

Feasibility Study of Bagasse Fibre and Ash in Concrete

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ABSTRACT: The usage of natural fiber in construction is widely used as building materials. However, using bagasse fibre in concrete construction will help to reduce crack in concrete. Furthermore, the usage of bagasse in construction can reduce of environmental pollution. In this study, a mixture of bagasse fibre and ash to be used in concrete to determine whether there is an increase in the compressive and tensile strength of the concrete. The flexural and splitting tensile strength of concrete were significantly reduced by the addition of bagasse fibre. To compensate the reduction in the compressive strength when using the bagasse fibre, additionally we use bagasse ash. The objective of this study is to determine the compressive and tensile strength of different concrete mix with bagasse fiber and ash. Compressive strength and tensile strength of specimens is to be tested on days 7, 14 and 28 after curing is carried out. The Utilization of fibre in concrete production not only solves the problem of disposing solid waste but helps conserve natural resources.

KEYWORDS: Bagasse fibre, Bagasse ash, compressive strength, tensile strength.

I. INTRODUCTION

More than 100 countries grow sugarcane as a main crop. Every year the total production is over more than 1000 million tons. In the list of production India is in 2nd place the states like Maharashtra, Punjab, and Bihar are the largest producer states in India sugarcane production is over 341 million tons/year that cause about 9.8 million tons of sugarcane bagasse ash as waste material. After the removal of all profitable sugar from sugarcane, about 39-44% fibrous waste is obtained, which is used in the same industry to produce the electricity waste is used as fuel in boilers for heat generation leaving behind 10-15% ash as waste, known as sugarcane bagasse ash (SCBA)

The present study was carried to study the use of SCBA as a partial replacement of fine aggregate in cement concrete since the availability of natural sand is less in the last decades as a result of ecological and environmental conditions. The experimental study shows that the workability properties of fresh concrete such as slump and also 7 and 28 days compressive strength, 7 and 28 days tensile strength and flexural strength with 5%, 10%, 15% replacement of bagasse ash by fine aggregate.

Various studies have shown that addition of sugarcane bagasse fibre reduces the compressive strength but the splitting tensile strength of the concrete increased and also found that 0.5% of the concrete mix is the optimum level to avoid the over reduction in compressive strength, therefore we are adding with the sugarcane bagasse ash, the sugarcane fiber at optimum level.

II. RELATED WORK

Characterization of natural fibres (sugarcane bagasse) in cement composites (m. J. Ghazali, c. H. Azhari, s. Abdullah & m. Z. Omar, July 2008) Blended cement composites were prepared by mixing the Portland cement with bagasse fibers and water. The mixing process was carried out by using the Wink worth mixer machine with water to cement ratio (W/C) of 0.25. The water was added gradually to the fiber-cement mixture for 5 minutes. Polymer emulsions were added to the mixture of fiber-cement composites after a complete addition of water, for a period of 10 minutes, with different weight percentages of 3, 6, 9, 12, 15, 18 and 21% to the weight of the mixture, respectively. The homogenous mixture was then hot-pressed into a mould of 10 mm diameter and 3.5 mm thick at 130°C with 50 tons load for 30 minutes. The samples were finally cooled at room temperature and kept for mechanical testing.

Experimental study on partial replacement of sand with sugarcane bagasse ash in concrete (akash g s, madhukar k k, dr. Shivakumara b6, May 2018) The work consists of performing the sieve analysis of sugarcane bagasse ash as per the Indian standard procedure and use the results for the concrete mix design to get the concrete of required strength and

quality. Thereafter the concrete is tested for ability parameters by performing the slump cone test followed by casting the cubes of concrete for further investigations. For carrying out the strength investigations a total 45 number of concrete cubes and 15 cylindrical specimens, 15 beams were prepared. Based upon the quantities of ingredient of the mixes, the quantities of sugar cane bagasse ash for 0%, 10%, 20%, 30% and 40% replacement by amount of sand were estimated. The water cement ratio was kept 0.40 and the dose of super plasticizer was kept constant at 1%. The casted concrete specimens were cured under standard condition in the laboratory and tested for 7 days and 28 days' flexural strength, 7 and 28 days split tensile strength and compressive strength.

Properties of sugarcane fiber on the strength of the normal and lightweight concrete (faisal sheikh khalid, herman shah herman, 2017) To achieve the objectives of this study, there are many approaches and methods that should be taken. Methods of work such as literature review, methods of mixing and testing in the laboratory is important to get a more accurate analysis result. The volume of sugarcane is 0.5%, 1.0% and 1.5%. The sugarcane bagasse will dry under the sun until completely dry for 7 days. Then the bagasse will cut into small relatively uniform strips with estimation 5cm until 10cm. Furthermore, bagasse needs to be treated first with Sodium Hydroxide NaOH Solution 50% dilute for 3 days. Purpose of the treatment is to remove the impurities and ensure the sugarcane withstand longer to use in concrete. Then, the treated sugarcane bagasse needs to be dried under the sun to ensure it completely dried before adding into concrete mixture. The volume of sugarcane is 0.5%, 1.0% and 1.5%. The size of the cube used are 100 mm x 100 mm x 100 mm for the compression test for the tensile test size of cylinder used are 100 mm x 200 mm. There are several tests conducted to achieve the objectives, which is compression and tensile tests of concrete that was done according to standard test. The curing process was carried out for 7 and 28 days in water at room temperature to let the concrete in the moist state as long as possible so that the hardening process happens in moderation in order to achieve maximum strength.

III. MATERIAL REQUIREMENTS

SUGARCANE FIBRES

Sugarcane bagasse is obtained by crushing the cane stalks using the Crusher, before being washed under running water. Then the bagasse is dried in sun light and the fibre is collected. Later the fibre is boiled at 100⁰c and again dried. The length of the fibre is about 50mm and it is clear in colour and smooth.



Fig.1 Sugarcane fibre

BAGASSE ASH

Bagasse ash is derived from the burning of the bagasse fibre. Bagasse fibre is very fine and moisture free substance, easily combustible. We collected the fibre and the ash from the Ambadiyil Dairy Milk, Eramallikkara, Thiruvananthoor, Chengannur. Extraction of all economical sugar from sugarcane, about 40-45% fibrous residue was obtained, which is reused in the same industry as fuel in boilers for heat generation leaving behind 8 -10 % ash as waste.



Fig.2 Bagasse ash

CEMENT

The cement water paste has its characteristic properties of adhesion and cohesion by which it can bond well with aggregate to form a strong rock like mass called concrete as a consequence of the chemical reaction between cement and water. Cement is the most widely used material in existence and is only behind water as the planet's most consumed resource.



FINE AGGREGATES

Fine aggregates are basically sand won from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 9.5 mm sieve. As with coarse aggregates these can be from primary, secondary or recycled source.

COARSE AGGREGATE

Aggregates are coarse particulate rock-like material consisting of a collection of particles ranging in size from < 0.1mm to > 50 mm. it includes gravel, crushed rock, sand, recycled concrete, slag, and synthetic aggregate.

WATER

Water is an important ingredient of concrete because hydration takes place only in the presence of water. The water, which is used for making concrete, should be clean and free from harmful impurities such as oil, alkali, acid etc. In general, the water which is fit for drinking but not for mixing concrete some specifications also accept water for making concrete if pH value of water lies between 6 and 8.

MOULDS

Cubical moulds of size 150 mm x 150 mm x 150 mm were used to prepare the specimens for determining the compressive strength of normal concrete. Care was taken during casting and compaction. Beam moulds of size 500 mm x 100 mm x 100 mm were used to prepare the concrete specimens for two-point loading. All the specimens were prepared in accordance with Indian Standard Specifications IS 516 – 1959. All the moulds were cleaned and oiled properly. They were securely tightened to correct dimensions and prevent leakage of slurry.

IV. MIX DESIGN

Mix design can be defined as the process of selecting ingredients of concrete and determining their relative proportion with the objective of producing concrete of certain minimum strength and durability as economically as possible. Two types of concrete mixes are normally used in the construction field. For normal works, nominal mix is used whereas for very important structures designed mix is used.

The mix design is done based on the Indian Standard Method (IS 10262;2009).

Water	Cement	Fine aggregate	Coarse aggregate
0.5	1	1.69	2.66

V. CASTING AND CURING OF TEST SPECIMEN

BATCHING

Weigh batching

Weigh batching is the correct method for measuring the materials. For important concrete invariably, weigh batching system is adopted. Use the weigh system in batching. Facilities accuracy, flexibility and simplicity. Different types of weigh batches are available, in smaller works, the weigh arrangement consist of two buckets, each connected through a system of levers to a spring-loaded dial which indicated the load. A simple spring balance or the common platform weighing machines also can be used for small works.

Automatic batch plants are available in small or large capacity. In this the operator has only to press one or two buttons to put into motion and weighing of all the different materials and the flow of each being cut off when the correct weigh is reached.

MIXING

Hand mixing

Hand mixing should be done over an impervious concrete or brick floor of sufficiently large size to take one bag of cement. Spread out the measured quantity of coarse aggregate and fine aggregate in alternate layers. Pour cement on the top of it, and mix them dry by shovel, turning the mixture over an again until uniformity of colour is achieved. This uniform mix is spread out in thickness of about 20 cm water is taken in water-can fitted with a rose-head and sprinkled over the mixture and simultaneously tuned over. This operation is continued till such time is good uniform, homogeneous concrete is obtained.



COMPACTION OF CONCRETE

Compaction of concrete is the process adopted for expelling entrapped air from the concrete. The test specimens are made as soon as practicable after mixing and in such a way as to produce full compaction of concrete with neither segregation nor excessive laitance. Each layer is compacted by hand or by vibration. When compacting by hand the standard tamping bar is used and the strokes of bar are distributed in a uniform manner over the cross section of the mould. The number of strokes per layer required to produce the specified conditions vary according to the type of the concrete.

CASTING OF SPECIMEN

Moulds were properly fixed with screws and oil is applied on the surface for easy demoulding. Concrete is prepared in the mixture and put in a tray. In this tray required quantity of bottle cap fibres are added and mixed properly. Fresh properties of concrete are determined. The specimens are cast. In the next day, specimens were demoulded and put in a curing tank.

VI. EXPERIMENTAL RESULTS

COMPRESSIVE STRENGTH TEST

Table 1. 7th day compressive strength test results

Mix type	Compressive strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	17.33
Bagasse ash 5% & fibre 0.5%	14.22
Bagasse ash 10% & fibre 0.5%	15.55
Bagasse ash 15% & fibre 0.5%	12.22

Table 2. 14th day compressive strength test results

Mix type	Compressive strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	19.21
Bagasse ash 5% & fibre 0.5%	15.73
Bagasse ash 10% & fibre 0.5%	17.34
Bagasse ash 15% & fibre 0.5%	13.41

Table 3. 28th day compressive strength test results

Mix type	Compressive strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	19.21
Bagasse ash 5% & fibre 0.5%	15.73
Bagasse ash 10% & fibre 0.5%	17.34
Bagasse ash 15% & fibre 0.5%	13.41

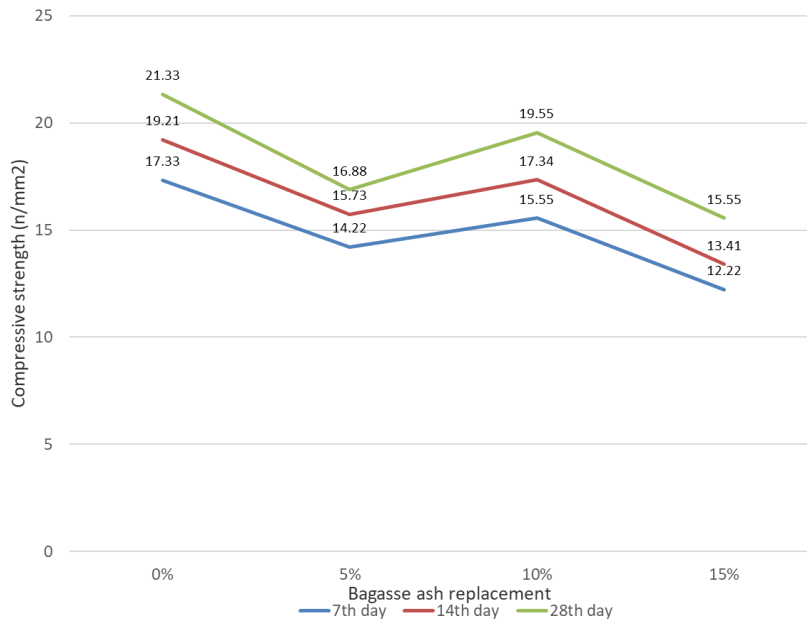


Fig.3

SPLIT TENSILE STRENGTH TEST

Table 4 7th day split tensile strength test result

Mix type	Spilt tensile strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	1.27
Bagasse ash 5% & fibre 0.5%	1.13
Bagasse ash 10% & fibre 0.5%	1.20
Bagasse ash 15% & fibre 0.5%	0.99

Table 5 14th day split tensile strength test result

Mix type	Spilt tensile strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	2.5
Bagasse ash 5% & fibre 0.5%	1.8
Bagasse ash 10% & fibre 0.5%	2.2
Bagasse ash 15% & fibre 0.5%	1.4

Table 6 28th day split tensile strength test result

Mix type	Spilt tensile strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	3.11
Bagasse ash 5% & fibre 0.5%	2.40
Bagasse ash 10% & fibre 0.5%	2.68
Bagasse ash 15% & fibre 0.5%	1.90

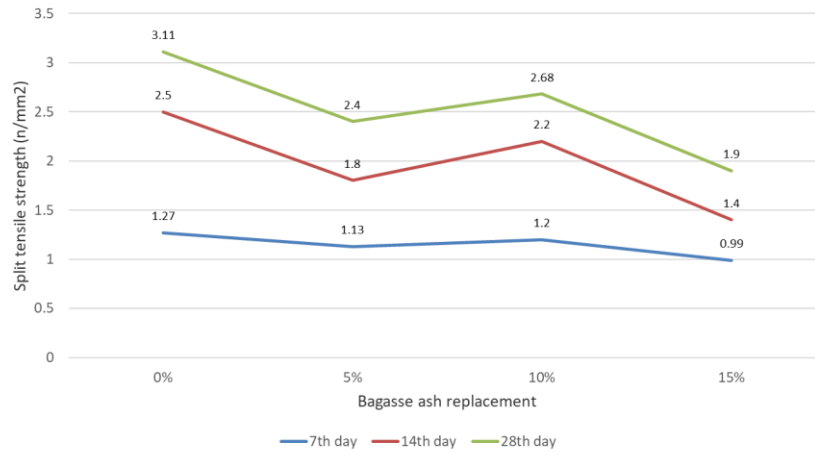


Fig.4

FLEXURAL STRENGTH TEST

Table 7 7th day flexural strength test result

Mix type	Flexural strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	1.8
Bagasse ash 5% & fibre 0.5%	0.9
Bagasse ash 10% & fibre 0.5%	1.2
Bagasse ash 15% & fibre 0.5%	0.6

Table 8 14th day flexural strength test result

Mix type	Flexural strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	2.7
Bagasse ash 5% & fibre 0.5%	1.5
Bagasse ash 10% & fibre 0.5%	2.3
Bagasse ash 15% & fibre 0.5%	0.9

Table 9 28th day flexural strength test result

Mix type	Flexural strength (N/mm ²)
Bagasse ash 0% & fibre 0.5%	3.6
Bagasse ash 5% & fibre 0.5%	2.4
Bagasse ash 10% & fibre 0.5%	3.0
Bagasse ash 15% & fibre 0.5%	1.2

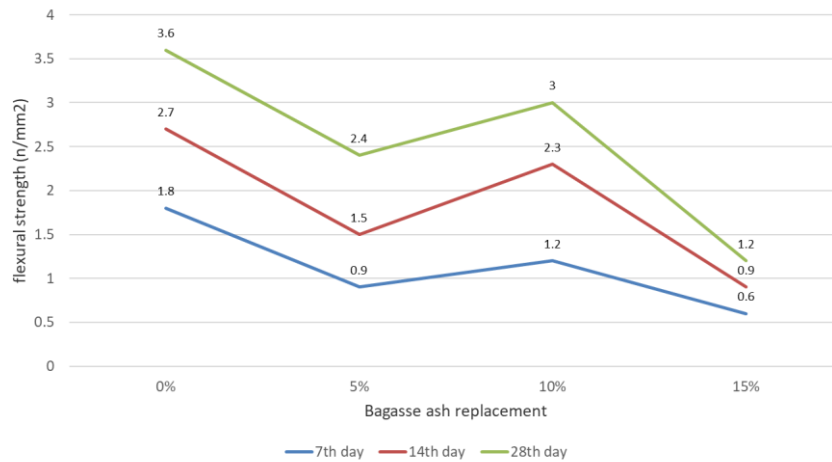


Fig.5

VIII.CONCLUSION

From the experimental investigation, the following conclusions are obtained:

- The optimum replacement level of the bagasse ash is found to be 10%.
- Compressive strength, split tensile strength and the flexural strength are obtained near to the value of the normal concrete.
- In the 15% replacement shows gradual reduction in the strength.
- In 5% replacement the compressive strength is reduced compared to the normal concrete, it shows that the addition of bagasse fibre reduces the compressive strength.
- The higher percentage of the replacement is not good for the concrete.
- The optimum of addition of the bagasse fibre is 0.5% and the bagasse ash is 10%.
- Here we obtained the strength values near to the normal concrete mix.
- The cost of the construction is reduced.
- It cannot be use suitable for high strength required construction.

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