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RESEARCH ARTICLE

Partial Replacement of Cement with Sawdust Ash in the Production of Sandcrete Blocks

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ABSTRACT

The need to find alternative materials to existing conventional ones and the urge to find a cheaper building material have compelled researchers to intensify work on substitute blocks. This project investigates the use of saw dust ash as a partial replacement of cement in sand crete block production. The sand Crete mix ratio of 1:12 were cast, cured and crushed at 7, 14, 21 and 28 days of ages to get their compressive strength. The sand Crete blocks were made of different levels of sawdust ash (SDA) cement replacement of 10%, 15% and 20% levels of sawdust ash (SDA) cement replacements. Apart from the strength test of the sand Crete blocks made of graded levels of sawdust ash (SDA) cement replacement. The result showed that the addition of sawdust ash (SDA) increased the porosity of the blocks but reduced their weights. Only 10% SDA replacement is adequate for use in sand Crete blocks for non-load bearing walls in buildings. It was seen that at 28 days of the curing period none of the blocks met the NIS required standard of 2.0N/MM2 for none load bearing walls. The 10% SDA replacement came very close with 1.78N/MM2 as curing continues till 56 days it may attain the minimum required strength for none load bearing wall. The weight of the sand Crete blocks decreases as the level of SDA increases in the block.

Keywords: *Sawdust Ash, Sandcrete Block, Cement, Partial Replacement*

Introduction

The basic necessity of man is food, air, water and shelter. Therefore, there is a serious need for affordable construction materials in providing adequate shelter for the teaming populace of the world. Walling material are of different types, but the commonest in Nigeria is sand crete blocks. Seeley (1993) defines sand crete blocks as walling material that is made of coarse natural sand or crushed rock dust mixed with cement in a certain proportion and water, and moderately compacted into shapes. On molding, they set, harden and attain adequate strength to be used as walling materials. The quality of sand Crete blocks is the function of the method employed in the production and the properties of the constituent's materials (Raheem et al, 2012). The materials used for production of sand Crete hollow blocks are cements, sand and water. Cement is highly noted to be the most expensive out of these materials, it could be asserted that both the limited raw materials and the industrial processes undergone by cement during production stages may have accounted for its high cost.

Sawdust or wood dust is a by-product of cutting, drilling, sanding or otherwise pulverizing wood with a saw or other tool, it is composed of fine particles of wood. It is also the byproduct of certain animals, birds and insect which live in wood, such as woodpecker and carpenter ant. It can present a hazard in manufacturing industries, especially in terms of its flammability, sawdust is the main component of particle board.

The high cost of construction of shelter facilities is alarming high and as such many people don't have the capital to go into it, there are so many ponds and some waste can be used as a low-cost material for construction of shelter. In this research, the stability test of sand Crete blocks produced by partial replacement of port land cement with saw dust ash was determined

Materials and Methods

The materials include; saw dust, Dangote cement, water, River sand, Weighing balance, shovel, trowel.

Methods

The saw dust used for this study was collected manually from saw mill at Nsukka timber shop complex in Enugu state Nigeria. Samples were carefully collected to avoid sand mixture this was assured by collecting the newly produced ones on top with shovel and packing into bags. The saw dust collected was sun dried to aid the burning process. The saw dust sample collected were burnt into ashes by open burning on top of zinc shits and it was covered to avoid external forces blowing it away. The ash was collected into an iron bucket and allow to cool.

Saw dust is a waste material from the timber industry. It is produced as timber is sawn into planks at saw mills located in most of the major towns in Nigeria. This is a daily activity process, causing heap of saw dust to be generated after each day. Some other industrial wastes have been studied for use as supplementary cementing materials such as fly ash (Siddique 2004; Wang and Baxter, 2007; Wang et al; 2008) silica fume (Lee et al; 2005; Turker et al, 1997) volcanic ash (Hossain, 2005), etc. Elinwa and Mahmoodb (2002) laid the foundation of my research by previously using ash from timber saw dust waste as cement replacement material in concrete and mortar production.

The sand used for this study was a sharp sand free of clay, loam, dirt and any organic or chemical matter and it was obtained from a local supplier. The cement used for this study is ordinary port land cement Dangote it is fresh, colorless, odorless and tasteless portable water that is free from organic matter of any kind was used for mixing, it was obtained from local water tanker supplier.

Production of Sand Crete Blocks with Cement, Saw Dust and Sand

The blocks were manufactured with the use of iron steel mold measuring (450mm by 225mm) a mix proportion of 1:12 cement sand ratio was used. Three levels of cement substitution with saw dust ash (SDA), (10, 15 AND 20%) by volume were used. Hand mixing was employed and the materials were turned over a number of times until a homogenous mix with uniform color and consistency was attained. Water was added in sufficient quantity to ensure workable of the mixture. The water judge to be sufficient when a quantity of palms caked without bringing out water (Raheem, 2006) the composite mixture was then introduce into the mold, the mold was lifted up and allowed hit on a level floor once or twice, then a flat wood was used to press the mixture more in the mold, before the mold was turned upside down and the block laid on a flat surface by hitting the two edges of the molds bottom with a wood and then gently pulled up the mold leaving the block on the ground.

Testing of the Blocks

The compressive strength and water absorption of the blocks produced were determined. Compressive strength test was carried out to determine the load bearing capacity of the blocks. The blocks that have attained the ripe ages for compressive strength of 7, 14, 21 and 28 days was taken from the curing area to the laboratory. Three to two hours before conducting the test to normalize the temperature and to make the blocks relatively dry or free from moisture. The weight of each block was taken before being placed on the compression testing machine in between metal plates. The blocks were crushed and their corresponding failure loads were recorded. The crushing force was divided by the gross sectional area of the blocks to give the compressive strength. The strength value was the average of three specimens.

Water absorption capacity performed on the sand Crete blocks after curing for 28 days. Five sample per saw dust content were removed from the curing area and sundry until there is no further loss in their dry weights. The sample were then immersed in water two hours and allow to dry for ten minutes before taking their wet weights. The different in weight is used to calculate the percentage water absorbed for each block as follows

$$W_a = \frac{W_s - W_d}{W_d} \times \frac{100}{1}$$

Where

$W_a = W(Percentage\ water\ absorption)$

$W_s = Weight\ of\ wet\ blocks$

$W_d = Weight\ of\ dried\ block$

Results and Discussions

Compressive strength of SDA block samples: The variations of compressive strength with age at curing are presented in table 1. The 10% replacement level have a compressive strength ranging from 0.76N/MM^2 to 1.78N/MM^2, 15% replacement have a compressive strength ranging from 0.68N/MM^2 _1.63N/MM^2 while the 20% replacement level have its compressive strength ranging from 0.72N/MM^2 _1.54N/MM^2. All these were test results between 7 to 28 days of curing.

Table 1: Compressive strength of SDA block samples

Days	KN	N/MM^2	KN	N/MM^2	KN	N/MM^2
		10%		15%		20%
7	25	0.76	23	0.68	24	0.72
14	37	1.0	31	0.92	29	0.86
21	47	1.39	51	1.52	39	1.16
28	60	1.78	55	1.63	52	1.54

KN = Kilo Neutrons

/MM^2 = Neutrons per millimeter squared

BLOCKS WEIGHT: The unit weight of each samples were taken and the results is as shown in table 3. The 10% replacement have an average

Block of 22.3kg, 15% replacement level have an average weight of 1.72kg why that of 20% replacement have an average weight of 21.56kg.

Table 2: Strengths per percentage replacement

Days	10% compressive strength in N/MM^2	15% compressive strength in N/MM^2	20% compressive strength in N/MM^2
7	0.76	0.68	0.72
14	1.0	0.92	0.86
21	1.39	1.52	1.16
28	1.78	1.63	1.54
Mean strengths per percentage replacement	1.23	1.19	1.07

It was seen that at 28 days of the curing period none of the blocks met the NIS required standard of 2.0N/MM^2 for none load bearing walls. The 10% SDA replacement came very close with 1.78N/MM^2 as curing continues till 56 days it may attain the minimum required strength for none load bearing wall.

The 15% SDA cement replacement level came second with 1.63N/MM^2 and the 20% SDA cement replacement level came last with 1.54N/MM^2 both may attain the minimum required strength at 56 days curing period, when water is continuously supplied to the block for proper hydration for those periods. The result indicate that the compressive strength of the blocks decreases with increase in saw dust ash content for all the ages at curing.

Block Weight

The result obtained shows that the introduction of saw dust ash reduced the unit weight of sand Crete blocks produced at various levels of replacement, this can be as a result of high organic particle and more air space in the blocks as shown in table 3

Table 3: Unit weight

10%	15%	20%
	Block weight(kg)	
22.3	21.8	21.9
22.6	21.7	21.5
22.2	21.9	21.2
22.0	21.5	21.8
22.4	21.7	21.4

Average	Average	Average
22.3	21.72	21.56

Conclusion

This study has demonstrated the compressive strength of sand Crete blocks increase as curing age increases but decreases as the SDA content increases. Only 10% SDA replacement is adequate for use in sand Crete blocks for non-load bearing walls in buildings. It was seen that at 28 days of the curing period none of the blocks met the NIS required standard of $2.0N/MM^2$ for none load bearing walls. The 10% SDA replacement came very close with $1.78N/MM^2$ as curing continues till 56 days it may attain the minimum required strength for none load bearing wall. The weight of the sand Crete blocks decreases as the level of SDA increases in the block.

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