e-ISSN:2582 - 7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 5, Issue 4, April 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 5.928

International Journal Of Multidisciplinary Research In Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928|

| Volume 5, Issue 4, April 2022 |

|DOI:10.15680/IJMRSET.2022.0504006 |

Durability Study of AAC Block Using Agricultural Waste

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ABSTRACT: Autoclaved AAC blocks are also known as autoclaved lightweight concrete (ALC). Autoclaved Aerated Concrete (AAC) is one of the green and certified building materials. Basically, aerated concrete is a mixture of cement, fly ash, gypsum, lime, water and aluminum powder. Lightweight concrete is widely used as a new building material in global infrastructure and has good thermal properties. Compared to ordinary concrete, aerated concrete has only 20% of its mass, which significantly reduces construction costs. The low specific weight of aerated concrete is almost 400 to 800 kg/m3.Aerated concrete is a lightweight concrete. Foam concrete is also called aerated concrete. Depending on the production, there are two main types. They are aerated concrete (non-autoclaved aerated concrete (NAAC)) and autoclaved aerated concrete (AAC). In the case of aerated concrete, samples are placed in an autoclave where steam curing of the sample takes place. Steam curing maintains a high temperature of 180°C and a pressure of up to 12 bar. Autoclaving time can vary from 8 to 12 hours. Cement or mortar base mix (cement + sand + water). In this overview document, more emphasis is placed on NAAC, in which the curing of concrete cubes or blocks is done with water. NAAC is made by adding a predetermined amount of aluminum powder and other additives to the slurry of sand, cement and water. In the case of NAAC, aggregates larger than sand are not used to make concrete. Foam concrete is not a particularly new material.

KEYWORDS: cement, waste polypropylene fibre; soil stabilization; sugarcane bagasse ash

I. INTRODUCTION

In general, autoclaved aerated concrete (AAC) is made from quartz-rich sand, lime, cement and calcium sulphate with traces of aluminium powder as a pore former. These components mix with large amounts of water and melt into a cellular green body with H2 gas. atmospheric pressure and then autoclaved for several hours at 200 ◦C under saturated steam pressure (Hauser et al., 1999). Aluminium reacts with calcium hydroxide or alkali, releasing hydrogen gas and forming bubbles as in Eq. (1). The rate at which air bubbles form is critical to the success of the final AAC product. The produced lightweight aerated concrete has a bulk density of 400-800 kg/m3, lower thermal conductivity, higher heat resistance and lower shrinkage than conventional concrete.

$$2Al + 3Ca(OH)_2 + 6H_2O \rightarrow 3CaO \cdot Al_2O_3 \cdot 6H_2O + 3H_2(gas) \quad (1)$$

In recent years, the production of lightweight concrete by incorporating siliceous pozzolanic material such as silica fume, coal fly ash and slag has received increased attention due to economical use of natural raw materials, recycling of waste materials and energy saving. Hauser studied pulp mill fly ash in AAC blends and found that the highly reactive calcium aluminates in fly ash produce significant amounts of hydrogarnet products, which increase the strength of concrete. Mostafa found that AAC samples replaced with blast furnace slag consumed lime faster than samples without slag. , and thus also the bound water increases due to the increasing amount of calcium silicate hydrate formed. Coal fly ash is a well-known substitute material, binder or aggregate for the manufacture of concrete, and today a large amount of fly ash is already used in the construction industry as a partial substitute for cement or filler ore and in cement manufacture. However, the use of BA is limited due to its relatively higher unburned carbon content and other structural properties compared to fly ash. However, it may be possible to separate unburned carbon by inexpensive treatment methods such as mechanical classification/particle size, gravity separation and electrostatic separation and evaluate the unburned carbon treated fraction in the concrete industry. BA is widely used as a low-cost substitute for

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| Volume 5, Issue 4, April 2022 |

|DOI:10.15680/IJMRSET.2022.0504006 |

more expensive sand for concrete production and as a fine aggregate in high-performance lightweight concrete (Kula et al., 2002). A previous study by Cheriaf confirmed that BA's pozzolanic activity could be enhanced by proper milling. However, it should also be noted that the BA milling resulted in an increased settling time and caused a reduction in the workability of the cement pastes. the one generally accepted by the concrete industry (yet; 6%). The pre-treated fly ash was then used as an aggregate with different replacement amounts. The mechanical, physical and microstructural properties of raw and finished products were studied to find out the effect of BA incorporation on AAC properties.

The construction industry consumes vast amounts of natural resources each year while generating a significant amount of construction and demolition (C&DW) waste. One of the biggest challenges for manufacturers is the implementation of measures to transition to a circular economy industry that, together with an efficient resource recovery system, brings environmental and economic benefits. Autoclaved Aerated Concrete (AAC) arises from the need to obtain a lightweight, pre-packaged material with the same physical and mechanical properties as a compact product. The massive growth of the application of Aerated Concrete (AAC) in the construction industry began in 1940 in Europe, supplies in a large amount of aerated concrete waste (AACW) in recent years.

II. LITERATURE REVIEW

Saand et al., (2019) studied the effect of partially replacing cement with rice hull ash at different percentages, i.e., H. 0%, 2.5%, 5%, 7.5%, 10%, 12.5% and 15%. Up to 10% replacement of cement with rice hull ash has been found to increase compressive strength and splitting strength, but further increasing the percentage of rice hull ash beyond 10% strength begins to decrease. The maximum values of compressive strength and divided tensile strength for 10% replacement of cement by RHA are 4.4 MPa and 0.53 MPa, respectively.

He et al., (2019) used fibres from recycled wood and rubber powder in Supported communication. Researchers used the different levels of recycled wood fibre and rubber powder in AAC to improve its performance and reduce negative environmental impacts. 0.4% has been found to be the optimum wood fibre content for the strength of aerated concrete blocks. No effect is observed at 0.5% and 1% gum powder content. A high performance AAC can be obtained with 1% gum powder content and 0.4% wood fibre content.

Sukmana et al. (2019) used phosphonyls in NAAC to study the effect on compressive strength. Taguchi's method is used for the experimental design. The result shows that the best composition for NAAC is Portland cement containing 34% phosphonyls. 35% and quicklime 10% to achieve the best resistance value of 20.93 kg/cm2 at a density of 806 kg/m3.

Karolina R. and Muhammad F. (2017) concluded that fly ash and bottom ash can be used in the manufacture of lightweight concrete to minimize the use of cement and sand. For standard NAAC lightweight concrete, the water uptake is 5.66%, which is the largest uptake in the study, and 2.76% is the smallest uptake when 30% fly ash is added to the concrete. For normal NAAC, the compressive strength is 8.891 MPa, which is the lowest compressive strength in the study, and the highest compressive strength is 12.687 MPa using fly ash. The researcher also concluded that the addition of 30% fly ash to the concrete provided the highest tensile strength, i.e., H. 1,540 MPa, while NAAC offers the lowest tensile strength, i.e., H. 0.801 MPa.

III. OBJECTIVES

1. To study and compare strength and durability characters of AAC blocks using bagasse ash, without bagasse ash
2. To study economic feasibility of AAC blocks adding bagasse ash
3. Observe advantages and disadvantages using bagasse ash in AAC blocks
4. Environmental benefits of AAC blocks using bagasse ash

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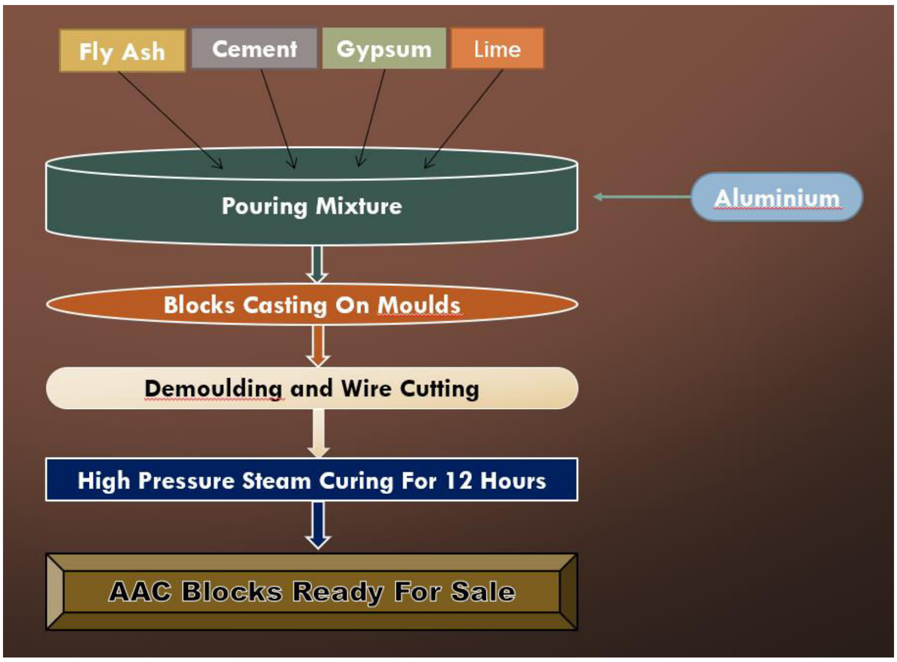
IV. MATERIAL USED

Cement: Cement is a material that is important in various types of construction, cement is a binder. The OPC used in AAC blocks are 53 Grade of cement, density of cement is 1440 kg/m3 and 53 MPa of compressive strength.
Fly Ash: Fly ash is a waste from industrial product used to reduce the cost of construction. It has pozzolanic properties, that it reacts with lime to form Cementous compounds.
Bagasse Ash: Sugarcane bagasse is one of the byproducts of industry, it is the waste from the combustion process. Sugarcane bagasse ash is procured from Waingangā Sugar and Power factory which located in Bhandara district.
Gypsum: Gypsum is a soft sulfate mineral composed of calcium sulfate dihydrate and it is used in powder form.
Limestone: Limestone is composed mostly of minerals calcite and aragonite. The purpose of adding lime is to make a binding between materials.
Aluminumpowder: Aluminum powder is powdered aluminum;it is an expansion agent.

V. METHODOLOGY



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VI. OBSERVATION TABLE

Mix proportions

1. Total Dry Material = 2500 gm
2. FLY ASH:LIME:CEMENT: GYPSUM = 69:20:8:3
3. Water ratio = 0.60-0.65
4. Aluminum is about 0.08% of total dry materials in the mix
5. Type of Cement – OPC Grade 53
6. Amount of Polypropylene = 0.4% of total dry material in the mix

Name of Sample	%Of Sample	Bagasse Ash	Fly Ash	Cement	Gypsum	Lime	AI Powder	Polypr-opylene
CT	0 %	0	1725 gm	200 gm	75 gm	500 gm	2 gm	0
(FA+SC BA)	10 %	175 gm	1575 gm	200 gm	75 gm	500 gm	2 gm	0
	20 %	350 gm	1400 gm	200 gm	75 gm	500 gm	2 gm	0
(FA+SC BA+PP)	10 %	175 gm	1725 gm	200 gm	75 gm	500 gm	2 gm	10 gm
	20 %	350 gm	1725 gm	200 gm	75 gm	500 gm	2 gm	10 gm

VII. RESULTS & DISCUSSION

1.Specific Gravity Test

Sr No	Samples	Weight	Specific Gravity
1	Weight of Empty Dry Bottle (W_1)	7.63 gm	**1.72**
2	Weight of Bottle + Bagasse Ash (W_2)	27.510 gm	
3	Weight of Water Filled with water and Bagasse Ash (W_3)	75.760 gm	
4	Weight of Water (W_4)	67.470 gm	

$$\text{Specific Gravity} = \frac{(W_2 - W_1)}{(W_4 - W_1) - (W_3 - W_2)}$$

2. Density Test

$$Density = \frac{\text{Specific Gravity of Material}}{\text{Specific Gravity of Water}}$$

$$Density = \frac{1.7152}{1}$$

$= 1.7152\ gm/cm^3$

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3. Compression Strength

Name of Sample	% Of Sample	Size of Blocks (mm)	Weight of Cube (Kg)	Density (Kg/m^3)	Load (KN)	Compression Strength (N/mm^2)	Mean Compression Strength (N/mm^2)
CT	0 %	150*150	2.5	750	100	4.5	4.5
(FA+SCBA)	10 %	150*150	2.9	720	91.37	4.2	3.85
		150*150	2.6		79.99	3.6	
	20 %	150*150	2.3	710	68.98	3.1	3.45
		150*150	2.4		85.02	3.8	
(FA+SCBA+PP)	10 %	150*150	3.0	730	116.55	5.2	5.0
		150*150	3.4		110.18	4.9	
	20%	150*150	2.9	720	105.98	4.7	4.6
		150*150	3.0		99.95	4.5	

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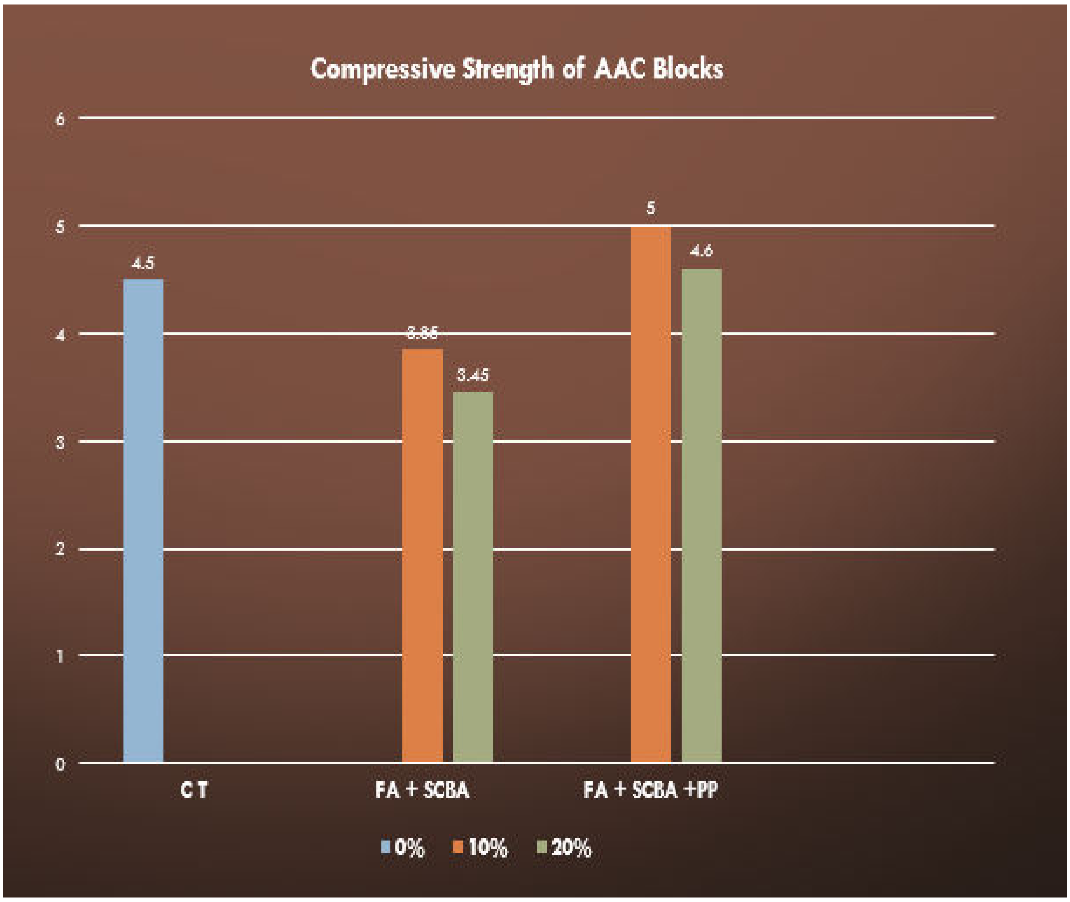

VIII. CONCLUSION

Sugar cane bagasse ash has a low specific gravity, which may be due to a large amount of light unburned particles (carbon content). The density of the sample is 1.72 g/cm3, which means that bagasse ash is a very light material. A new type of ACC using sugar cane waste from bagasse ash as the siliceous raw material, cement and lime as the calcareous raw material, and aluminum powder as the blowing agent has been successfully produced. From the result and the graph, it can be seen that when 10% of the cement is partially replaced with sugar cane bagasse, there is good compressive strength of 20% replacement, and the workability of the concrete is not affected, and it is economical.

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| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928|

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