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TO INVESTIGATE THE BEHAVIOR OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH SUGARCANE BAGASSE ASH AND ADDITION OF COATED PET FIBER IN CONCRETE

Mayaser Jahan Wani[1], Sourabh lalotra[2]

[1] PG Scholar, Sri Sai College of Engineering and Technology, Pathankot, India
[2] Assistant Professor, Sri Sai College of Engineering and Technology, Pathankot, India

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Abstract - Concrete is the back bone of the construction industry. The growth in population has placed an enormous need for more and more infrastructure and it keeps growing. The outcome of this demand is the increase in production of cement. The global production of cement is about 4.1 billion metric tons and is expected to increase to 4.83 billion metric tons in 2030. The quantity of plastics of all types consumed annually all over the world has increased substantially. The manufacturing processes, municipal solid wastes (MSW) and service industries generate a large amount of waste plastic materials. The wastes that are of economic importance are bagasse, molasses, and filter press mud. Bagasse is the fibrous residue remaining after the extraction of the cane juice from sugarcane. Sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose, and 25% of lignin. The research work here deals with the partial replacement of cement by mass with Sugarcane bagasse ash with addition of coated PET fibers in concrete. After mixing, casting and curing the characteristic strength of this new concrete are compared with standard concrete of M35 grade. The experimental investigations are administered for compressive strength Split Strength and flexural strength for curing period of 7, 14 and 28 days. The experimental results show that the for a combined replacement percentage of 21% SBA and 4% PET, is show positive results. Workability reduces with increasing % age of Sugarcane bagasse ash with addition of coated PET fibers in concrete. The maximum proportion of replacement has been found by conducting the following strength tests: Compressive strength test, Flexural strength test and Split Tensile Strength Test.

Keywords: Sugarcane Bagasse ash (SBA), polyethylene terephthalate (PET), Pozzolanic material, Compressive strength, Flexural strength and Split tensile strength

1.1 INTRODUCTION

Today Ordinary Portland cement (OPC) is considered as foremost construction material across the globe. Portland cement is the conformist material used in buildings that in fact is accountable for roughly about 5% - 8% of carbon dioxide emissions globally. As there is exponential increase in the demand of cement, this environmental effect of it might increase considerably. Investigators thought out the globe today are concentrating on different ways for the use of either industrial or agricultural waste, as key materials for industry. Being not only cost effective but may help us in environmental pollution control. The Portland cement industry are examining substitutes to produce green building materials. Industrial wastes, such as blast furnace slag, fly ash and silica fumes are being used as additional cement replacement materials.

1.2 PET FIBER

In comparing with restrained shrinkage cracking, the mix reinforced with1%byvolumeof 50 mm long deformed fibers exhibited the best performance as no cracks were observedafter28days. Including it use in the form of grids acquired in a manual and very simple way of cutting strips from traditional mineral bottles has produced excellent results in terms of adhesion, ductility, and strength in test conducted on concrete plate of small thickness, reinforced and subjected to dynamic loading. Mix of aggregates and PET fragments in mortar is effective in terms of the physical structure and strength of concrete. In addition, this mixture changes the behaviour of concrete against applied stress.

1.3 SUGARCANE BAGASSE ASH

The wastes that are of economic importance are bagasse, molasses, and filter press mud. Bagasse is the fibrous residue remaining after the extraction of the cane juice from sugarcane. Sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose, and 25% of lignin. In a lot of sugarcane industries, the bagasse generated is usually used as fuel while also reducing its volume for disposal. This residual ash generated from burning or incineration is called bagasse ash inclusive of both bottom and fly ashes. In most modern plants, the bottom ash gets mixed with fly ash in the water channel that comes from the gas washer. This waste is typically disposed of into pits and is also applied on land as soil amendment in some areas.

2. LITERATURE REVIEW

Jayminkumar A. Patel1, Dr. D. B. Raijiwala 2015 There in this analysis the ecological and environmental effect of cement is considered as of much concernas it generates a lot of carbon dioxide also on the other hand sugarcane baggase ash is serious issue of land fills. In this study SCBA isused in M25 grade of concrete by replacing cement 5% by weight and compare with normal M25 grade of concrete to squared the possibility of SCBA in concrete. This analysis reveals that SCBA can be used as partial replacement of cement".

R.Srinivasan 2010 "In this paper, Bagasse ash has been partially replaced in the ratio of 0%, 5%, 15% and 25% by weight of cement in concrete. Fresh concrete tests slump cone test were done also test on the hardened state concrete like compressive strength, , flexural strength and modulus of elasticity split tensile strength at 7 and 28 days was obtained. There was an increase in the strength of the concrete reveals the study.

Satish Rao (2018): The aim of this research was to study the fire resistance of concrete using the PET (Polyethylene Terephthalate) coated with silica fume in the form of short fibers poured into concrete to improve the durability characteristics of concrete as well as temperature resisting endurance. The experimental study was performed on two aspect ratios i.e. AR25, AR50 with varying fiber dose or fiber ratio 0.5%, 1%, 1.5% of PET fibers. The partial replacement of cement is done with fibers. The size of the fiber for AR25 is 50mm×2mm, for AR50 is 100mm×2mm .The purpose of the investigation was to determine or compare the difference in the properties of the concrete with containing no PET, and containing PET coated with silica fume (SF). This investigation as carried out by using several tests, which include compression test and major fire test (Muffle furnace fire test). On other hand we know that the plastic is a harmful waste and its life as a waste is very high as compare to its useful life.

Pradhan & Dutta D (2003): Studied the effects of silica fume on conventional concrete, concluded the optimum compressive strength was obtained at 20% cement replacement by silica fume at 24 hours,7days and 28 days. Higher compressive strength resembles that the concrete incorporated with silica fume was high strength concrete.

Sajjad Ali Mangi (2017) SCBA when used in concrete produces compressive strength which is much more compared to the normal concrete, hence optimal results were found at the 5% replacement of cement with SCBA, the workability of fresh concrte increased to to the replacement of cement; future recommendation to determine several more properties for the use of SCBA in concrete. Modulus of elasticity, flexure test, split tensile test, drying shrinkage was observed through the experimental work that the study reveals that compressive strength increases with incorporating SCBA in concrete. Outcomes showed that with use of 5% increased SCBA in M20 concrete the increase in compressive strength by 12% as related to the normal concrete.

3. MATERIAL

3.1 CEMENT: Cement is a binding material in concrete that develops strong bonding properties when mixed with water and provides strength to the concrete. The chemical composition of cement mainly contains lime. There are many types of cement available in the market according to the need and strength desired. The cement we will use in this research work is 43 Grade Ordinary Portland Cement conforming to IS: 8112 with brand name Ambuja Cement and the physical properties related to cement is provided by the concerned lab.

3.2 FINE AGGREGATES: Fine aggregate consists of crushed sand particles or natural river sand passing through a 4.75mm sieve. In general, river sand is used as a fine aggregate having a particle size of 0.07mm. The extraction is done from rivers, lakes or sea beds. Sieve analysis would be done to find out the zone conforming IS: 383-1970. The physical properties of sand were provided by the concerned lab.

3.3 COARSE AGGREGATE: The particles retained on a 4.75mm sieve are termed coarse aggregate. For making a good concrete mix, coarse aggregated must be hard, clean, and free from any chemical coating of clay and dust on the surface. Crushed stone makes the majority of the particle of coarse aggregate. Coarse aggregates angular in shape are used in this research work that is obtained from the local crusher. Grading of coarse aggregate was done according to IS:383-1970. Aggregates of Nominal size 20mm & 10mm to form a graded aggregate. The concerned lab provided the properties of coarse aggregate.

3.4 SILICA FUME AND POLYETHYLENE TEREPHATHALATE FIBERS

. The quantity of fibre applied to the concrete mix is expressed as a proportion of the total volume of the composition (concrete and fibres) , called "volume fraction" Vf typically range i.e., 0.5,1 and 1.5 percentage. In the production of PET fibres, the topic of the most concern has always been alkali resistance, but after careful study it was found noticed that there was no problem in traditional concrete. In comparing with restrained shrinkage cracking, the mix reinforced with1%byvolumeof 50 mm long deformed fibers exhibited the best performance as no cracks were observedafter28days. Including it use in the form of grids acquired in a manual and very simple way of cutting strips from traditional mineral bottles has produced excellent results in terms of adhesion, ductility, and strength in test conducted on concrete plate of small thickness, reinforced and subjected to dynamic loading. Mix of aggregates and PET fragments in mortar is effective in terms of the physical structure and strength of concrete. In addition, this mixture changes the behavior of concrete against applied stress.

COMPONENT	VALUE
Color	White
Lusture	Briht
Elastic modulus	90
Specific gravity	1.38
Solubility in Water	Insoluble

Table -1: **Physical properties of PET**

3.2.5 BAGGASE ASH Bagasse ash is a fibrous material obtained from sugar cane plant after the extraction of sugar cane juice. Sugar factory waste bagasse is used as bio fuel and in manufacturing of paper. Sugar industry produces 30% bagasse for each of crushed sugar cane, when this bagasse is burnt the resultant ash is known as bagasse ash. Bagasse shows the presence of amorphous silica, which is an indication of pozzolonic properties, responsible in holding the soil grains together for better shear strength.

Constituent	Baggase ash	Cement
Sio2	71.0	81.42
Al2O3	1.9	10.41
Fe2O3	7.8	1.54
CaO	3.4	3.35
MgO	0.3	0.76
NA2	3.4	1.36
K_2O	8.2	1.31

Table -2 Chemical composition of bagasse ash

4. METHODOLOGY

4.1 **BATCHING**: All the materials are collected and appropriately weighted. The measurement of the materials to be replaced is done, and then materials are adequately mixed. The water is added in a proper amount, and then the mixture is placed in a respective mould.

4.2 **CASTING**: The mixture is tested for workability via slumptest and then placed in a mould. The mould to be used is greased or appropriately oiled before use. After placing the mixture in the mould, it is adequately compacted. The exact process is carried on for all specimens to be tested. Three samples are prepared for each mix.

4.3 **CURING**: Before removing the mould, it is dried for 24 hours, and then specimens are placed in a water tank made to cure specimens. The specimens must be marked for identification so that there must not be any error. The specimens are removed from the tank and dried before putting in the testing machine. The specimens are kept in the tank for 7, 14, 28 days.

4.4 SLUMP CONE TEST It can be used in site as well as in lab. This test is not applicable for very low and very high workability concrete. It consists of a mould that is in the form of frustum having top diameter of 10cm, bottom diameter of 20cm and height of 30cm. The concrete to be tested if fitted in the mould in four layers. The each is compacted 25 times with the help of tamping rod. After the mould is completely filled it is lifted immediately in the vertically upward direction which causes the concrete to subside

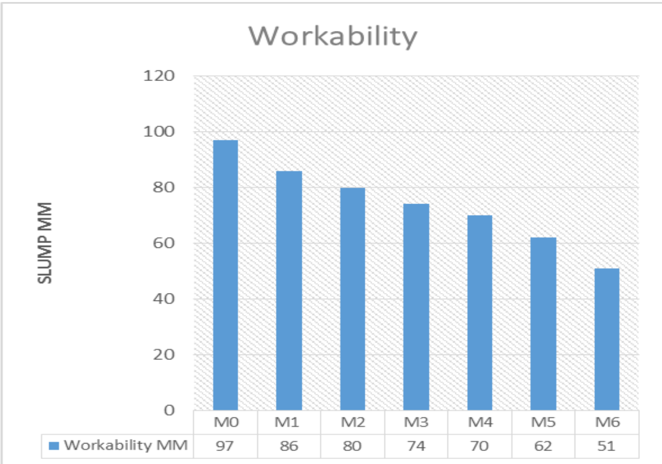

Fig -1: **SLUMP CONE TEST**

4.5 COMPRESSIVE STRENGTH TEST Then fresh concrete is filled in mould in 4 layers and after filling each layer tamping should be done 35 times in case of cube and 25 times in case of cylinder by using standard tamping rod. Once the mould is filled then leveled top surface of concrete with trowel. After the day the mould will removed and specimen are dropped in the curing tank under standard temperature of 27±2° c. After 7,14 days and 28 days in this research.

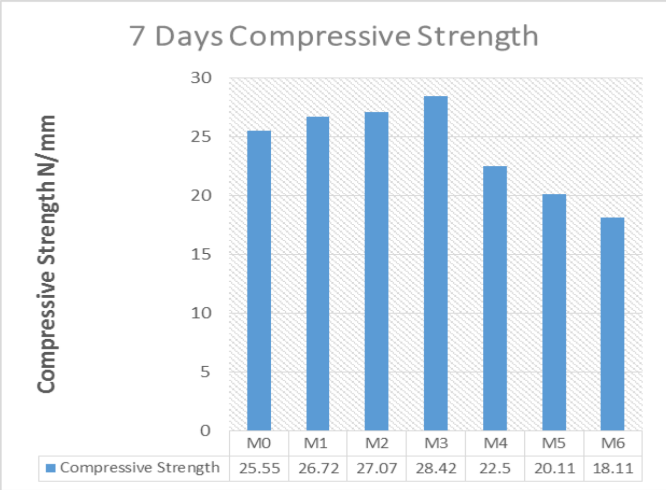

Fig -2: **COMPRESSIVE STRENGTH TEST7 DAYS**

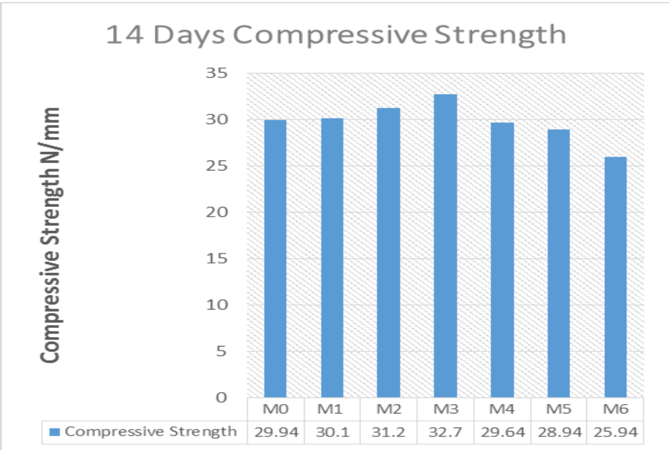

Fig -3: **COMPRESSIVE STRENGTH TEST 14 DAYS**

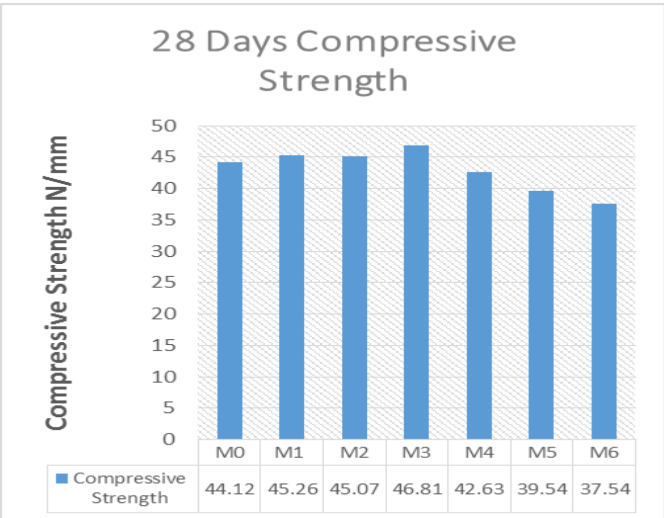

Fig -4: **COMPRESSIVE STRENGTH TEST 28 DAYS**

4.6 SPLIT TENSILE STRENGTH TEST

The specimen used for this test is cylindrical and its dimension is 150 mm in diameter and 300mm in length. The instrument used for this testing is universal testing machine. The fresh concrete is prepared in according to the required grades and respective mix proportion. The fresh concrete is filled in mould in layers and each layer is tamping with standard tamping rod with 25 blows for each layer. After the day the mould is removed and specimen is placed in the curing tank for 7,14 days and 28 days in this research at the temperature 27+ 2°c. Then draw the line on the specimen.

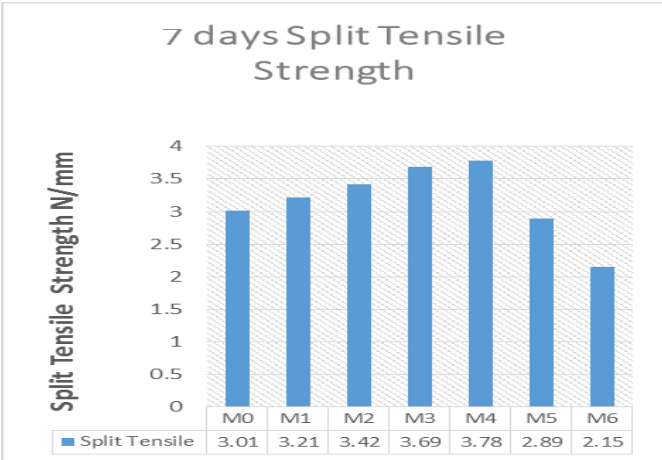

Fig -5 SPLIT TENSILE STRENGTH 7 DAYS

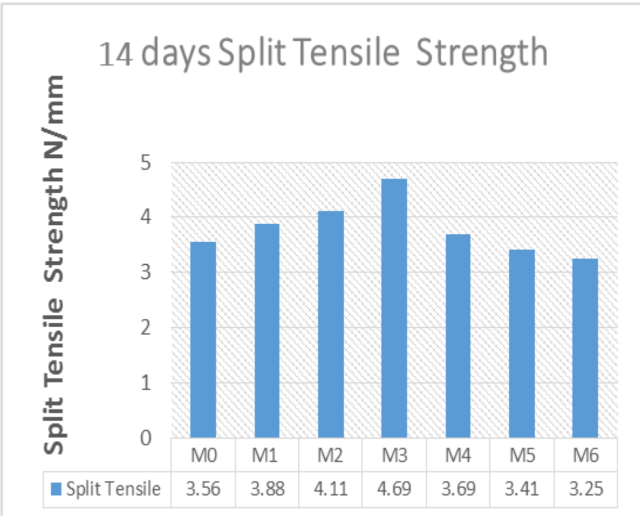

Fig -6 SPLIT TENSILE STRENGTH 14 DAYS

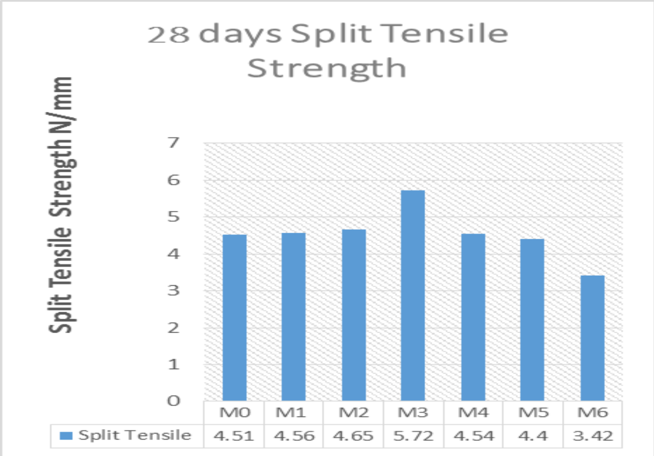

Fig -7 SPLIT TENSILE STRENGTH 28 DAYS

4.7 FLEXURAL STRENGTH TEST

The concrete is prepared at required rate of mass element the mould is filled with concrete in layers and blows 25 times with standard tamping rod. After the day or we can say 24 hours the mould is removed and specimen placed in the water tank for curing at a temperature of 27 + 2 C. Depending upon the requirement the test specimen is removed from the water tank and wipe it properly for 7,14 and 28 days for testing.

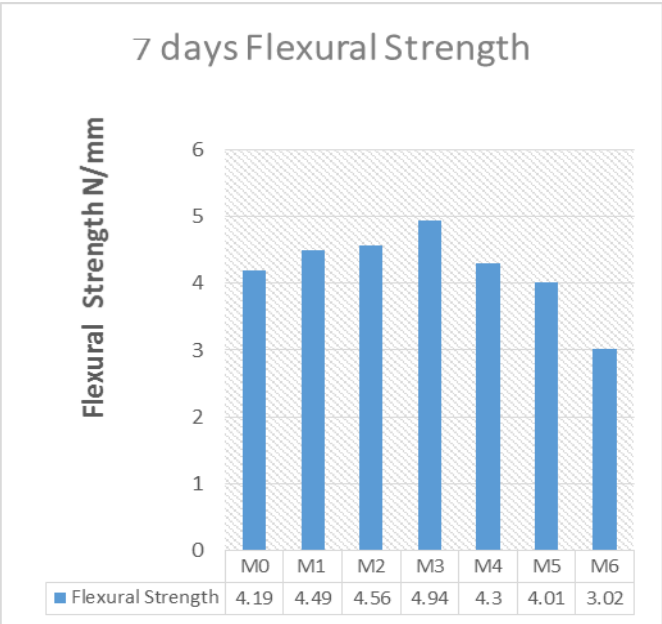

Fig -8 FLEXURAL STRENGTH 7 DAYS

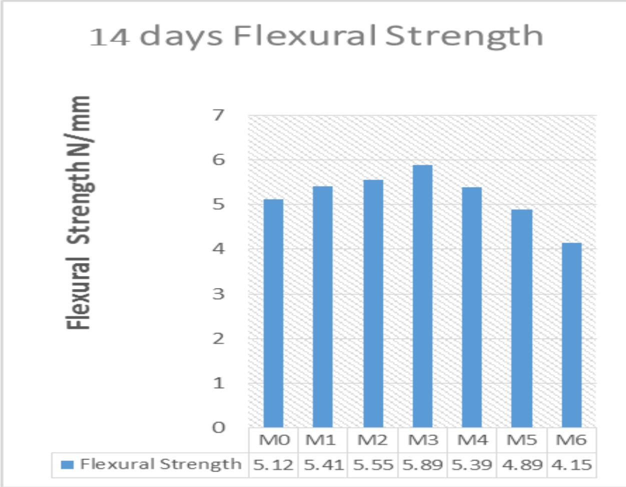

Fig -9 FLEXURAL STRENGTH 14 DAYS

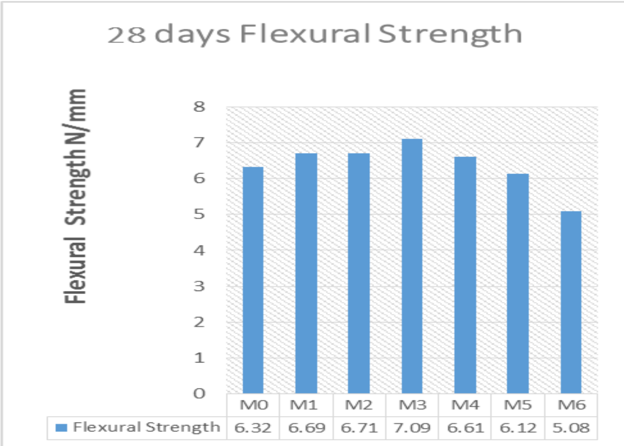

Fig -10 FLEXURAL STRENGTH 28 DAYS

5. CONCLUSIONS:

- Workability results show that if we replace cement with 21% replacement of Bagasse powder and 4% Addition of coated PET fibers, however, after a further increase in the replacement, there is a minor decrease in workability. All the concrete mix containing Bagasse Ash and PET shows enough workability to be easily compacted and finished. It must be noted that the material used as a replacement must be adequately grounded. Otherwise, the water absorption will increase, which will reduce the workability of the concrete mix.

- The compressive strength results show that as we replace cement with Bagasse ash and with Addition of coated PET fibers, there is an increase in the compressive strength, but at higher replacements, there is a decline in the compressive strength of concrete.

- The max compressive strength is achieved by replacing cement with 21% replacement of Bagasse Ash and 4%

Addition of coated PET fibers on 28th day as 46.81 Mpa compared to 44.12 Mpa as of standard concrete.

• The split tensile strength is optimum at 21% replacement of Bagasse Ash and 4% Addition of coated PET fibers. After a further increase in replacement, it keeps on decreasing. 28th day split tensile strength at this replacement is 5.72 Mpa compared to 4.51 Mpa as of standard concrete.

• The flexure strength is optimum at 21% replacement of Bagasse powder and 4% Addition of coated PET fibers. After a further increase in replacement, it keeps on decreasing. 28 days flexural strength at this replacement is 7.09 Mpa compared to 6.32 Mpa as of standard concrete.

• Hence from this research work, it can be concluded that the optimum value of strength for different tests performed on concrete observed at 21% replacement of Bagasse powder and 4% Addition of coated PET fibers.

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