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Experimental Investigation on Replacement of Bagasse Ash in Bricks

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ABSTRACT: This paper carried out partial replacement of fly ash by bagasse ash in order to reduce industrial waste. The effective use of these waste products is challenging task for researcher through environmental impact. Bagasse is often used as a primary fuel source for sugar mills. When burned in quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare. This sugar manufacturing industries produces a lot of sugarcane bagasse ash which is disposed off in an open land. Huge quantity of ash which is a waste product, available at very negligible rate. This sugarcane bagasse ash is a fibrous waste product and has pozzolanic properties which can be made use in construction industry. Pozzolanic materials can be used as a partial replacement in the production of low cost fly ash bricks. The aim of this research was to make economical and green bricks to maintain environmental balance, and avoid problem of ash disposal. It is very essential to dispose these wastes safely without affecting health of human being and environment. So, there is a great need for its reuse, also it is found that bagasse ash in high in silica and found to have pozzolanic property. So it can be used as substitute to construction material.

KEYWORDS: SCBA, Fly ash bricks, Greener bricks.

I. INTRODUCTION

Population scenario comes towards India by means of increasing industries. The fruitful efforts of industries lead to develop India. As the industries increases also the waste coming from them at the end of product increases. At the end of survey result coming that the amount of the approximately 250 to 300 million tons of industrial wastes are being produced every year by chemical and agricultural process in India. It is very essential to dispose these wastes safely without affecting health of human being, environment, fertile land, sources of water bodies; etc. Sugar cane bagasse, the fibrous residue after crushing and juice extraction of sugar cane, is a major industrial waste product from the sugar industry. The burning of bagasse which a waste of sugarcane produces bagasse ash. Presently in sugar factories bagasse is burnt as a fuel so as to run their boilers. This bagasse ash is generally spread over farms and dump in ash pond which causes environmental problems also research states that Workplace exposure to dusts from the processing of bagasse can cause the chronic lung condition pulmonary fibrosis. So there is great need for its reuse, also it is found that bagasse ash is high in silica and is found to have pozzolanic property so it can be used as substitute to construction material. Agro wastes such as rice husk ash, wheat straw ash, hazel nutshell and sugarcane bagasse ash are used as pozzolanic materials for the development of construction materials. Sugarcane is major crop grown in over 110 countries and its total production is over 1500 million tons. Sugarcane production in India is over 300 million tons per year. The processing of it in sugar-mill generates about 10 million tons of SCBA as a waste material. One ton of sugarcane can generate approximately 26% of bagasse and 0.62% of residual ash. The residue after combustion presents a chemical composition dominated by silicon dioxide⁽³⁾.

In 2009, the total production of sugarcane in the world was estimated to be approximately 1661 million tons. The largest producer of sugarcane is Brazil. Bagasse is often used as a primary fuel source for sugar mills; when burned in

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quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill. The dumping of these industrial wastes in open land poses a serious threat to the society by polluting the air and waste bodies. This also adds the no availability of land for public use. After the extraction of all economical sugar from sugarcane, about 40-45% fibrous residue was 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 SCBA contains high amounts of un-burnt matter, silicon, aluminum and calcium oxides⁽⁴⁾.

II. MATERIALS AND METHODS

The material used for this experimental work are Fly ash, SCBA, water, lime and quarry dust.

Fly ash

Fly ash is finely divided residue resulting from the combustion of powdered coal, transported by the flue gases and collected by electrostatic precipitators. Its proper disposal has been a cause of concern since long, which otherwise leads to pollution of air, soil and water. Fly ash can be referred as either pozzolonic or cementious. A cementious material is one that hardens when mixed with water. It also improves workability and reduces internal temperature. Pulverized fuel ash commonly known as fly ash is a useful by-product from thermal power stations using pulverized coal as fuel and has considerable pozzolanic activity. Fly ash is collected from different rows of electrostatic precipitators in dry form. It is a fine-grained, powdery particulate material in nature. It is carried through the flue gas and collected from the flue gas by means of electrostatic precipitators, bag-houses or mechanical collection devices such as cyclones. Fly ash is generally light tan in color and consists mostly of clay-sized and silt-sized glassy spheres. Coal based thermal power plants all over the world face serious problems of handling and disposal of the ash produced. Nearly about 67% of the total energy consumption in the country is fulfilled by coal as it is one of the primary sources of energy. India is one of the largest resources of coal in the world. The high ash content (30-50%) of the coal in India makes this problem complex. At present, about 80 thermal power stations produce nearly 100 million tons of coal ash per annum. Safe disposal of the ash without adversely affecting the environment and the large storage area required major concerns. The coal ash can be utilized in bulk only in engineering applications such as construction of embankments as a backfill material, as a sub material etc.

SCBA

The burning of bagasse which a waste of sugarcane produces bagasse ash. Presently in sugar factories bagasse is burnt as a fuel so as to run their boilers. This bagasse ash is generally spread over farms and dump in ash pond which causes environmental problems also research states that Workplace exposure to dusts from the processing of bagasse can cause the chronic lung condition pulmonary fibrosis, more specifically referred to as bagassosis. So there is great need for its reuse, also it is found that bagasse ash is high in silica and is found to have pozzolonic property so it can be used as substitute to construction material. 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 dominated by silicon dioxide (SiO_2). 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.

Quarry dust

Quarry dust is a residue produced during the crushing process of boulders. It has sharp edges. It is just like sand but mostly grey in color.

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Water

Water plays an important role in the formation of concrete as it participates in chemical reaction with cement. Due to the presence of water the gel is form which helps in increase of strength of concrete. Almost any natural water that is drinkable and has no pronounced taste or odour can be used as mixing water. Water from lakes and streams that contain marine life are also usually suitable. Water available in the site campus conforming to the requirements of water for concreting and curing as per IS:456-2000.

Lime

Pure calcium oxide is fused with coke in order to render the highest yield in the manufacture of acetylene. The quality of the resultant carbide lime is a direct result of the excellent quality raw materials. Carbide lime is finer in particle size, and physically, having a very finely divided particle size makes carbide lime better. A finer particle size means faster and more reactivity..

III. TESTING METHODS

To determine the hardened properties of bricks standard tests like compression test on bricks for compressive strength, of brick, water absorption test and room temperature test were carried out at 7days and 28days of curing.

Compressive strength

Compressive strength test was carried out for bricks with different mix proportion of carbon buster. The specimen is placed between two plywood sheets of each having 3mm thick and carefully centered in compression testing machine. The ultimate load is noted. The compressive strength is the ratio of ultimate load to the resisting area of brick loaded. An average of three specimens are taken as the compressive strength.

$$\text{Compressive strength} = \text{Ultimate load} / \text{Resisting Area}$$

Table 5.1 compressive strength of carbon buster brick

S.NO	SCBA PERCENTAGE	COMPRESSIVE STRENGTH(N/mm ²)
1	0	5.85
2	10	5.98
3	20	6.43
4	30	6.98
5	40	5.15
6	50	4.58

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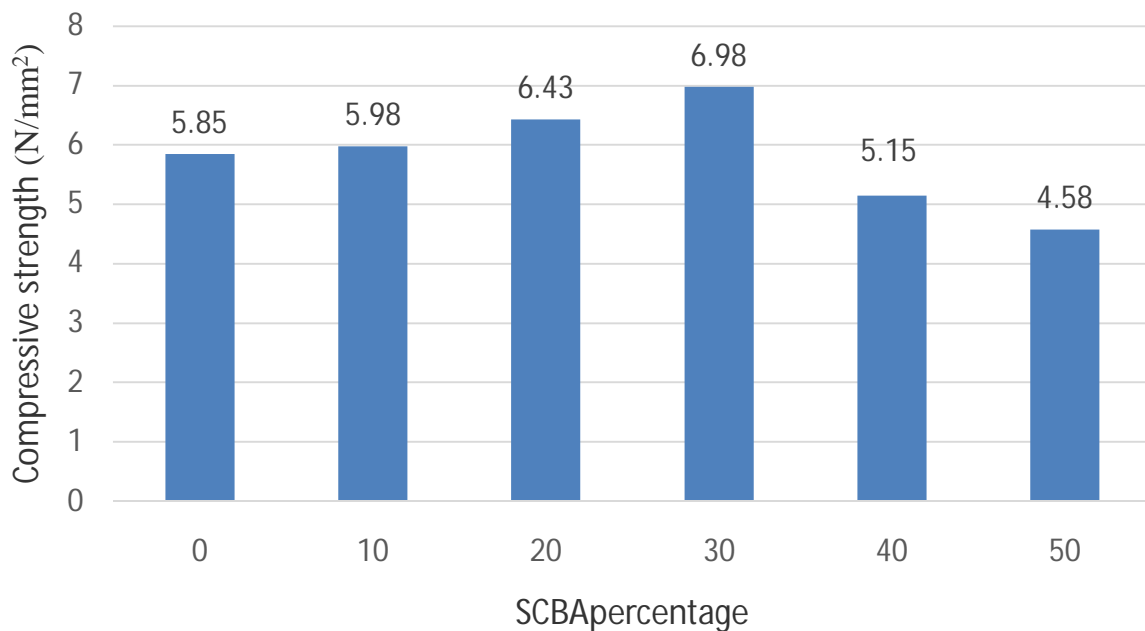


Fig: 5.1 Compressive strength of SCBA brick

Water absorption

In Water absorption test, the dry weight of brick was noted as weight (M_1). Then the dry brick was completely immersed in water at room temperature for 24 hours. After 24 hours bricks were removed from the water and allowed to drain for 3 minutes and wipe out any traces of water with damp cloth. Now the weight was noted as (M_2). The water absorption was calculated in percentage and tabulated in table.

$$\text{Water absorption (\%)} = \frac{\text{wet weight} - \text{dry weight}}{\text{Dry weight}}$$

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Table Water absorption of carbon buster brick

S.NO	SCBA PERCENTAGE	DRY WEIGHT OF BRICK(M1)	WET WEIGHT OF BRICK(M2)	WATER ABSORPTION
1	0	3.22	3.52	8.40
2	10	3.48	3.78	8.157
3	20	3.23	3.55	8.86
4	30	3.33	3.64	8.640
5	40	3.40	3.72	8.68
6	50	3.35	3.65	8.25

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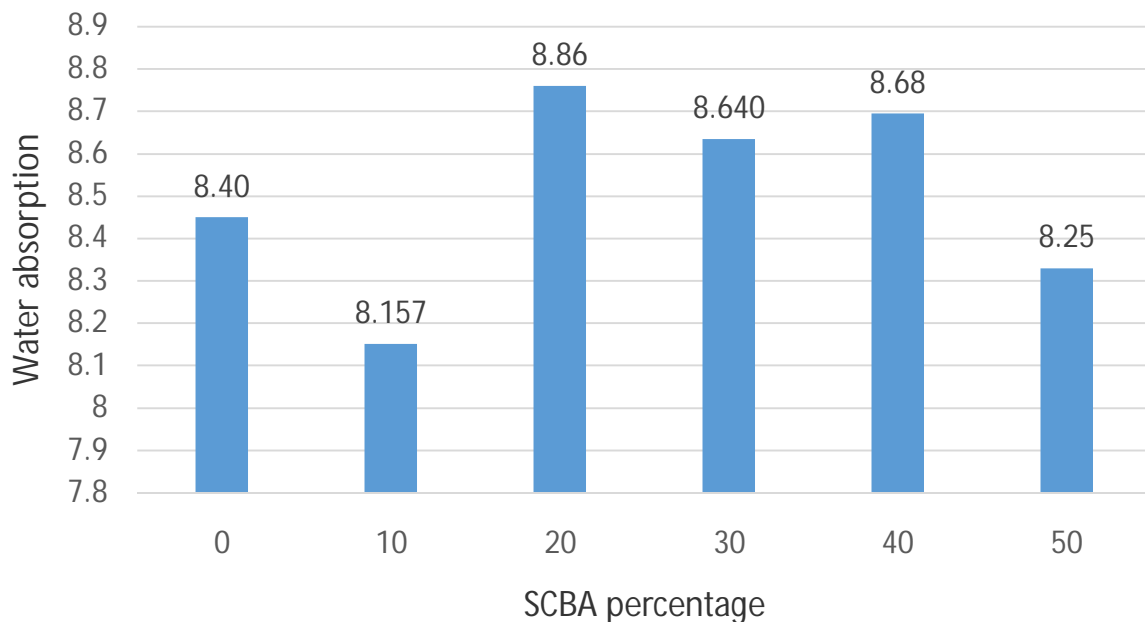


Fig: : Water absorption of SCBA bricks

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Testing for compression load

All wall panels were tested for a uniformly distributed compression load. To transfer the externally applied concentrated load as a uniformly distributed load at the top of the wall, I-Section was placed at the top of the wall. Two Displacement gauges were placed at top of the wall and the top midpoint of the wall. Using this testing arrangement, the compression load is increased with a loading rate of 0.5 Kn/Sec.



Test setup on wall panel

The objective of this study is to determine the compressive and flexural strength of the wall panel tested according to standard test requirement, as indicated in BS 5628: PART1: 1992(4). For the cement sand mixture, the mix proportion of 1:2 (1kg of cement and 2kg of sand) with addition of water was used to make standard cement mortar. The size of wall 0.5 X 0.5 X 0.23m.

Table :Wall panel test for SCBA bricks

S. No	Load (Kn)	Lateral Displacement (mm)	Linear Displacement (mm)
1	0	0	0
2	5	0.64	4.30
3	10	1.12	6.83
4	15	2.32	11.08
5	20	3.18	11.56
6	25	4.07	14.78

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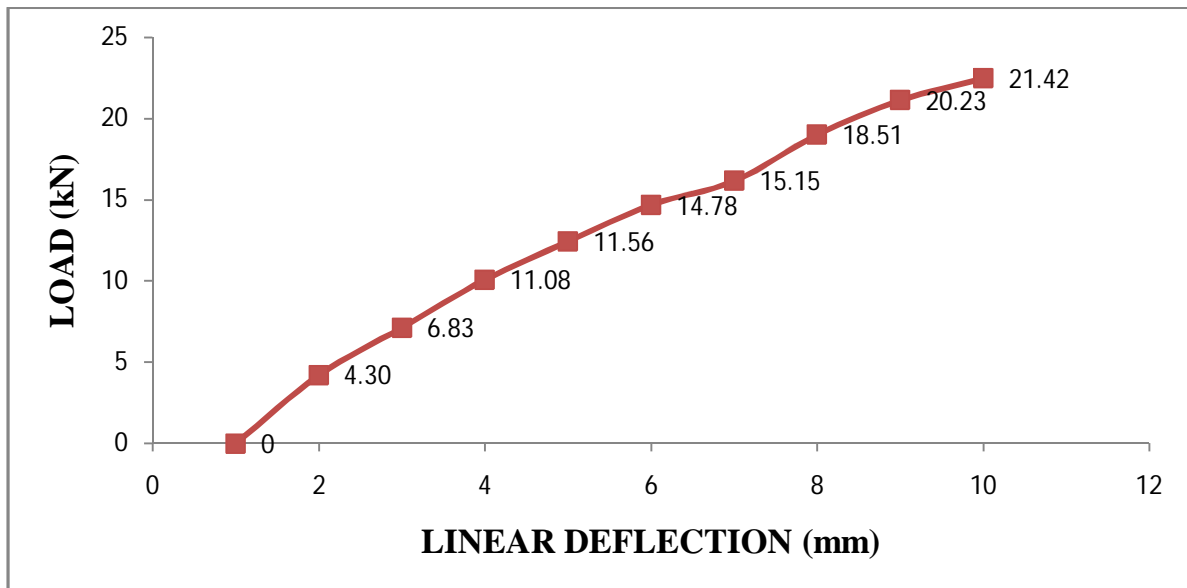
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7	30	5.22	15.15
8	35	6.13	18.51
9	40	7.27	20.23
10	43.2	8.38	21.42

Brick is the most commonly used building material which plays a minor role in resisting fire. When brick is exposed to fire there is a major reduction in its strength. Fire safety measures in structural members are generally termed as fire resistance.



IV. CONCLUSION

Based on experimental investigations, the following observations are made regarding of partially replaced Bagasse ash:

- Use of bagasse ash in brick can solve the disposal problem, reduce cost and produce a 'greener' Eco-friendly bricks for construction.
- Environmental effects of wastes and disposal problems of waste can be reduced through this research.
- A better measure by an innovative Construction Material is formed through this research.
- It provides innovative use of class F fly ash which contains less than 20% lime.
- This study helps in converting the non-valuable bagasse ash into bricks and makes it valuable.

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