Impact of Saw Dust and Crushed Waste Glass in the Properties of Sandcrete Blocks – A General Review

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ABSTRACT

Sandcrete blocks have been in use in many nations of the world for a long time, playing a major role in the building and construction industry. The urge to find alternative materials to existing conventional ones and the need to improve the strength of sandcrete blocks have compelled researchers to intensify work on substitutes to cement with a view to investigating their usefulness wholly as a construction material or partly as a substitute for cement in sandcrete blocks. This paper reviews the possible use of rice husk ash (RHA) and coconut husk ash (CHA) as a partial replacement of cement in sandcrete block production.

Keywords: Sandcrete blocks, Rice Husk Ash, Coconut Husk Ash, Engineering Properties.

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1. INTRODUCTION

Blocks made from a mixture of sand, cement and water are called Sandcrete blocks. They are used extensively in virtually all African countries including Nigeria. For a long time until perhaps a few years ago these blocks were manufactured in many parts of Nigeria without any reference to any specifications either to suit local building requirements or for good quality work. The high and increasing cost of cement has contributed to the non-realization of adequate housing for both urban and rural dwellers. Alternatives to cement as a material for construction are very desirable in both short and long term as a stimulant for socio-economic development. In the short run, any material that can complement cement and is much cheaper will be of great interest. Over the past decade, the presence of mineral admixtures in construction materials has been observed to impart significant improvement on their strength, durability and workability [6].

Sawdust or wood dust is a by-product of cutting, grinding, drilling, sanding or otherwise pulverizing wood with a saw or other tool, it is composed of fine particles of wood. It is the main component of particleboard. SD used in this research is a mixture of wastes from both hard and soft woods. The sawdust thereby constitutes an environmental nuisance as they form refuse heaps in the areas where they are disposed. The use of sawdust as a partial replacement to sand and provide an economic use of the by-product and consequently produce cheaper blocks for low cost buildings. Production of sandcrete blocks were made by partial replacement of sand with a varying proportion (10%, 20%, 30%, 40%) of sawdust, concluded that if the recommendations herein should be followed, problems of cost and weight in building construction shall be reduced [1].

Large quantities of waste glass, especially in the form of empty bottles are thrown away as garbage and the quantity of such glass waste is likely to be on the increase as more and more foodstuffs and drinks are sold in glass bottles and containers. The above poses a

disposal problem which is accentuated by severe restrictions on environmental pollution. It is generally believed that glass is not suitable for use in concrete because alkali in the cement paste may react with the silica in the glass causing harmful expansion. The alkali-silica reaction (ASR) can occur in concrete produced with many other types of aggregate, and the problem has been extensively studied [2]. The partial replacement of natural aggregate by waste glass in Portland Cement Concrete was studied. The research showed that there are several approaches that can effectively control the expansion of ASR due to glass aggregate. These are in addition to the conventional approaches used to minimize ASR expansion of regular Portland Cement Concrete, such as the use of silica fume and various additives [5], [3].

2. MATERIALS AND METHODOLOGY

The materials used and research methodology employed in the investigations were thus presented.

2.1 MATERIALS OF SANDCRETE BLOCKS

The sandcrete blocks were made of sand, cement, water, SD and CWG.

2.1.1 Sand

The sand used was clean, sharp river sand that was free of clay, loam, dirt and any organic or chemical matter. It was sand passing through 4.70 mm zone of British Standard test sieves. The sand had a specific gravity of 2.66 and an average moisture content of 0.90%. The coefficient of uniformity of the sand was 2.95.

2.1.2 Cement

The cement used was Ordinary Portland Cement from the West African Portland Cement Company, Ewekoro in Ogun state of Nigeria with properties conforming to BIS 12-1971.

2.1.3 Water

The Water used was fresh, colourless, odourless and tasteless potable water that was free from organic matter of any type.

2.1.4 Sawdust (SD)

It was composed of fine particles of wood. The physical and chemical properties of sawdust vary significantly depending on several factors, especially the species of wood. SD used was the mixture of wastes from both hard and soft woods. Preliminary analysis was conducted on the sawdust to determine their suitability for block making. Tests conducted include: particle size analysis of sand, specific gravity test on sawdust and sand. Majority of the fine particles of sawdust passed through 4.76 mm BS test sieve.

2.1.5 Crushed Waste Glass (CWG)

The crushed waste glass was obtained from a supplier with Beta Glass Plc, Agbara, Industrial Estate, Lagos, Nigeria. Broken bottles were obtained from some breweries, washed dried and later crushed into fine aggregates. The chemical analysis of the crushed waste glass and the cement used in the investigation were carried out at the Federation Institute of Industrial Research and Organization (FIIRO) at Oshodi, Lagos. Table 2 shows the results of the crushed waste glass (first and second batches) used in the first test. Table 3 shows the results of the chemical analysis of the crushed waste glass and cement used in the second test.

The specific gravity of CWG was also determined. This was found to be 2.51 for the first batch and 2.50 for the second batch (first test)

Table 1. Chemical Analysis of CWG (First Test)

	CRUSHED WASTE GLASS	
	BATCH1	BATCH 2
OXIDES	LEVEL DETECTED (%)	LEVEL DETECTED (%)
SiO^2	72.11	72.24
Na_2O	13.38	11.36
CaO	8.27	8.12
K_2O	2.44	3.26
MgO	1.50	2.70
$A1_2O_3$	0.80	1.12

Table 2. Chemical Analysis of CWG and Cement (Second Test)

OXIDES	CRUSHED GLASS (%)	CEMENT (%)
Silica (SiO^2)	73.04	21.0
Calcium Oxide(CaO)	7.74	64.73
Sodium Oxide (Na_2O)	13.68	0.19
Ferrous Oxide (Fe_2O_3)	0.15	4.75
Potassium Oxide (K_2O)	0.2	0.42
Barium Oxide (BaO)	0.03	-
Aluminum Oxide (Al_2O_3)	2.54	5.22
Sulphate (SO_3^2)	-	1.48
Lead Oxide (PbO)	0.02	-
Magnesium Oxide (MgO)	2.60	2.01

2.2 RESEARCH METHODOLOGY

The research methodology consisted of general procedure for making and testing of sandcrete blocks [7].

- ✓ Washed sharp sand was collected from bed of river Kaduna in the northern part of Kaduna.
- ✓ Bags of Portland Cement (Dangote Cement were purchased)
- ✓ The cement and sand was measured in liters according to mix ratio of the research using measuring bowl.
- ✓ The cement and sand was then mixed at ratio 1:1 before 0.35 liters of water-cement ratio was added which is considered to be an optimum for proper hydration and maximum strength.
- ✓ The mould was then lubricated with oil.
- ✓ The cement-sand and water mixture was then fed into the mould of the block, and raised to a height of 0.6 m for proper compaction.
- ✓ The compacted block was carefully removed on leveled surface timber plate and placed on a good location for curing.
- ✓ Step 6 and 7 were repeated until the entire mix ratio was exhausted from ratio 1-6.
- ✓ The block produced was cured by spraying water.
- ✓ At the age of 7 days, 3 blocks per each mix ratio from the brand of cement was carried to the material laboratory of the civil engineering department, Kaduna Polytechnic where compressive strength were determined.
- ✓ The above procedure was repeated for the remaining mix ratio at the age of 7, 14, 21 and 28 days respectively.

2.3 MANUFACTURE OF SANDCRETE BLOCKS

The blocks can be made in a machine or alternatively approved metal or wooden moulds can be used:

The usual sizes are as follows:

a. 450 mm x 225 mm x 225 mm
b. 450mm x 150 mm x 225 mm
c. 450 mm x 115 mm x 225 mm

The mix ratio of 1:8 at different replacement of sand with sawdust in the percentage range 0-40% at intervals of 10% were used for the manufacture of sandcrete blocks of size (b). Mix design was carried out by absolute volume method to select the most suitable materials (cement, SD, sand and water) that will produce blocks with the desired properties. The cement, SD and sand were then mixed together to obtain a homogenous mixture and the resulting mortar was transferred to the steel hollow mould to half the depth. The block samples were allowed for wet curing and later sent for compressive tests [1].

Sandcrete block of size (a) with two mix proportions 1:6 and 1:8 were used in that investigation. In the first test crushed waste glass was used as a partial replacement of the sand in the sand-cement matrix with the percentage of CWG by volume of the total fine aggregate was then varied in steps of 5% to a maximum of 30%. In the second test the CWG was used as a partial replacement of the cement in the sand-cement matrix with the percentage of the fine CWG by weight of the cement was then varied in steps of 5% to a maximum of 30%. Hand mixing was employed and the materials were turned over a number of times until an even colour and consistency were attained. After removal from moulds and kept for wet curing. Testing for crushing strength was then carried out at ages 7, 14, 21, 28 days [5].

2.4 COMPACTION

This can be done by the use of approved standard machine compaction but hand compaction can also be used when the blocks have been manually produced using metal moulds. In either case, what is essential is that the approved strength must be attained. In that research effort standard machine compaction was utilized [5].

2.5 DISCUSSION OF RESULTS

Increase in the replacement level of sawdust with the sand also increases the water-cement ratio. At 10% sawdust replacement, there was about 10% reduction in weight and 3% reduction in production cost. For achieving better results in the use of sawdust for sandcrete blocks production, the percentage replacement of sand should not be more than 10%. Sawdust sandcrete blocks were eco-friendly and for reducing the building weight, sawdust sandcrete blocks could be a good option [1].

In the first test, CWG was used as partial replacement of the sand in the sand-cement matrix. The compressive strength of sandcrete blocks was increased by 31% at a mix ratio of 1:6 and increased by 33% at the mix ratio of 1:8. The optimum CWG content was found to be 15% for the mix ratio of 1:6 and 20% for the mix ratio of 1:8. The compressive strength of the blocks began to fall as the percentage CWG content increased. In the second test, CWG was used as partial replacement of the cement in the sand-cement matrix. The compressive strength of sandcrete block of size (a) was increased by 74% at a mix ratio of 1:6 and

increased by 66% at a mix ratio of 1:8. The compressive strength of sandcrete block of size (b) was increased by 39% at a mix ratio of 1:6 and increased by 23% at a mix ratio of 1:8. The optimum CWG content was found to be 5% irrespective of the mix proportion [5].

2.6 CONCLUSION

The main conclusions derived from this investigation are as follows:

- ✓ This literature survey has given the guidelines for the manufacture of Sandcrete Blocks.
- ✓ For obtaining the best results, mix proportion of 1:8 and partially replacing sand with 10% of Saw Dust and 20% of Crushed Waste Glass is recommended.
- ✓ The replacement of 10% Saw Dust with sand, there is about 10% reduction in weight and 3% reduction in production cost.
- ✓ The increase in the strength of sandcrete blocks, due to the presence of lime in the cement reacts with the silica in the CWG.
- ✓ In the future line of work, sandcrete blocks can be manufactured with SD and CWG with the mix proportion of 1:8 as per Indian Standards with the base of Nigerian Industrial Standards will be studied.
- ✓ The impact of both SD and CWG in the Properties Sandcrete Blocks will be studied.

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