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STUDY ON THE STRENGTH AND COST ANALYSIS OF CONCRETE WITH SUGARCANE BAGASSE ASH

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***Abstract*— Cement mortar & Concrete is most widely used construction materials. Due to the boost of the construction activity in the country, a huge shortage is created in most of the construction materials especially cement, resulting in steady increase of price. Agricultural waste materials are usually dumped to landfill causing economic and environmental problems. The present work focuses on ash for partial cement replacement obtained from agricultural wastes, either by incineration in the laboratory or directly from industries where the waste has been incinerated for energy production. The Sugarcane bagasse ash mixture provides strength equal to the nominal strength of the concrete and reduces the cost at a large scale**

This paper is summarizes the experimental studies on strength of cement mortar with partial replacement of Ordinary Portland cement by Sugarcane Bagasse Ash (SBCA). Cement mortar paste were prepared with various percent of SCBA as partial replacement of OPC in range 5%, to 20 % by weight of cement. The compressive strength test was carried out as per relevant Indian standard codes. The test results show that replacement of cement to the extent of approximately 10% by weight of cement was found to give the optimum results for the 28 days strength.

***Index Terms*— Concrete, Compressive Strength, Replacement, Sugarcane Bagasse Ash.**

I. INTRODUCTION

Ordinary Portland cement is the most extensively used construction material in the world. Cement is the third most energy intensive material after steel and aluminum produced in tones. Cement industry consumes raw materials rich in silica, alumina, iron and calcium. Therefore this industry has been actively involved in finding ways to use waste products in the manufacturing of cement both as secondary fuel and raw material.

Increasing concern for environmental protection, energy conservation with minimal impact on economy have been motivating researchers to look for other alternatives for cement in the concrete industry. If some of raw material having similar composition can be replaced by weight of cement in concrete then cost could be reduced without affecting its quality. For this reason sugarcane bagasse ash (SCBA) is one of the main byproduct can be used as binders, partially replacing cement.

Bagasse is a by-product from sugar industries which is burnt to generate power required for different activities in the factory. The burning of bagasse leaves bagasse ash as a waste, which has a pozzolanic property that would potentially be used as a cement replacement material. It has been known that the worldwide total production of sugarcane is over 1500 million tons. Sugarcane consists about 30% bagasse whereas the sugar recovered is about 10%, and the bagasse leaves about 8% bagasse ash (this figure depend on the quality and type of the boiler, modern boiler release lower amount of bagasse ash) as a waste. The disposal of the bagasse ash will be of a serious concern.

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

In this study, sugarcane baggese ash (SBA) was replaced for cement in various proportions of 0%, 5%,10%,1 5%, 20% in Cement Sand Mortar and its compressive strength was studied.

II. MATERIALS

Sugarcane Bagasse Ash

Sugarcane production in India is over 300 million tons/year that cause about 10 million tons of SCBA as un-utilized and

waste material. The sugarcane bagasse ash used for the study was collected during the cleaning operation of a boiler operating in the Maa Rewa Sugar Mill located in Bhitoni, Jabalpur,

Madhya Pradesh. The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin. Each ton of sugarcane generates approximately 26% of bagasse (at a moisture content of 50%) and 0.62% of residual ash. The residue after combustion presents a chemical composition dominates by silicon dioxide (SiO2). 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.

Chemical properties of SCBA used in preparing blended mortars and pastes are shown in Table no.1.

Water consistency, setting time of pastes and flow values of mortar were checked before preparing the final specimens. Mortar specimens (75 x 75 x 75 mm) and pastes were prepared with four replacement ratios. Strength development was studied by subjecting blended mortars to (compressive and flexural strength).

Table no. - 1

Chemical Composition Comparision of OPC & SCBA								
	SiO2	Al2O3	Fe2O3	CaO	MgO	SO3	K2O	OI
OPC	18.4	5.6	3.0	66.8	1.4	2.8	0.5	2.0
SCBA	62.43	4.38	6.98	11.8	2.51	1.48	3.53	4.73

A. Cement:

The most common cement is used is ordinary Portland cement. Many tests were conducted to cement some of them are consistency tests, setting tests, soundness tests, etc.

B. Fine Aggregate:

Locally available free of debris and nearly riverbed sand is used as fine aggregate. The sand particles should also pack to give minimum void ratio, higher voids content leads to requirement of more mixing water. In the present study the sand conforms to zone II as per the Indian standards. The specific gravity of sand is 2.68. Those fractions from 4.75 mm to 150 micron are termed as fine aggregate, and the bulk density of fine aggregate (loose state) is 1393.16kg/m3 and rodded state is 1606.84kg/m3.

C. Water:

Water available in the college campus conforming to the requirements of water for concreting and curing as per IS: 456-2000.

III. EXPERIMENTAL INVESTIGATION

A total of 5 Mortar mixes were prepared, one of the mixes was made of 100% cement (no SCBA content), The remaining 4 mixes were prepared by adding SCBA content partial replacement to cement i.e. 5%,10%,15% and 20% respectively of weight of cement. These mixes are denoted by SCBA content, e.g. 5% SCBA. The tests for compressive strength were conducted on mortar cubes of size 75mmx75mmx75mm, Details of all specimens are given in Table 2. All mortar ingredients were mixed according to the procedure given Indian Standard Guidelines. All the values are the average of the three trails in each case in the testing program of this study.

Table no. 2 Compressive Strength of Mortar

Replacement of Cement by SCBA	**Compressive Strength (N/mm2)**		
	3 Days	7 Days	28 Days
0 %	24	37	50
5%	21	37	49
10%	22	36	48
15%	12	20	33
20%	4	9	17

IV. CONCLUSION

Based on the experimental studies following conclusion can be drawn.

- Concrete had significantly higher compressive strength compare to that of the concrete without SCBA. It is found that the cement could be advantageously replaced with SCBA upto maximum limit of 15%. Although, the optimal level of SCBA content was achieved with 15 % replacement.
- Partial replacement of cement by SCBA increases workability of fresh concrete, therefore use of super plasticizer is not essential.
- It is cost effective too as it mitigates the cost by 12% for 1 m3 of concrete.
- Thus a cheaper concrete can be made with industrial waste products for an equivalent strength.

The utilization of bagasse ash in concrete solves the problem of its disposal thus keeping the environment free from pollution.

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