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Study On Performance Of Sugarcane Bagasse Ash Waste As A Concrete Cement

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ABSTRACT
In recent years, environmental pollution represents major concern for society. So that researchers all over the world today are focusing on the ways of utilizing either industrial or agricultural waste, as a source of raw materials for industry. This waste utilization would not only be economical, but also results in environmental pollution control. Beyond the economic and environmental aspects, one cannot fail to see the technical advantages that come from the incorporation of mineral additives to cement. Various researches indicate benefits of rheology, on the mechanical properties and on the durability achieved by the employment of mineral additives in mortar and concrete.

The product bagasse ash waste from an in-line sugar industry and bagasse biomass fuel in electric generation industry. When the residue from sugarcane after extracting sugar is burnt under controlled conditions, it gives an ash which mainly contains amorphous silica and aluminium ion. This amorphous silica has pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industry to study the pozzolanic activity and their suitability as binders, partially replacing cement. Therefore it is possible to use Sugarcane Bagasse Ash as cement replacing material to improve quality and reduce the cost of construction. So, this new cement can be used to produce concrete and products that save on maintenance costs while they ensure a cleaner environment.

This paper presents an overview of the Sugarcane Bagasse Ash (SBA) is a by-product of sugar factories obtained after burning sugarcane as well as the results of the laboratory research especially towards environment purifying action &Sba as replacement for cement in Lightweight Concrete **[3]**. The implementation of this type of material in urban and interurban areas is not only eco-friendly but also a great savage for society.

Keywords:
SBA, Ash, Pozzolanic material & Cementatious material.

INTRODUCTION

With the development of modern society's aftermath of industrial revolution, the factory sector got momentum. This pragmatic revolution gave rise to new problems in the form of SBA (sugar bagasse ash) garbage. SBA wastes leads major environmental problems. Nowadays industrial wastes such as ground granulated blast furnace slag, pulverized fly ash and silica fumes are being used as supplementary cement replacement materials. In addition to these, agricultural wastes such as rice husk ash and wheat straw ash are also being used as pozzolanic materials. Currently, there has been an attempt to utilise the large amount of bagasse ash, the residue from an in-line sugar industry and bagasse biomass fuel in electric generation industry.

It has been known that the worldwide total production of sugarcane is over 1500 million tons. India being one of the largest producers of sugarcane in the world, produces around 300 million tons per year and large quantity of sugarcane bagasse is available from sugar mills. Sugarcane bagasse is partly used as fuel at the sugar mill. Sugarcane bagasse ash has recently been tested in some parts of the world for its use as a cement replacement material. The bagasse ash was found to improve some properties of the paste, mortar and concrete including compressive strength and water tightness in certain replacement percentages and fineness. The higher silica

content in the bagasse ash was suggested to be the main cause for these improvements. Although the silicate content may vary from ash to ash depending on the burning conditions and other properties of the raw materials including the soil on which the sugarcane is grown, it has been reported that the silicate undergoes a pozzolanic reaction with the hydration products of the cement and results in a reduction of the free lime in the concrete.

When the residue from sugarcane after extracting sugar is burnt under controlled conditions, it gives an ash which mainly contains amorphous silica and aluminium ion. This amorphous silica has pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industry to study the pozzolanic activity and their suitability as binders, partially replacing cement. Therefore it is possible to use Sugarcane Bagasse Ash as cement replacing material to improve quality and reduce the cost of construction.

EXPERIMENTAL OBJECTIVE

Main objectives of our project work is to to develop concrete with good strength with economical cost for structural applications with less cement content in it.

With the increase in urbanization like **INDIA & ETHIOPIA** countries, the number industries and consequently the amount of used SBA is going to increase significantly in the future. Hence, the no environmental nature of these wastes is going to be a potential threat. The main objectives are mentioned below:

- This study can show the suitability of using sugarcane bagasse ash as replacement of cement in concrete.
- For the purpose studying the behaviour of concrete, replacing cement by SBA in different replacement percentage to get optimum results and using it for M40 grade of concrete.
- Therefore, it is the aim of this study to compare the mechanical properties of conventional concrete and SBA replaced concrete.
- Through this study, it is Commenting on the effect of sugarcane bagasse ash on concrete with respect to workability, compressive strength and split tensile strength on concrete.
- Hence the possibility of using waste SBA as an alternative construction material will be investigated.

By conducting different tests on prepared specimens, it is intended to analyze the results.

MATERIALS USED

The basic materials for mixing Concrete are required such as

- Ordinary Portland Cement
- Sugarcane Bagasse Ash
- Aggregates
- Water
- Super Plasticizer

Ordinary Portland cement of grade 53 conforming to the requirements of IS 12269 – 1987 was used in this study. Grade of cement indicates minimum strength of cement in N/mm^2 tested as per IS 12269 – 1987. For example, 53 grade of cement should give minimum strength of 53 N/mm^2 after 28 days of curing.

Sugarcane Bagasse Ash was collected from a sugar factory near Mandya. And it was transported by packing them in cement bags

Sand is of Zone-IV as per IS: 383-1970, In this study, locally available crushed angular coarse aggregates of sizes 20 mm and 4.75 mm were used in the ratio of 70:30 for conduction of experiment in BMS laboratory,as per IS: 383-1970.

The physical properties of aggregate were consider according IS: 2386(1963).super plasticizer- Conplast SP 430 conforming to IS code 9103 – 1999 is used.

SBA (SUGERCANE BAGASSE ASH):

Sugarcane Bagasse Ash was collected from a sugar factory near Mandya. And it was transported by packing them in cement bags. Table 1 represents the chemical composition of Sugarcane Bagasse Ash.

The more percentages of Silicon and Aluminum oxides in the Table 1 shows that Sugarcane Bagasse Ash is a very good pozzolanic material **[1]** and it can be used as a suplimentary cementatious material in the construction field **[2].**

TABLE 1: CHEMICAL COMPOSITION OF SBA

Serial Number	Name of the chemical	Composition (in %)
1	SiO_2	58.55
2	Al_2O_3	15.43
3	Fe_2O_3	4.04
4	CaO	4.92
5	MgO	1.32
6	Na_2O	0.35
7	K_2O	2.68
8	SO_3	0.86
9	Loss in ignition	11.85

MIX PROPORTION

Sl No	Replace-ment	Wt of the specimen (kg)	Compressive Strength MPa	Avg Compr strength MPa
1	0%	8.190	30.520	29.07
2		8.152	27.904	
3		8.169	28.776	
4	5%	7.970	26.160	25.12
5		7.890	23.980	
6		7.730	25.230	
7	10%	7.758	22.670	20.20
8		7.491	18.312	
9		7.630	19.620	
10	15%	7.513	13.080	12.06
11		7.450	12.210	
12		7.407	10.900	

- In this study four type of mix is considered and designed as per Indian Standard Specification IS: 10262(2009).
- Water cement ratio- The water cement ratio must be correct as per grade of concrete and mix design has to be done.
- Quality aggregates – The aggregates must be high quality as per standards.
- The other three concrete mixes were made by replacing the coarse aggregates with 0%, 05% and 10% and 15% of SBA by weight.

EXPERIMENTAL PROGRAM
WORKABILITY ASPECT:

In this study, the replacement of cement by waste SBA effects on the workability of the concrete. The workability of SBA concrete shows workability of concrete decreases continuously with the increase in percentage replacement of cement with SBA. A total 24 cubes and 12 cylinder were casted for concrete of grade M40 for different percentages of SBA like 0%, 5%, 10% and 15%. The tests conducted after 7 days and 28 days of curing.

The tests results obtained are tabulated below.

Sl No	Replacement	Slump mm
1	0%	80
2	5%	100
3	10%	35
4	15%	0

HARDENED CONCRETE PROPERTIES
COMPRESSIVE STRENGTH:

Compression test according to IS: 516(1959) is carried out on these cubes. The specimens were loaded at a constant strain rate until failure. The compressive strength of concrete after 7 days of curing decreases with the increase in the percentage of replacement of cement by Sugarcane Bagasse Ash.

TABLE: 2 COMPRESSION TEST RESULTS AFTER 7 DAYS CURING.

Above table 2 shows that, The Compressive strength of concrete after 7 days of curing decreases with the increase in the percentage of replacement of cement by Sugarcane Bagasse Ash.

TABLE: 3 COMPRESSIVE STRENGTH AFTER 28 DAYS CURING

Sl No	Replacement percentage	Wt of the specimen (kg)	Compressive Strength Mpa	Avg Compr Strength MPa
1	0%	8.140	47.088	46.22
2		8.100	46.216	
3		8.260	45.344	
4	5%	7.910	37.060	35.32
5		7.720	34.880	
6		7.840	34.010	
7	10%	7.700	40.200	41.60
8		7.630	41.860	
9		7.610	42.730	
10	15%	7.530	29.212	28.92
11		7.580	30.520	
12		7.430	27.030	

Above table 3 shows that, the compressive strength of concrete after 28 days decreases initially at 5% replacement and then increases slightly at 10% replacement and then it

decreases with the increase in replacement percentage of cement with SBA.

SPLIT TENSILE ASPECT:

Each three cylinders of size 150 mm in diameter and 300 mm in length were cast and cured for 28 days. Each splitting tensile strength result is the avg of the three specimens. The test was conducting in a compression testing machine as per the Indian code IS 516 – 1959 and the maximum load applied on the specimen at the failure was recorded. And calculated by using appropriate equation.

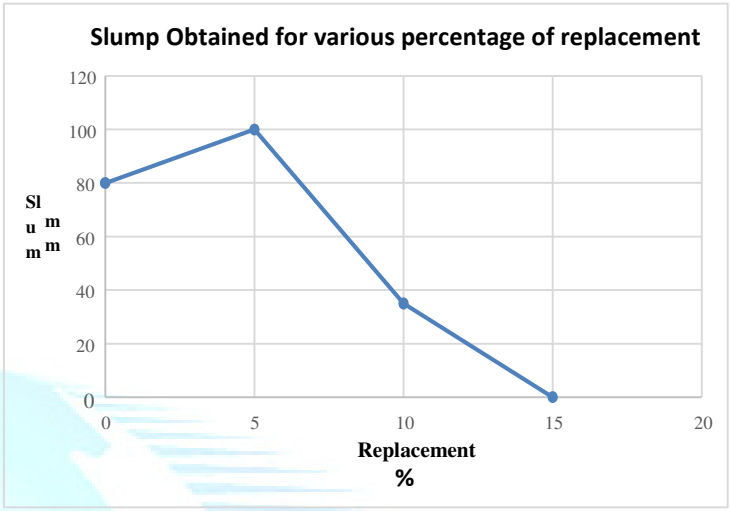
TABLE 4: SPLIT TENSILE TEST AFTER 28 DAYS CURING.

Sl No	Replacement %	Diameter of specimen (D) in mm	Length of specimen (L) in mm	Split Tensile Strength Mpa	Avg Split Tensile Strength MPa
1	0%	150	280	3.270	3.38
2		150	280	3.494	
3		150	280	3.382	
4	5%	150	280	3.006	2.85
5		150	280	2.703	
6		150	280	2.858	
7	10%	150	280	3.168	3.29
8		150	280	3.420	
9		150	280	3.292	
10	15%	150	280	2.678	2.74
11		150	280	2.795	
12		150	280	2.735	

Above table 4 shows the split tensile strength of concrete after 28 days of curing decreases initially at 5% replacement and then increases slightly at 10% replacement and then it decreases with the increase in replacement percentage of cement with SBA.

GRAPHS:

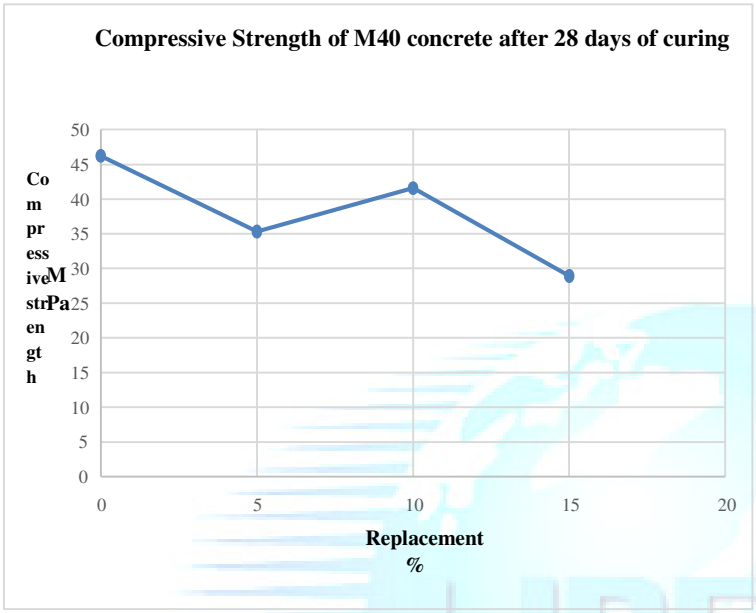
VARIATION SLUMP FOR DIFFERENT PERCENTAGES OF REPLACEMENT OF CEMENT WITH SBA



COMPRESSIVE STRENGTH OF CONCRETE AFTER 7 DAYS

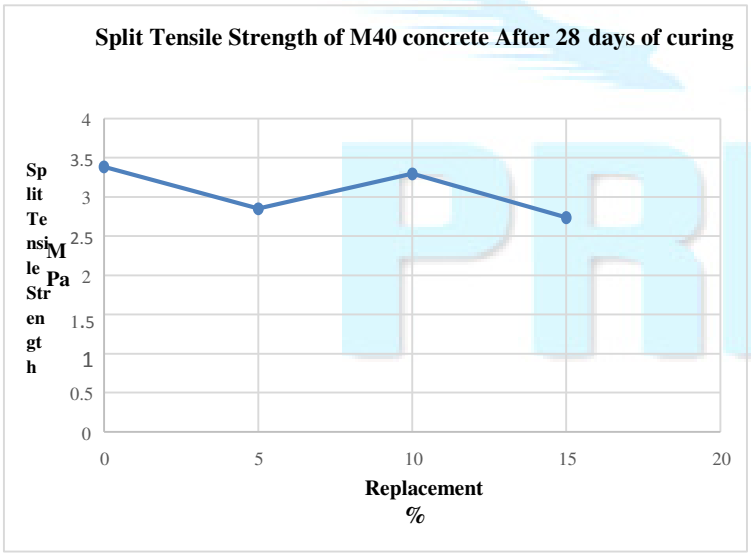
From above graph known that the compressive strength of concrete after 7 days of curing decreases with the increase in the percentage of replacement of cement by Sugarcane Bagasse Ash.

COMPRESSIVE STRENGTH OF CONCRETE AFTER 28 DAYS



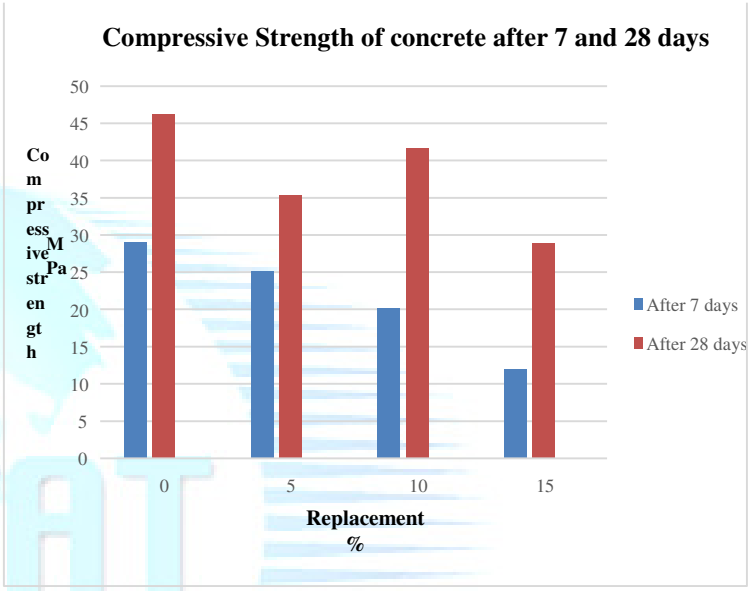
It is known that, the compressive strength of concrete after 28 days of curing decreases initially at 5% replacement and then increases slightly at 10% replacement and then it decreases with the increase in replacement percentage of cement with SBA.

SPLIT TENSILE STRENGTH OF CONCRETE AFTER 28 DAYS



Above graph shows, the split tensile strength of concrete after 28 days of curing decreases initially at 5% replacement and then increases slightly at 10% replacement and then it decreases with the increase in replacement percentage of cement with SBA.

COMPARISON OF COMPRESSIVE STRENGTH OF CONCRETE AFTER 7 AND 28 DAYS OF CURING



INFERENCES AND CONCLUSIONS:

- The compressive strength of concrete after 7 days of curing decreases with the increase in percentage of replacement of cement with Sugarcane Bagasse Ash.
- The results showed that, the concrete with 10% of SBA after 28 days of curing, had higher strength when compared to concrete with other replacement percentages.
- The results of both compression test and split tensile tests suggests that Sugarcane Bagasse Ash can be used for partial replacement of cement up to 10% by weight of cement without any major loss in strength.
- The results show that the reduction in compressive strength is least for 10% replacement when compared to other replacement percentages. Hence 10% is considered as the optimum percentage for replacement.
- The slump test results show that, at higher replacement percentages (i.e. 10% and above) of cement by SBA there is loss in the workability of concrete in terms of slump value. This is the main disadvantage of using Sugarcane Bagasse Ash as a supplementary cementitious material.

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