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# EXPERIMENTAL INVESTIGATION ON FIBER REINFORCED CONCRETE USING WASTE BOTTLE CAP FIBER

S.Paneerselvam[1] S.A.Iswariya[2,*] V.Karthiga[3,*] S.Keerthana[4,*] R.Eniya[5,*]
[1] Assistant professor, Department of Civil Engineering, Vivekanandha College of Technology for women
2345 UG student, Department of Civil Engineering, Vivekanandha college of Technology for women

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**ABSTRACT**

Cement concrete is most extensively used construction material in the world. It has some limited properties, low tensile strength, low ductility, shrinkage and cracking. Out of all drawbacks low tensile strength is important to counteract this problem some fiber like material can be added to concrete to increase its tensile strength. Experimental investigation is done using M25 mix by addition of waste materials like soft drink bottle caps. In these investigations caps were cut into strips of size 4mm width and 10mm length. They are added in 0%, 2%, 3%, 4%, 5%. To review the physical properties and strength aspect of bottle cap fiber concrete done in experiments with different variations. The review results show the physical properties and strength properties of concrete by adding of waste bottle cap fiber with dosage limit.

## 1. INTRODUCTION

Concrete is most widely used man made construction material. Plain Concrete possesses a very low Tensile strength, Ductility and little resistance to cracking. The micro cracks are formed in the concrete during hardening stage. Fiber added to the cement that acts as an crack arrestor in concrete. It also controls External Propagation of cracks

Composite concrete such as fiber reinforced concrete or glass is widely used in different structures such as aircraft parking, fiber reinforced concrete slab and rigid pavements the fiber can make concrete resist to deformation without cracks or very less cracks compare with normal concrete. Fiber can give higher ductility and toughness to concrete and increase compressive, tensile and flexural strength. This makes concrete more durable ,low maintenance cost and high load resistance. This study will investigate the use of strips of caps in concrete.

## 2 FIBER REINFORCED CONCRETE

A fiber reinforced concrete can be defined as a composite material consisting of mixtures of cement, mortar and discontinuous, discrete, uniformly dispersed suitable fibers. There are two types of fibers used in concrete organic and inorganic fibers organic fibers are coir, coconut shell, sugarcane husk. Inorganic fiber include steel, glass, carbon, asbestos, polypropylene, nylon.

Therefore reinforced concrete contains randomly distributed short discrete fibers which act as internal reinforcement so as to enhance the properties of the concrete. As a result of these characteristics plain concrete members could not support loads and tensile stresses that occurred, on concrete beams and slabs. Concrete members are reinforced with continuous reinforcing bars to withstand tensile stresses and compensate for the lack of ductility and strength. The addition of steel reinforcement increases strength of concrete ,and results in concrete with homogenous tensile properties. The development of micro cracks in structure is checked. The introduction of fibers is generally taken as a solution to develop concrete in view of enhancing its ,Compressive ,Tensile and Flexural Strength. Steel fibers is most commonly used fiber generally round fibers are used the diameter may vary from 0.25to0.75 mm. the steel fibers are slightly get rusted and lose some of its strength but investigation have shown that rusting of fibers takes place only at the surface.

## 3. OBJECTIVE

- To collect the literature review
- To design the mix ratio for M25 grade of concrete
- To test the specimens,
- To determine the compressive, flexural and split tensile strength of concrete by adding waste bottle cap fibers by varying percentages.
- To compare the strength behavior with normal concrete.

## SCOPE

- Waste bottle cap fiber reinforced concrete reduce environmental pollution.
- Waste bottle cap fiber concrete is cost effective.
- Mechanical properties of concrete is improved

## 4. MATERIALS COLLECTION

**Cement:** Ordinary Portland cement of 53 grades available in local market is used in this project. The Cement used has been tested for various proportions as per IS 4031-1988 and found to be confirming to various specifications of are IS 12269-1987.The specific gravity is 3.14.

**Fine Aggregate:** Locally available M sand is used in this research.

**Coarse Aggregate:** Locally available quarry stone in good strength.

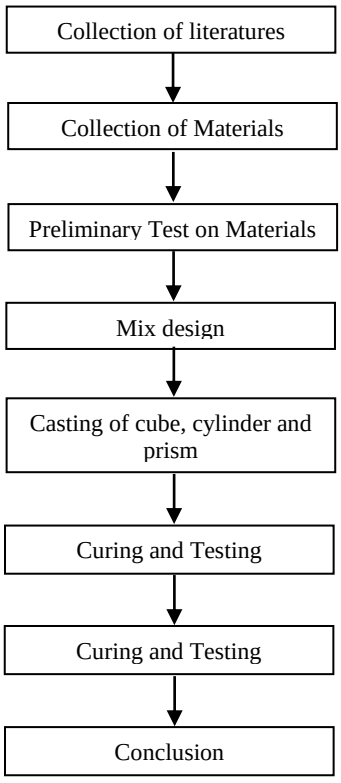
**Water:** Ordinary potable water without acidity and alkaniety available in the Material Testing laboratory was used.

**Bottle Cap Fiber:** The recent development of secondary reinforcement in concrete in various fields has provided a strong technical base for improving the quality of the material. To overcome the deficiencies fibers are used as secondary reinforcement. FRC is Portland cement concrete reinforced with more or less randomly distributed fibers. these fibers may be flat shaped or rounded shape .the flat shaped fibers with 4mm width and length 10mm is used in investigation.

Waste bottle cap fiber specifically provides concrete with protection against early age crack formation. Every fiber helps to prevent the tiny fissures that can occur when concrete's tensile strength is weakest. By reducing early age crack formation, the number of weakened planes and the potential for future crack formation may also be reduced. Although every type of fiber has been tried out in cement and concrete, not all of them can be effectively and economically used. Each type of fiber has its characteristic properties and limitations.

**Figure 1: Soft drink bottle caps**

## 5. METHODOLOGY




## 6. PREPARATION OF SPECIMENS

**a)Batching** Weigh batching is adopted for concrete production to measure cement , Coarse aggregate, fine aggregates, fiber Weight batching is the correct and preferred method of measuring concrete ingredients which leads to more uniform proportioning. Weigh batching system facilitates simplicity, flexibility and accuracy. The manual batching weighing of all concrete ingredients is done manually for this study.

**b)Mixing :** Mixing of ingredients is done by Hand mixing for this study. The cementitious materials are thoroughly blended and then the aggregates is added and mixed followed by gradual addition of water. Wet mixing is done until a mixture of uniform colour and consistency are achieved which is then ready for casting. Before casting of the specimens, workability of the different concrete mixes was found by Slump cone test for each mixes.

**c) Casting of specimens** Cube specimens of 150mm x 150mm x 150mm size for compressive strength, cylinder specimens of size 150mm diameter x 300 mm height for split tensile strength and prism size of 100mm x 100mm x 500mm for flexural strength were casted according to Indian standards. The moulds were tightly fitted. The inner sided of the mould was thoroughly oiled before going for concreting. The prepared concrete was placed in the moulds and is compacted using
vibration table. After specimens were compacted the top surface is levelled with a trowel. The same process is adopted for all specimens.

**d) Curing of specimens** The specimens are left in the moulds undisturbed at room temperature for about 24 hours after casting. The specimens are then removed from the moulds and immediately transferred to the curing tank with fresh water. The operation of curing is to overcome the problem of loss of hydration. The prepared specimens are cured in a curing tank for a period of 28 days.

## 7. Test Performed on specimens

**Compressive Strength Test** : Cube specimens are used of size 150mmx150mmx150mm to determine compressive strength of mix design concrete no of cube casted for compressive strength is 12cubes with the addition of waste bottle cap fiber(0%,2%,3%,4%,5%)for 28 days under normal water curing

**Table :1 Tested Values**

| S NO | % of fiber added | 28 days compressive strength($N/mm^2$) |
|---|---|---|
| 1 | 0% | 2.40 |
| 2 | 2% | 2.46 |
| 3 | 3% | 2.48 |
| 4 | 4% | 3.6 |
| 5 | 5% | 4.2 |

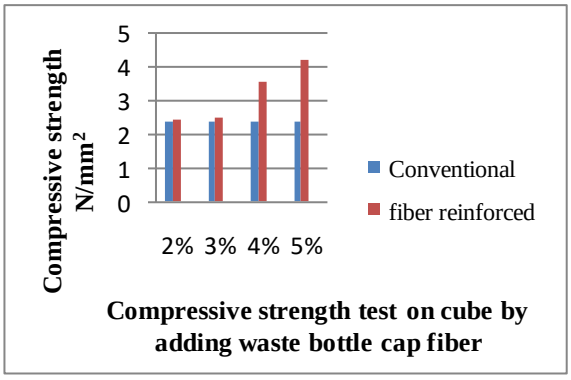



**Figure 1. Compressive Strength Test**

**Tensile Strength :** Normal cylinders and waste bottle caps reinforced concrete cylinder of size 150(dia) x300mm height are casted and cured. No of Specimens casted for Split tensile Strength is 12 cylinders with addition of waste bottle cap fiber (0%,2%,3%,4%,5%)for 28 days. the tensile strength test is calculated.

**Table 2. Tested Values**

| | % of fiber added | 28 days compressive strength(N/mm$^2$) |
|---|---|---|
| 1 | 0% | 3.5 |
| 2 | 2% | 4.6 |
| 3 | 3% | 5.8 |
| 4 | 4% | 6.3 |
| 5 | 5% | 6.9 |

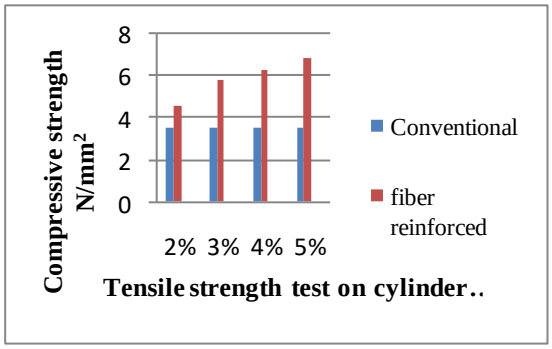



**Figure : 2 Tensile strength test**

**Flexural strength test**: Normal mix concrete beams and addition of waste bottle cap concrete mix beam size 150mmx150mmx700mm are used for flexural testing machine . No of Specimens casted for Flexural Strength is 12 beams with the addition of waste bottle cap of (0%,2%,3%,5%) for 28 days.

**Table:3 Tested Values**

| S NO | % of fiber added | 28 days compressive strength(N/mm$^2$) |
|---|---|---|
| 1 | 0% | 3.5 |
| 2 | 2% | 4.1 |
| 3 | 3% | 8.0 |
| 4 | 4% | 8.6 |
| 5 | 5% | 9.4 |

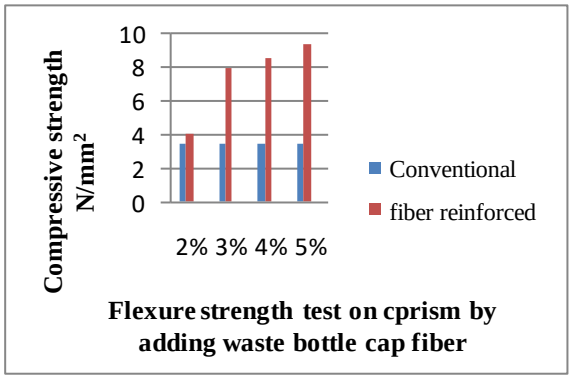



**Figure 3: Flexural Strength Test**

## 7. Conclusion

A simple experimental study was conducted on concrete with addition of steel bottle cap fibers. The strengths were improved by adding the fibers. But surplus mixing of steel fibers reduced the strength. It happened due to over mixing of fibers with respect to other materials in concrete's, steel fibers if used in Adequate quantity can improve the mechanical strength of concrete.

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