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COMPARISON OF STRENGTH OF SANDCRETE BLOCKS PRODUCE WITH FINE AGGREGATE FROM DIFFERENT SOURCES

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ABSTRACT
Sandcrete blocks comprise of water, natural sand cement. Sandcrete blocks are the building units used in the construction of wall and partitions. Diverse sizes of sandcrete blocks are used to construct free standing walls and building structure with load and non – load bearing units. This research work investigate and compared strength of sandcrete blocks produced with fine aggregate from different source in Owo local government area. The targeted areas within Owo local government are Emure, Ipele and Shagari. Sieve analysis was conducted on the samples and the result revealed that all the samples are good for sandcrete block production. Thirty six sandcrete cubes samples were mould. The mix proportion 1:6 was used. Batching by volume was adopted. Curing was done by full immersion of sandcrete and compressive strength test was carried out on each specimen at 7, 14. 21 and 28 days respectively. The percentage of fine aggregate used in this research was 100% for all samples. The results revealed that sandcrete blocks produced with fine aggregate from Ipele, Shagari and Emure gives compressive strength of 4,15N/MM^2, 3.56N/MM^2 and 5.48N/MM^2 at 28 days respectively. Based on the result of this research work, it is recommended that Emure fine aggregate (sand) is considered as most suitable out of the samples tested for sandcrete blocks production.

Keywords: *Sand, Sandcrete blocks, Compressive strength, Curing, Production practice.*

1. INTRODUCTION

British standard (BS 6073) part I [1] defines block as a mansory unit of large size in all dimensions than specified for bricks but no dimensions should exceed 650mm nor should the height exceed either its length or six times its thickness. Sandcrete blocks are of various sizes: 225mm (9 inches), 150 mm (6 inches) , 125 mm (5 inches) and 10 mm (4 inches) respectively.

Over 90% of physical infrastructures in Nigeria are being constructed using sandcrete blocks, [2]. They are very popular as a long lasting and low maintenance investment for institutional and industrial buildings [3]. Sandcrete blocks are manufactured in many parts of the country (Nigeria) without any reference to suit good quality work or local building requirements [4]. The presence of mineral admixtures in construction materials has been observed to input significant improvement on their workability, strength and durability over the past decade [5]. In an attempt to enhance the manufacturing practice and best materials in the year 2000, the standard organization of Nigeria (SON) developed a reference document which prescribed the minimum requirements and uses of different kinds of sandcrete blocks [6]. In 2004, the document was reviewed thus NIS 87:2004 – standard for sandcrete blocks became the country's standard reference document for sandcrete. There was another review thus NIS 87:2007 standard for sandcrete block emerged as the standard reference document for sandcrete block production in Nigeria [7].

The Nigerian industrial standard defines sandcrete block as a composite material made up of cement, sand and water, molded into different sizes [6]. Sandcrete blocks are building units usually made up of ordinary Portland cement, sharp sand obtained from rivers or stream and water from streams, rivers

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or water boreholes, mixed in appropriate proportions and molded into different desired sizes [8].

Sandcrete blocks can either be solid or hollow rectangular types with 450mm × 225mm × 225mm and 450mm × 150mm × 225mm being the most common sizes [9]. Anosike and Oyebade [7] reported that the NIS specified two types of blocks, types **A** blocks which are load bearing and type **B** blocks which are non – load bearing. Both of them can either be solid or hollow. Sandcrete blocks are relatively cheap when compared to other construction materials. They provide an excellent resistance to damage without the added cost of protection devices. They do not contain any material that is harmful to the environment. Sandcrete blocks do not decay, rust or provide a home for damaging insects as other building materials can [10]. Oyetola and Abdullahi [11] argued that sandcrete has been in use throughout West Africa for over 5 decades as a popular building material for preparation of building blocks and bricks. Right from the inception of production, most concrete mansory units are manufactured on the local level and industry standard are not always adhered to [12-14]. Okoli, et. al [15] argued that apart from manufacturers and entrepreneurs who are producing block strictly for business purposes, quite a number of contractors and clients are also making blocks for use on their projects. Oyekan and Kamiyo [04] added that this comes with great challenge in Nigeria due to the large size of the block manufacturing industry and are inadequately trained.

Chandrasekhar, *et.al* [16] argued that sancrete is the main building material used for the construction of walls of most post independent building in Nigeria. Samson, et. al [17] agrees that quality and standardization of sandcrete blocks are of paramount importance in the study of building components since these will serve as standards for measurement reflecting the level of development attained by a nation. While quality can be viewed as compliance with specification or 'fitness for purpose'. According to Abdullahi [18] the quality of sandcrete blocks, however is inconsistent due to the different production methods employed and the properties of constituent materials. Quality management and quality assurance on the other hand have been adopted to include all aspect of producing and accepting a construction project which meets all required quality standards [19]. In a similar view Ogunsanmi, et.a l [20] identified quality as one of the three key elements for developing risk classification model for design and build projects. Okafor and Ewa, [21] found that in order to minimize cost and maximize profits, producers of sandcrete blocks in Nigeria reduce the quality of cement needed to give acceptable quality of sandcrete block leading to the flooding of low – strength blocks in the commercial markets. Abdullahi [18] studied the compressive strength of sandcrete blocks produced in some parts of minna, Niger state Nigeria and discovered that they were below the minimum NIS standard requirement. Raheem, [22] considered as assessment of the quality of sandcrete blocks produced by LAUTECH block industry, an area of the business ventures of Ladoke Akintola university of Technology, Ogbomoso, Nigeria . The results indicates that compressive strength of 450mm×225mm×225mm (9 inches) blocks increased from 0.54N/MM^2 at age 3 days to 1068N/MM^2 at age 28 days. While that of 450 × 225 × 150mm (6 inches) blocks increased from 0.53N/MM^2 at age 3 days to 1.59N/mm^2 at age 28 days. That is, about 60 % of the compressive strength at 28 days was developed at day 7 for both 9 and 6 inches blocks. Boeck, et.a l [23] reported low average compressive strength value of 1.21 N/mm^2 and 0.73 N/MM^2 in dry and wet state respectively. When commercially available sandcrete blocks obtained from block making factories within the federal capital territory, Abuja Nigeria were subjected to test.

Odeyemi, et. al [24] observed that the average compressive strength of manually produced blocks and machine compacted blocks at 28th days of curing were 2.83N/MM^2 and 2.96NMM^2 respectively. Previous research has shown dismal results in the production of sandcrete blocks, which have exhibited compressive strength far below the standard requirement for the construction of houses [25]. Compressive strength is influenced by the level of quality control employed. Afolayan [26] opined that a good selection of materials and adequate curing method among others can influence the compressive strength of sandcrete blocks. Abdullahi opined that [18] blocks should be left to mature for at least 28 days (by curing them) before they are laid if enough if enough strength is needed.

Abdullahi [18] suggests improvement in the selection of materials and curing techniques as remedy for enhancement of the quality of sandcrete blocks.

2. MATERIALS AND METHODS

This study was derived from a survey designed to compare compressive strength of sandcrete block produce with fine aggregate from different sources in Owo local government area. The local government is located in the south west of Nigeria, within the lowland humid tropical rainforest. It is characterized by wet and dry seasons.

Three types of investigations were carried out in this study; namely; field, literature review and interviews. Locally excavated sands (fine aggregate) used were gotten from three sources in Owo ; at Ofi – Ipele Owo, Shagari Owo and Emure Owo respectively. The cement widely used in Nigeria is the ordinary Portland cement (OPC). Dangote cement with properties conforming to BS (British standard) was used during this research work. There are different sources of water but for the purpose of this study, borehole water was used throughout. The instrument and tools used for the study are solid sandcrete cube mold, sieve machine, head pan, spade and shovel..

Sieve analysis and Techniques of experimental procedure were carried out to achieve the objective of the study targeted at comparing the compressive strength of solid sandcrete blocks produced with fine aggregate (sand) from different sources in Owo local government area.

3. RESULTS AND DISCUSSIONS

Tables 1 through 4 show the result of sieve analysis experiment for Ipele, Shagari and Emure sand to determine the different sizes and properties of samples.

Table 1 shows the particle size distribution result for Ipele fine aggregate (sand) with the highest level of percentage finer of 97.6% with sieve size 3.35mm and other percentage were arranged as the sieve sizes decreases. Sieve size 0.452mm has the maximum soil retained of 150g with percentage retain of 30.2%. Total weight of soil retained = 497g.

Table 2 shows the grain size distribution result for Shagari fine aggregate (sand) with the highest level of percentage finer of 87.1% with sieve size 3.35mm and other percentage were arranged as the sieve sizes decreases. Sieve size 0.452mm has the maximum soil retained of 74g with percentage retain of 15.4%. Total weight of soil retained = 482g.

Table 3 shows the particle size distribution result for Emure fine aggregate (sand) with the highest level of percentage finer of 98.4% with sieve size 3.35mm and other percentage were arranged as the sieve sizes decreases. Sieve size 0.452mm and 0.212 has the maximum soil retained of 125g with percentage retain of 25.0%. Total weight of soil retained = 501.

Table 1: Particle size distribution result for Ipele sand sample.

Sieve size (mm)	Weight of empty sieve (g)	Weight of sieve + soil retained (g)	Weight of soil retained (g)	% of soil retained (g)	Weight of soil passing (g)	Cum. % of soil retained (%)	% passing	% finer (%)
3.35	498	510	12.0	2.4	496	2.4	99.80	97.6
2.36	487	503	16.0	3.2	480	5.6	96.58	94.4
1.70	478	506	28.0	5.6	452	11.2	90.95	88.8
1.18	458	509	51.0	10.3	401	21.5	80.68	78.5
0.850	437	503	66.0	13.3	335	34.8	67.40	65.2
0.425	403	553	150.0	30.2	185	65.0	37.22	35.0
0.212	382	498	116.0	23.3	69	88.3	13.88	11.7
0.150	365	399	34.0	6.8	35	95.1	7.04	4.9
0.075	359	382	23.0	4.6	12	99.7	2.41	0.3
0.63	358	359	01.0	0.2	11	99.9	2.21	0.1
Pan	328	328	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author laboratory work, 2019.

Table 2: Particle size distribution result for Shagari sand sample.

Sieve size (mm)	Weight of empty sieve (g)	Weight of sieve + soil retained (g)	Weight of soil retained (g)	% of soil retained (g)	Weight of soil passing (g)	Cum. % of soil retained (%)	% passing	% finer (%)
3.35	498	560	62.0	12.9	434	12.9	90.04	87.1
2.36	487	547	60.0	12.5	374	25.4	77.59	74.6
1.70	478	547	69.0	14.3	305	39.7	63.29	60.3
1.18	458	528	70.0	14.5	235	54.2	48.76	45.8
0.850	437	481	44.0	9.1	191	63.3	39.63	36.7
0.425	403	477	74.0	15.4	117	78.7	24.27	21.3
0.212	382	438	56.0	11.6	61	90.3	12.66	9.7
0.150	365	391	26.0	5.4	35	95.7	7.26	4.3
0.075	359	378	19.0	3.9	16	99.6	3.32	0.4
0.63	358	360	2.0	0.4	14	100	2.91	0.00
Pan	328	328	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author laboratory work, 2019.

Table 3: Particles size distribution result for Emure sand sample.

Sieve size (mm)	Weight of empty sieve (g)	Weight of sieve + soil retained (g)	Weight of soil retained (g)	% of soil retained (g)	Weight of soil passing (g)	Cum. % of soil retained (%)	% passing	% finer (%)
3.35	498	506	8.0	1.6	495	1.6	98.8	98.4
2.36	487	498	11.0	2.2	484	3.8	96.6	96.2
1.70	478	510	32.0	6.4	452	10.2	90.2	89.8
1.18	458	525	67.0	13.4	385	23.6	76.8	76.4
0.850	437	492	55.0	11.0	330	34.6	65.9	65.4
0.425	403	528	125.0	25.0	205	59.6	40.9	40.4
0.212	382	507	125.0	25.0	80	84.6	15.97	15.4
0.150	365	413	48.0	9.6	32	94.2	6.4	5.8
0.075	359	383	24.0	4.8	6	99	1.2	1.0
0.63	358	364	6.0	1.2	2	100	0.4	0.0
Pan	328	328	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author laboratory work, 2019.

Table 4: Compressive strength of sandcrete cube on day 7, 14, 21 and 28.

Days	Samples (Fine Aggregate Location)	Average Compressive Strength (N/Mm^2)
7	Ipele	$4N/mm^2$
14	Ipele	$4N/mm^2$
21	Ipele	$4.15N/mm^2$
28	Ipele	$4.15N/mm^2$
7	Shagari	$2.96N/mm^2$
14	Shagari	$3.41N/mm^2$
21	Shagari	$3.48N/mm^2$
28	Shagari	$3.56N/mm^2$
7	Emure	$3.85N/mm^2$
14	Emure	$4.59N/mm^2$
21	Emure	$4.96N/mm^2$
28	Emure	$5.48N/mm^2$

Source: Authors laboratory works, 2019.

Table 4 shows the results of average compressive strength of sandcrete cubes on day 7, 14, 21 and 28 for each sample. The table also shows that compressive strength of Ipele sandcrete cube is same at day 7 & 14 also same at day 21 & 28. Shagari and Emure sandcrete cubes has their lowest compressive strength at day 7 and their highest compressive strength at day 28.

4. SUMMARY OF FINDINGS

This research carried out shows that the Emure sand contains more fines particle with 98.4%, follow by Ipele sand 97.6% and Shagari sand with 87.1%. This research work also show that Emure sand to sandcrete cube improve the compressive strength of sandcrete blocks as shown in Table 4, although Ipele sand sandcrete cube has it highest compressive strength on day 21 and 28 which is 4.15N/mm2. On

day 28 Shagari sand sandcrete cube has it highest compressive strength with 3.56N/mm2. On day 14, 21 and 28 Emure sand sandcrete cube has highest compressive strength with 4.59N/mm2, 4.96N/mm2 and 5.48N/mm2 respectively.

5. CONCLUSION

This research work compared the compressive strength of sandcrete blocks produced with fine aggregate (sand) from different source in Owo Local Government Area, Ondo State, Nigeria. From the results gotten it was revealed that the sandcrete cube produced with fine aggregate (sand) from various sources comply with the minimum standard requirement compressive strength value of 2.5N/mm2 for non-load bearing or 3.45N/mm2 for load bearing walls at 28 days of curing. But among the fine aggregate (sand) Emure sand came first with compressive strength of 5.48N/mm2 follow by Ipele sand with 4.15N/mm2 and Shagari sand with compressive strength of 3.56N/mm2.

6. RECOMMENDATIONS

Based on the research findings the following are hereby recommended;

1. Emure fine aggregate (sand) has the optimum compressive strength therefore this sand is recommend for production of sandcrete block in Owo Local Government Area.
2. Curing should be properly done, because it was observed from the results that the compressive strength of sandcrete cube increased at each crushing days.
3. I also recommend that workshops and seminars should be organized periodically to enlighten producers of sandcrete blocks on the importance of adhering to standard. This will reduce cracks and defects in wall.

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