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Utilization Of Plastic Bottle Caps and Coir Fibre in Concrete

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Abstract: environmental destruction has become the foremost important issue within the recent years. Like manufacturing of cement produce gas whereas the assembly of aggregates adds dust to the environment. Production of coarse aggregates also impact the geology of the globe from they were extracted. A step taken during this direction is that the use of waste products along with or in replacement of cement. Use of more and more environmentally friendly materials in any industry normally and construction study particularly, is of paramount importance. additionally, because the high cost of conventional building materials is that the key factor affecting housing delivery in India. This has necessitated research into alternative materials of Construction. Our present project intends to explore the foremost effective use of stuff like plastic bottle caps waste (PET), and coconut fibre as a constituent of concrete mix replacing the coarse aggregate partially. the foremost objective is to encourage the use of these waste products as construction materials in low-cost housing. during this study, M25 grade of concrete was used and 28 cubes were casted furthermore as their compressive strength and workability was evaluated at 3, 7 and 28 days. The compressive strength and flexural strength of concrete was reduced and increased because the share replacement was varied. The result showed that this concrete is used in concrete construction.

Index Terms **- plastic bottle caps, coir fibre, concrete.**

I. INTRODUCTION

Concrete structure is the most common type of structure Concrete is the most manually used material in the construction industry and as the most used thing on Earth. In simple terms, it is defined as a mixture of four ingredients such as coarse aggregates which form the largest proportion of the paste, fine aggregates such as sand which acts as filler material in the voids, binder material such as lime or Portland cement which binds this material together and water which reacts with the binding material. The mixture of these four materials gives us a paste which is called a matrix. At this point it is called fresh concrete or green concrete and hardens like a stone as the water reacts with the binder. This reaction is called concrete hydration. Thanks to its properties such as strength, durability and ease of processing, it can be used for many purposes. Studies show that plastics are almost inert, so they are much less affected by chemicals and have greater durability. Disposal of plastic waste is a big problem because it is due to the lack of organic compounds; it is an indecomposable material and proves to be a threat to our environment as it presents many health risks. Since the decomposition of plastic is a serious problem as it takes a long time and negatively affects the environment in many ways. So, we can use it in construction, where we need to improve the durability of the structure and the use of plastic waste after a little processing can help us reduce the waste in the environment, which is the new motto of the civil engineering.

Coconut fibre is extracted from the outer shell of a coconut. The common name, scientific name, and plant family for coir are coco, coco nucifera, and Aceraceae (palm), respectively. There are two types of coconut fibre, brown fibre from ripe coconuts and white fibre from unripe coconuts. Coconut fibres are stiff and strong and have low thermal conductivity. Coconut fibres are commercially available in three forms: pile (long fibres), mattresses (relatively short) and husked (mixed fibres).

II. LITERATURE REVIEW

Elango A and Ashok Kumar A in 2018, They used OPC 53, river sand and crushed aggregates. They used plastic instead of fine aggregates in the proportion of 10%, 20% and 30%. They tested the mechanical and durability properties on their concrete samples. They found a decrease in the strength of the concrete. But they found that concrete gave good results against acid attack and increased elasticity. They therefore concluded that plastic aggregate concrete can be used where lower compressive strength but longer life is required.

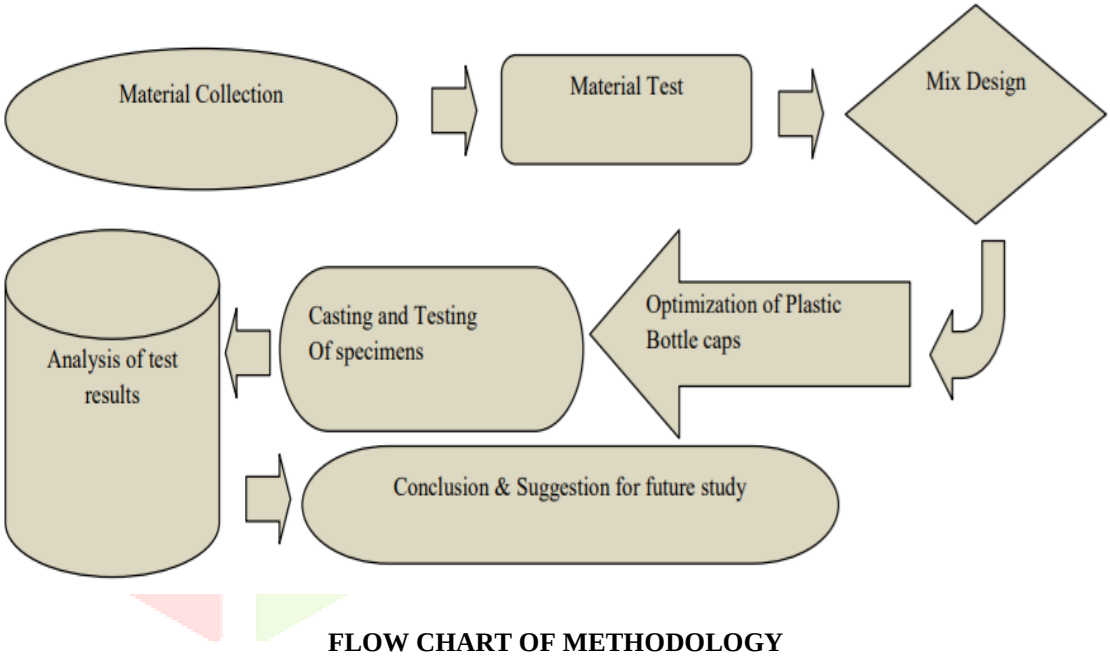
LhakpaWangmoThinghTamanget. in 2017, they carried out the experiment on plastic in concrete as coarse aggregate. They carried out the test of the mechanical properties of concrete containing plastic aggregates. They use plastic aggregates in the proportions of 10%, 15% and 20%. They found a marginal reduction in strength and suggested the optimal outcome as a 15% replacement.

B Jaivignesh and A Sofi carried out in 2017 the study on the properties of concrete with plastic waste as aggregate. They used the plastic place of fine aggregates and coarse aggregates in the proportion of 10%, 15% and 20%. They also added steel fibre to the concrete. Their research concludes the reduction of force, but suggested its use for the reduction of waste and ecological materials.
MB Hossain et. al. in 2016 performed work on Use of waste plastic in concrete as a constituent material. They replace coarse aggregates in proportion of 5%, 10% and 20 %. They found that the concrete was lighter in weight. But the compressive strength was lesser than that of conventional concrete. They also found that the concrete with 10% plastic aggregates shows strength nearly similar to the conventional concrete. Therefore, the optimal result was 10% plastic aggregates.
RaghatateAtul M. conducted a study in 2012 They carried out tests on concrete with different proportions of plastic aggregates to replace the coarse aggregates and found the optimal result with a 22% replacement of the coarse aggregates by plastic aggregates. They also tested other properties on concrete with 22% plastic aggregate and found that concrete with plastic aggregate was lower in fire resistance.

III. OBJECTIVE OF THE STUDY

1. Check the compression strength and flexural strength of concrete when aggregate is partially replaced by coir fibre and plastic bottle caps.
2. Check the workability of concrete aggregate is partially replaced by coir fibre and plastic bottle caps.
3. To determine the percentage of coir fibre and plastic bottle caps. Which gives more strength when compared to control concrete.
4. Utilization of waste coir fibre and plastic bottle caps. try to control environmental pollution which is due to plastic materials.

IV. METHODOLOGY



FLOW CHART OF METHODOLOGY

Table 1: Percentage replacement of NCA by PBC and coir fibre

Concrete name	Plastic bottle cap %	Coir fibre %
M1	0 %	0 %
M2	1 %	1.2 %
M3	3 %	1.0 %
M4	5 %	0.8 %

4.1 Design Of Concrete Mix

Concrete mix is the way by which we choose the different constituents used in the concrete and determining their amount and by taking care about the economy and various properties of the concrete like workability, slump value, strength criteria etc. For designing the concrete mix, we followed IS:10262-2009. A design mix for M25 grade od concrete was prepared and trial mixes were prepared to check the mix design and to adjust amount of admixture and Water cement ratio. The following parameters were used for mix design Specific gravity of FA = 2.60 Specific Gravity of C.A 20mm =2.77

Table 2 Mix Proportion for M25 grade Concrete

Unit of Batch	Cement (Kg)	Fine Aggregates (Kg)	Coarse aggregate (Kg)	Water(kg)
Cubic meter content	435.45	662.2	1119.5	196.6
Ratio	1	1.53	2.57	0.44

The design mix was followed to get the desired results. The cement content was increased when hand mixing was done.

Coarse Aggregates

20 mm coarse aggregates are the most commonly used aggregate for the variety of applications in the general concrete construction. Hence 20 mm graded aggregates were used.

Coir fibre

Coir or coconut fibre, is also called natural fibre extracted from the outer husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. Length of coconut fibre Generally, the natural lengths of coconut fibres are from 61-235 mm. However, in this study chopped coconut fibres used with size of 16-34 mm. Diameter of coconut fibre micrometre was used with precision of 0.01 mm. It has been observed that diameter of coconut fibre is from 0.16-0.23 mm.

Plastic bottle cap

Concrete is a crucial material within the constructional world because it has many advantages which are mentioned above. Although plastic bottle cap materials is beneficially incorporated in concrete. However, the overwhelming majority of plastic bottle caps are made of recyclable plastics, with four of the foremost common being polyethylene terephthalate (PET), which is robust and light-weight and sometimes used for bottle / potable lids polylactic acid. Studies have shown that PET have the best rate of use for the assembly of concrete. However, other plastics could also be used. thanks to the wide use of bottle caps, using recyclable materials is that the responsible thing to try and do. the fabric chosen for the bottle cap must take into consideration characteristics like how long it'll be used. Specific gravity = 2.77 Water absorption = 0.37%

4.2 Specimens

All the specimens were casted according to the mix proportions. For these mix proportions required quantities were measured and then mixed.

4.2.1 Specimens for Compressive Strength

To check the compressive strength of concrete mix, specimens of cubic shape size 150mmX150mmX150mm were prepared. The required quantities of materials required were weighed according to the mix proportion. Admixture was added to the water. Water was then added to the dry mix. Total 24 similar cubes were casted, each three cubes for 3, 7 days and 28 days testing. After 24 hours of casting, the cubes were demoulded and placed into curing tank

4.3 Testing of Concrete

After casting, specimens were tested after 3, 7 and 28 days of curing. the procedure follows for testing of specimens for various properties like compressive strength.

4.3.1 Compressive Strength

To check the compressive strength of concrete, cube specimens were used. Specimens were then placed in curing tank. Specimens were taken out of tank after 3,7 and 28 days of curing and surface dried. they must be dried under shade. Compressive strength = P/A

Where, P = load in KN and A = Area of cross section

SETUP FOR COMPRESSIVE STRENGTH

V. RESULTS AND DISCUSSION

5.1 Slump Test and compacting factor test

Slump test and compacting factor testing performed on fresh concrete mixes to check the workability of concrete. Workability of concrete is defined as the ease to do work with it, without segregation. Workability of concrete is an important property of fresh concrete. Concrete should have good workability.

TABLE 3. SLUMP AND COMPACTION FACTOR VALUE

S.NO.	SAMPLE	SLUMP (mm)	COMPACTION FACTOR VALUE
1	M1	124mm	0.88
2	M2	85mm	0.85
3	M3	73mm	0.82
4	M4	55mm	0.79

The result of slump test shows that there was first increase in slump up to 1% addition of plastic and then it starts decreasing.

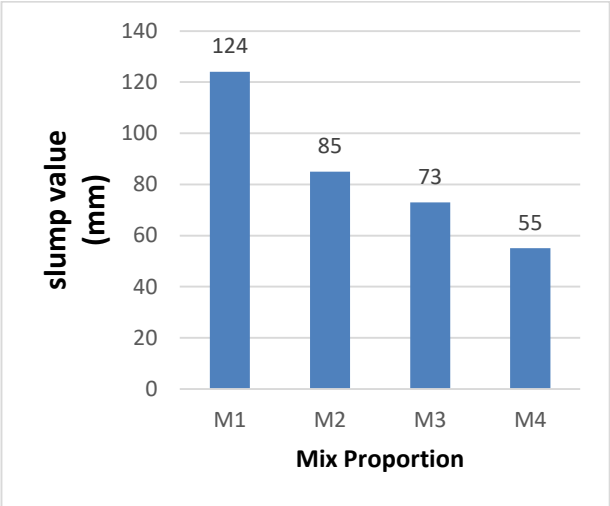


Fig.: Variation of Slump for different mix proportions

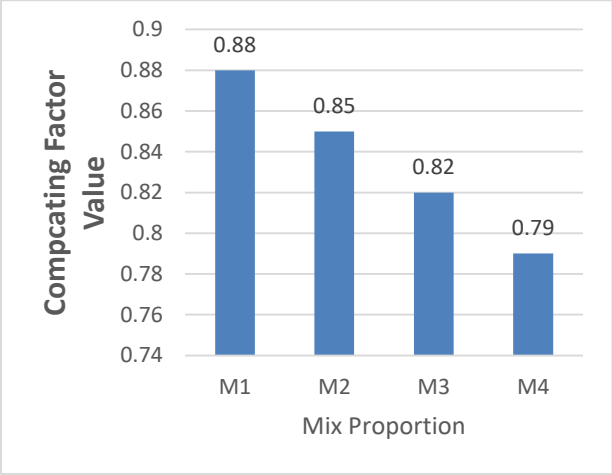


Fig.: Variation of compacting factor for different mix proportions

VI. COMPRESSIVE STRENGTH TEST

This test is performed on hardened concrete, to check the strength of concrete. The concrete specimens were put under the load per unit area of cross section in uniaxial compression under a fixed rate of loading. The compressive strength of concrete is expressed in N/mm^2. We performed this test on standard cubes of size150mmX150mmX150mm.It was then left for 24 hours for initial setting

Compressive strength =P/A

Here, P = load on the cube

A= cross-sectional area of cube

Table 4. Compressive strength of concrete

Mix Name	3 days strength (N/mm²)	7 days strength (N/mm²)	28 days strengths (N/mm²)
M1	7.2	17.2	26.1
M2	8.7	18.7	28.9
M3	7.9	15.6	25.3
M4	8.3	18	28.6

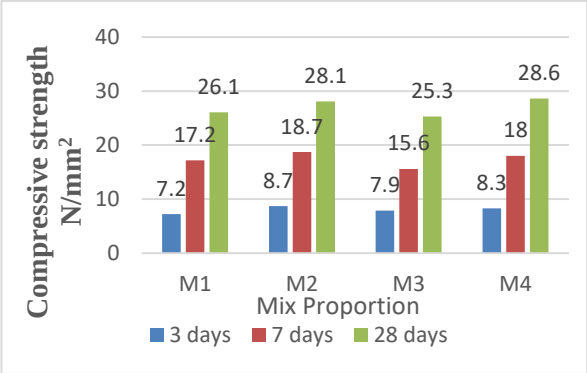


Fig. Variation of compressive strength of concrete after 3,7 and 28 days

VII. FLEXURAL STRENGTH

Flexural strength testing was completed after 28 days of curing. Total of two cube specimens per casting were tested for flexural strength test. The beam specimens used for flexural strength test testing results of the above specimens are given as following, Results of flexural strength is shown in table.

Fig. Flexural Strength Test

Table 5 Flexural Strength Test Result For 28 Days

Sample	Flexural Strength (N/mm²)
M1	5.13
M2	4.3
M3	4.16
M4	3.9

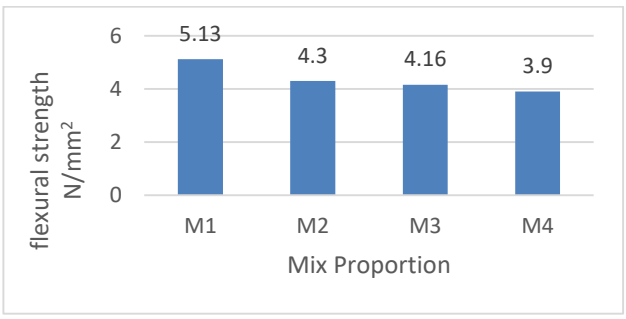


Fig. Variation of flexural strength of concrete after 28 days

VIII. CONCLUSIONS

1. We can replace the plastic bottle caps waste up to 5 % only, due to decrease in compressive strength up to a large extent.
2. By using this, it can reduce the plastic waste up to some extent.
3. it can reduce the cost of work.
4. It can only be used for small construction works.
5. With respect to compressive strength, incorporating a small amount of coir fibre 1.2% enhances the performance of concrete, as expected and counters harmful shrinkage effects in concrete.

8.2 Future Scope of the Study

We have performed the experimental investigation to check the strength and performance of design mix concrete i.e., M25 grade as various replacement of NCA with PBC and CF. Various tests performed in the laboratory are compressive strength, split tensile strength, and flexural strength by curing the specimen at 3,7 and 28 days. In future, of various chemical reactions on it. It can also be tested for higher grades of concrete. The strength of concrete containing PBC for a longer age of curing can also be tested.

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