Experimental Investigation on Concrete With M-Sand and Waste Bottle Cap

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Abstract - A large portion of the world's structure is made of concrete, and as technology has evolved, its various parts have undergone alterations. Cement, sand, coarse aggregate, and water are the main four components in concrete. Technology development improves human comforts while also degrading the environment. Environmental engineers struggle concerning the disposal of metal caps from soft drink bottles, which either involves recycling or repurposing. To further increase the strength, we will add metal caps fibre to the concrete there. This design displays the findings from a study on the effects of bottle caps on concrete behavior. concrete is mixed with metal bottle cap fibre at volumes of 0 %to 1.5% in coarse aggregate, and its compressive and flexural strengths are analysis. Here M20 is the concrete grade utilized in the project. 1:1.6:3 is the mix ratio.

Key Words**:** metal cap, environmental engineers disposing, repurposing, cap fibre,

1.INTRODUCTION

. When compared to wealthy nations, a considerable amount of waste is created in our nation. Waste bottle caps from cold drinks are more prevalent throughout the summer. Our goal was to use bottle caps that would otherwise be wasted more effectively. Therefore, we employ that as a fibre to improve the concrete's compressive and flexural strengths. One of the main building materials utilized in the global construction sector is concrete. It may be utilized for all different kinds of concrete structures because it is such a flexible material. Cement, water, and aggregates make up the bulk of the composite building material known as concrete. The aggregates are bound together by the cement ingredients. Concrete utilizes both coarse and fine aggregate. Concrete is mixed with water to give it shape and to aid in the process of hydration, which causes concrete to harden. In India, concrete is a common building material, with annual consumption connecting with 100 million cubic meters. Conventional ordinary concrete, which has a structure based on compressive strength, falls short of many functional requirements because it cannot withstand harsh weather conditions, construction time, energy absorption, repairs, and numerous other alterations. Therefore, it is necessary to develop some alternatives that may completely or partially replace any concrete composite without damaging the characteristics of concrete that give it greater strength. By effectively utilizing these byproducts, which would otherwise be discarded as waste, the usage of such materials not only improves the strength and other qualities of concrete but also contributes to the preservation of favorable environmental conditions. Coarse aggregate can be partially replaced by the metal caps from soft drink bottles

2. MATERIALS USED

2.1 CEMENT

In accordance with IS 8112-1989, 53-grade Ordinary Portland Cement (OPC) was used for the study. The role of cement is to bind various materials together and solidify independently. The standard consistency is 33%, and the initial and final setting times are 60 minutes and 300 minutes, respectively

2.2 COARSE AGGREGATE

This study utilized coarse aggregate that was 20mm or smaller in size and had a specific gravity of 2.755. The testing was conducted following the Indian Standard Specification IS: 383-1970, and here coarse aggregate used was larger than 4.75 mm in size. After testing, the coarse aggregate had a water absorption rate of 0.256, a crushing value was 21.07% and an impact value is 23%, respectively, as per IS 2386 part IV 1963.

2.3 FINE AGGREGATE

Study is obvious to go for M-sand which is easily accessible in my locality and meets the zone I requirements. The M-sand was tested as per the Indian Standard Specification IS: 383-1970. Any aggregate size below 4.75 mm is categorized as fine aggregate. The specific gravity and water absorption of the M-sand are 2.83 and 0.79 respectively.

2.4 WATER

When it comes to making concrete, the quality of the water used is crucial. It is recommended to use clean, drinkable water that is free from any contaminants or bacteria. Ensure that the water used meets the IS 3025-1964 standards to guarantee the concrete's durability in different weather conditions. Always keep in mind to use water that conforms to these standards for optimal results. Additionally, the pH value of the water used in the mixing process is 8.37.

2.5 FIBRES

This study recently repurposed some cool drink bottle caps by using the Fibre inside them, which is actually manufactured 0 from a steel alloy. To do this, the plastic rubber inside the cap is removed and then flatten it forms a cup-shaped cap fibre . After that, cap fibre is shredded into small pieces, with each cap being cut into 12 pieces. the water absorption of the cap fibre is nil and the specific gravity is 6.35. The aspect ratio is also 3.5:1.

Fig -1:Bottle cap fibre

3.CASTING AND TESTING

3.1 CASTING OF SPECIMEN

Here it adhered to the IS: 10262 (1982) guidelines for concrete mix design and conducted physical property tests on the materials according to Indian Standards. The concrete mix ratio utilized here is 1:1.6:3 with a water-to-cement ratio of 0.5. Additionally, secured the moulds with screws and applied oil to the surface to facilitate demoulding. 150mmx150mmx150mm concrete cubes are casted to measure compressive strength and 150mmx150mmx700mm concrete beams for flexural strength. Here replacing the coarse aggregate with waste bottle caps in varying proportions such as 0%,0.5%,1% &1.5%

3.2 TESTING OF SPECIMEN

The samples were taken out of the mould after 24 hours and immersed in water for a curing period of 7 and 28 days. Following the curing process, the specimens were analysed for compressive strength and flexural strength. The strength of the specimens was evaluated at 7 days,14 days and 28 days using a compression testing machine with a capacity of 2000KN, as per the Indian Standard specification IS: 516-1959

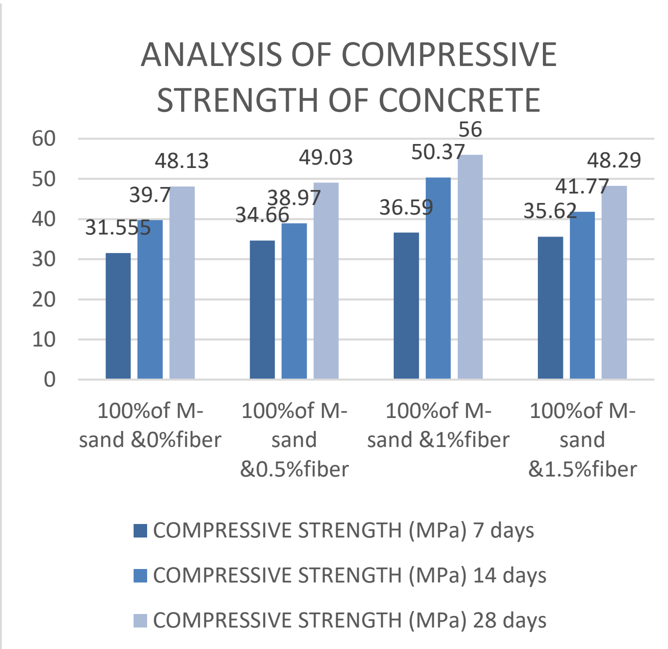
3.3 COMPRESSIVE STRENGTH

In this experiment, the compressive strength of concrete was tested using M-sand and replacing 0-1.5% of course aggregates with bottle caps. The results showed that after 7 days of curing, the modified concrete with 1% bottle cap fibre replacement had a strength of 36.59MPa, increasing to 50.37MPa after 14 days. After 28 days of curing, the modified concrete had a compressive strength of 56MPa greater than that of conventional concrete with an equal amount of bottle caps replaced. Table-1 provides the average compressive strength results for 7, 14, and 28 days, while Chart-1 displays the variations in compressive strength with different percentages of bottle cap replacement.

Table -1: Compressive Strength

PERCENTAGE OF FIBRE	COMPRESSIVE STRENGTH (MPa)		
	7 days	14 days	28 days
100%of M-sand &0%fibre	31.555	39.70	48.13
100%of M-sand &0.5%fibre	34.66	38.97	49.03
100%of M-sand &1%fibre	36.59	50.37	56.00
100%of M-sand &1.5%fibre	35.62	41.77	48.29

Chart 1:Compression Strength Bar Chart



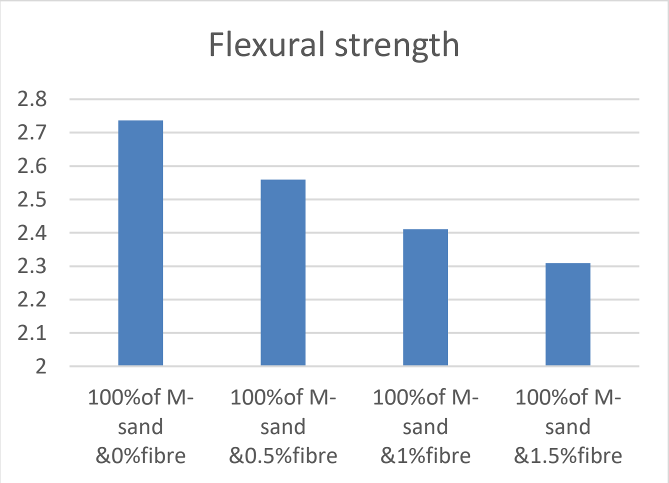
3.4 FLEXURAL STRENGTH

The concrete's flexural strength underwent testing with 100% M-sand and 0-1.5% replacement of bottle caps in place of course aggregates. After 28 days of curing, the modified concrete displayed a flexural strength of 2.559MP with 0.5% replacement. Table-2 presents the average flexural strength results for 28 days, while Chart-2 depicts the variation in flexural strength with different percentages of bottle cap replacement. The data indicates that the flexural strength of the concrete was affected by the percentage of bottle cap replacement used.

Table -1: Flexural Strength

Percentage of fibre	Weight(Kg)	Displacement(mm)	Flexural strength
100%of M-sand &0%fibre	12.755	0.866	2.737
100%of M-sand &0.5%fibre	12.655	0.8	2.559
100%of M-sand &1%fibre	12.495	0.723	2.411
100%of M-sand &1.5%fibre	12.502	0.7	2.309

Chart 2: flexural strength bar chart



4. CONCLUSIONS

1. Compressive strength increases as the percentage of bottle caps increases. It was observed that after 28 days, the maximum strength was achieved at a 1% replacement of bottle caps, resulting in an increase of 56MPa. These findings suggest that the addition of bottle caps can significantly enhance the compressive strength of the material.
2. When bottle caps were added to the mixture, the material's strength under flexural load decreased. The maximum strength of 2.73 was achieved when 0% of the mixture was replaced with bottle caps, while the minimum flexural strength of 2.309 at 28 days was obtained at 1.5% replacement.
3. According to the findings of this study, incorporating bottle caps in concrete mixes up to 1% presents a promising opportunity for utilization.
4. The problem of waste disposal can be effectively addressed by incorporating bottle caps into the construction industry.

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