International Journal of Scientific Research and Engineering Development-– Volume 4 Issue 2, Mar- Apr 2021
Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Effect of Salt Water on the Compressive Strength of Sandcrete Blocks

1. Eno Cletus Ukpong, 2. Udeme Hanson Iron and 3. Udechukwu John Abaraogu;
1,2 & 3: Department of Civil Engineering, Faculty of Engineering, University of Uyo, Akwa Ibom State, Nigeria.

----------------------------------*************************----------------------------

ABSTRACT

The study investigated the effect of salt water in the compressive strength of sand Crete blocks. Grain size analysis, specific gravity and bulk density test were conducted on the sand which was used for the experiment. The results from these test all met required standard. The authors also produced thirty six sandcrete hollow blocks to be used for the 7th, 14th and 28h day laboratory tests, with salts added directly into the mix and also into the water at 5%, 15% and 305. The value of the compressive strength at 30% did not meet the required control value of 2.1N/mm^2 as average compressive strength

----------------------------------*************************----------------------------

INTRODUCTION

Sandcrete blocks are composite material made up of cement, sand and water, moulded into different sizes. It is the principal wall unit for building construction in Nigeria and other African countries. Sandcrete blocks is used for load-bearing and non-load-bearing walls; piers; partitions; fire walls; backup for walls of brik, stone, and stucco facing materials; fireproofing over steel structural members; fire safe walls around stairwells, elevators, and other enclosures; retaining walls and garden walls; chimneys and fireplaces, concrete floors; and many other purposes.

Sandcrete blocks also participate mainly in the task of transforming the actual load from the overlaying structural element to the foundation. In this case the load bearing wall are those walls acting as supports for the whole structure to transmit the weight to the ground surface underneath it for stability (NIS 87:2000).

The importance of the blocks as part of local building, materials cannot be over emphasized in building and construction industry. Sandcrete blocks have widely been used for building construction in Nigeria. The use of sandcrete blocks in Nigeria is an improvement on the earlier construction technique of using mud to erect building.

In Engineering, circles, it is often regarded as a micro-concrete and thus expected to exhibit similar trends as concrete except perhaps for its lower strength. They are usually mould into different sizes and weights and can be easily handled by the bricklayer with the facing surface layer than that of brick but conveniently dimensioned. The rapid changes in the use of brick to block in Nigeria as a result of its non-uniformity in quality have encouraged in the investigation into the use of sandcrete blocks to be more elaborate.

However, the quality of sandcrete blocks produced however differ in different parts of the country due to the properties of the constituents materials used in its production.

Water, as one of the constituent materials in sandcrete block is important for two main reasons. Firstly, to enable reaction with cement which causes the setting and hardening to take place and secondly, to make the mix moldable. Its importance as a constituent material cannot be over importance as a constituent material cannot be over emphasize as it greatly contributes to the strength of sandcrete blocks. But its quality needs to be known as it could affect the strength of the block.

To regulate standards, the Standard Organization of Nigeria (SON) in 1974 defined sandcrete block as a masonry unit used for building. SON also specified the dimension of sandcrete blocks. The height of a sandcrete block shall be exceed either its length or six times its thickness. The specified dimensions are stated below.

1. 460 x 230mm x 230mm
2. 460 x 152mm x 230mm
3. 460 x 115mm x 230mm
4. 460 x 105mm x 230mm

Sizes (1) and (2) are mainly used for building when the wall are expected to carry loads while sizes (3) and (4) are used for minor construction works, partitions, where the load are small and in frame structures, where the load are not carried by the block wall.

Statement of the Problem

The proposed topic becomes necessary in light of reported incessant collapse of building in the Riverine areas of the country and the researchers personal observation of the rate of deterioration of sandcrete blocks wall particularly when they are not rendered or plastered. The collapse of building may be caused by salt since the presence of salt in water weakens the strength of cement.

Research Objectives

The major objective of this research is to determine if there will be any major effect of salt water on the compressive strength of sandcrete blocks. It is also aimed at examining the role of other parameters, such as compaction, curing and other modes of productions influencing the compressive strength of sandcrete blocks.

Since the building material is a principal wall unit in Nigeria, there is no material published literature yet as to the effect of salt water on sandcrete blocks. For this reason, a brief discussion of the highlights of this investigation seams justified.

Scope of the Study

This study shall only be based on crushing test experiments conducted in the laboratory which is aimed at determining the effects of salt water on the compressive strength of sandcrete blocks. Ordinary Portland cement will be used and fresh water and salt water (Nacl) with 5%, 15%, 30% degree of salinity and with 5%, 15%, 30% of salt added to the total mass of the mixture will be used as well. A water/cement ratio between 0.4 and 0.6 will be used and a sand/cement ratio of volume 6 and 13.

Methodology

The general overview methods that will be used are:

1. Production of blocks under factory condition by the author.
2. Crushing of blocks produced by the author for the purpose of comparison with required standard.

The required method expected to be carried out are;

1. Testing of water for its portability
2. Cement test to determine its soundness and consistency.
3. Grain size analysis.
4. Specific gravity test.
5. Bulk density test for the sand.
6. Laboratory production of blocks.
7. Curing for 7, 14 and 28 days.
8. Compression test

LITERATURE REVIEW

This section review some research works, finding and recommendation by several researchers concerning waste water, compressive strength of sandcrete blocks and possibly its effect. A lot of people have carried out extensive research works on the properties of sandcrete blocks and as a result, this review will be broken down bit by bit for proper understanding.

Sandcrete Block Definition

The word sandcrete has no standard definition; what most workers have done was to define it in a way to suit their own purpose. The word for it in some local dialect means brick earth and the name sandcrete is merely a translation solely to the use to which these blocks are put. (Abdullahi, 2005) Sandcrete blocks are often too crude to reveal the nature and origin of the sandcrete exhibiting the same physical properties. Through sandcrete varies within wide limit one feature remains constant, the same amount of combined silica in proportion to the alumina present, and it is in this respect that sandrete, differ from clays. (Baiden and Tuuli 2004). Abdullahi (2005) posited that it appears increasingly difficult to give a purely morphological definition of sandcrete because sandcrete, covers a wide variety of aspects of tropical soil formation. Barry, (1969) described sandcrete block as a composite material made up of cement, sand aand water moulded into different sizes. Often times, it is considered as a micro-concrete in engineering circles and thus expected to exhibit similar trend s as concrete but has a less compressive strength than concrete. Abdullali (2005) stated that since no general agreement has been reached on the definition and what material should be classified as Sandcrete, the trend at present is to lay emphasis on the grading i.e. Sieve analysis, specific gravity test and bulk density without much regard for mode of formation, geological and geomorphological condition (Sparkly and Lloyd, 1967). Sandcrete blocks are often too crude to reveal, their nature exhibit the same physical properties.

Research activities in different countries on Sandcrete blocks show dismal result in this production which had exhibited compressive strength far below the recommended values in the Codes (Afolayan *et al.* 2008). He attributed the low compressive strength to poor quality control measures. Investigations into the properties of the material has shown that some factors which either are not usually considered in relation to the strength of concrete have considerable influence on the strength of the Sand Crete blocks.

Compressive Strength of sand Crete Block

Abdullahi, (2005) stated that the strength characteristics of sandcrete are influenced by a variety of factors whose effect is not sufficiently understood accurate forecasting particularly under test condition. he wrote that the time of mixing sandcrete with cement does not influence its strength characteristics. Also the time lapse between mixing and compaction has found to affect the strength. A time lag will not only diminish the hardening effect of cement but will require extra energy to break down the aggregation of particles to achieve the desired density. An increase in strength with age and curing temperature has also been reported for cement stabilized sandcrete, but this depends on the nature and texture of sand and on the percentage of cement added. Vallenger (1980) observed that the compressive strength of sancrete materials increases with increased cement content. However, it is important to understand the true significance of the foreword to BS3921: 1965 which pointed out that strength is not to be taken as an indication of durability. Tyler (1980) described compressive strength of sandcrete as a symbol of quality and so quality construction work is weighted on the scale of compressive strength. NIS-75 defined hollow Sand Crete blocks as one in which one or more large hole or cavities pass through the block and the solid material is between 50% and 75% of total volume of the block calculated from the overall dimensions. The code gave the minimum compressive strength requirement for hollow and solid blocks. The load at failure during the test is divided by the gross area of the blocks.

Eze-Uzomaka (1977), upheld that it is the solid area of the block that actually transmits and sustains the load. Consequently, compressive strength of a hollow block should be defined with respect to the solid area only.

$$F_{cu} = \frac{P}{BL-2ab}$$

Where,

F_{cu}= Compressive Strength in N/mm^2
P = Maximum Failure Load in N
B = Breadth or Width of Block
L = Length of the Block
a = Breath of the hollow Section
b = Length of the Hollow Section

Kopycinsk *et al* (1979) observed that the relatively high compressive strength of block is required because of load imposed on the wall and durability of the block in severe climatic condition (heavy rain, low, external ambient temperature, soaking and dry walls. But Florek (1985) observed that most of the above mentioned harmful effect does not occur in Nigeria. Specially, there are no low external temperature affecting durability and stability of hollow block structures.

Taking into account the above mentioned aspects, the Federal Ministry of Works during one of her Annual Conference held in kano decided to lower requirements for Sand crate blocks as follows: The 28-day compressive strength (based on gross area) of Sand Crete block for load bearing walls of 2 or 3 storey building shall not be less than 2.1N/mm^2, for an average of 6 blocks, and that the lowest strength of individual block should not be less than 1.75N/mm^2. This specification adopted in 1985 does not allow for flexibility in design of masonry walls and its application is limited to 2 or 3 storey building. However, NIS-75 envisaged specifying two types of blocks, type A being load-bearing blocks and type 'B' non-load bearing. The load-bearing blocks (type 'A') are strength – graded while type B although not strength-graded is required to posses minimum crushing strength of 1.5N/mm^2.

Table 2.1: Proposed Strength Grading

	Minimum Compressive Strength	
Block Type and Designation	**Average of 10 Blocks N/mm^2**	**Lowest Individual Blocks N/mm^2**
Type B	1.50	1.00
A(2.5)	2.50	1.75
A(3.5)	3.50	2.50
A(5.0)	5.00	3.50
A(7.5)	7.50	5.50
A(10.0)	10.00	7.50
Additional grades advancing increment of 2.5 N/mm^2	Designated strength grade	75% of designated strength

NIS-75, like BS 2028 for concrete blocks, specified three types of blocks. Type 'A' for loading bearing and non-load bearing external use; type 'B' for load-bearing internal use; or for load-bearing or non-load bearing for non-load bearing use NIS-75 specified minimum strength requirement for the three types of blocks as shown in table 2.2 below.

Block classification	**Average of 8 Blocks N/mm^2**	**Individual Units N/mm^2**
A	7.5	5.5
B	5.0	4.0
C	3.5	2.5

The proposed strength grading is better than NIS-75 because it encourages flexibility in design. It also embraces any other specification for Sand Crete including NIS-75 for Sand Crete block, NIS-75 specification for Sand Crete when compared with BS 2028 strength grading for concrete block of type 'A' showed that the minimum compressive strength specified for sancrete blocks of type A is greater than the minimum strength-grade for type 'A' concrete blocks.

Abdullahi (2005) stated that NIS-87 (2000) specified that the lowest compressive strength of individual load bearing blocks shall not be less than 2.5N/mrn2and average compressive strength of five blocks shall not be less than $3.45N/mm^2$.

Previous Research On The Compressive Strength of Sancrete Blocks In Nigeria

Masonry studies in, for example, Enugu, a city in the eastern part of Nigeria, revealed that none of the 84 tested blocks (450x225x225) selected by random sampling at the 28 day crushing test met the minimum standard strength of 1.7 N/mm. (Okolie and Akagu 1994). Moreover, the strength of the samples varied from one block industry to another, and similar strength variatiosn were noticed even within samples from a single source (block industry). A total of 25 block moulding industries were used for this investigation.

In a similar study carried out in mid-western Nigeria (Benin City), Okpalla and Ihaza (1987) revealed that only 21% of the tested sample blocks had strength values up to or greater than the required mean strength of 2.1N/mm. However, 52% met the minimum strength requirement of 1.7N/mm, but the remaining 27% failed to meet the minimum strength requirement. A total of 30 block moulding industries were randomly selected for the Benin City investigation. Nonetheless, masonry studies carried out in another town within mid-western Nigeria (Ekpoma) and it vicinity revealed a total of 95% of the tested block samples failed to meet the minimum standard requirements of 1.7N/mm. Furthermore, similar results were obtained at Ughelli, Effurun, and Warri, towns in mid-western Nigeria. Investigation in Ughelli and Warri revealed that none of the tested block samples in each of these towns met the standard minimum requirement of 1.7N/mm. (Clarke 2000; Olaniyi 2000). Not less than 20 block moulding industries were used for this investigation. In addition, only 13% of the tested blocks samples in Effurun at the 28 day crushing test met the minimum standard requirement. Before and after independence in 1960, Nigeria was a federation of three Regions: Northern, Western, and Eastern. (Okpalla and Ihaza 1987) confirmed that the blocks produced in the northern part of Nigeria were of very low quality. A total of 306 block samples were used for this investigation.

However, the high and increasing cost of cement, which is a major constituent material used in the production of sandcrete blocks has contributed to the non-realization of adequate housing for both urban and rural dwellers in the country. Consequently, manufacture shave resorted to sharp practices in mix proportion and unacceptable substitutes for sand and cement. therefore, any material that can complement sand and cement will be gladly accepted for socio-economic development of the country.

Several researchers have in recent years worked on the possible partial replacement of cement with agricultural and natural products. Falade (1997) reported that the 28 days compressive and flexural strength values of concrete increased when cement was partially replaced with powered glass. Cisse and Laquerbe (2000) observed that the mechanical resistance of sandcrete blocks obtained when raw ash was added increased in performance over the classic mortar blocks. Oyekan (208) observed that the presence of mineral admixtures to building products impart significant improvement on its strength durability and workability.

Alabadan (2006), investigated the potentials of grandaunt Shell Ash as concrete admixture. Grandaunt Shell Ash (GSA) is an agricultural waste common in the northern part of Nigeria in large quantity. He observed that the replacement of cement with GSA up to 30% would be suitable when compared with a control.

Okpala (1993) investigated the effect on some engineering properties of sandcrete blocks when cement was partially replaced with rice Husk Ash (RHA). The compressive strength of the blocks was reported to decrease with increasing RHA content. This report also, agree with Michael (1994) investigation on the potentials of rice husk as a stabilizing agent in clay bricks where he concluded the compressive strength to clay bricks reduces as the amount of husk is increased in the rice husk brick.

Oyekan (2008) investigated the effects on Granite fines on the structural and hygrothermal properties of sandscrete blocks. In his study, tests were performed on hollow sandcrete blocks containing cement, sharp sand and granite fines in varying proportion. The percentages of granite fines by volume of the total fined aggregate was varied ins teps of 5% to a maximum of 30%. Results of the tests show that 15% granite fines content is the optimum for improved structural performance and most compact in hygrothermal properties Adullahi (2005) stated that to obtain good quality sandcrete blocks, it is essential that the constituent materials be selected.

Cement

Cement is any material that hardens and becomes strongly adhesive after application in plastic form. The term cement is often used interchangeably with glue and adhesive, in engineering and building construction the term usually refers to, a finely powered, manufactured substance consisting of gypsum plaster or Portland cement that hardens and adheres after being mixed with water.

Cements are used for various purposes, such as binding sand and gravel together with Portland cement to form concrete, for uniting the surfaces of various materials, or for coating surfaces to protect them from chemic attack. Cements are made in a wide variety of compositions for a wide variety of uses. They may be named for the principal constitutents, such as calcareous cement, which contains silica, for the materials they join, such as glass or vinyl cement, for the object to which they are applied, such as boiler cement, or for their characteristic property, such as hydraulic cement, which hardens underwater, or acid-resisting cement, or quick-setting cement. Cements used in construction are sometimes named for their commonly reported place of origin, like Roman cement, or for their resemblance to other materials, such as Portland cement, which produces a concrete resembling the Portland stone used for building in England. Cements that resist high temperatures are called refractory cements.

Cements set, or harden, by the evaporation of the plasticizing liquid such as water, alcohol, or oil, by internal chemical change, by hydration, or by the growth of interlacing sets of crystals. Other cements harden as they react with the, oxygen or carbon dioxide in the atmosphere.

Cement is one of the constituent materials in sandcrete block that has an adhesive properties which helps in binding fine aggregates together ina sandcrete mixture. Accordign to Tyler (1980), British standards say they shall be made by intimately mixing together Calcareous materials (i.e. containing calcium Carbonate) with argillaceous materials (i.e. containing clay or silica, alumina and iron oxide) burning at, a clinkering temperature and grinding the resulting clinker with only gypsum to be added after burning to prevent the quick setting of C_3A. There are four main compounds present in a cement material. They are:

1. Tricalcium silicate (C_3S)
2. Dicalcium silicate (C_2S)
3. Tricalcium aheminoferrite (C_4AF)
4. Tricalcium aluminate (C_3A)

The characteristics of a cement depends on the proportion of the above named compounds in it. Tyler (1980) stated the different hardening and strength-acquiring rates of these compounds as shown in Table 2.3 below.

Table 2.3: Strength Acquisition and Hydration Rate of Compounds in Cement

Compound	Hydration rate	Strength Acquisition
(C_3S)	Moderate	Good early strength
(C_2S)	Very slow set	Late strength
(C_4AF)	Rapid hydration and set	Little final strength
(C_3A)	Very rapid	Little final strength

Barry (1971) stated that the most commonly used Portland cements are:

1. Ordinary Port Cement (OPC)
2. Rapid Hardening Portland Cement (RHPC)
3. Sulphated resisting Portland Cement
4. Extra rapid hardening Portland Cement
5. Low heat Portland cement
6. Portland Blast Furnace
7. White Portland
8. Portland Pozzolana

Ordinary Portland Cement (OPC)

This is the cheapest and most commonly used cement especially in Nigeria. But sulphate such as those present in ground water have disintegrating effect on it.

Rapid Hardening Portland Cement (RHPC)

This is similar to OPC except that the cement powder is more finely grounded and this enables it to react more quickly with water to develop strength more rapidly than OPC.

2.5.3 Sulphate Resisting Portland Cement

The proportion to the constituents of the cement that are affected by sulphates i.e. aluminate is reduced to provided increased resistance to the effect of, sulphates. For this reason they are used in concrete in sulphate bearing soils, marine works, sewage installations and manufacturing processes where soluble sulphates are present.

Extra Rapid Hardening Portland Cement

This is produced by grinding up to 2% of Calcium Chloride with ordinary Portland cement. Calcium Chloride acts as an accelerator by increasing the rate of hydration of cement and developing early strength. The increase in strength at 2 days is of the order of 25% as compared to rapid hardening Portland. This type of cement is used for concreting in cold weather when ordinary or rapid hardening cement concrete might be affected by frost and in the repair of surfaces, such as pavements that cannot be closed for log periods. This cement is highly vulnerable to attach by sulphates.

Low Heat Portland Cement

This is used mainly for mass concrete works in dams and other large constructions where the heat developed by hydration of other cements would cause serious shrinkage cracking. The heat developed by the hydration of cement I concrete in construction works is dissipated to the surrounding air whereas in large mass concrete works it dissipates slowly. Control of the constituents of low heat Portland causes it to harden more slowly and therefore develop heat less rapidly than other cements.

Portland Blast Furnace

This is manufactured by grinding Portland cement clinker with blast furnace slag, the proportion of slag being up to 65% by weight and the percentage of cement clinker not less than 35%. This cement develops heat more slowly than ordinary cement and has a good resistance to the destructive effects of sulphates and is commonly used in marine works.

White Portland Cement

This is manufactured from China clay or limestone and is used to produce white concrete finishes. It is considerably more expensive than ordinary cement and used mainly for the surface of exposed concrete and for cement renderings.

Portland Pozzolana Cement

This is manufactured by grinding a mixture of Portland cement and pozzolana, the proportions of pozzolana been 15 to 50%. The name pozzolana originally described volcanic ash but in the production of this cement either pumice, diatomaceous earth, burnt clay or fly are used. Where supplies of the pozzolana or other materials are readily available this type of cement is somewhat cheaper than ordinary cement. It has a slow rate of heat development and strength and has good resistance to sulphate attach.

The two cements not of the Portland cement group which are used in building and engineering works are

1. Super sulated cement
2. High alumina cement

Super Sulphated, Cement

This is a mixture of 80-85 of granulated blast furnace slag, 10-15% of calcium Sulphate and 5% of Portland cement clinker. This cement is highly resistant to the destructive effects of sea water and high concentrations of sulphates in ground water. It has a low heat of hydration and required more water to complete the chemical reaction.

2.7 High Alumina Cement

This is manufactured from bauxite and limestone or chalk in equal proportions. It is also said to have been highly resistant to the destructive effects of sulphates and acids and has a very high rate of strength development about 80% of its ultimate strength being developed some 24 hours after mixing with water. It is limited for use in thin structural members and slabs.

Disadvantages of this cement are that there is a serious falling off in strength in hot moist atmospheres such as occur in tropical climates and this cement is attacked by alkalies.

Vallenger (1980) observed that the compressive strength of sandcrete materials it increases with increase in cement content.

SAND

Sand is a loose, incoherent mass of mineral materials in a finely granular condition, usually consisting of quartz (silica), with a small proportion of mica, feldspar, magnetite, and other resistant minerals. It is the product of the chemical and mechanical distintegration of rocks under the influences of weathering and abrasion. When freshly formed the particles are usually angular and sharply pointed, becoming smaller and more rounded by attrition by the wind or by water.

Sand is an important constituent of most soils and is extremely abundant as a surface deposit along the courses of rivers, on the shores of lakes and the sea, and in arid regions. One specific form of sand is the major ingredient in glassmaking. Other types of sand are used in foundries to make casting molds and in ceramics, plasters and cements. Sand is used as a grinding and polishing abrasive in the form of sandpaper, which is a sheet of paper covered on one side with sand or a similar abrasive substance Sandblasting is an important technique used for cleaning stone or for smoothing rough metal surfaces by blowing a stream of sand under air or steam pressure.

Sand is the fine aggregate used in the production of Sandcrete blocks. Its ratio to cement is between 6 to 13. Several researchers have noted that coarser sands develop higher crushing strength. The particle sizes of sand were expressed in terms of specific surfaces in order to express the result in qualitative terms. It was also noted that the crushing strength of sandcrete units is very much affected by the total available surface area per unit weight of sand which has to be coated by the cement paste (Uzoamaka 1977). This is because in mixes where the total surface area is too large, the available cement paste may not be sufficient to coat all the surfaces and thus adequately bind the sand particles.

However, Abdullahi (2005) noted that the properties of a sandcrete sand that will influence its rate and ease of mixing include its degree of fineness, density, and sharpness. Also the relative proportions and the number of component will consisderably influence the rate of mixing (Makanjuola, 1976). Nevertheless, over grading of in aggregate (sand) must satisfy the grading limit according to BS 882 (1992).

Water

Water is a common name applied to the liquid state of the hydrogen-oxygen compound H_2O, pure water is an odorless, tasteless liquid. It has a bluish tint, which may be detected, however, only in layers of considerable depth. Under standard atmospheric pressure (760mm of mercury, or 760 torr); the freezing point of water is 0°C (32°F) and its boiling point is 100°C (212°F). Water attains its maximum density at a temperature of 4°C (39°F) and expands upon freezing. Like most other liquids, Water can exist in a supercooled state; that is, it may remain a liquid although its temperature is below its freezing point. Water can easily be cooled to about -25°C (-13°F) without freezing, either under laboratory conditions or in the atmosphere itself. Supercooled water will freeze if it is disturbed, if the temperature is lowered further, or if an ice crystal or other particle is is added to it. Its physical properties are used as standards to define the calorie and specific and latent heat and in the metric system for the original definition of the unit of mass, the gram. Water is one of the best-known ionizing agents. Because most substances are somewhat soluble in water, it is frequently called the universal solvent. Water combines with certain salts to form hydrates. it reacts with metal oxides to form acids. It acts as a catalyst in many important chemical reactions. (Microsoft Encarter 2009).

Basene (2008) observed that the quality and quantity of water on cement mix affect the properties of hardened concrete and the presence of impurities sucha s salts, acids, alkalis, and oils affect the strength and durability of concrete. This could be so in sandcrete blocks as it is known to be a micro concrete in the engineering circles. Goldberg (1997) noted that water with less than 200ppm of total dissolved solids will not have any significant effect on the hydration of Portland cement, although lower concentrations can still cause some efflorescence which occur is due to presence of soluble salts which are dissolved by water and transported by gravity or capillary action to a surface exposed to air where the salt solution evaporates and leaves behind the crystalline deposit.

Salinity

Salinity is a measurement of the mass of dissolved solids present in a given amount of water. In most circumstances, especially in the context of seawater, the vast majority of dissolved solids are salts, and the terms dissolved solids and salts can be used interchangeably. salinity is measured in grams of salt per kilogram of solution (glkg), which can also be expressed as parts per thousand (ppt or %0). Seawater contains a mixture of salts, the most abundant being sodium chloride (NCI), or table slat. the oceans contain an average of 35 grams of salts per kilogram of seawater (35 ppt).

Salts are molecules that break apart in water to form ions, ions are atoms or groups of atoms that carry positive or negative electrical charges. In seawater, electrically neutral sodium chloride molecules separate to form positive sodium (Na) and negative chloride (Cl-) ions

Sodium chloride constitutes about 85 percent of seal salts. Five more ions, sulfate (SO_4^{1-}), account for all but 0.02 percent of the remaining salinity. These ions mostly float freely in the water. When water evaporates, the ions pair up with each other to form solid salts such as calcium sulfate (gypsum), potassium chloride (sylvite, also known as light salt for people, on a low-sodium diet), and sodium chloride. Along with these major ions, the oceans contain trace amounts of every element found in nature. For example, there are about 7 million metric tons of gold (Au) in the ocean, worth approximately $100 trillion (at a market price of about $15 per gram, or $400 per ounce). But that gold is mixed with 1.4 billion (1.4 quintillion) metric tons of seawater. Gold is prevent in seawater in extremely small amounts, about 5 parts per trillion, or 6 billion times less than sodium chloride.

The relative proportion of the different sea salts – the amount of one salt present relative to the amount of another – remains virtually constant throughout the world's oceans. However, the salinity, or the total amount of salts present in seawater, varies with location in the oceans. Salinity changes result mainly from the addition of fresh water by rivers and precipitation and melting of sea ice or from the removal of fresh water by evaporation and freezing of sea ice. (Microsoft Encarter, 2009). However since in sea water, the basic efflorescing salt is sodium chloride (Nacl) and in the case of cement, we have calcium hydroxide (CA $(OFI)^2$). Table 2.4 below shows a typical analysis of city water supplies and seawater.

Table 2.4: Analysis of City Water and Seawater Samples for Soluble salt Levels

In parts Per Million							
Analysis No.	**1**	**2**	**3**	**4**	**5**	**6**	**Seawater**
Silica (Sio_2)	2.4	0.0	6.5	9.4	22.0	3.0	-
Iron (Fe)	0.1	0.0	0.0	0.2	0.1	0.0	-
Calcium (Ca)	5.8	15.3	29.5	96.0	3.0	1.3	50-480
Magnesium (Mg)	1.4	5.5	7.6	27.0	2.4	0.3	260-1,410
Sodium (Na)	1.7	16.1	2.3	183.0	215.0	1.4	2,190-12,200
Potassium (k)	0.7	0.0	1.6	18.0	9.8	0.2	70-550
Bicarbonate ($HCCO_3$)	14.0	35.8	122.0	334.0	549.0	4.1	-
Sulphate (SO_4)	9.7	59.9	5.3	121.0	11.0	2.6	550-2,810
Chloride (Cl)	2.0	3.0	1.4	280.0	22.0	1.0	3,960-20,000
Nitrate (NO_3)	0.5	0.0	1.6	0.2	0.5	0.0	-
Total Dissolved solids	31.0	250.0	125.0	983.0	564.0	19.0	35,000
Different seas contain different amount of dissolved salts							

Source: Richard P. Goldberg (1991).

Nevertheless, BS 3148 (1980) recommended a portable drinking water from the tap for construction work.

Water Cement Ratio

The water-Cement ratio of a mix used for block production, refers to the water of the block immediately after molding, as different from any water it absorbs later due to the curing, condition. Tyler (1980) noticed a trend of increasing strength with decreasing water cement ratio from his experiments on blocks. However, studies by Eze-Uzoamaka (1977) showed that strength increases with water-cement ratio up to a point where it starts decreasing. It was found that a water-cement ratio range of 0.4 to 0.6 was practical. Mixes below 0.4 were found to be unworkable probably under the compacting equipment used, the mixes lacked sufficient cohesiveness to retain hope after casting. Obodoh (1999) however noted that for water cement ratio above 0.7, much damage occurs during molding, this discouraged further increase in water-cement ratio. There is an optimum value of water cement ratio most suited for a particular sand-cement ratio and curing condition. This has to do with water required for complete hydration of cement, as well as for better compaction to be achieved due to the lubrication of particles provided by water. Obodoh (1999) also noted that when water-cement ratio exceed beyond this optimum value, excess pore water resists the compaction effort, causing a decrease in strength.

METHODOLOGY

This chapter deals with the main laboratory experiment required for the project to establish the aim and objective in the verification of effect of salt water on the compressive strength of sandcrete blocks. The study was carried out in a well equipped laboratory condition at Gitto Construction Company, Rivers State. The experiment carried out included;

(1) Testing of water for portability
(2) Cement test to determine its soundness and consistency.
(3) Grain size analysis.
(4) Specific gravity test.
(5) Bulk density test

(6) Laboratory production of blocks
(7) Curing for 7 days, 14 days and 28 days.
(8) Compressive test for the produced blocks for purpose for comparison with the required standards.

Water Test

The water used for the block production was regarded as portable, which is drinkable and has no definite taste of odour for the control mixes. It is the same water in which the company uses for its projects. The researcher was informed that the water used by the company is salt free, and that using a waste for their construction will result in a structure with a reduced strength, and as such, the water used for the production was not tested. But waste water containing up to some PPM of dissolved salts was used for the purpose of this research.

Cement

The cement used for the production of the sandcrete blocks is the ordinary Portland cement. The result of tests conducted by the West African Portland Cement Company revealed an average specific gravity of 3.15. This was assumed throughout the production of the sandcrete blocks.

Grain Size (Sieve) Analysis

Studies have shown that soil grain sizes affect the strength of blocks, For instance fine sand produces weaker block than coarse sand. Hence, there is the need to analyze the grain size of sand for block moulding.

Generally, there are three methods or procedures of analysis (sieve, hydrometer and combined) that are in use to determine grain size of the soil. But for this experiment, the sieve method was used.

Apparatus

Set of sieves, beam balance, drying oven, brush (for cleaning sieve), mechanical shaker, large pan and the sand from the company. See plate for set of sieves.

Procedure

A sample of the sand was oven dried for twenty four hours to burn off organic matter. The grading of the aggregate is shown in table 4.1 and fig 4.1.100g of it was passed through the set of British sieve, the sieve arranged starting with larger opening and system and the quantities retained in each sieve weighed. The sand met specification required as specified by standard

Specific Gravity Test

This test is done to determine the specific gravity sand by density bottle method as per 15:2720-1980. Specific gravity is the ratio of the weight in air of a given volume of soil sample at a standard temperature to the weight in air of an equal volume of sistilled water at the same stated temperature.

Apparatus

Two density bottles of approximately 50ml capacity along with stoppers, constant temperature water bath ($27.0+01^0$c), vacuum desiccators, oven capable of maintaining a temperature of 105 to 100^oc weighing balance with an accuracy of 0.01g and a spatula.

Procedure

The sand sample (50g) was ground to pass through a 2mrn is a sub-sample was obtained by riffling and oven-dried at a temperature of 105^oc to 100^oc, the density bottle along with the stopper was dried at the same temperature, cooled in the desiccators and weighed to the nearest 0.01g(wl). After that the soil sample which had been oven dried was transferred to the density bottle directly from the desiccators in which it was cooled. The bottles and contents together with the stopper were weighed to the nearest 0.01g(w2). The soil was then covered with air-free distilled water from the glass bottle and left for a period of about $2\frac{1}{2}$ hours for soaking with the bottle half filled with water.

After this was done, entrapped air was removed by heating the density bottle on a water bath with the bottle being kept without the stopper in a vacuum desiccators for about 1 hours until there is no further loss of air then the sand was gently stirred in the density bottle with a rod. This process was repeated until no more air bubbles were observed in the soil-water mixture and the constant temperature in the bottled was observed and recorded as well. The stopper was inserted in the density bottle, wiped and weighed (w3) before the bottle was emptied, cleared thoroughly and the bottle was again filled with distilled water at the same temperature. For the last time the stopper was inserted into the bottle, wiped dried from the outside and weighed (w4). The observation was taken twice on the same soil.

The specific gravity of the soil= (w2-w1)/[(w4-w1)-(w3-w2)]

The specific gravity was also calculated at a temperature of 27^{o}c and was 2.66 with a fines modulus of 2.63.

Bulk Density Test

This test was done to determine the bulk density of the sand which was used in carrying out the experiment. Bulk density is the weight of soil for a given volume. It is used to measure compaction. In general, the greater the density, the loss pore space for water movement.

Apparatus

The apparatus needed for this test are graduated cylinder, meter balance, funnel, hand sledge, flat-bladed knife and garden trowel.

Procedure

A funnel was suspended above a measuring cylinder. The funnel was filled with a sample of the sand and was allowed to freely flow into the measuring cylinder. The excess material on top of the measuring cylinder was scraped off with a straight edge, The sand was then weighed and oven dried in the mettle balance and was also weighed again after being oven dried and the weight/volume (bulk density) was determined by;

Soil bulk density kg(m^3)=$\frac{over\ dry\ weight\ of\ soil}{volume\ of\ soil}$

Laboratory Production Of Blocks

The sandcrete blocks which were used for the research ware produced under factory conditions at Gitto Construction Company, East-West Road, Choba Rivers State. The method production by the researcher was nominated using the standard mix proportion of 1:6 cement sand and 0.6 water ratios as specified by BS2028 and SON.

Apparatus and Materials

The following apparatus and materials were used, 450mm x 225mm 150mm metal block mould, weighing balance, salt, rammer, measuring cylinder, trowel, elephant cement, sand.

Procedure

Batching by was the method used because it is the appropriate batching method on third (1/3) of the bag of cement (1/3 x 50kg= 16.7kg), sand (1.7kg x 6 = 100.2kg) and portable water were weighed, mixed in a concrete platform thoroughly to uniform and the consistent state before waste water salt at different parentages were introduced into the mix. After which they were put into the mould. Hand compaction method was used to rammed the mix to remove air. The mixed cement and sand mortar with water was placed in the mould in the layers with each layer receiving 25 blows of the rammer. Three blocks each were produced for the test at 7th, 4th and 28th day respectively at salt percentages of 5, 15, and 30. The compressive strength of the blocks is tabulated in table 4.4

3.8 Curing Of Sandcrete Block

The mouldsandcrete blocks were kept under shade for twenty four hours to allow for proper setting and hardening devoid of excessive release of heat of hydration before blocks were taken to an open space were curing with water was done on each block 7th, 14th and 28 days respectively.

Compressive Test For The Authors Produced Block Strength Requirement.

The compressive strength of block when tested in accordance with the standard and measured in Newton per square millimeter on net area shall be as follows

Type of Block	Strength test on average of the block
A. Load bearing	2.07N/mm^2
B. Non-Load bearing	1.72N/mm^2

The compressive strength of the weakest individual block in the test sample must not be less than 80% of the average value.

Verification of Compressive Strength of Sandcrete Blocks

The ELE unit which is an electro-hydraulic testing machine having a maximum local capacity of 1000KN was used to verify the, strength of the block. The machine has dial gauges ranging from 0-50KN, 0-100KN and 0-200KN. All readings were recorded from the 0-100KN dial.

Crushing of Sandcrete Block

The total number of blocks crushed was thirty six which was produced by the author.

A plywood 470mm x 240mm x 20mm was used as top capping to ensure even distribution of load over the entire surface of the block and steel plate of 12mm thick was used as the base. The dimension of the blocks and strength are stated in table 4.4.

Calculation for Net Compressive Strength of the Blocks

The compressive strength of the block is given as

$F = \frac{B}{BL - 2ab}$

Where: F= compressive strength in N/mm^2

P = Maximum Failure Load in N

B =width of block

L = Length of the block

a = Length of the hollow block section

b = width of the hollow block section

DISCUSSION OF RESULTS AND ANALYSIS

From the laboratory experiments carried out and the results obtained on the investigation of the Effect of waste water on the compressive strength of Sandcrete Blocks, the results are hereby discussed under the following headings.

(1) Grain size analysis
(2) Specific gravity test
(3) Bulk density test
(4) Compressive strength of blocks molded by the researcher**Grain Size Analysis.**

From the result and graph plotted, the sand being used for the block production met the sieve analysis standard as stated by BS 882: 1992 requirement. The sand is well graded in the five medium and, coarse ones with little or no clay and silt present.

The result of the weight and calculation are as shown in table 4.1 below.

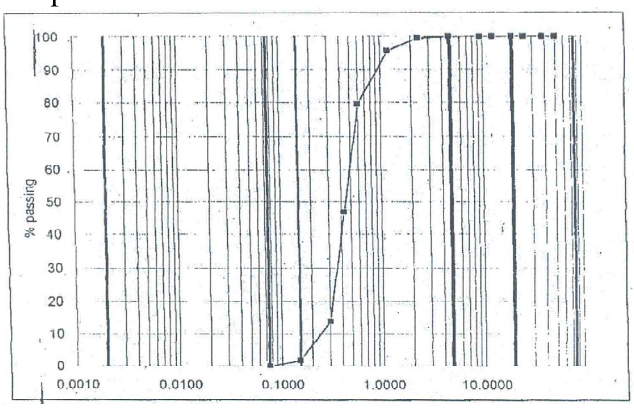
Table 1: Grain size analysis
Grain Size Analysis- BS 882:1992
Reference: River Sand

Sieve	Diameter (mm)	Weight (g)	Retained (%)	Passing (%)	Diameter (mm)
4	100.000				100.0000
31/2''	90.000				90.0000
3''	75.000				75.0000
21/2''	63.000				63.0000
2''	50.000			100.00	50.0000
11/2''	37.500			100.00	37.5000
1''	25.000			100.00	25.0000
3/4''	19.000				19.0000
1/2''	12.500				12.5000
3/8''	9.500				9.5000
4	4.750			100.00	4.7500
8	2.360	2.26	0.49	99.5	2.3600
16	1.180	19.69	4.43	95.6	1.1800
30	0.600	80.20	20.47	79.5	0.6000
40	0.425	164.40	53.35	46.7	0.4250
50	0.300	164.40	86.15	13.9	0.3000
100	0.150	60.29	98.21	1.8	0.1500

200	0.075	8.59	99.93	0.1	0.0750
	>0,075	0.37	0.37	**Passing n. 200 sieve**	
Sum (g)	499.63				
Initial weight (g)	500.00				

From the result shown on the table above, it could be concluded that the sand was devoid of silt and clay, its is well graded and the sand met specification required as specified by the standards.

Figure 4.1 below shows the result of the particle size distribution of the sand.



GRAIN SIZE IN mm

Figure 1: Particle size distribution chart

SECIFIC GRAVITY TEST

The table below shows the test result of the specific gravity of the sand which was used for the production of the sandcrete blocks.

Table 2: Table Showing Specific Gravity of Sand

	TEST 1	TEST 2
Weight of bottle, bottle, soil and water (W3)(g)	1628.00	1627.80
Weight of bottle, bottle, soil and water (W2)(g)	746.00	746.00
Weight of bottle, bottle, soil and water (W4)(g)	1503.00	1502.40
Weight of bottle, bottle, soil and (W1)(g)	547.70	546.80
(W2-W1) (g)	198.80	199.90
(W4-W1) (g)	955.80	955.60
(W3-W2) (g)	881.40	881.10
(W4-W1) – (W3-W2) (g)	74.40	74.50
Specific gravity of sand $GS=\frac{(2-1)}{[(4-1)-(3-2)]}$	2.67	2.68
Mean Specific Gravity	2.68	

From the table above, the value of the specific gravity is 2.68, the value obtained falls within the limit for natural aggregate with value of specific gravity of 2.6 and 2.7 and therefore meets the standard requirement.

4.4 Bulk Density Test

Table 4.3 shows the test result of the bulk density of the sand which the researcher used for the production of the blocks.

Table 3: Bulk density of the sand

	TEST 1	TEST 2
Weight of empty cylinder (W1)kg	4.24	4.23
Weight of empty cylinder+ weight of sand (W2)kg	5.82	5.86
Weight of oven dried sand (W3)kg	1.59	1.62
Volume of cylinder (v) litre	1	1
Bulk density (We/V)kg/m^3	1590	1620
Mean bulk density kg/m^3	1605.3	

Table 4: Table showing the average strength for 7th, 14th and 28th days for Fresh Water Mix

NO.	L(mm)	B(mm)	H(mm)	a(mm)	b(mm)	2ab(mm)^2	LB(mm)^2	LBH(mm)^3	Net area (mm)^2	Load (KN)	Com. Strength	Average strength
1	450	150	225	200	110	44000	67500	0.015	23500	34	1.4468	-
2	450	150	225	200	110	44000	67500	0.015	23500	46	1.9574	1.70
1	450	150	225	200	110	44000	67500	0.015	23500	52	2.2128	-
2	450	150	225	200	110	44000	67500	0.015	23500	38.4	1.6340	1.92
1	450	150	225	200	110	44000	67500	0.015	23500	45	1.9149	-
2	450	150	225	200	110	44000	67500	0.015	23500	56.6	2.4085	2.16

Table 5: Table Showing the average strength for 7th, 14th Days for 5% Waste Water Mix

Crushing day	No.	L(mm)	B(mm)	H(mm)	a(mm)	b(mm)	2ab(mm)²	LB(mm)²	LBH(mm)³	Net area (mm)²	Load (KN)	Com. Strength	Average strength
7th day	1	450	150	225	200	110	44000	67500	0.015	23500	41.2	1.7532	-
	2	450	150	225	200	110	44000	67500	0.015	23500	39.20	1.6681	1.71
14th day	1	450	150	225	200	110	44000	67500	0.015	23500	42.00	1.7872	-
	2	450	150	225	200	110	44000	67500	0.015	23500	43.60	1.8553	1.82
28th day	1	450	150	225	200	110	44000	67500	0.015	23500	42.30	1.80	-
	2	450	150	225	200	110	44000	67500	0.015	23500	41.50	1.7660	1.78

Table 6: Table Showing the average strength for 7th, 14th Days for 15% Waste Water Mix

Crushing day	No.	L(mm)	B(mm)	H(mm)	a(mm)	b(mm)	2ab(mm)²	LB(mm)²	LBH(mm)³	Net area (mm)²	Load (KN)	Com. Strength	Average strength
7th day	1	450	150	225	200	110	44000	67500	0.015	23500	30	1.2766	-
	2	450	150	225	200	110	44000	67500	0.015	23500	31.20	1.3277	1.30
14th day	1	450	150	225	200	110	44000	67500	0.015	23500	36.10	1.5362	-
	2	450	150	225	200	110	44000	67500	0.015	23500	34.30	1.4596	1.50
28th day	1	450	150	225	200	110	44000	67500	0.015	23500	34.13	1.4523	-
	2	450	150	225	200	110	44000	67500	0.015	23500	30.13	1.2821	1.37

Table 7: Table Showing the average strength for 7th, 14th Days for 30% Waste Water Mix

No.	L(mm)	B(mm)	H(mm)	a(mm)	b(mm)	2ab(mm)²	LB(mm)²	LBH(mm)³	Net area (mm)²	Load (KN)	Com. Strength	Average strength
1	450	150	225	200	110	44000	67500	0.015	23500	30.60	1.3021	-
2	450	150	225	200	110	44000	67500	0.015	23500	31.00	1.3191	1.31
1	450	150	225	200	110	44000	67500	0.015	23500	38.00	1.6170	-
2	450	150	225	200	110	44000	67500	0.015	23500	29.60	1.2596	1.44
1	450	150	225	200	110	44000	67500	0.015	23500	28.20	1.2000	-
2	450	150	225	200	110	44000	67500	0.015	23500	25.00	1.0638	1.13

Table 8: Table Showing the average strength for 7th, 14th Days for 5% Waste Water Mix

	L(mm)	B(mm)	H(mm)	a(mm)	b(mm)	2ab(mm)²	LB(mm)²	LBH(mm)³	Net area (mm)²	Load (KN)	Com. Strength	Average strength
1	450	150	225	200	110	44000	67500	0.015	23500	30	1.2766	-
2	450	150	225	200	110	44000	67500	0.015	23500	31.2	1.3277	1.30
1	450	150	225	200	110	44000	67500	0.015	23500	33.00	1.4043	-
2	450	150	225	200	110	44000	67500	0.015	23500	33.40	1.4213	1.41
	450	150	225	200	110	44000	67500	0.015	23500	36.80	1.5660	-
	450	150	225	200	110	44000	67500	0.015	23500	38.80	1.6511	1.61

Table 9: Table Showing the average strength for 7th, 14th Days for 15% Waste Water Mix

Crushing day	No.	L(mm)	B(mm)	H(mm)	a(mm)	b(mm)	2ab(mm)^2	LB(mm)^2	LBH(mm)^3	Net area (mm)^2	Load (KN)	Com. Strength	Average strength
7th day	1	450	150	225	200	110	44000	67500	0.015	23500	49.8	2.1191	-
	2	450	150	225	200	110	44000	67500	0.015	23500	48.40	2.0596	2.09
14th day	1	450	150	225	200	110	44000	67500	0.015	23500	50.30	2.1404	-
	2	450	150	225	200	110	44000	67500	0.015	23500	54.10	2.3021	2.22
28th day	1	450	150	225	200	110	44000	67500	0.015	23500	38.80	1.6511	-
	2	450	150	225	200	110	44000	67500	0.015	23500	37.80	1.6085	1.63

Table 10: Table showing the average strength for 7th, 14th Days for30% Waste Water Mix

L(mm)	B(mm)	H(mm)	a(mm)	b(mm)	2ab(mm)^2	LB(mm)^2	LBH(mm)^3	Net area (mm)^2	Load (KN)	Com. Strength	Average strength
450	150	225	200	110	44000	67500	0.015	23500	30.60	1.3021	-
450	150	225	200	110	44000	67500	0.015	23500	31.00	1.3191	1.31
450	150	225	200	110	44000	67500	0.015	23500	38.00	1.6170	-
450	150	225	200	110	44000	67500	0.015	23500	29.60	1.2596	1.44
450	150	225	200	110	44000	67500	0.015	23500	28.20	1.2000	-
450	150	225	200	110	44000	67500	0.015	23500	25.00	1.0638	1.13

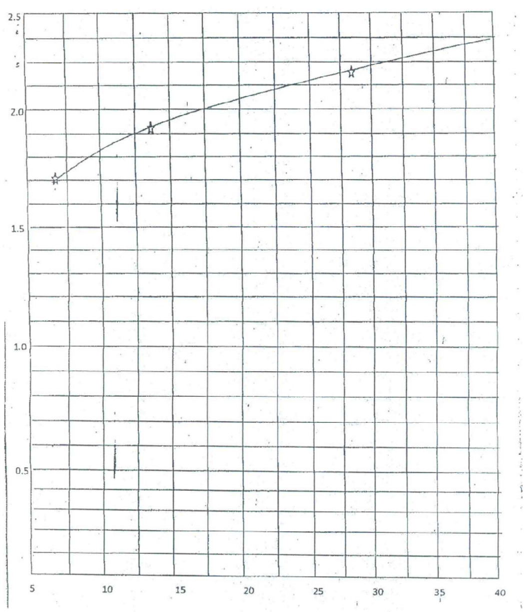


Fig. 2: Compressive strength variation with age for fresh water mix cured in fresh water

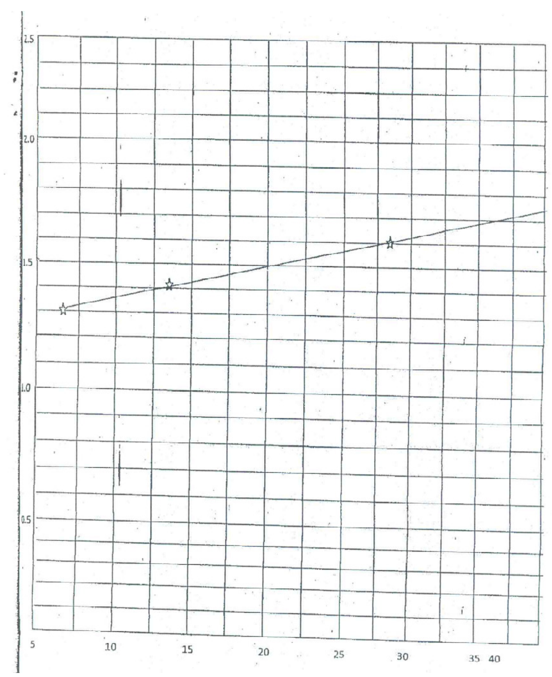


Fig. 3: Compressive strength variation with age for 5% fresh water mix cured in fresh water

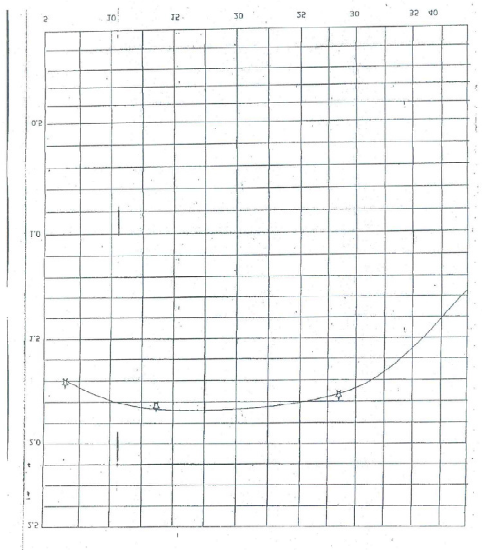


Fig. 4: Compressive strength variation with age for 15% fresh water mix cured in fresh water

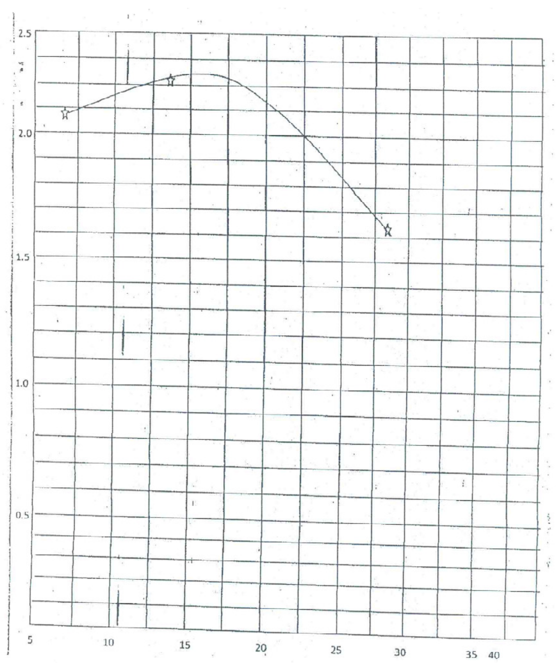


Fig. 5: Compressive strength variation with age for 30% fresh water mix cured in fresh water

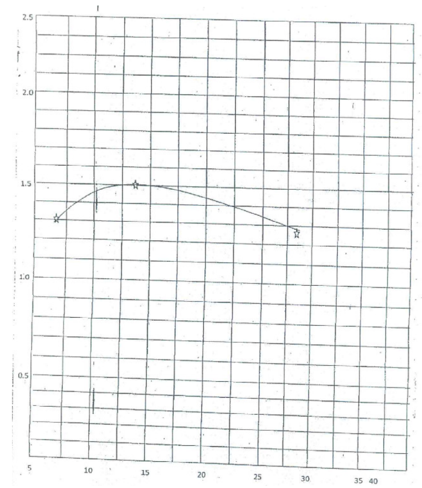


Fig.6: Compressive strength variation with age for 5% fresh water mix cured in fresh water

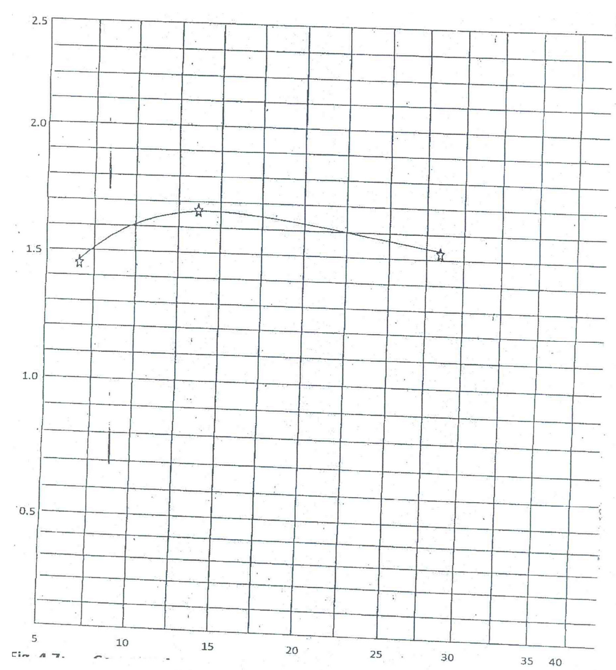


Fig.7: Compressive strength variation with age for 15% fresh water mix cured in fresh water

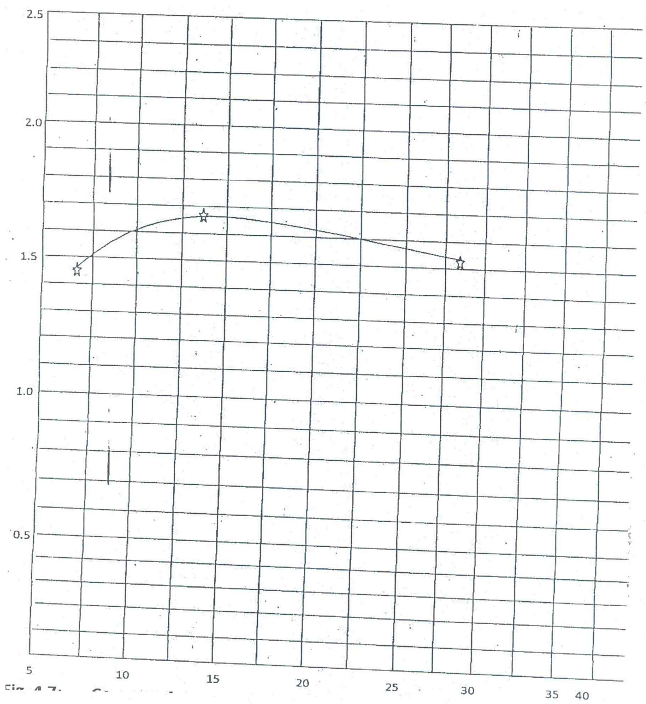


Fig. 8: Compressive strength variation with age for 15% fresh water mix cured in fresh water

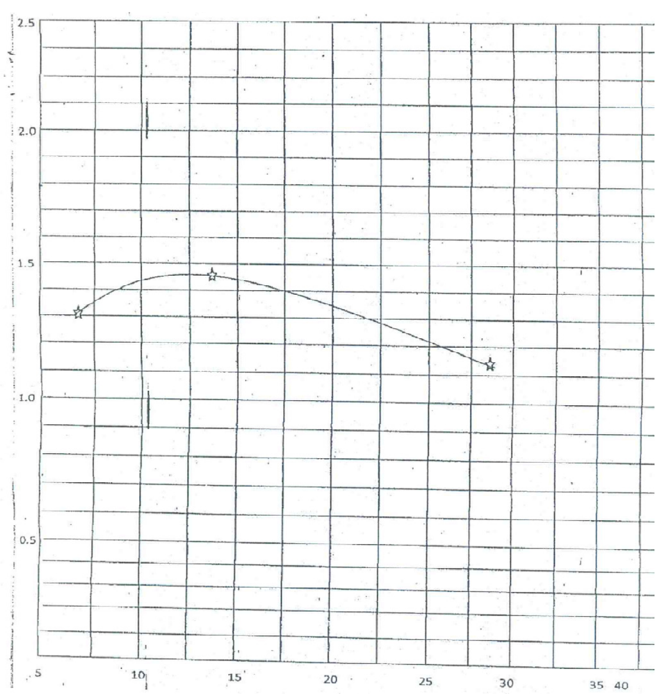


Fig. 9: Compressive strength variation with age for 30% fresh water mix cured in fresh water

COMPRESSIVE TEST RESULTS

Since the aim of this research work is to know if there will be any effect of waste water on the compressive strength of sandcrete blocks, the researcher have to produce blocks under factory condition to check against quality control. The results of compressive loads for the various mixes (i.e. waste water and fresh water) are shown in the tables below.

Interpretation of Results

From the compressive test result shown in table 4.4.1 above, it is seen that the specimen has a gradual increase in strength up to 14 days, width strength of 1.92N/mm^2. At this point it further shows a gradual increase in strength up to 28days, having a strength of 2.16N/mm^2. This conforms with the NIS-75 specification of block type A (2.5) having the lowest individual blocks of 1.75N/mm^2

From table 4.2.2 above, the specimen with 5% waste water mix cured in fresh water showed a gradual increase in strength up to 14 days with strength of 1.78N/mm^2. This also confirm with the NIS-75 standard for Load bearing wall to be 1.75mm^2.

Table 4.3.3 showed a gradual increase in compressive strength from the 7 days strength of 1.71N/mm^2 to the 14 days strength of 1.83N/mm2.

Eventually, there was a gradual fall in strength value of 1.74N/mm2. This observation contradicts the recommendation of NIS-75 and the behavior of sandcrete mix which increases with age (as a micro-concrete).

With 30% .n1t water mix. This specimen showed a sharp increase in compressive strength with the early day up to 7 days, the strength value of 2.09N/mm^2. It further showed an increase in strength up to 14 days, with strength value of 2.22N/mm^2. Eventually, there was an immediate drop in strength at the 28th day with strength value of 1.63N/mm^2. This is also contrary to the behavior of sandcrete mix and recommendation of NIS-75 which increases with arc (as a micro concrete) 5% salt mix.

This specimen showed a gradual increase in compressive strength from the 7th day strength value of 1.3N/mm^2 to the 14 days strength value of 1 50N/mm^2 ventually there was a gradual fall in strength value of 1.37N/mm^2 at the 28111 day. This behavior contradicts the strength behavior of sandcrete mix and also falls below the standard recommended by NIS-75 for sandcrete block mix. 15% salt mix.

This specimen showed a gradual increase in compressive strength from the 7 days strength of 1.45N/mm^2 to the 14 day strength of 1 .67N/mm^2 where it reached its peak value and gradually fell to 1.52N/mm^2 in 28111 day. This is contrary to the behaviour of sandcrete mix and the value falls below the recommendation of NIS-75 from Table 4.1.30% salt Mix.

This specimen showed a gradual increase in compressive strength from the 7 days strength of 1.3N/mm^2 to the 14 day strength of 1.44N/mm^2. Eventually, there was a sharp drop at 28 day, with strength value of 1.13N/mm^2. This observation contradicted the behavior of sandcrete mix and falls below the recommendation of NIS-75.

Conclusion

With experimental results gotten from the various test carried out on the effect of waste on the compressive strength of sandcrete blocks, it could be concluded that:

The compressive strength of sandcrete mix with fresh water, 5% waste water and 5% salt mix can be used for block production as it shows gradual increases in strength from 7 days up to 28 days which is in accordance with the behaviour of sandcrete mx and NIS – 76.

Sandcrete blocks prepared with 15% and 30% waste water and 15% and 30% Salt mix respectively showed an increase in strength value at 28 days. This is however not normal behavior of a sandcrete mix and falls below the recommendation of N1S-75.

Recommendations

The next researcher should develop a model that will help in lowering the degree of salinity in water before it is used for sandcrete block production. Also, the ministry of works in the local government should ensure that the salinity of water used for construction purposes is checked

REFERENCES

1. Abdullahi (2006) Specification of Sandcrete blocks production.
2. Aladadam (2006), Investigated the potential of groundnut shell ash as concrete admixture.
3. Baiden, B. K. and Tuuli, M. M. (2004). Impact of quality control practices in sandcrete block production, J. Arch Eng. 10(2); 53:60.
4. Barry, R. (1971). The Construction of Building, Vol. iv. pp 54-55.
5. Cisse, I. K. and Laquerbe M. (2006). Mechanical Characterization of filler sandcrete with rice hust ash additions: Study applied to Senega. Cement Concrete Research 30(1): 13-18
6. Clark, P. O. (2000). Investigation on the compressive strength of hollow blocks produced in Ughelli, Department of Civil Engineering, University of Benin, Nigeria.
7. Eze Uzomaka (1977). Quality of compressive strength of a hallow block.
8. Faladde, F. (1999). Effects of Separation of grain sizes of fine aggregate on properties of concrete containing granite fines J. University of Science and Technology, Ghana 19(1,32): 62-66)
9. Florek, A., "Quality of sandcrete hollow blocks manufactured in Northern Nigeria" Proceedings of the conference on material testing, control and research Federal Ministry of Words and Housing, Lagos. Feb. 1985.
10. Ifedebe, A. E. "Role of Government Agencies in protecting the public against substandard projects". Proceeding of symposium on sandcrete block and the

construction industry, Department of Civil Engineering, University of Nigeria, Nsukka, August 1975, pp. 105-111.
11. Kopycinsk, B. and other “Ordinary Concrete”, Arkady (1978).
12. Michael (1994). Investigation on the Potentials of rub husk as a stabilizing agent in clay bricks.
13. Tyler (1980). Investigation on the Concrete Block.