)
150mm x 150mmx150mm	17.3	7 Days
150mm x 150mm x150mm	14.2	14 Days
150mm x 150mm x150mm	19.3	28 Days

4) 10% Bottle cap Replacement in aggregate

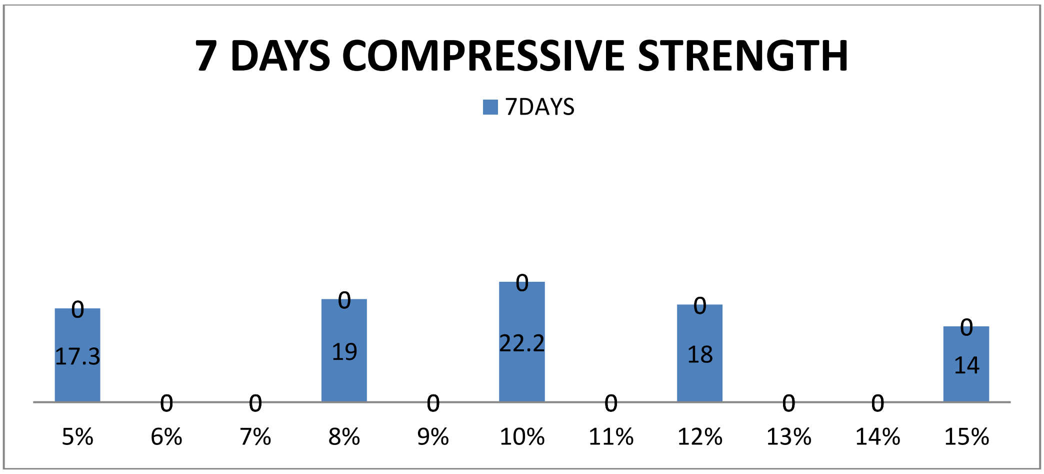
Size of Cube (mm)	Compressive Strength (N/mm^2)	Curing Period (Days)
150mm x 150mmx150mm	22.2	7 Days
150mm x 150mm x150mm	19	14 Days
150mm x 150mm x150mm	26	28 Days

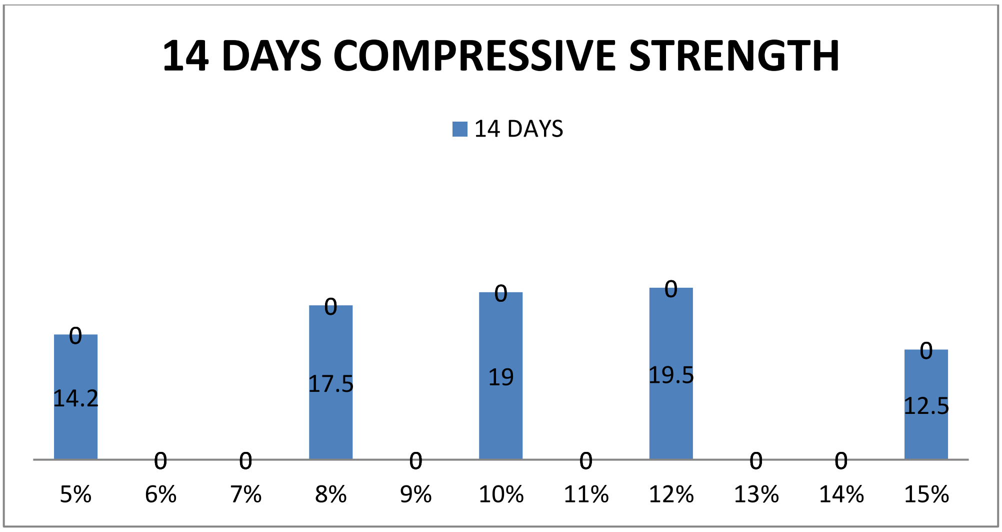
5) 12% Bottle cap Replacement in aggregate

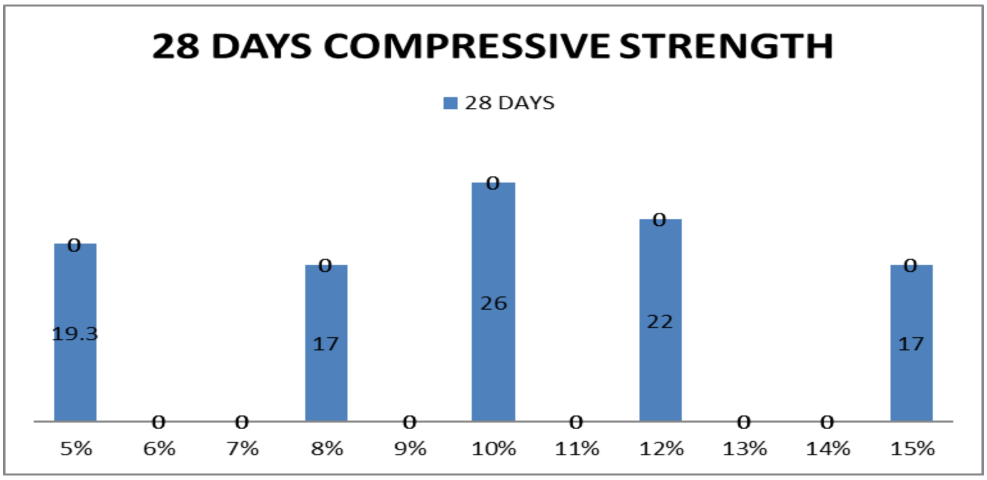
Size of Cube (mm)	Compressive Strength (N/mm^2)	Curing Period (Days)
150mm x 150mmx150mm	18	7 Days
150mm x 150mm x150mm	19.5	14 Days
150mm x 150mm x150mm	22	28 Days

6) 15% Bottle cap Replacement in aggregate

Size of Cube (mm)	Compressive Strength (N/mm^2)	Curing Period (Days)
150mm x 150mmx150mm	14	7 Days
150mm x 150mm x150mm	12.5	14 Days
150mm x 150mm x150mm	17	28 Days







CONCLUSION:

Compressive strength increase with the increase in percentage of bottle caps. The maximum strength obtained at 10% replacement of bottle caps increase by 9.72% and 5.97% at 7 days and 28 days over the conventional concrete. Split tensile strength increase with the increase in percentage of bottle caps. The maximum strength obtained at 15% replacement of bottle caps increase by 99.01% and 53.69% at 7 days and 28 days over the conventional concrete. The test results of this study indicate that there is great potential for utilization of bottle caps in concrete mixes up to 10%. With the utilization of bottle caps in construction industry the waste disposal problems can be solved.

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