Experimental investigation on partial replacement of cement by sugarcane bagasse ash in concrete mixture

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ABSTRACT: The usage of cement has been increasing tremendously in this developing world which in turn increases the environmental pollution in the atmosphere due to its emission of carbon di oxide. One of the way to minimize the emission of green house gas is to use the agricultural and industrial waste products as a ingredient in concrete .To reduce the consumption of cement, many research works are carried out. This project addresses the appropriateness of the effect of sugarcane bagasse ash in concrete as a partial replacement of cement. In this research the bagasse ash used is collected from the sugar factory at Eraiyur,which is heated with required temperature to remove the moisture content and sieved through 300 micron sieve and then used in M40 concrete as the partial replacement of cement in the ratio of 10% , 20%, 30% by weight.To determine the properties of fresh concrete , slump cone test is conduced and for hardened concrete, compression test and split tensile strength of cube and cylinder were taken at the age of 7 and 28 days. According to the researchers SCBA generally has pozzolanic properties so addition of admixture is not necessary. So it can be used as partial replacement instead of cement but only optimum amount of bagasse ash can be replaced. Ordinary Portland cement of grade 53 is used in the study. Compressive strength and tensile strength of concrete with SCBA is compared with conventional concrete. The results shows that the strength of concrete increases with decrease in percentage of SCBA by weight. Results obtained from the test are plotted in the form of graph.

Keywords *:* SCBA, Concrete, ordinary Portland cement, compressive strength, pozzolanic.

1.INTRODUCTION

General:

In present world, cement is one of the major construction material used. The demand for the cement increases day by day due to various reasons such as increase in population, industrialization etc. At the same time, the increase in the production of cement, the atmosphere gets affected due to the emission of carbondioxide during cement manufacturing process. So many researches is been carried out across the world to minimize the demand for cement. As a result, for the problem to be solved researches focus on utilizing industrial and agricultural waste as a source of raw material for cement. Industrial wastes such as blast furnace slag, fly ash and silica fume are being used as a supplementary cement replacement material.

Recently agro wastes such as sugarcane bagasse ash is also been used as replacement material instead of cement. Sugarcane bagasse ash is a fiberous waste obtained from sugarmill as a by product. Generally these bagasse will be used by the sugarmill authorities for the production of electricity. After this production of electricity, sugarcane bagasse ash will be obtained by burning of sugarcane bagasse at high temperature. Sugarcane bagasse ash having

amorphous silica which has pozzolanic properties can be used as cement replacement material. A few study has been carried out on the ashes obtained directly from the industries such as colour of the ash, temperature at which it is burnt, particle size of the ash etc. To study the pozzolanic property and their suitability as binder, as partial replacement of cement. According to researchers it can be used as a partial replacement of cement.

Sugarcane grows in tropical countries. India is a tropical country which is one of the largest sugarcane producing country in the world. To utilize the sugarcane waste in a useful manner instead of disposing into land, it can be used as a partial replacement of cement in construction industry.

2. OBJECTIVE:

- To investigate the effect of SCBA in concrete.
- To utilize the agricultural waste in suitable manner for minimizing the disposal problem of those work.
- To determine the effect of bagasse ash on compressive strength of SCBA concrete under different percentages.
- To determine the optimum replacement of SCBA in cement, compared with conventional concrete.

3.LITERATURE REVIEW

***Ganesan et al 2007*.** Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapour. Bagasse ash mainly contains aluminium ion and silica. Use of bagasse ash as a supplementary cementitious material significantly enhances the microstructure of concrete and helps to attain less permeable concrete.

Here, bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 10% and 15% by weight of cement in concrete. Fresh concrete test like slump cone test was done and Hardened concrete test like compressive strength and flexural strength of the concrete of the concrete at the age of 7 and 28 days was done and results has been obtained. The results show that the strength of concrete increased as percentage of bagasse ash replacement increased.

Brittany Radke2012, who described thatBrazil has been mass producing ethanol from sugarcane since 1970's. Ethanol accounts for over 50% of the fuel used in passengers cars. Sugar is extracted from sugarcane. Similarly bagasse is burned to produce energy and steam for power. After burning, ash only remains. In brazil approximately 2.5 million tons of sugarcane bagasse ash are produced in each year. Aggregates acts as fillers while the cement and water are the binders that hold everything together. Manufacturing of Portland cement accounts for 5% of the world carbon emission. High silica content: 87%.Low specific gravity 1.80. Percentage passing 45 micron is 95%

Bahurudeen et al 2014.Sugarcane bagasse ash (SCBA) is obtained as a by-product from combustion boilers in sugar industries. Bagasse ash is mainly composed of reactive silica and can be used as pozzolonic material in concrete. In all previous studies, raw bagasse ash was ground to cement fineness and directly used in the concrete for the performance evaluation. In this paper,durability performance of SCBA was investigated by different methods. The methods used were rapid chloride penetration test (RCPT), chloride conductivity test and water permeability test. The results from this study show that use of SCBA in concrete significantly enhances its durability performances.

Banger sayali .S*2017,*Demand and consumption of cement is increasing day by day which has led researchers and scientists to search for locally available alternate binders that can replace cement partially and are ecofriendly and contribute towards waste management. In this direction the industrial & agricultural waste play vital role. The

agricultural waste product like Sugar Cane Bagasse Ash (SBCA) is used as alternate binding material in the present study. This will result in saving in cement production equivalent to the alternative binding material used in concrete. The bagasse ash used for the research work is obtained from Vighnahar Sugar Factory (Pune) which is grinded and sieved through sieve of size 150 micron and passing out fraction is used in concrete as a partial replacement of cement in the ratio of 2% 4%, 6%, 8% & 10%by weight of the cement. Ordinary Portland Cement 53 grade cement is used in the study. The effect of replacement of cement by bagasse ash on properties like workability for fresh concrete are tested and for hardened concrete compressive strength at the age of 7 days and 28 days are determined.

MISS.Patilb.K 2016In this work we have to study the properties of conventional concrete & moderate concrete by the replacement of cement by bagasse ash & natural sand by crushed aggregate. In this the cement will be replaced by 10%, 20%, & 30% by bagasse ash & aggregate by 100% of natural sand. Fresh concrete tests like compaction factor test and slump cone test were undertaken along with hardened concrete tests like compressive strength, split tensile strength. The result shows that bagasse ash can be a suitable replacement to cement & crushed aggregate can be a suitable replacement for natural sand & it should be economical as well as light weight.

4.MATERIALS AND METHODOLOGY

CEMENT: Ordinary Portland cement is very common and easily available everywhere. Ordinary Portland cement of grade 53 was used in this project to prepare the control specimen.

Table 1 Physical Properties of Cement

S.No	Characteristics	Value Obtained experimentally
1	Standard Consistency	30%
2	Fineness of cement as retained on 90 micron sieve	5%
3	Specific gravity	3.15

FINE AGGREGATE: Fine aggregate which is free from debris, obtained from nearby river having **2.65** of specific gravity and passing through **4.75 mm** sieve were used.

COARSE AGGREGATE: Coarse aggregate is commonly known as crushed aggregates. The nominal maximum size of **20mm** aggregate were used in this study.

S.No	Characteristics	Value Obtained experimentally
1	Specific gravity	2.71
2	Size of aggregate	20mm
3	Water absorption	2%

WATER: Water accessible within the campus laboratory were utilized for the mixing and curing of concrete specimens.

SUGARCANE BAGASSE ASH: Bagasse ash is a fibrous matter that remain after sugarcane or sorghum stalks are crushed to extract their juice. It is used as a biofuel and in the manufacture of pulp and building materials**.**

After crushing of sugarcane in sugar mills and extraction of juice from processed cane by milling, the discarded fibrous matter is called bagasse. Bagasse is burnt around 500^{o}C in a controlled process to use its maximum fuel value. The residue after burning, namely bagasse ash is collected using bag-house filter.

Bagasse ash is directly disposed to the nearest land as a slurry.In spite of being a material of hard degradation

and that presents few nutrients, the ash is used on the farms as a fertilizer in the sugarcane harvests. In this sugarcane bagasse ash was collected during the cleaning operation of a boiler operating in the ERAIYUR SUGAR FACTORY, located in Pennadam(Cuddalore), Tamilnadu. The various chemical composition of bagasse are listed

Table 2 Chemical Composition of Bagasse

S.NO	COMPONENT	MASS (%)
1	Silicon Dioxide(SiO_2)	78.34
2	Aluminium (Al_2)	8.55
3	Ferrous Oxide(Fe_2O)	3.61
4	Calcium Oxide(CaO)	2.15
5	Na_2O	0.12
6	Potassium Oxide(K_2O)	3.46
7	Magnesium Oxide(MgO)	0.13
8	Titanium Oxide(TiO_2)	0.50
9	Barium(BaO)	<0.16
10	(P_2O_5)	1.07
11	Loss of Ignition	0.42

5. MIX PROPORTIONS

Cement : 458.51 kg/m^3

Fine aggregate :851 kg

Coarse aggregate: 1022.25 kg

Water : 0.197

Water/cement ratio: 0.43

Mix proportion: 1:1.85:2.22

6.EXPERIMENTAL WORKS

Cubes and cylinders were casted for the experimental analysis, where the size of each cube was taken as 150x150mm and the size of cylinder is 150mm diameter and 300mm length. Concrete mixes were prepared as per the mix design.

These specimens were kept for the curing purpose for the period of 7 and 28 days. Afterwards cement is replaced partially by sugarcane bagasse ash for 10%, 20%, 30% of cement and same shall be cured for the mentioned period of time.

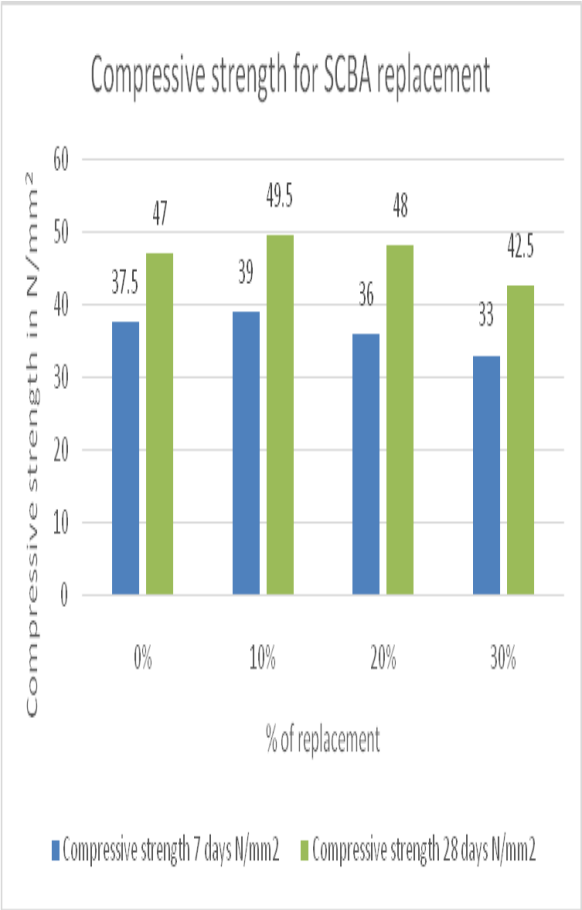
After the completion of curing period, every specimen was checked for compressive strength and split tensile strength.

COMPRESSIVE STRENGTH OF CONCRETE: Universal testing machine was used to test the complete concrete cubes. The compressive strength of concrete M40 grade were tested for the calculated mix design with partial replacement of cement by 10%, 20%, 30%. These specimen were cured for different curing period which is provided in the table and its compressive strength is determined. The results are as follows

Table 3 Compressive strength Test on SCBA replacement

Percentage replacement of SCBA	After 7 days	After 28 days
0%	37.5	47.0
10%	39	49.5
20%	36	48.0
30%	42.5	42.5

Figure 1 Compressive Strength of SCBA replaced Concrete



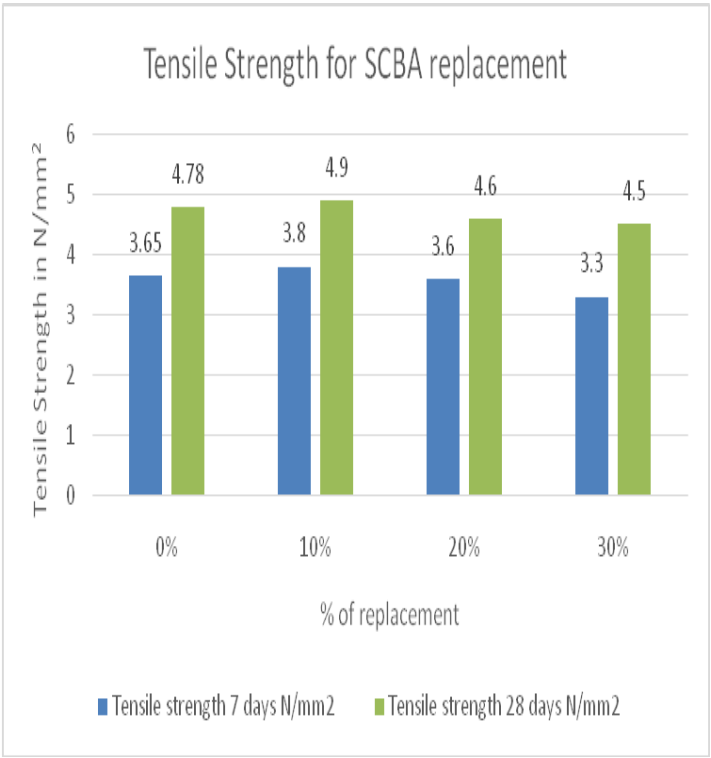
TENSILE STRENGTH OF CONCRETE :

Universal testing machine is used to determine the tensile strength of entire cylinder specimens. The results of tensile strength at different curing period are provided in the table. From the tests conducted, results are obtained and graph is plotted.

Table Tensile Strength test on SCBA replacement

Percentage replacement of SCBA	Tensile strength at 7 days N/mm^2	Tensile strength at 28 days N/mm^2
0%	3.65	4.78
10%	3.8	4.90
20%	3.6	4.6
30%	3.3	4.5

Figure 7.7 Tensile Strength of SCBA replaced Concrete



7.CONCLUSION

This research was successfully carried out by analysing the effect of SCBA in concrete as a partial replacement of cement.

The above results picturises clearly that the replacement of sugarcane bagasse ash upto 10% proves to be the best to enhance the strength of concrete and further replacement of ash decreases the workability of concrete.

The results shows that the compressive strength was decreasing with the increase in the percentage of replacement of SCBA.

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