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Review on 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.



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 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.

Disposing of AAC in landfills instead of being reused and recycled in new construction can cause environmental problems such as: B. the leaching of pollutants and pH changes in the surrounding soil and water. The AAC production market is valued at US\$6.32 billion in 2016 and is projected to reach US\$10.98 billion by 2023. The advanced properties of autoclaved aerated concrete and the increasing importance of green buildings are some of the key factors affecting the growth of the market. The exceptional properties of AAC are due to its closed-cell porous structure, created by the reaction between the alkaline components of cement and a blowing agent, aluminium powder. To promote the crystallization of calcium silicate hydrate phases (especially Tobermory), a significant amount (2-5%) of calcium sulphate is added to the raw materials in the form of gypsum or anhydrite. Therefore, the chemical composition of AAC waste can represent an important limit in its recycling, as sulphate compounds can cause serious technical problems such as efflorescence and internal sulphate attack, as well as environmental impacts (salinization, sulphite formation, eutrophication) caused by leaching into groundwater.

II. LITERATURE REVIEW

Saand et al., (2019) studied the effect of partially replacing cement with rice hull ash at different percentages, i.e., 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. (1)

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% woodfibrecontent. (2)

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. (3)

Fabien et al., (2019) performed experimental work on the substitution of sand by recycling residual perlite and pure perlite. Pure perlite sand and residual perlite sand (30% +30%), that is used for sand substitution, is characterized by its low density, which causes the concrete to expand in non-autoclaved conditions. The presence of these waste products reduces mechanical resistance but improves thermal insulation. It has been found that by increasing cement by 2% we can increase mechanical strength by 21%. A 100% consumed material with a thermal conductivity of 0.176 W/. k was obtained. Therefore, non-autoclaved expansion solutions have fuelled the development of thermal insulation materials based on the recycled product. (4)

Kunchariyakun et.al., (2018) conducted an experimental study on replacing sand with two agricultural wastes, namely rice hull ash and bagasse ash in the production of AAC blocks. These samples are sterilized in an autoclave at different autoclave temperatures (140 °C, 160 °C and 180 °C) and different times (4 h, 8 h and 12 h). The effect of increasing temperature and autoclaving time has been found to be directly related to increasing resistivity and microstructural properties. But at 180°C it has been found that there is no significant increase in strength with time. The reason the strength does not increase significantly is because the Si ions in the sand reach their maximum dissolution. (5)



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. (6)

Shuisky A. et al., (2017) studied the effect of the additive sodium sulphate in NAAC. In this study, a sample containing 1.54% sodium sulphate was prepared and the most swollen portion was removed from the sample. This extracted part is used to prepare a new sample. Three new samples were prepared using 20% trim with a sodium cement variation of 1.23%, 2.4% and 3.7%. After analysing these samples, they concluded that adding sodium sulphate at a level of 1.23% and cutting back by 20% gave the best structural properties. (7)

Shrivastva and Tiwari (2017) use different proportions of aluminium in the production of AAC blocks with a size of 70.6 mm*70.6 mm*70.6 mm. The percentage of aluminium used is 0%, 0.04%, 0.08%, 0.12% and 0.16% of the dry weight of the material. The researchers observed that the density of the concrete decreases as the proportion of aluminium powder increases. It is observed that the compressive strength of sample S1 (when the percentage of aluminium powder used is 0.04%) and S2 (when the percentage of aluminium powder used is 0.08%) of the NAAC block is 4.48 N/mm² and 3.75 N/mm² which is higher than the strength of the third-class brick. (8)

Il'ina and Rakov., (2016) studied the effect of grinding Portland cement clinker with silica, carbonate components and mineral additives on the mechanical properties of NAAC. Wollastonite and diopside are used as additives to test the compressive strength, thermal conductivity and density of NAAC. The addition of additives to NAAC reduces the energy consumption in the concrete. The hardness and modulus of elasticity of the diopside additives are higher. The addition of 5% diopside gives a compressive strength of 3.3 MPa, a thermal conductivity of 0.131 W/m and an average of 580 kg/cm³. Density. (9)

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

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.

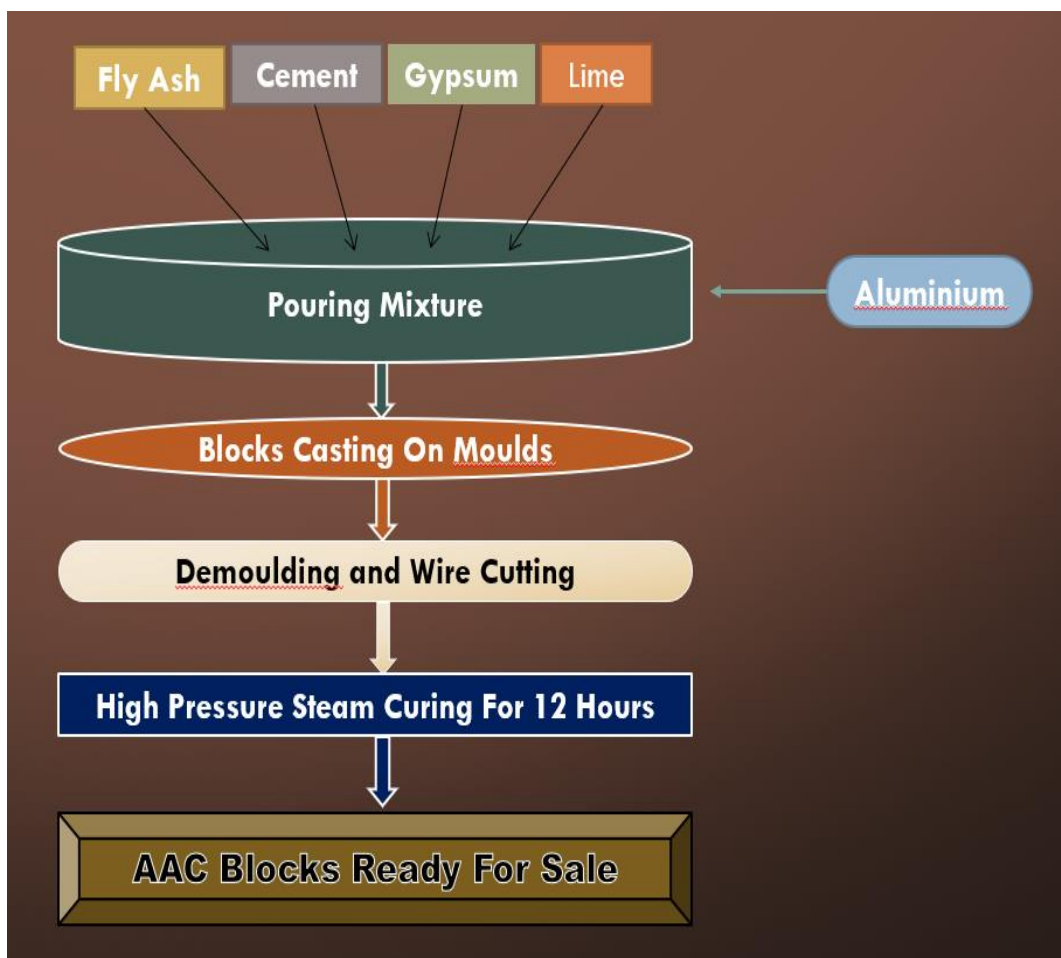
Bagasse Ash:Sugarcane bagasse is one of the byproducts of industry, it is the waste from the combustion process. Sugarcane bagasse ash is procured from Waingangā Sugar and Power factory which located in Bhandhara district.

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.

Aluminum powder:Aluminum powder is powdered aluminum, It is an expansion agent.

V. METHODOLOGY



VI. 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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