Experimental Study on Partially Replacement of Cement by using Sugar Cane Bagasse Ash in Concrete

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Abstract

The recent technology is towards waste utilization and cost reduction in construction industries. In today's construction industry concrete is major and versatile building materials and in concrete, cement is the most expensive material and our project deals with, to reduce cement cost by introducing agricultural waste in concrete and may also environmental pollution control. Sugar cane bagasse ash is used as a partial replacement of concrete. India produces around 24MT of sugar these days and also same is approximately the estimated sugar cane bagasse ash (SCBA) produce of India. Sugar cane bagasse ash (SCBA) is replaced by cement up 0% to 20% in concrete and their comparative is study is done on basis of their compressive strength and workability. The slump cone test was under taken as well as hardened concrete test is compressive strength and tensile strength at the age of 7,14 and 28 days was obtained.

Keywords — *sugar cane bagasse ash, cement, concrete*

I. INTRODUCTION

Portland pozzolana cement is recognized as a major construction material throughout the world. Researchers all over the world today are focusing on ways of utilizing either industrial or agriculture waste, as a source of raw materials for industry. This waste, utilization wouldn't only be a economical, but may also environmental pollution control. Industrial wastes, such as blast furnace slag, fly ash and silica fume are being used as supplementary cement replacement materials. Currently, there has been an attempt to utilize the large amount of bagasse ash, the residue from an in-line sugar industry and the bagasse-biomass fuel in electric generation industry. When this waste is burned under controlled conditions, it also gives ash having amorphous silica, which has pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industries to study pozzolanic activity and their suitability as binders, partially replacing cement. It is also used in concrete without adverse effect in concrete durability. Therefore, it is possible to use Sugarcane Bagasse Ash (SCBA), as cement replacement material to improve quality and reduce the cost of construction material such as mortar, concrete pavers, and concrete roof tiles and soil cement interlocking block. The present study was carried out by Partial Replacement of Cement by Sugarcane Bagasse Ash (SCBA). Our project analyses the effect of SCBA in concrete at ratio of 0%, 5%, 7.5%, 10%, 15%, 20%. The experimental study examines the compressive strength of hardened concrete. The main ingredients consist of Portland Pozzolana Cement, SCBA, river sand, coarse aggregate and water. After mixing, concrete specimens were casted and subsequently all test specimens were cured in water at 7,14, and 28 Days.

II. MATERIALS USED

A. Cement

The most common cement is used is Ordinary Portland Cement. Out of the total production, Ordinary Portland Cement accounts for about 80-90%. Many tests were conducted to cement some of them are Consistency test, Setting Time tests, etc.

B. Fine Aggregate

Fine aggregate is locally available, free from debris and soil and nearly river bed sand is used. 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 (IS). The specific gravity of sand is 2.60. Those passing from 4.75mm to 150 microns are known as F.A.

C. *Coarse Aggregate*

The crushed aggregate used were 20mm nominal maximum size and are tested as per Indian standards and results are within the permissible limit. The specific gravity of coarse aggregate is 2.80.

D. *Water*

The requirements of water for concreting and curing as per IS: 456 – 2000, after available in college campus.

E. *Sugarcane Bagasse Ash (SCBA)*

The sugarcane bagasse ash consists of approximately 50% of cellulose, 25% of hemi cellulose and 25% of lignin. Each tons of sugarcane generates approximately 26% of bagasse. The specific gravity of sugarcane bagasse ash is 2.

III. OBJECTIVES

- To determine the effectiveness of sugarcane bagasse ash (SCBA) as a cement material in concrete.
- To evaluate the pozzolanic activity of bagasse ash with cement.
- To achieve increase in strength and a better bonding between aggregate and cement paste.

IV. ADVANTAGES AND APPLICATION

A. Advantages

- To improve the quality and reduce costs of construction materials.
- Low specific gravity-2 (cement specific gravity 3.12)
- Bagasse ash is very light weight.

B.Application

- Making of floor and wall tiles.
- Bricks manufacturing
- Light weight in concrete.

V. LITERATURE REVIEW

R.Srinivasan and K.sathiya conducted an experiments on concrete cubes, cylinder and prism specimens in which cement was replaced with SCBA in 0-25% ratio. It was observed that the strength of concrete under compression, tension, young's modulus and flexure increased up to 10% of replacement after that strength result was decreased.

Nithi Relan and Dr.A.K.Saxena conducted on experimental study by replacing the cement in concrete by SCBA in 5-25% ratio and conducting compressive strength test and slump test on resulting concrete. The test result indicated that the cement could advantageously replace with SCBA up to a maximum limit of 12.5% for M35 concrete, also the study revealed that the compressive strength increased up to 10% replacement whereas beyond 15% replacement the strength was found to be decreased.

Dr.D.B.Raijiwal and JayminKumar A.Patel replaced the cement by 0 & 5% SCBA. 150X150X150 mm cubes were casted in M25 concrete and tested the specimen for 7^{th} day, 14^{th} day, 28^{th} day and 56^{th} day of curing in compressive Testing machine. The results show that the compressive strength of concrete can be increased reducing the consumption of cement indicating best use of SCBA instead of landfilling and making the environment clean.

Pragalbha Khare and Neeti Mishra replacement for cement in concrete as well as mortar. It can be easily replaced up to 20%. In case of split tensile strength 10% replacement gave higher strength. The improvement in compressive strength of mortar by partially replacing cement by SCBA is due to filler effect and pozzolanic reaction between reactive SiO_2 from SCBA and $Ca(OH)_2$ from cement hydration.

Lathamaheswari.R, and Mohankumar.G replaced the cement by 2.5, 5, 7.5, 10 and 12.5%of bagasse ash. Mix design is made for conventional M20 grade concrete and tested the specimen for 7^{th} day, 14^{th} day and 28th day of curing in compressive strength test. The optimum level of cement replacement with bagasse ash is observed to be 7.5%.

Mallikharjuna Rao Kelam and V.Sandeep partially replaced the cement at ratio of 0%, 5%, 7.5%, 10%,12.5% and 15% was compared with nominal mix. Cubes were casted and tested in compressive and tensile strength test. 12.5% of bagasse ash replaced concrete has given more strength when compared to the normal concrete.

Piyush Kumar and Pratap Singh conducted an experiments on concrete cubes and cylinder specimen in which cement was replaced with sugarcane bagasse ash in 0%, 5%, 10%, 15% and 20% ratio. The strength of normal concrete by using grade M30 at 7days and 28 days. It is found that the cement could be advantageous replaced with bagasse up to maximum limit of 10%.

Bangar Sayali. S, Gawade Anjali. Y and RahaneA. B conducted on experimental study by partially replacement of cement in the ratio of 2%, 45, 6%, 8% and 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.

G.Nithin Kumar Reddy, G,Harsha Vardhan and S.Vijaya Bhaskar Reddy partially replaced the cement by 0%, 5%, 10%, 15%, 20% and 25% the cubes are been casted and cured in normal water. SCBA concrete performed better when compared to ordinary concrete up to 10% replacement of sugarcane bagasse ash due to presence of high amount of silica in SCBA.

VI. MATERIAL REULTS

TABLE I
Test result of cement

S.No.	Properties	Value
1.	Finess	5%
2.	Specific Gravity	3.12
3.	Initial Setting time	40 minutes
4.	Final Setting time	635 minutes

TABLE II
Test result of Coarse Aggregate

S.No.	Properties	Value
1.	Impact value	7.43%
2.	Crushing value	13.85%
3.	Water absorption	1.80%
4.	Specific gravity	2.65

TABLE III
Test result of sugarcane bagasse ash

S.No.	Properties	Value
1.	Finess	6%
2.	Plasticity Index	Non plastic
3.	Specific gravity	2.1

TABLE IV
Test of Fresh Concrete

% of SCBA	Workability	
	Slump(mm)	Compaction factor
0%	75	0.92
5%	187	0.96
10%	200	0.96
15%	220	0.97
20%	225	0.97

VII. EXPERIMENTAL INVESITIGATION

A. Preparation and Casting of Specimen

This study included a preparation cube samples (150 × 150 × 150 mm) for compressive strength test and samples of cylinder (150 mm diameter × 300 mm height) for split tensile strength test. For each mix, 3 cubes were tested for compressive strength at 7 days 14 days and 28 days of curing, 3 samples of cylinder were tested for split tensile strength for 7 days, 14 days and 28 days of curing.

A. Compression test Results

TABLE V
Compressive strength (N/mm²) of concrete

MIX	Compressive strength (N/mm²)		
	7th day	14th day	28th day
Conventional	14.41	19.20	21.45
M1	15.85	20.21	29.48
M2	13.98	19.81	24.76
M3	8.96	18.87	19.32
M4	8.57	18.34	18.85

B. Tensile test Results

TABLE VI
Tensile strength (N/mm²) of concrete

MIX	Tensile strength (N/mm²)		
	7th day	14th day	28th day
Conventional	0.722	1.342	1.625
M1	0.954	1.548	1.942
M2	0.900	1.334	1.62
M3	0.738	1.307	1.45
M4	0.634	1.165	1.253

IX. CONCLUSION

- ✓ Replacement of cement by ash reduce industrial waste and to save cement. By saving cement reduced greenhouse gases emission and makes environmental green.
- ✓ The result of the hardened properties of the mix have shown that the concrete mix proportion of partial replacement of the cement by using waste material higher compressive strength almost at all tested age of concrete.
- ✓ From the above experimental result, it is proved that, waste material can be used partial replacement for the cement and compressive strength are increased by using waste material.
- ✓ Percentage replacement: We have taken maximum percentage replacement so that maximum cement can be saved and also prevent environmental pollution.

REFERENCES

[1] Jayminkumar A. patel, Dr.D.B.Raijiwala "Experimental study on Use of Sugar cane Bagasse Ash in Concrete by Partially Replacement with Cement", International Journal of Innovative Research in Science, Engineering and Technology, Vol.4, Issue 4, April 2015.

[2] R.Srinivasan and K,Sathiya "Experimental study on Bagasse Ash in Concrete" International Journal of Innovative Research in Science,Engineering and Technology, Vol.5, 2010.

[3] Pragalbha Khare, Neeti Mishra "Partial Replacement of Cement with Sugar Cane Bagasse Ash in Concrete: A Review" International Research Journal of Engineering and Technology (IRJET), Vol.5, April 2018.

[4] IS 456 – 2000, Bureau of Indian Standard, New Delhi.

[5] IS 10262 – 2009, Guidelines for concrete mix design proportioning.

[6] M.S.Shetty, 'Concrete Technology' Chand & co Ltd, India.