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Durability Study on Sugarcane Bagasse Ash and Recycled Coarse Aggregate as a Partial Replacement in Concrete

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ABSTRACT

Demand for the construction materials has been increasing with the growth of population. In this development era, there is a huge requirement of the resources to meet the needs of the human beings. Hence to enable sustainable development of the resources in the construction field, the materials which we are using regularly (i.e., cement, sand, coarse aggregate) have been partially replaced with other materials such as sugarcane bagasse Ash, recycled coarse aggregate etc. The main motto of the selection of partial replacement of materials is to attain greater strength when compared with the ordinary mix. And to use renewable resources which are environmental friendly in ratio. Here, we used M30 grade for different W/C ratio of 0.43, 0.45. Tests have been conducted for fresh concrete and hardened concrete for different ages like 7days, 28days & 56days respectively. In order to know the feasibility of the mix proportions. It is observed that the compressive strength for different W/C ratio using partially replaced materials is more than the compressive strength of the nominal mix. The amount of replacement of bagasse Ash with cement has been taken up to 10% and recycled coarse aggregate with coarse aggregate is up to 25% to get higher strength of the mix.

Keywords: Sugarcane bagasse ash (SCBA) and Recycled coarse aggregate (RCA)

1. INTRODUCTION

The concentration of population in cities has been increased rapidly when compared to older days. The social & economic infrastructure of the country has been widely progressed in the recent days. As a result the number of construction has been increased. The material used for the construction can be replaced with substitute materials. The agricultural waste & recycled materials can be used as substitutes so that any kind of material can be used to its fullest efficiency.

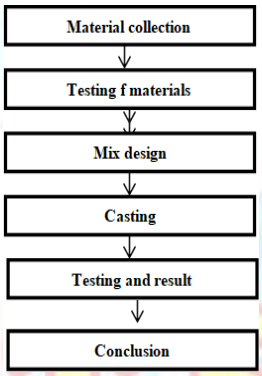
Sugarcane bagasse Ash (SCBA) is a waste material which is obtained from sugarcane after extracting its ingredients. SCBA (sugar cane bagasse ash) is a common sugar and ethanol industrial waste.This SCBA is widely used in agricultural sector as a manure product which provides nutrients to plants and also or discarded in landfills, raising environmental problems In generally, Combustion of Bagasse to Produce Electricity The Rankine cycle, in which high pressure/temperature steam travels through an

expansion device such as a turbine to extract energy and drive an electrical generator, is used in traditional steam power generation. Now a day SCBA can be used in construction field as a replacement material with cement for economic development Original aggregate is connected with mortar in the recycled coarse aggregate. The mortar that comes with it is light and porous. As a result, as compared to natural aggregate, the specific gravity and density of recycled aggregate are obviously lower. Recycled coarse aggregate (RCA) is obtained from construction debris which consists crushed cement concrete. Now a days this RCA is reused in building projects in an efficient manner. The RCA is used as a replacement material with coarse aggregate by replacing partially.

2. LITERATURE REVIEW

Many researchers have done their work on exploring the physical properties and mechanical properties of SCBA and RCA. **B K Baguant & G T C Mohamed bhai** from their study concluded bagasse ash shows too poor reactivity with Portland cement to make it effective pozzolana in concrete. Bagasse ash can is effectively used as fine aggregate in concrete to produce a range of compressive strength up to about70N/mm^2. However, generally reduced workability is observed in the fresh concrete, due to the coarse grading and angular texture of the ash particles. The shrinkage of bagasse ash concrete is not excessively higher than that of normal concrete. However more data are required to access this property of the concrete. The initial surface absorption characteristics of bagasse ash concrete do not give any indication of low durability in comparison with basalt-sand concrete. The addition of a super plasticizer can reduce the initial absorption capacity of bagasse ash concrete.**G Nitin Kumar Reddy** et al used SCBA in concrete as a partial replacement of cement up to 100% will offers best results compared to traditional concrete and conjointly it helps in increasing the electric resistance towards attack like sulfate. **Yong, P C & Teo, D C L**, during this analysis, RCA concrete specimen are used. The cubed here is 28days concrete cubes after compression test from a local construction site. These concrete cubes are crushed to suitable size and reused as RCA. The amount of RCA used in this research 200kgs approximately. Several researches state that the RCA area unit solely appropriate for non-structural concrete applications. This analysis, they show that the RCA obtained from tested concrete specimen keep quality cement. **H Dilbas et al (2014)** This observation is found that a cube sample containing 0% -5% silica fume increases the tensile splitting strength when RCA is replaced with the natural coarse aggregate. The increase in the silica. **Jitender Sharma** it is cleared that RCA can be used safely up to 25% as there is not so much difference between the compressive strength of 0% & 25% concrete mix.

3. EXPERIMENTAL PROCEDURE



4. EXPERIMENTAL PROGRAM

MATERIALS:

The detailed properties has described below:

CEMENT:

Cement is a material that has cohesive and adhesive properties in the presence of water. Such Cements are called Hydraulic cements. These consist primarily of silicates and aluminates of lime obtained from lime stone and clay. There are different types of cement, out of which OPC is used. Ordinary Portland cement is (OPC) is the basic Portland cement and is suited for use in general cement construction. They are 3 types of cement 33 grades, 43 grades and 53 grades. One of the best benefits is the faster the development of strength. Casting the specimens Ordinary Portland cement is available in the market as conforming to IS 12269-1987. The physical properties are shown in table1

Table1 . Physical properties of cement

S.NO	PROPERTIES	CEMENT
1.	Fineness	96%
2.	Specific gravity	3.05
3.	Normal consistency	30%
4.	Initial setting time	28min
5.	Final setting time	140min
6.	Compressive Strength (28 Days)	53Mpa

SUGARCANE BAGASSE ASH

After the extraction of all economical sugar from sugarcane about 40%-45% fibrous residue is obtained, which is reused in the same industry as fuel in boilers for heat generation leaving behind 8-10% ash as waste, known as sugarcane bagasse ash (SCBA). The physical properties are shown in table2

Table2 . Physical properties of SCBA

S.NO	PROPERTIES	SCBA
1.	Fineness	94%
2.	Specific gravity	2.18
3.	Normal consistency	33%
4.	Initial setting time	34min
5.	Final setting time	178min

FINE AGGREGATE:

Locally available river sand in dry condition is used for the preparation of specimens. The grading of sand conforms to zone-I. As per IS 383-1970. The specific gravity of sand is 2.69 .The physical properties are shown in table3

Table.3.PROPERTIES OF FINE AGGREGATE

S.NO	PROPERTIES	TEST RESULT
1.	Specific gravity	2.69
2.	Fineness modulus	3.03
3.	Water absorption (%)	0.5
4.	Compacted Bulk density (gm/cc)	2.0
5.	Loose Bulk density (gm/cc)	1.8

COARSE AGGREGATE:

Crushed granite aggregate conforming to IS: 383-1970 is used for the preparation of concrete. Coarse aggregate of size 20mm, is having the specific gravity of 2.72. The physical properties are shown in table4

Table 4. PROPERTIES OF COARSE AGGREGATE

S.NO	PROPERTIES	TEST RESULT
1.	Fineness	7.33
2.	Specific gravity	2.72
3.	Water absorption (%)	0.62
4.	Crushing stone (%)	27
5.	Impact strength (%)	10.3

RECYCLED COARSE AGGREGATE:

Recycled coarse aggregate (RCA) is produced by crushing sound concrete, clean demolition waste. Other materials that may be present in RCA are gravel, crushed stone, hydraulic cement concrete or a combination of deemed suitable for premix concrete production. The physical properties are shown in table5

TABLE5. Physical properties of recycled coarse aggregate

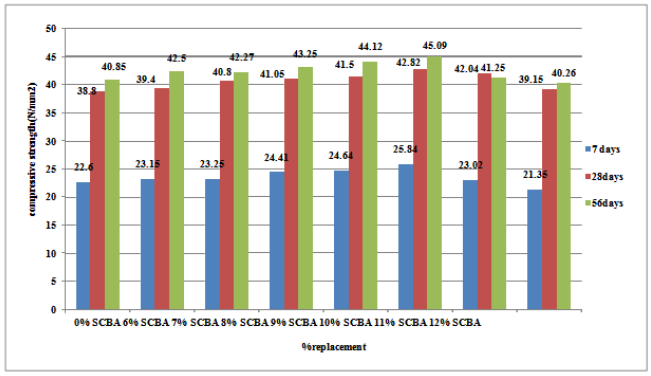
S.NO	PROPERTIES	Recycled coarse aggregate
1.	Fineness	7.47
2.	Specific gravity	2.74
3.	Water absorption (%)	1.05

5. PREPARATION OF MIX

Mix design was done as per IS 10262:2009. The mould used in this experiment are of size 150mm*150mm*150mm with different water cement ratio of 0.45 & 0.43 were casted with replacement of sugarcane Bagasse Ash(SCBA) in cement and recycled coarse aggregate(RCA) in coarse aggregate With different ages like 7 days , 28 days & 56 days to know the compressive strength result.

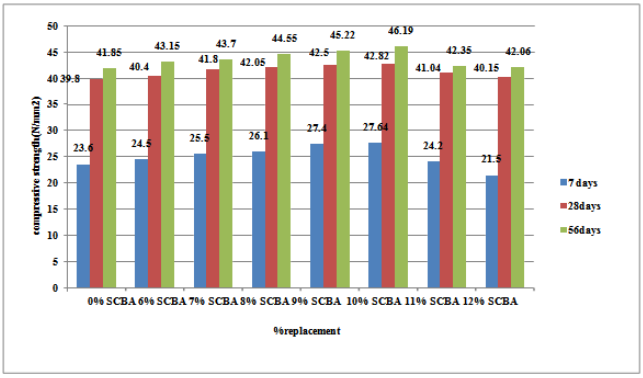
6. RESULTS AND DISCUSSION

Concrete mould of size 150mmx150mmx150mm were casted for different ages,the results are shown below.



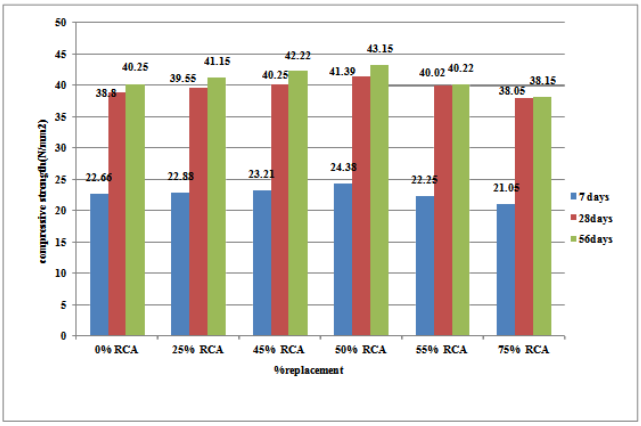
Graph1. Variation of compressive strength using SCBA for 0.43

The above graph1 shows the variation between nominal mix and the partially replaced mix. Using sugarcane Bagasse Ash in place of cement as 0%,6%,7%,8%,9%,10%,11% &12% by weight for different age like 7days, 28days and 56days for w/c-0.43. We got the maximum value at 10% for 7days, 28days & 56 days are 25.84N/mm², 42.82 N/mm² & 45.09 N/mm² when compared with normal mix for 7days,28days &56 days are 22.6 N/mm²,38.8 N/mm² &40.85N/mm².²



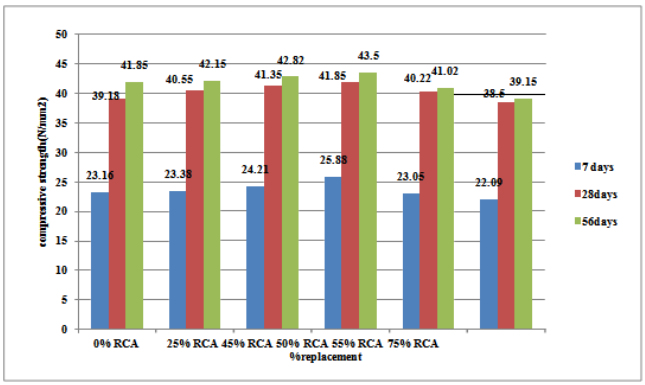
Graph2. Variation of compressive strength using SCBA for 0.45

The above graph2 shows the variation between nominal mix and the partially replaced mix. Using sugarcane Bagasse Ash in place of cement as 0%,6%,7%,8%,9%,10%,11% &12% by weight for different age like 7days, 28days and 56days for w/c-0.45. We got the maximum value at 10% for 7days, 28days & 56 days are 27.64N/mm², 42.82N/mm² & 46.19 N/mm² when compared with normal mix for 7days, 28days &56days are 23.6 N/mm²,39.8 N/mm² &41.85N/mm²



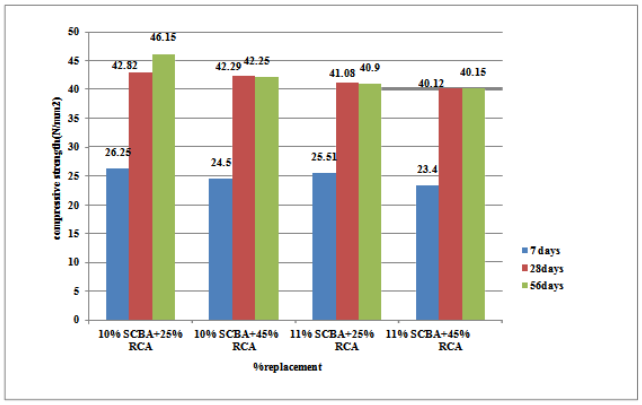
Graph3. Variation of compressive strength using RCA for 0.43

The above graph3 shows the variation between nominal mix and the partially replaced mix. Using Recycled coarse aggregate in place of coarse aggregate as 0%,25%,45%,50%,55% &75% by weight for different age like 7days, 28days and 56days for w/c-0.43. We got the maximum value at 50% for 7days, 28days & 56 days are 24.38N/mm², 41.39N/mm² & 43.15 N/mm² when compared with normal mix for 7days, 28days &56days are 22.66 N/mm²,38.8 N/mm² &40.25N/mm²



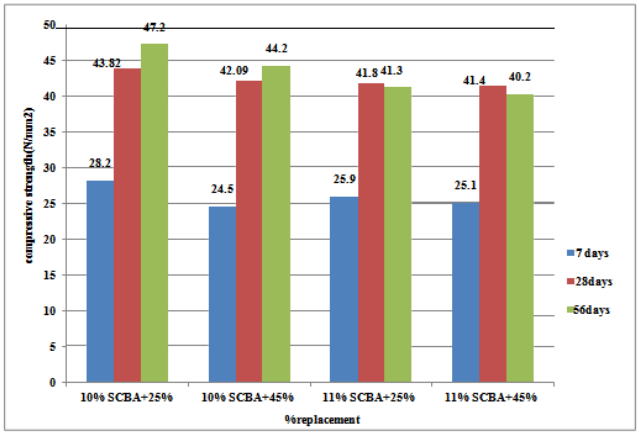
Graph4. Variation of compressive strength using RCA for 0.45

The above graph4 shows the variation between nominal mix and the partially replaced mix. Using Recycled coarse aggregate in place of coarse aggregate as 0%,25%,45%,50%,55% &75% by weight for different age like 7days, 28days and 56days for w/c-0.45. We got the maximum value at 50% for 7days, 28days & 56 days are 25.88N/mm², 41.85N/mm² & 43.5 N/mm² when compared with normal mix for 7days, 28days &56days are 23.16 N/mm²,39.18 N/mm² &41.85N/mm²



Graph5. Variation of compressive strength using SCBA & RCA for 0.43

The above graph5 shows the variation between nominal mix and the partially replaced mix. Using Recycled coarse aggregate in place of coarse aggregate as 0%,25%,45%,50%,55% &75% by weight for different age like 7days, 28days and 56days for w/c-0.43. We got the maximum value at 10% of SCBA & 25% of RCA for 7days, 28days & 56 days are 26.25N/mm², 42.82N/mm² & 46.15 N/mm² when compared with normal mix



Graph6. Variation of compressive strength using SCBA & RCA for 0.45

The above graph6 shows the variation between nominal mix and the partially replaced mix. Using Recycled coarse aggregate in place of coarse aggregate as 0%,25%,45%,50%,55% &75% by weight for different age like 7days, 28days and 56days for w/c-0.45. We got the maximum value at 10% of SCBA & 25% of RCA for 7days, 28days & 56 days are 28.2N/mm², 43.82N/mm² & 47.2N/mm² when compared with normal mix.

7. CONCLUSION

From the experimental studies the following results are concluded:

a) Sugarcane bagasse ash act like a pozzolanic material and also it gives best workability values

b) In place of cement, bagasse ash can be replaced which gives best results upto 10% replacement of SCBA

c) The compressive strength of SCBA For 7days ,28 days and 56 days for different water cement ratio(i.e 0.43 & 0.45) are 25.84N/mm², 42.82N/mm² & 45.09N/mm² for 0.43 and 27.64 N/mm²,42.82 N/mm²,46.19 N/mm² for 0.45. Scba gives best results when compared with nominal mix

d) using recycled coarse aggregate is a non virgin material also gives the best results when compared with conventional mix

e) The compressive strength of RCA For 7days ,28 days and 56 days for different water cement ratio(i.e 0.43 & 0.45) are 24.38 N/mm², 41.39 N/mm²& 43.15 N/mm² for 0.43 and 23.16 N/mm², 39.18 N/mm² & 41.85 N/mm² for 0.45

f) After many investigation and test it is concluded that SCBA and RCA can be replaced up to 10%SCBA and 25 % RCA combinely

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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