STUDY ON STRENGTH OF M40 GRADE CONCRETE USING SUGARCANE BAGASSE ASH AND M-SAND

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Abstract *Concrete is the most widely used composite construction material in any construction. Fine aggregate and cement plays an important role for imparting better properties to concrete in its hardened state. By manufacturing of cement, a lot of carbon dioxide and other chemicals are released and with every one ton of cement manufacture, it releases half ton of* co_2*. So using Sugarcane bagasse ash as a partial replacement of cement can maintain environmental condition and improving properties of concrete.*

On the other hand, due to the continuous mining of sand from river bed leads to depletion of ground water and it causes a lot of environmental issues, so to reduce this problem alternatively i am using M-sand as a partial replacement for fine aggregate

The paper presents an experimental investigation on the properties of concrete and enhances the strength and quality of concrete. In this project, first i am partially replacing the cement with SCBA in different percentages they are 5%, 10%, 15%. By comparing the results, the percentages where the optimum strength was obtained will be taken as a common percentages and i will partially reinstate the sand with M-sand in different percentages are 5%, 10%, 15% & 20%.

The concrete was tested for slump test in fresh concrete and also properties of concrete in harden state i.e, compressive strength, flexural strength, split tensile strength are studied. The mix design was carried out for M40 grade of concrete.

1. INTRODUCTION

The most frequently utilized construction material on the planet is concrete. It's a composite building material comprised mostly of aggregate, cement, and water. The term concrete derives from the Latin word "concretes," which means "compact or condensed," and is the perfect passive participle of "concrescere," which comes from the words "con" (together) and "crescere" (to compress) (to grow). A chemical process known as hydration causes concrete to solidify and harden after it has been mixed with water and placed. The water interacts with the cement, forming a strong stone-like substance that binds the other components together. Concrete comes in a variety of formulas with different qualities, and it is the most widely used man-made substance on the planet.

Bagasse is a by-product of the sugar industry that is burned to produce electricity for various manufacturing activities. Bagasse ash, which has pozzolanic properties and might be utilized as a cement replacement material, is produced when bagasse is burned. Sugarcane production in the globe is estimated to reach more than 1500 million tones. Because bagasse makes up approximately 30% of sugarcane, the sugar recovered is about 10%, and the bagasse leaves around 8% bagasse ash as a waste (this figure varies depending on the grade and type of boiler; contemporary boilers release less bagasse ash), the disposal of bagasse ash will be a major problem.

Sugarcane bagasse ash has lately been studied for use as a cement substitute in several regions of the world. In particular replacement percentages and fineness, bagasse ash was shown to improve various qualities of the paste, mortar, and concrete, including

compressive strength and water tightness. It was claimed that the greater silica concentration in bagasse ash was the key reason for the benefits. Although the silicate content of the ash varies depending on the burning conditions and other properties of the raw materials, such as the soil on which the sugarcane is grown, it has been reported that the silicate undergoes a pozzolanic reaction with the cement's hydration products, resulting in a reduction of free lime in the concrete.

2. LITERATURE REVIEW

B. Vijaya etal. (2013):

The behaviour of concrete was observed for several grades ranging from M25 to M60. According to their research, the normal mix with 100 percent manufactured sand has a maximum strength of 53 MPa, whereas the mix with natural sand has a maximum strength of 49 MPa. They also discovered that produced sand has superior physical qualities and better particle packing, which leads in a greater binding effect and higher strength.

Pallavi S.Kumbhare (2019):

She stated that they had chemically and physically described "partial replacement of cement in concrete with sugarcane bagasse ash" and partial replaced in the ratios of 10%, 20%, and 30% by weight of cement in concrete. The SCBA concrete had much better compressive strength than the concrete without SCBA, according to the findings. It was discovered that SCBA could be used to substitute cement up to 25% of the time. In a concrete mix, replacing cement with sand increases the strength while lowering the cost.

3. MATERIALS USED AND MIX DESIGN

OPC 53 Grade cement

In the sequence of cement processes, the Ordinary Portland Cement (OPC) 53 grade is employed. The concrete specimens' binding substance is cement. Because it is a basic element of concrete, mortar, stucco, and most non-specialty grout, Portland Cement (also known as OPC) is the most prevalent form of cement in general usage across the world. Limestone is the source of this substance.



Fig 1: OPC 53 Grade cement

Fine aggregates

Natural sand, crushed stone sand, or crushed gravel stone dust make up fine aggregate. It should be hard, durable, chemically inert, clean, and free of organic matter, with no visible clay balls or pellets, as well as other detrimental contaminants such as alkaline, salt, mica, dead vegetation, lumps, and so on. The fine aggregate grade is listed below.



Fig 2: Fine aggregates

M- Sand

Manufactured sand (m-sand) is a concrete building material that may be used instead of river sand. Crushed hard granite stone is used to make manufactured sand. Only VSI crusher/Rotopactor produced sand is cubical and angular in form. Other types of machinery produce flaky sand, which is difficult to deal with. Jaw crushers are commonly used to reduce stones to metal or aggregates. Jaw sand that has been manufactured All sand particles

should have a higher crusher, since cone and roll crushers frequently have a larger percentage of dust and flaky particles.



Fig 3: M Sand

Coarse aggregates

Throughout the experiment, crushed coarse material with a size range of 10 to 20 mm was obtained from local crusher facilities. In compliance with IS:2386-1963 and IS:383-1970, the aggregate was evaluated for physical parameters such as gradation, fine modulus, specific gravity, water absorption, and bulk density.

The coarse aggregate comes from a closer zone. The collected material is sieved via a 20 mm sieve before being kept on a 10 mm sieve. The characteristics of newly mixed concrete are influenced by particle form and surface roughness more than the qualities of cured concrete. Smooth, rounded compact aggregate requires more water to generate workable concrete than rough textured, angular, and elongated particles.



Fig 4: Coarse aggregates

Sugarcane Bagasse Ash

SCBA is a sugar agro-industry by-product that is widely available in various parts of the world and possesses cementitious qualities, indicating that it may be used in conjunction with cement. It is somewhat utilized as a source of energy. However, bagasse ash (SCBA) is classified as garbage, posing a disposal issue. Furthermore, the SCBA can be reused if sugarcane bagasse is burnt under regulated conditions.



Fig 5: Sugarcane Bagasse Ash

Water

Water is an important component in the production of concrete. The quality of the water used in concrete should be considered. "If you can drink it, you can create concrete with it," says an old adage about water quality. Municipal water sources are used to make a considerable volume of concrete. Good quality concrete, on the other hand, may be manufactured with water that does not meet regular drinking water requirements.

Super plasticizer

Naphthalene based super plasticizer commonly used in daily engineering construction was selected and the effects of the super plasticizers on the setting time, compressive strength, workability. It was the first to extract naphthalene from coal tar in 1819. When soft coal is burned in an insufficient quantity of air, coal tar forms, which is a brown to black thick liquid. It is made up of a complex hydrocarbon mixture. It is extracted by heating the raw material to a temperature of 200c to 25oc, resulting in middle oil is distilled to separate its many components one of which is naphthalene.



Fig 6: Naphthalene

Mix design

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining with the object of producing of certain minimum strength and durability as economically as possible. Mix design for M40 grade concrete has been done with trail method by making the use of specification and guideline given by EFNARC and IS:10262-2009.

Table 1: Mix ratios of SCBA

Trails	Blending ratios		Quantity of materials	
	Cement (%)	SCBA (%)	Cement kg/m³	SCBA kg/m3
5% SCBA	95	5	373.08	19.64
10% SCBA	90	10	353.45	39.27
15% SCBA	85	15	333.81	58.91

From the test results, the maximum strengths obtained at 10%. Now it is considered as standard value and partially replace the normal sand with M-sand.

Table 2: Mix ratios of SCBA and M-sand

Trails	Blending ratios		Blending ratios for fine aggregate		Quantity of materials	
	Cement (%)	SCBA (%)	Normal sand (%)	M-sand (%)	Normal sand (Kg/m³)	M-sand (Kg/m³)
10% SCBA+ 5% M-sand	90	10	95	5	667.52	35.13
10% SCBA+ 10% M-sand	90	10	90	10	632.38	70.26
10% SCBA+ 15% M-sand	90	10	85	15	597.25	105.39
10%SCBA+ 20% M-sand	90	10	80	20	562.12	140.53

Table 3: Mix proportion for conventional concrete and replaced M_{40} grade

Trails	Cement (kg/m³)	SCBA (kg/m³)	FA(kg/m³)		CA (kg/m³)	Water (kg/m³)	W/C	Chemical admixtures (kg/m³)
			Normal sand	M-sand				
Nominal	392.72	-	702.65	-	1261.96	157.09	0.4	1.96
Trail-1	353.45	39.27	654.58	34.45	1261.96	157.09	0.4	1.96
Trail-2	353.45	39.27	610.33	67.81	1261.96	157.09	0.4	1.96
Trail-3	353.45	39.27	592.62	104.58	1261.96	157.09	0.4	1.96
Trail-4	353.45	39.27	546.87	136.72	1261.96	157.09	0.4	1.96

Tests to be conducted on concrete

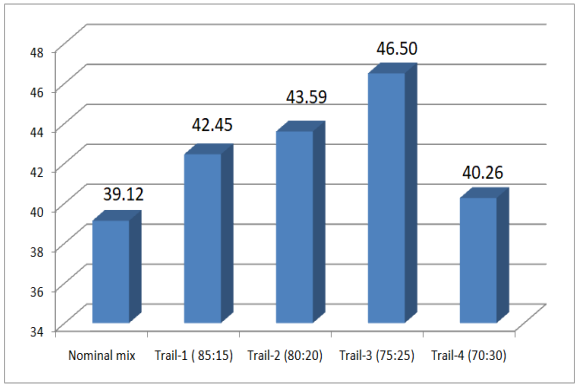
The following are the 3 tests which are carried out on the concrete after curing process for the respected 7days, 14days and 28 days curing period which are

1. Compressive strength
2. Split tensile strength
3. Flexural strength

4. RESULTS AND ANALYSIS

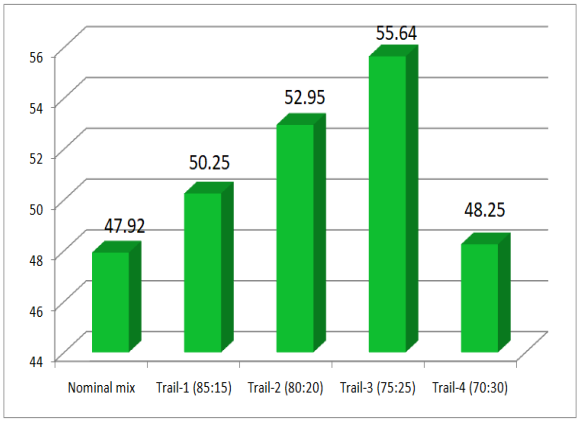
Compressive strength

7days



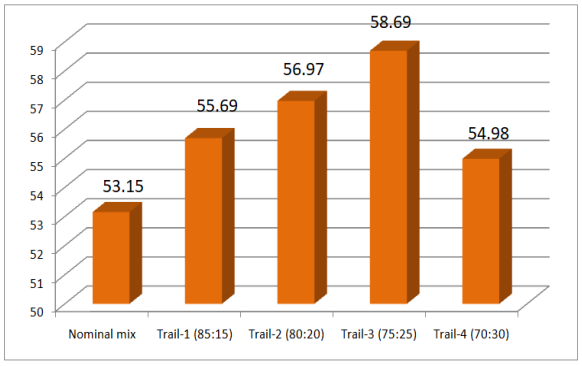
Graph 1: Comparison of 7days compressive strength

14days



Graph 2: Comparison of 14days compressive strength

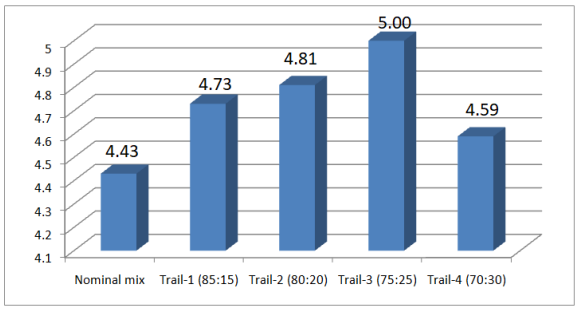
28days



Graph 3: Comparison of 28days compressive strength

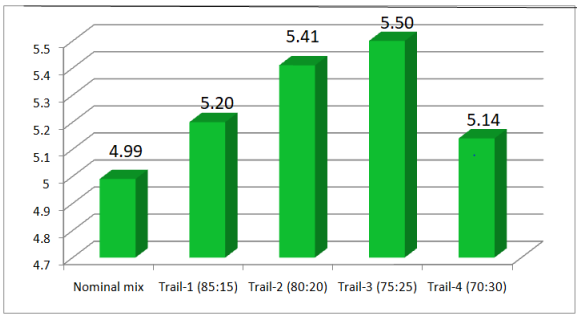
Split tensile strength

7days



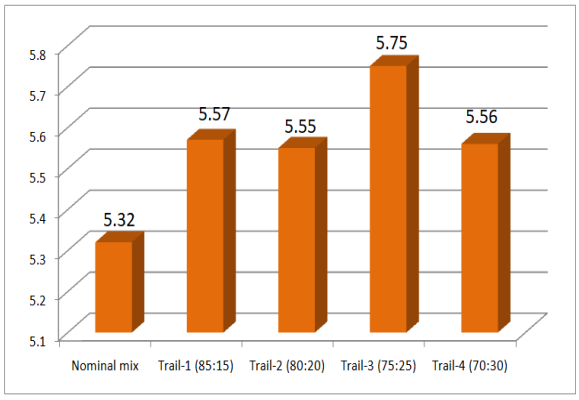
Graph 4: Comparison of 7days tensile strength

14days



Graph5: Comparison of 14days tensile strength

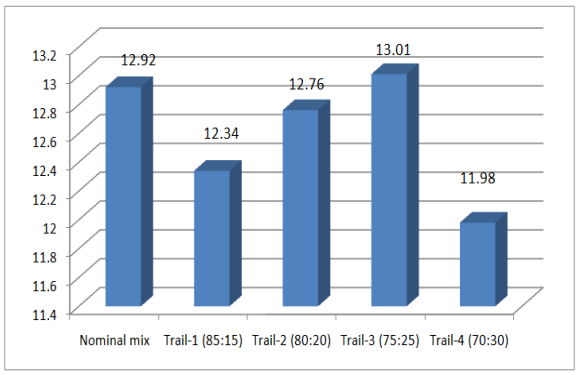
28days



Graph6: Comparison of 28days tensile strength

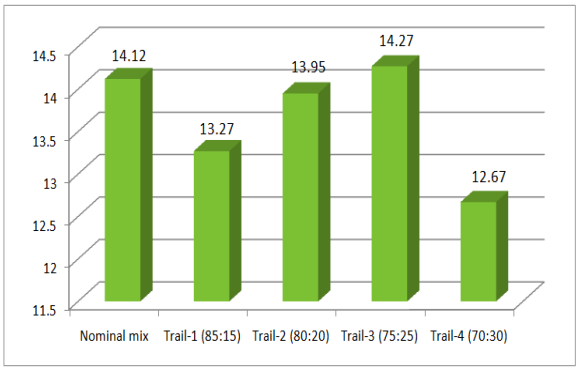
Flexural strength

7days



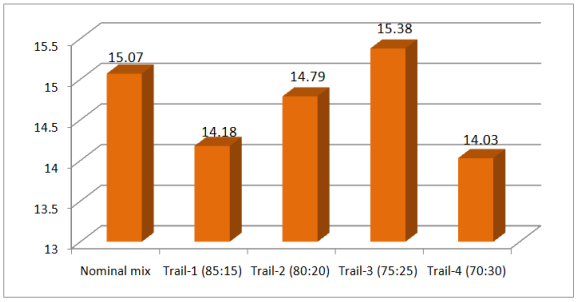
Graph 7: Comparison of 7days flexural strength

14days



Graph 8: Comparison of 14days flexural strength

28days



Graph 9: Comparison of 28days flexural strength

5. CONCLUSIONS

1. There is a significant potential for the growth of recycled waste as an appropriate and green solution for sustainable development in construction industry.
2. From the results of the test Sugarcane Bagasse ash concrete performed better when compared to ordinary cement up to 10% replacement of SCBA. The increase of strength is mainly due to presence of high amount of silica.
3. The usage of SCBA on concrete is not only for waste minimizing technique, also it saves the amount of cement.
4. By replacing sand with M-Sand on the 10% sugarcane bagasse ash in concrete, the hardened concrete strength value increased at 15%.
5. By increasing the M-Sand ratio more than 15% in the SCBA, the hardened concrete strength values decrease gradually.
6. So the safe amount of M-Sand that can be replaced on the SCBA concrete is about 0 to 15%.
7. From this experimental study, by comparing the conventional concrete with replaced SCBA and M-Sand in concrete, the hardened concrete strengths increased. Such as compressive strength, split tensile strength, flexural strength.
8. **A safe percentage for the replacement of sugarcane bagasse ash in place of cement in M40 grade concrete is upto 10%.**
9. **A safe percentage for the replacement of M-sand in place of sand in M40 grade concrete is upto 15%**

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