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COMPARATIVE ANALYSIS OF CORN COB ASH (CCA) AND SAW DUST ASH (SDA) AS PARTIAL REPLACEMENT FOR CEMENT IN CONCRETE

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ABSTRACT

The study premeditated on the daily skyrocketing cost of buying cements for the production of concrete, mortal and so on. The study experimented on the use of CCA, SDA and the combination of the duo as alternative materials to cement. The objectives entail the comparison of the use of SDA, CCA and the combination of the duo as partial

Introduction

Cement may be prescribed or describe as a material with cohesive and adhesive properties which make it capable of bonding mineral fragments into a compact whole. For construction purposes, the meaning of the term cement is restricted to the bonding materials used with fine, coarse aggregates, and water to produce concrete. The cement is used in the production of concrete as property of setting under water by virtue of a chemical reaction called hydraulic cement Source.

It is an acceptable fact that cement serves as a binder in the production of concrete, concrete is a construction material that consist of Portland Cement, Fine aggregate, Coarse aggregate and Water, each of which contributes to the strength of the concrete, and cement remains the most expensive ingredient in the production of

replacement for cement in concrete via scientific analysis as well as proffering probable solution to the use of alternative materials as partial replacement for cement in concrete with guidance from the review of related literatures, laboratory experiments conducted based on a research methodology that entailed replacement of cement by weight at varying percentages of 15%, 30%, 45% and 60% with SDA, CCA and equal combination of the two, as well as the chemical composition, slump test, sieve analysis test, compressive strength test and 100% cement concrete mix ratio 1:2:4 - 19mm aggregate. and water and cement ratio of 6.0 which was later increased to 7.0 was examined and compared. Findings from the laboratory experiment revealed that the average compressive strength of the control concrete cubes were compared to other substituted samples of 7, 14, 21 and 28 days respectively. At 7 days, duo at 15% has the highest average of compressive strength of 6.3N/mn^2 while saw dust ash and corn cob ash at 60% has the lowest average strength of 1.1N/mn^2. At 14 days, duo at 15% has the highest average of compressive strength of 9.4N/mn^2 while saw dust ash and corn cob ash at 60% has the lowest average strength of 3.5N/mn^2 and 3.0N/mn^2 At 21 days, duo at 15% has the highest average of compressive strength of 10.3N/mn^2 while saw dust ash and corn cob ash at 60% has the lowest average strength of 3.7N/mn^2 and 3.0N/mn^2 At 28 days, duo at 15% has the highest average of compressive strength of 12.0N/mn^2 while saw dust ash and corn cob ash at 60% has the lowest average strength of 3.8N/mn^2. Although no partial replacement of cement concrete cub had more compressive strength than the partial replacement concrete cubes sample had the closest results to the control experiment mix. From the results, it was recommended that only 15% partial replacement of cement of the duo sample enjoys adequate strength.

Keywords: *Cement, compressive strength, corn*

concrete, It is therefore important to find alternative material to cement. Decades ago, attempts were made by researchers to obtain supplementary cementation materials with certain desired characteristic, high performance and durability parameters to meet the requirements and demand for cement in the production of buildings and modern structures. In addition, admixtures such as corn cob ash (CCA) and saw dust ash (SDA) are naturally deposited materials and industrial agricultural waste or bye product that requires less energy to manufacture. Pozzolanas are materials containing reactive silica and or alumina which on their own have little or no binding properties, but when mixed with chemicals or cement as admixtures can improve the strength and properties of the concrete or materials used to produce. Pozzolans are important ingredients in the production of alternative cementing materials to Portland Cement.

BACKGROUND OF THE STUDY

The use of cement as a binding agent in the production of concrete, mortal and other building materials such as sandcrete blocks, bricks, brick interlocks, kerbs, well water concrete rings, concrete electricity poles, concrete barricades, and so on cannot be over emphasized. As important as cement is explained above, the cost of buying cement for the production of aforementioned is skyrocketing every day by day and becoming unaffordable for the masses, and that necessitated the need to investigate into finding alternative materials to cement such as corn cob ash and saw dust ash. The high demand for cement in building production and civil engineering works using Portland Cement drastically reduce the natural deposit of lime stones which has damaged the environment, thereby causing landslides and explosions resulting from the intense mining activities for the extraction of limestone also the carbon dioxide emissions from cement plants causes environmental pollution thereby contributing about 7% of the world carbon dioxide emissions, thirdly the continuing increase in price of cement due to inflation, high cost of production and the rise of freight charges make the total cost of cement and production of buildings unaffordable.

SIGNIFICANCE OF THE STUDY

The study into the use of corn cob ash or saw dust ash or the combination of the duo as alternative materials to cement could reduce the cost of buying cement and cumulatively reduce the cost of producing building generally. In addition, the use of corn cob ash or saw dust ash or the combination of the two will be advantageous to the builders, civil engineers and other professionals in the Built Environment, and prospective house owners

OBJECTIVES OF THE STUDY

- Review of relevant and related literature on the use of saw dust ash or corn cob ash or the duo as partial replacement for cement in concrete.
- To compare the use of saw dust ash or corn cob ash or the combination of the duo as partial replacement for cement in concrete via scientific research.
- To proffer probable solutions to the use of alternative materials as partial replacement for cement in concrete.

REVIEW OF RELATED AND RELEVANT LITERATURE

This project is limited to comparative analysis of corn cob ash, saw dust ash and the combination of the duo as partial replacement for cement in concrete. Corn cob ash is a residue obtained from the burning of dry corn cobs into fine powdery substance on a metallic platform to prevent it mixing up with sands, and the same process goes for obtaining saw dust ash. Saw dust is a grain particles collected from the milling industry or wood work machineries. There had been various efforts on the use of some industrial wastes as a replacement for cements in concrete and other building materials such as mortal, sandcrete blocks, bricks, electricity concrete poles, sandcrete roof files and many more. Olutoge (2010) presents a comparative study on fly ash and groundnut shell ash and also granulated blast furnace slag (GGBE) performance of concrete, Adesanya and Raheem (2010) investigate the permeability and acid attack on corn cob ash blended cement, results of an experiment confirmed that, the use of wood waste as a partial replacement for cement in the production of structural grade concrete and mortal, the authors concluded that the compressive strength generally increases with the curing period and decreases with increased amount of saw dust ash, and only 5%. saw dust ash substitution is adequate to enjoy

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maximum benefit of strength gain. It was also observed that, the effect of replacing cement with groundnut shell ash in sand-crete block production, and cement was replaced by 10%, 20%, 30 %, 40% and 50% groundnut shell ash in sand Crete block production, and compressive strength was found to decrease with increase in percentage replacement of groundnut shell ash above 20% replacement. Effect of rice husk ash as partial replacement for cement in sand-crete blocks was investigated upon, and the result showed that, the addition of rice husk ash produces blocks of lower density. The compressive strength of the block was not enhanced while the thermal properties of the blocks were significantly affected. It was also observed that, the use of saw dust ash (5%, 10%, 15%, 20% and 25%) as partial replacement for cement in sand-crete blocks, and it was observed that sandcrete blocks with up to 10% saw dust ash replacement can be used for non-load bearing walls. Olufusi and Olutoge (2021) assert the strength properties of com cob ash concrete, they concluded that concrete do not attain their designed strength at 28 days and the strength of corn cob ash concrete are dependent on its pozzolanic activities.

SAW DUST ASH

Saw Dust Ash (SDA) is predominantly obtained from burning of dry saw grains or dust from the milling industries and the ash contains mainly silicates (67%)

Table 2.1 The Chemical Composition of Saw Dust Ash

CHEMICAL CONSTITUENTS	COMPOSITION IN PERCENTAGES
Silica (SiO_2)	65.42%
Alumina (Al_2O_3)	5.69%
Iron (Fe_2O_3)	2.16%
Calcium (CaO)	9.82%
Magnesium Oxide (MgO)	4.23%
SO_3	1.09%
Sodium (Na_2O)	0.04%
$CaCO_3$	7.89%
Potassium (K_2O)	2.38%

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Loss on ignition	4.89%
LSF	1.09%
AR	11.35%
SR	10.53%

(Source: Lime and other alternative cements, Stafford-Holmes., and Mathet, 2011)

CORN COB ASH

Corn Cob Ash (C.C.A) is obtained from subjecting the dry corn core, the central of an ear of corn to burning completely into a powdery ash known as the Com Cob Ash.

Table 2.2 The Chemical Composition of Corn Cob Ash

TEST PARAMETERS	PROPORTION IN PERCENTAGE
Calcium (CaO)	10.35%
Iron Fe2O3	4.45%
Alumina (Al2O3)	9.85%
Silica (SiO2)	62.87%
Magnesium Oxide (MgO)	4.18%
Sodium (Na2O)	0.035%
SO3	2%
Potassium (K2O)	1.71%

Source: Research, 2022

BENEFITS OF CORN COB ASH AND SAW DUST ASH

These ashes do not only strengthened and sealed the pores of concrete, they have many other beneficial features. The benefits derivable from the application of corn cob ash and saw dust ash include:

A SPHERICAL SHAPE: The particles are almost totally spherical in shape, allowing them to flow and blend freely in mixtures.

B BALLBEARING EFFECT: The ball-bearing effect of corn cob ash and saw dust ash particles creates a lubricating action when concrete is in its plastic state.

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1. ECONOMIC SAVINGS: These supplementary cementations material CCA and SDA are additives which can replace higher volumes of the most costly ingredients in concrete production "Cement" with typically less cost per cubic volume.
2. DECREASED PERMEABILITY: Increased density and long-term pozzolanic action, which lies up free line, results in fewer bleed channels and decreases permeability.
3. REDUCED SHRINKAGE: The largest contribution to drying shrinkage 1s water content, the lubrication action of CCA and SDA reduces the need for water therefore also drying shrinkage
4. REDUCED SULPHATE ATTACK: Corn cob ash and Saw dust ash ties up free lime that other-wise could combine with surface to create destructive expansion.
5. INCREASED DURABILITY: Dense Pozzolans create help to keep aggressive compounds on the surface where destructive action is lessened, Pozzolans concrete is also more resistance to attack by sulfate, water and sea water.

CONCRETE

Concrete considerable crushing strength is durable, has good tensile properties, poor resistance to fire (due to rapid loss of strength under high temperature) and very good both in shear and in compression, thus a combination of these materials result in good tensile and compressive strengths. Concrete on its own is a composite materials of a binder (cement), fine aggregates (Sand) and coarse aggregate (gravel or crushed stones) and water. Its good workability allows it to be easily used in many shapes ranging from bulky dam wall to very thin shell roof, concrete can be exposed to a wide range of conditions such as the soil, sea water or the atmosphere. "Concrete is an important part of modem infrastructure, and can be used in buildings, roads, bridges and dams, It is known for its high compressive strength and versatility which makes it an ideal material for the basis of most structures".

ADVANTAGES OFUSING CONCRETE

A. ABILITY WORK WITH REINFORCEMENT: Concrete also provide good protection to reinforcement bar due to the perfect environment concrete provide to the reinforcement and cover from aggressive chemical attack and preventing steel corrosion.

B. ABILITY TO CONSUME WASTE: Many industrial waste can be recycled as a substitute for cement or aggregates examples are com cob ash and saw dust ash.

C. LESS MAINTENANCE: No or less maintenance is needed for concrete structures.

D. ABILITY TO BE CAST: It can be formed into different desired shapes and sizes right at the construction site.

E. EXCELLENT RESISTANCE TO WATER: Unlike wood and steel, concrete can harden in water and can withstand the action of water without serious deterioration.

F. AMBIENT TEMPERATURE HARDENED MATERIALS: Because cement is a low temperature bond inorganic material and its reaction occurs at room temperature, concrete can gain its strength at ambient temperature.

CLASSIFICATIONS OF CONCRETE

The concrete is classified as follows:

1. According the binding material: I Cement Concrete, II Lime Concrete,
2. According to design: I Plain Cement Concrete, II Reinforced Cement Concrete (R.C.C), III Pre-stressed Cement Concrete(P .C.C)
3. According to purpose: I Light-weight concrete , II Sawdust concrete, III White and colored cement concrete, IV No-fines concrete, V Cellular or Aerated concrete, VI Vacuum Concrete, and VII High easily strength concrete

USE OF WATER IN CONCRETE

Water (Chemical Formula H_2o) is an organic transparent, tasteless, odorless and nearly colorless chemical substance. Its chemical formula H_2o indicates that each of its molecules contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement, it help to form the strength giving cement gel, the quality and quantity of water is required to be looked into carefully.

- Water plays a significant role in mixing, transporting and proper laying of the concrete.
- The strength of the concrete depends upon the quality and quantity of water used in the mix.
- The water to be used for preparing the mortar should meet with the following requirements:
    i. Should be clean and fresh.
    ii. Should be free from organic impurities, hygroscopic, greasy and oily substances.
    iii. Should preferably be drinkable.

Functions: Following functions are performed by water in the preparation of concrete

(i) It wets the surfaces of aggregates.
(ii) It facilitates spreading of cement/lime over the fine aggregates.
(iii) it makes the mortar workable (by acting as a lubricant for the aggregates).

It causes hydration of cement and eminently hydraulic lime due to which setting and hardening of cement and lime takes place.

USEOF CEMENT CONCRETE

Cement may be prescribed as a material with cohesive and adhesive properties which make it capable of bonding mineral fragments into a compact whole. The definition embraces a large variety of cementing materials; For construction purposes the meaning of the term cement is restricted to the bonding materials used with stones, sand, building blocks and civil engineering works, the cements of interest in the making of concrete have property of setting under water by virtue of a chemical reaction with it and therefore, called hydraulic cement. Source: (Civil Engineering Materials, Tata McGraw-Hill).

CLASSIFICATIONS OF CEMENT

A-NATURAL CEMENT

- It is manufactured from stones containing 20 to 40 per cent of clay, the remainder being carbonate of lime mixed with carbonate of magnesia, the stones are first burnt and then crushed.
- It possesses a brown color and set rapidly when mixed with water.

B-ARTIFICIAL CEMENT

- It may be Portland cement or special cement
- Portland cement is so named because a paste of cement with water, after it sets hard, resembles in color and hardness a Portland stone, a lime stone in Dorset, and it is prepared in different varieties.

PROPERTIES OF CEMENT

A good cement possesses the following properties (which depends upon its chemical composition, thoroughness of burning and fineness of grinding):

1. Provides strength to masonry, stiffness or hardens early, possesses good plasticity, and an excellent building material, and easily workable. with good moisture-resistant.

USES OF CEMENT

The following are the various uses of cement:

1. It is used in cement mortar for masonry work, plastering, pointing and so on.
2. It is used for making joints for pipes, drains and so on.
3. It is used in concrete for laying floors, roofs and constructing lintels, beams, stairs, pillar and so on.
4. It is employed for manufacturing precast pipes, piles, fencing posts and so on.
5. It is used in the construction of important engineering structures such as bridges, culverts, dams, tunnels, light houses and so on.
6. It is used in the preparation of foundations, water tight ponds, water

tight floors, foot path and so on.

7. It is employed for the construction of well water tank, tennis courts, telephone cabins, roads, lamp post and so on.

TYPES OF CEMENT

The following are the various types of cement available in the market:

1. **PORTLAND CEMENT** :

Ordinary Portland cement, rapid hardening Portland cement, Modified Portland cement, Sulphate resisting Portland cement, Water-proof Portland cement, Lower heat Portland cement, and Water-repellant Portland cement

OTHER VARIETIES OF CEMENT : High alumina cement, Quick setting cement, White cement, Acid-resistant cement, Hydrophobic cement, Super-sulphated cement, Portland Pozzolana cement, Masonry cement, Color cement, Blast furnace slag cement, and Expanding cement

CHEMICAL CONSTITUENTS OF CEMENT

The percentages of various ingredients for the manufacture of Portland cement should be as follows:

Table 2. 3 Chemical Composition of Cement

INGREDIENTS	PROPORTION (%)
Lime (CaO)	63.00%
Silica (SIO2)	22.00%
Alumina (AlO3)	6.00%
Iron Oxide (Fe2O3)	3.00%
Magnesium Oxide (MgO)	2.50%
Sulphurtrioxide (So3)	1.75%
Loss on Ignition	1.50%
Insoluble residue	0.25%

Source: Laboratory Research 2022

Besides the above ingredients calcium (CaS04), Commonly known as gypsum is also added by 3% to 4% during the grinding for controlling the

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initial setting time of gypsum (larger the proportion of gypsum, more will be the initial setting time of cement and verse-versa). Cement is also a compound material as it is a mixture of limestone and clay. It is made by burning the two compounds together at extremely high temperatures ranging from l400-1600°C, the most popular type of cement is known as Portland cement. Portland cement uses crushed CaCo3 (also known as limestone), mixed with clay, sand and iron ore to form a homogeneous powder, this powder is heated to the high temperatures, to achieve these temperatures, the mixture is poured into a kilns which consist of long steel cylinders that are rotated on an inclined position depending on the size of the kiln, the materials can take up to 2 hours to pass slowly through the cylinder. The slow process allows the different components of the material to react, the reaction of these materials involves the following processes:

1. l. EVAPORATION: The first stage of the process is the loss of water from the mixture due to evaporation.
2. CALCINATION: Decomposition occurs in the dry mixture due to the loss of water and carbon dioxide.
3. CLINKERING: The mixture then undergoes a transformation in which calcium silicates are formed. These are pieces that are the size of marbles
4. COOLING: Once the mixture leaves the kiln, It is allowed to cool to working temperature.

The cooled clinkers is then ground once more and a compound known as gypsum is added to the mixture, this is in order to regulate the setting of the mixture, In Portland cement 5% of its chemical composition is the GYPSUM mineral, the major compounds that make up Portland cement are tricalcium silicate, dicalcium silicate, dicalcium aluminate, tetracalcium aluminoferrite and gypsum, once this process is complete, the cement is packaged and stored for use (Source: R.K. Rajput, Material Science and Engineering).

CONCRETE PRODUCTION-SPECIMENS

Made from **Fine aggregates** which are basically natural sand particles from the land through mining process, the fine aggregates consist of

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natural sand or any crushed stone particles that are 1⁄4 or smaller, this product is often referred to as 1⁄4" minus as it refers to the size or grading of this particular aggregate called **Coarse Aggregates**. **WATER** is used for mixing the concrete was clean, free form impurity and engine oil and obtained from a tap source in the Civil Engineering Concrete Shed. The water increase the workability of the mix and also promote hydration and carbonation. **F**ine aggregates and coarse aggregates used for the mix were sharp sand and crushed granites. **CEMENT is** used as a binder for the production of the concrete specimens. Batching of constituents was done by weight using weighing scale in the concrete laboratory, saw dust ash, corn cob ash and the combination of the duo were used to replace ordinary Portland cement at 0%, 15%, 30%, 45% and 60% by weight of cement, concrete cube with 100% cement and no com cob ash and saw dust ash serve as the control experiment, the mix ratio used was 1:2:4- l 9mm aggregates with water for workability of 0.6 which was later increased to O.7. and 0.8 respectively. The concrete cube was cast using 150mm X 150mm X1500mm steel mould, the cube steel mould were assembled prior to casting and properly lubricated with engine oil for easy removal of hardened concrete cubes, each mould was then filled with prepared fresh concrete in three layers and each layer of 50mm was compacted with tamping rod using (35) strokes uniformly distributed across the surface of the concrete in the mould, the top of mould was smoothened and leveled with hand trowel and then the external surface was cleaned, the mould and their content was left in the open air for 24 hours, the concrete was remolded after 24 hours of the concrete setting under ambient temperature and later kept in storage curing tank measuring filled with water only for periods of 28 days.

TEST PROCEDURES FOR SLUMP

The slump test is a means of measuring the consistency of fresh concrete using slump cone. The process is as follows:

i. The slump cone is properly cleaned up and lubricated with engine oil internally.
ii. The slump cone is placed on a horizontal surface I.e. on a clean and dry flat metal surface.

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iii. The cone was filled with concrete in three layers and each layer was compacted with thirty five strokes of steel rod.
iv. After filling the slump cone to the brim, the unwanted concrete was removed with a straight edge.
v. The cone was then removed gently in a vertical direction.
vi. The fall height is then measured and recorded with the slump cone been placed by its side.

COMPRESSIVE STRENGTH TEST

Compressive strength is the capacity of the material or structure to withstand loads tending to reduce its size, as opposed to tensile strength which withstand loads tending to elongate. Firstly, (2) cubes sample were selected from each specimen of curing categories and were tested for compressive strength on curing completion using universal testing machine. The compressive load, L (KN) of each sample is computed and compressive strength is derived via calculation using the formula below:

Compressive strength (N/mm2) = Compressive load (KN) X 1000
Surface area (mm2)
Surface area of the cube sample (mm2)
= Length (L) X Breath (B)
= 150mm X 150mm
= 22,500mm2

The specimens is placed on the platform of the CTM, the load is applied gradually until the failure stage occurs, the ultimate load noted and calculated for the compressive strength of the specimens. Before crushing, the cubes were brought out of the storage curing tank for 24 hours for most of the water to dry off, then weighed on a weighed balance and then taken to the digital compression machine with maximum capacity of 1000KN in accordance with BS 1881: Part 116 (1983). The compressive strength value was the average of two concrete cubes, compressive load was applied at a constant rate of stress equal to 0.0IN/mm2 per seconds, the concrete cubes will experience crocks due to failure in their strength as a results of the load applied by the compressive machine. The compressive strength will be recorded to the nearest 0.0 IN/mm2.

DISCUSSION OF FINDINGS

Below shows method of batching and the ratios

Table 4.1 BATCHING INFORMATION FOR SAW DUST ASH (SDA)

SDA REPLACEMENT (%)	CEMENT (Kg)	SAW DUST ASH (Kg)	SAND (Kg)	GRANITE (Kg)	WATER (Kg)	W/b
Control Mix (0% SDA)	2.314 Kg	0 Kg	4.629 Kg	9.257 Kg	1.388 Kg	0.6
15% SDA - 85% CEMENT	1.967 Kg	0.347 Kg	4.629 kg	9.257 Kg	1.620 Kg	0.7
30% SDA - 70% CEMENT	1.620 Kg	0.694 Kg	4.629 Kg	9.257 Kg	1.620 Kg	0.7
45% SDA - 55% CEMENT	1.273 Kg	1.041 Kg	4.629 Kg	9.257 Kg	1.850 Kg	0.8
60% SDA - 40% CEMENT	0.926 Kg	1.388 Kg	4.629 Kg	9.257 Kg	1.850.Kg	0.8

Source: Laboratory Research (2022)

Table 4.2 BATCHING INFORMATION FOR CORN COB ASH (CCA)

CCA REPLACEMENT (%)	CEMENT (Kg)	CORN COB ASH (Kg)	SAND (Kg)	GRANITE (Kg)	WATER (Kg)	W/b
Control Mix (0% CCA)	2.314 Kg	0 Kg	4.629 Kg	9.257 Kg	1.388 Kg	0.6
15% CCA - 85% CEMENT	1.967 Kg	0.347 Kg	4.629 kg	9.257 Kg	1.620 Kg	0.7
30% CCA - 70% CEMENT	1.620 Kg	0.694 Kg	4.629 Kg	9.257 Kg	1.620 Kg	0.7
45% CCA- 55% CEMENT	1.273 Kg	1.041 Kg	4.629 Kg	9.257 Kg	1.850 Kg	0.8
60% CCA - 40% CEMENT	0.926 Kg	1.388 Kg	4.629 Kg	9.257 Kg	1.850.Kg	0.8

Source: Laboratory Research (2022)

TABLE 4.3 BATCHING INFORMATION FOR THE COMBINATION OF THE DUO CORN COB ASH (CCA) AND SAW DUST ASH (SDA)

SDA AND CCA REPLACEMENT (%)	CEMENT (Kg)	SAW DUST ASH (Kg)	CORN COB ASH (Kg)	SAND (Kg)	GRANITE (Kg)	WATER (Kg)	W/b
Control Mix (0% SDA)	2.314 Kg	0 Kg	0 Kg	4.629 Kg	9.257 Kg	1.388 Kg	0.6
15% SDA+CCA - 85% CEMENT	1.967 Kg	0.174 Kg	0.174 Kg	4.629 kg	9.257 Kg	1.620 Kg	0.7
30% SDA+CCA - 70% CEMENT	1.620 Kg	0.347 Kg	0.347 Kg	4.629 Kg	9.257 Kg	1.620 Kg	0.7

45% SDA+CCA - 55% CEMENT	1.273 Kg	0.521 Kg	0.521 Kg	4.629 Kg	9.257 Kg	1.850 Kg	0.8
60% SDA+CCA - 40% CEMENT	0.926 Kg	0.694 Kg	0.694 Kg	4.629 Kg	9.257 Kg	1.850.Kg	0.8

Source: Laboratory Research (2022)

COMPRESSIVE TEST INTERPRETATION

Table 4.4: Compressive strength (N/mm2) of CCA concrete cubes for different percentages with 7days curing age

S/N	CURING DAYS	SPECIMENS	SAMPLES	COMPRESSIVE LOAD	COMPRESSIVE STRENGTH (N/mm2)	AVERAGE COMPRESSIVE STRENGTH LOAD	AVERAGE COMPRESSIVE STRENGTH (N/mm2)
1	7 days	Control Experiment (0%)	Sample A	194.47	8.5	190.05	8.1
			Sample B	185.63	7.6		
2	7 days	CCA 15%	Sample A	83.44	3.7	84.99	3.8
			Sample B	86.53	3.8		
3	7 days	CCA 30%	Sample A	75.86	3.2	68.48	3.1
			Sample B	61.09	3.0		
4	7 days	CCA 45%	Sample A	55.48	2.5	54.14	2.4
			Sample B	52.79	2.3		
5	7 days	CCA 60%	Sample A	29.89	1.3	25.36	1.2
			Sample B	20.82	1.1		

Source: laboratory research work, 2022.

Table 4.5: Compressive strength (N/mm2) of SDA concrete cubes for different percentages with 7 days curing age.

S/N	CURING DAYS	SPECIMENS	SAMPLES	COMPRESSIVE LOAD	COMPRESSIVE STRENGTH (N/mm2)	AVERAGE COMPRESSIVE STRENGTH LOAD	AVERAGE COMPRESSIVE STRENGTH (N/mm2)
1	7 days	Control Experiment (0%)	Sample A	194.47	8.5	190.05	8.1
			Sample B	185.63	7.6		
2	7 days	SDA 15%	Sample A	86.45	3.8	84.53	3.7
			Sample B	82.60	3.6		
3	7 days	SDA 30%	Sample A	56.21	2.5	58.03	2.6
			Sample B	59.85	2.7		
4	7 days	SDA 45%	Sample A	53.43	2.4	47.13	2.1
			Sample B	40.82	1.8		
	7 days	SDA 60%	Sample A	23.79	1.1	24.23	1.1

5			Sample B	24.66	1.1		

Source: laboratory research work, 2022.

Table 4.6: Compressive strength (N/mm2) of CCA concrete cubes for different percentages with 28 days curing age.

S/N	CURING DAYS	SPECIMENS	SAMPLES	COMPRESSIVE LOAD	COMPRESSIVE STRENGTH (N/mm2)	AVERAGE COMPRESSIVE STRENGTH LOAD	AVERAGE COMPRESSIVE STRENGTH (N/mm2)
1	28 days	Control Experiment (0%)	Sample A	293.43	12.9	308.06	13.4
			Sample B	322.69	13.9		
2	28 days	CCA 15%	Sample A	141.96	6.3	139.40	6.2
			Sample B	136.84	6.1		
3	28 days	CCA 30%	Sample A	195.92	8.8	178.78	8.0
			Sample B	161.64	7.2		
4	28 days	CCA 45%	Sample A	110.75	4.9	111.20	4.9
			Sample B	111.65	5.0		
5	28 days	CCA 60%	Sample A	66.72	3.7	76.29	3.8
			Sample B	89.86	3.9		

Source: laboratory research work, 2022.

Table 4.7: Compressive strength (N/mm2) of SDA concrete cubes for different percentages with 28 days curing age.

S/N	CURING DAYS	SPECIMENS	SAMPLES	COMPRESSIVE LOAD	COMPRESSIVE STRENGTH (N/mm2)	AVERAGE COMPRESSIVE STRENGTH LOAD	AVERAGE COMPRESSIVE STRENGTH (N/mm2)
1	28 days	Control Experiment (0%)	Sample A	293.43	12.9	308.06	13.4
			Sample B	322.69	13.9		
2	28 days	SDA 15%	Sample A	208.44	9.3	185.78	8.3
			Sample B	163.12	7.3		
3	28 days	SDA 30%	Sample A	169.53	7.5	163.32	7.3
			Sample B	157.10	7.1		
4	28 days	SDA 45%	Sample A	89.84	4.3	88.40	4.1
			Sample B	86.96	3.8		
5	28 days	SDA 60%	Sample A	86.25	3.8	84.33	3.8
			Sample B	82.41	3.8		

Source: laboratory research work, 2022.

Table 4.8: Compressive strength (N/mm2) of DUO concrete cubes for different percentages with 28 days curing age.

S/N	CURING DAYS	SPECIMENS	SAMPLES	COMPRESSIVE LOAD	COMPRESSIVE STRENGTH (N/mm2)	AVERAGE COMPRESSIVE STRENGTH LOAD	AVERAGE COMPRESSIVE STRENGTH (N/mm2)
1	28 days	Control Experiment (0%)	Sample A	293.43	12.9	308.06	13.4
			Sample B	322.69	13.9		
2	28 days	DUO 15%	Sample A	230.49	12.10	223.14	12.0
			Sample B	215.79	11.99		
3	28 days	DUO 30%	Sample A	163.12	7.3	188.28	8.4
			Sample B	213.44	9.5		
4	28 days	DUO 45%	Sample A	136.84	6.1	139.37	6.2
			Sample B	141.89	6.3		
5	28 days	DUO 60%	Sample A	41.31	3.8	43.99	3.9
			Sample B	46.66	3.9		

Source: laboratory research work, 2022.

SUMMARY OF SLUMP TEST RESULTS IN 7 DAYS

The results from the slump test shows that the slump value decreases as CCA, SDA and DUO content increases from these results, it was noticed that concrete become less workable as the CCA, SDA and DUO percentages increases meaning that more water is required to make it more workable, this was what led to increasing the water cement ratio from 0.6 since the mixture was becoming stiff.

SUMMARY OF COMPRESSIVE STRENGTH RESULTS IN 7 DAYS

The results at 7days after curing decreases in strength from 8.1N/mm^2 for control to 1.2N/mm^2 for 60% CCA replacement, 1.1N/mm^2 for 60% SDA replacement and 1.7N/mm^2 for 60% DUO replacement, only 15% DUO replacement has closest compressive strength of 6.3 N/mm^2 to the control sample of 8.1 N/mm^2.

SUMMARY OF 28 DAYS RESULTS

At 28 days there is continuous increase in compressive strength for all concrete samples, the strength gained can be attributed to cementitious product formed as a result of hydration of cement and those formed when lime stone reacts with possolan. The concrete will decrease in strength from 13.40N/mm^2 for control to 3.8N/mm^2 for 60% CCA and SDA replacement while DUO at 60% replacement has 3.9N/mm^2. Since DUO

sample at 28days curing age of 15%, 30% and 45% replacement respectively meet the minimum strength of 6N/mm^2 recommended by BS 5224 (1976) for Masonry cement, DUO concrete could be used for general concrete work where strength is less importance such as in mass concrete, floor screed and mortal.
Source: Laboratory research work (2022).

CONCLUSIONS

Different tests were carried out, which include the slump test, sieve test, and compressive strength test were carried out. In respect to the slump test carried out, 15% and 30% replacement of cement with the combination of the DUO had the best workability of 5mm while other samples had a slump of 7mm and 9mm respectively. As for the compressive strength, the minimum requirement of 25N/mn^2 cube strength of concrete. At 28 days, DUO at 15% has the highest average of compressive strength of 12.025N/mn^2 while saw dust ash and corn cob ash 60% has the lowest average strength of 3825N/mn^2. The researchers included compressive strength test on the samples, that is, the combination of corn cob ash and saw dust ash, but, corn cob ash or saw dust ash cannot be used as total replacement of cement in concrete except by 15% of the duo as replacement of cement in concrete, which will produce a reliable compressive strength. There is high difference between the control and the result obtained from the tested samples.

RECOMMENDATIONS

The study results have proven that, the saw dust ash and corn cob ash have chemical compositions similar to that of ordinary Portland cement hence, there is possibility of using them as binding agents in concrete and mortal productions. However, the difficulty lies in the fact that the contents of the chemicals (limestone, calcium CaO, magnesium oxide MgO and gypsum) in the saw dust ash and corn cob ash are small, meaning that, they cannot be relied upon solely for concrete and mortal production; the corn cob ash and saw dust ash should be obtained with the addition of limestone at ratio 85% to 15% on equal combination of the duo. It is also recommended that, the saw dust ash and corn cob ash should not be used as total replacement of cement in the production of concrete and mortal at 100% replacement level. It is also recommended that, the best way this local materials can be effectively used as a partial replacement for cement and mortal in concrete, chemicals such as limestone, gypsum, iron oxide MgO and silica SiO^2 could be added to the combination of the duo to improve their strengths and workability. Limestone is very significant ingredient in the production of cement, these ingredients should be added to saw dust ash and corn cob ash constituting about 85% of the entire composition will improve the adhesive and cohesive properties of the materials as to replace cement entirely.

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