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Production of Cement from Mixture of Palm Kernel and Periwinkle Shell

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General Note

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ABSTRACT

Periwinkle and palm kernel shell were sourced, cleaned and incubated in an electric furnace at temperature of 600^{0}C and 140^{0}C respectively, and thereafter grinded and sieved through BS sieve (75microns) to fine ash. Chemical analyses (GC analysis) were conducted on the periwinkle shell ash, palm kernel shell, Dangote and Bua cement used for comparison. The periwinkle shell ash and palm kernel shell ash were mixed in various proportion, 4:1, 3:2, 2:3, 1:4 and 1:1 respectively and each incubated at temperature 350^{o}C with the addition of various percentage of additives to produced five (5) samples of cement A, B, C, D and E respectively. Initial and final setting time of each sample was conducted. Fifteen (15) concrete mixes (three from each sample) were produced by combining each sample, fine aggregate and coarse aggregate in ratio 1:2:3, with cement to water ratio of 0.6, which was allowed to curled for 7, 14 and 21 days for each sample. Test on compressive strength was conducted on the fifteen samples. The results showed that palm kernel shell ash and periwinkle shell ash contains all the chemical component of Dangote and BUA cement in various proportion, and the appropriate proportion to combine periwinkle shell ash and palm kernel ash in cement production should be in ratio 4:1 (sample D) respectively, due to it higher compressive strength and moderate setting time when compared to other mix proportion. Chemical analysis on sample D shows a slight deviation in chemical composition of calcium, silicon and aluminum compared to Dangote cement. Therefore, additives such as MgO, SiO_2 and CaO are required to produce cement of satisfactory quality compared to Dangote and BUA cement. The compressive strength of each sample increases with increasing proportion of periwinkle shell ash and age of curing. Periwinkle shell ash and palm kernel shell ash can be used to produce cement, if appropriate additives are added and appropriate technology is developed for proper utilization.

Key words: Production, cement, mixture, palm kernel, periwinkle shell

1. INTRODUCTION

In developing countries where concrete is widely used, the high steadily increasing cost of cement has made construction very expensive. This coupled with the detorating effect of cement production on the environment as a result of clay mining, has led to the studies on production of cement from palm kernel shell and periwinkle shell, which could be used in replacement of ordinary Portland cement in concrete. This research aimed at putting into effective use of our local materials, such as palm kernel shell (PKS), and periwinkle shell (PSA), which have been investigated to be pozzolanic in good proportion, to replace ordinary Port Land Cement (OPC), and reduce the high cost of structural concrete.

In most country palm kernel shell and periwinkle shell are considered to be classified as waste and in Nigeria the federal government is facing the problem of pollution and waste management and control in the country. Palm kernel shell and periwinkle shell are agricultural aquatic waste product and how to dispose of it is a problem. This work has solved the environmental impact and disposal of this agricultural aquatic waste. The advantage of concrete as a construction material are well known, but according to (Olafusi and Olutoge, 2012), it production exacts a heavy toll on the environment. The negative environmental impact, coupled with rising costs of materials have necessitated research into alternative materials to reduce over-dependence on Portland cement and rock aggregates used in construction. Replacing Portland clinker either partially or entirely is being investigated as an alternative to carbon dioxide emissions (Igarashi et al.,, 2000) and also as an alternative to reduction of the substantial amount of energy used in the production of cement (Coutinho, 2003).

A pozzolana is a sillicious or allominosilleceous material, which is not cementious, but in finely divided form, and in the presence of moisture, chemically reacts with calcium hydroxide released by the hydration of Portland cement, to form calcium silicate hydrate and other cementious material. The advantages of using pozzolana as partial replacement of Portland cement in construction have been reported (King, 1999, Dahunsi and Bamisave, 2002).

Generally, the utilization of waste materials in construction provides both practical and economic advantages (Nevile and Brooks, 2003) as well as it contributes to resources conservation and environmental protection. The potential uses of agricultural wastes in construction have been investigated by (Tay and Show, 1995).

Concrete today assumed the position of the most widely used building material globally. Concrete is defined in term of aggregate composition with the crush granite aggregate concrete generally regarded as conventional concrete. Others are latertic concrete, made from using Lateric rock and Rice Husk Ash (RHA) concrete made from partially replacing cement with RHA. Aggregates occupy 60-80% of the volume of concrete (Abdullah et al., 2006, Tangchirapul et al., 2007., Benur, 2002).

In any developing country like Nigeria today, we are faced with the problem of inadequate housing. It is worthy to note that, among the items needed to complete a housing unit, the most expensive of them is cement. Cement, which is the finest binding material in concrete or morta production, is the most expensive. This is primarily because the Nigeria market depends partly on it importation and partly on the local production. It is interesting to note that in most cases, it is limited in supply (Sensate, 2006., Balogun, 2004).

Ordinary Portland Cement (OPC) is acknowledged as the major construction material throughout the world. The production rate is approximately to about 3.5 billion tons per year by 2015 (Coutinhe, 2003., BIS, 1985). According to Adepegba, 1975, the annual cement requirement in Nigeria is about 8.3 million tones and only 4.6 million tons of Portland cement is produced locally. The balance of 3.6 million tons or more is imported. If alternative cheaper cement can be produced locally, the demand for Portland cement will reduce and ultimately reduce the cost. The search for suitable local materials to manufacture pozzolana cement was therefore intensified and one of the discoveries was that of palm bunch waste (Adepegba, 1975., ASTM, 1994).

Periwinkle Shell Ash (PSA) is one of the import pozzolan that can replace ordinary Portland cement (OPC) in concrete. It is aquatic waste product generated from the consumption of a small greenish-blue marine snail (Periwinkle), housed in a V-shaped spiral shell, found in many coastal communities within Nigeria and word-wide, is a very strong, hand and brittle material.

These snails called periwinkle are found in the lagoons and mudflats of the Niger Delta between Calabar in the East and Badagary in the West of Nigeria, the people in this area consume the edible part as sea food and dispose of the shell as waste. The disposals of this shell as waste, already constituting a problem in areas, where they cannot find any use for it, and large deposits have accumulated in many places over the years. Based on this view, the wasted periwinkle shell is being investigated, to utilize it, in addition to palm kernel shell, to produce binders that can suitably substitute ordinary Portland cement in concrete. In view on the advantages of pozzolana and the potential of PKSA, PSA an appropriate combination of PKSA, PSA and pozzolana as partial or complete replacement of Portland cement and coarse aggregate in concrete, provides an opportunity to use relatively cheap and durable materials to improve infrastructural development in developing countries, whilst reducing construction costs.

Various studies have been carried out on the use of supplementary cemetitious material such as pozzolana to replaced Portland cement. And on the use of Rice Husk Ash (RHA) as replacements of Portland cement and crushed aggregates in concrete.

This study is to investigate the potential of producing cement binder, from appropriate mixture of Periwinkle Shell Ash (PSA) and Palm Kernel Ash (PSA) as a partial or completely replacement of Ordinary Portland Cement (OPC) in concrete the effect of increasing the volume of mixture of PSA and PKSA replacement on the compressive strength of concrete and the extent to which appropriate mixture of PSA and PKSA can partially replace cement in concrete.

Poverty alleviation and environmental pollution control in less developed countries are paramount goals of sustainable development. Lower building cost and reduced pollution should make development sustainable. Many researchers have proved that, the qualities that should be desired in a well-proportioned concrete mix are acceptable workability of fresh mixed, durability, economy, and strength and fire resistance. Durability is the ability of concrete to resist deteriorating agents, maintain its original form, and be serviceable and environmentally compatible. While economy is the affordability of the concrete. The most expensive concrete material, is the binder (cement), and if such all-important expensive material, is partially or completely replaced with more natural, local and affordable material such as PKSA and PSA cement, will not only take care of waste management, but will also reduce the problem of high cost of concrete and housing. This study, therefore, is an investigation of the performance of cement made of partially replacing OPC with appropriate mixture of PKSA and PSA on structural integrity, and properties of mixture of PKSA and PSA cement. The aim of the study is to produce binder (cement) from appropriate mixture of palm kernel shell ash and periwinkle shell ash (PSA), to completely replaced ordinary Portland cement in concrete.

2. MATERIALS AND METHODS

The Materials Used

- Palm kernel shell ash (PKSA) used in this study was collected from local palm oil processing factory at Odogwa in Etche Local Government, Rivers State. The palm kernel shell was flushed with water to remove dirt, it was then dried in oven to a temperature of 140^0C, and grinded into fine ash particle (PKSA). The PKSA was sieve through 75microns sieve in order to remove any foreign material and bigger size ash particles and only the fine ash which passes through the 75microns sieve were collected (which is available abundantly locally).
- Periwinkle shell ash (PSA). The periwinkle shell were obtained, from periwinkle dump site in Iwofe waterside, Rumuolumeni Port Harcourt, they were free of dirt and organic matters, the periwinkle had been remove from the shell. The shells were heated in an oven to a temperature of 600^0C, and thereafter grinded to fine particle with the aid of grinding machine. The resulting ashes were sieve through BS sieve (75mm) to obtain a fine ash.
- Coarse and fine aggregate. The coarse aggregate and fine aggregates used in the investigation are of locally available. The coarse aggregates are of angular shaped. Crushed granite aggregate are confined to 20mm size. Fine aggregates used are of river origin and is free from organic matter.
- Gypsium: This is cement additive of white virtreoussilty substances with chemical formular $Mgso4.2H_2O$. It is found in larger sedimentary deposit associated with hatite, anhydrile, sulfur, calcite and dolomite, it is also known as plaster of Paris, use as hardening retard.
- Drying Agent: Calcium oxide is used as drying agent, in cement; it is a white powder that is capable of absorbing water in concrete to form a compound known as slaked lime.

$$CaO_{(s)} + H_2O_{(1)} \rightarrow Ca(OH)_{2(s)}$$

Table 1 Equipment and Function

S/N	Equipment	Function
1.	Grinding machine	Used for crushing PKS and PSA
2.	Electronics furnace	Used for heating and calcinations
3.	Electronics weighing balance	Used for weighing samples and additives

4.	Vacat's apparatus	Used for determination of initial and final setting time
5.	Mixing Bowl	Used for mixing and collection of all mixed sample
6.	Thermocouple	Used for measuring the temperature of sample
7.	Cylindrical and square mould	Concrete
8.	Malest compression tester	Used for the determination of compressive strength of concrete.

Specimen preparation

Preliminary test

Some preliminary tests were done on the crushed palm kernel shell, periwinkle shell, and the final cement produced, which include, chemical analysis, sieve analysis, determination of initial and final setting time, and determination of crushed strength.

A. Chemical Analysis: The chemical analysis of the palm kernel shell ash (PKSA) and periwinkle shell ash (PSA) was performed in Jiangsu Skyra, Instrument Co. Ltd, Ondo State. The chemical analysis was done using Gas chromatography (GC) technique radiating a voltage of 40.OKv and currentof 300mA to the sample in standard tabular samples of cement, to obtain the chemical analysis of the palm kernel shell powder and the periwinkle shell powder.

Manufacture of PKSA and PSA Cement Mixing of Samples

The periwinkle powder and the palm kernel powder obtained, after sieving through a 75microns sieve, were mixed in different proportion to obtained five samples as illustrated in Table 2.

Table 2: The Mix Ratio of Palm Kernel Ash and Periwinkle Shell Ash

Sample	Palm kernel shell ash (g)	Periwinkle shell ash (g)
A	200	800
B	400	600
C	600	400
D	800	200
E	500	500

Calcinations of the Prepared Samples

Each sample prepared, were fed into a cylindrical cast iron container and labeled for easy identification;it was then heated in an electric furnace in civil laboratory (Rivers State University), to a temperature of 300^0C for 24hrs.

Addition of Additives

200g of gypsium and 50g of calcium oxide (CaO) were added to each sample, so as to facilitate, the hardening and drying characteristics of the cement produced respectively, and the final mixture were healed to a temperature of 150^0C in an oven.

Production of Concrete

For this study, a mix ratio or 1:2:3 of cement, fine aggregates and coarse aggregate respectively was used to prepare the concrete for sample A,B, C,D and E. Table 3 shows the amount of material used to prepare each sample.

Table 3: The mix ratio of Specimen Sample, Fine and Coarse Aggregate

Sample	Cement (g)	Fine Aggregates (g)	Coarse Aggregate (g)
A	200	400	600
B	200	400	600
C	200	400	600
D	200	400	600
E	200	400	600

The cement (sample), were properly mixed with the aggregates and estimated amount of water in ratio 0.6 for cement to water was added, and mixed to form the concrete.

B. Casting of sample: For the production of test sample, cylindrical molds of height 110mm and diameter 100mm were used. The mold were cleaned and oiled to facilitate easy retrieval of sample from the molds. The mixed concrete as labeled was transferred into the oiled molds, and finally, the top of the concrete was finished smooth with a trowel, and covered with plastics sheets to prevent water loss through evaporation. The specimen were demolded after 24hrs and then immersed in curing tank to cure for strength gain and general improvement of properties in the hardened state. Three specimen of each mix were crushed at 7days, 14 days and 21 days, using unconfined compressive strength (UCS) BS 1924, ASTMD5102.

Determination of Setting Time for each Sample

100g of water was mixed with 300g of neat cement from each sample, with the aid of standard spatula. After about 30secs, it was thoroughly mixed with hand for one minute to form a kneaded paste tossed about six times from one hand to the other. Vacat's apparatus, as set up in Table1 was used to estimate the initial and final setting time. The paste was pressed into the hard rubber mold D. E, through the bigger end as illustrated in Table1, and the mold was completely filled with paste, after the removal of extra paste by a single movement of the palm. The inverted mold with it larger end was placed on glass plate F and slice of extra paste from top by a single movement of trowel. The mold testing was placed on gas plate under 1.mm square needle. The needle was then released on the surface of the paste, the time interval between the time the needle fails to penetration a point of 5mm above the glass plate, and from the time the water is added to the paste, is recorded as initial setting time. For the final setting time, the 1mmm square needle is replaced by needle which has an annular attachment around 1mm square needle and projecting by 0.5mm below it. As in the case of the initial setting time, the needle was released on the paste in the mold, the time interval between the time the attachment fail to make any impression on the surface of the paste, whereas, the needle make one, and the time water was added to the paste was recorded as the final setting time.

3. RESULT AND DISCUSSION

Chemical Analysis of Periwinkle Shell Ash and Palm Kernel Shell Ash

Table 4 and 5 shows that the periwinkle shell ash and palm kernel shell ash contains the main constituents of cement which are calcium Ca, Silicon Si, and Iron Fe, even though the percentage is lower compared with that present in Dangote cement and BUA cement shown in Table 6 and 7 respectively.

Table 4 Chemical Analysis of Palm Kernel Shell

Element	Content
Mg	0.0000
Al	0.6115
Si	1.1015
P	0.1698
S	0.6897
K	1.0007
Ca	0.4068
Ti	0.0000
V	0.0056
Cr	0.0045
Mn	0.0212
Co	0.0104
Fe	1.1188
Ni	0.0896
Cu	0.0766

Zn	0.1618
As	0.0000
Pb	0.0057
W	0.1723
Au	0.0000
Ag	0.0020
Rb	0.0048

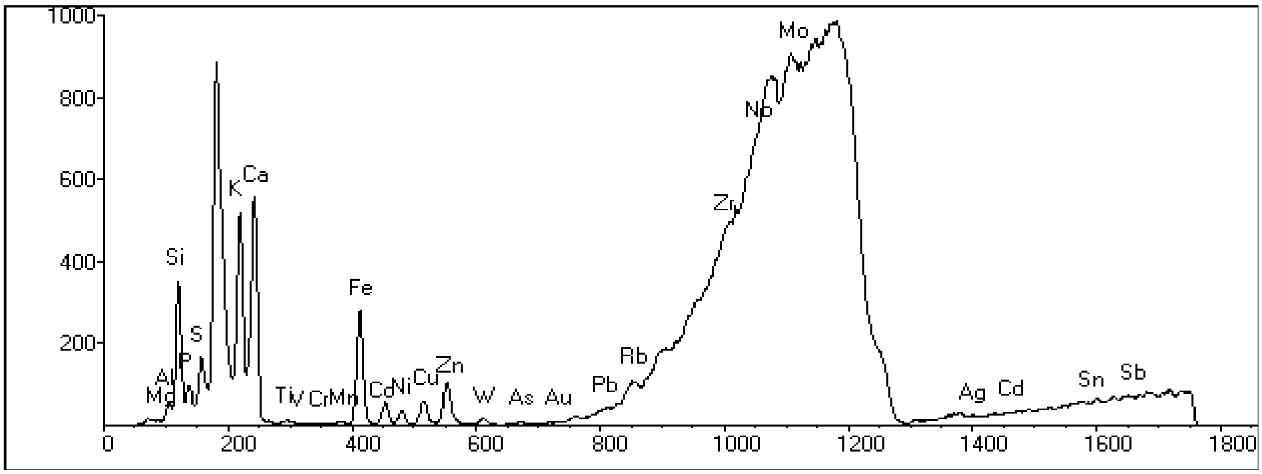

Figure 1 Graph Showing the Chemical Analysis of Palm Kernel Shell

Table 5 Chemical Analysis of Periwinkle Shell

Element	Content
Mg	0.0000
Al	0.3685
Si	0.3033
P	0.2704
S	0.4609
K	0.0000
Ca	60.5899
Ti	0.0000
V	0.0041
Cr	0.0000
Mn	0.0079
Co	0.0007
Fe	0.1604
Ni	0.0261
Cu	0.0230
Zn	0.0436
As	0.0000
Pb	0.0000

W	0.0000
Au	0.0000
Ag	0.0000
Rb	0.0001

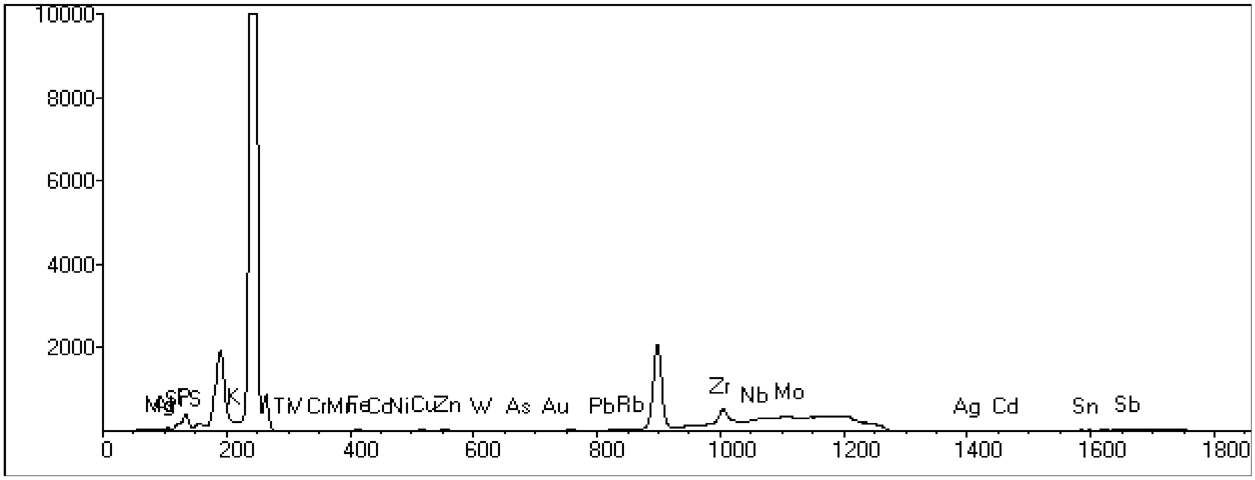

Figure 2 Graph Showing the Chemical Analysis of Periwinkle Shell

Table 6 Chemical Analysis of Dangote Cement

Element	Content
Mg	0.6721
Al	2.0343
Si	5.4426
P	0.4459
S	4.3281
K	0.0000
Ca	66.7244
Ti	0.0000
V	0.0000
Cr	0.0000
Mn	0.0069
Co	0.0114
Fe	1.4887
Ni	0.0104
Cu	0.0090
Zn	0.0238
As	0.0000
Pb	0.0000
W	0.0000
Au	0.0208
Ag	0.0012
Rb	0.0006

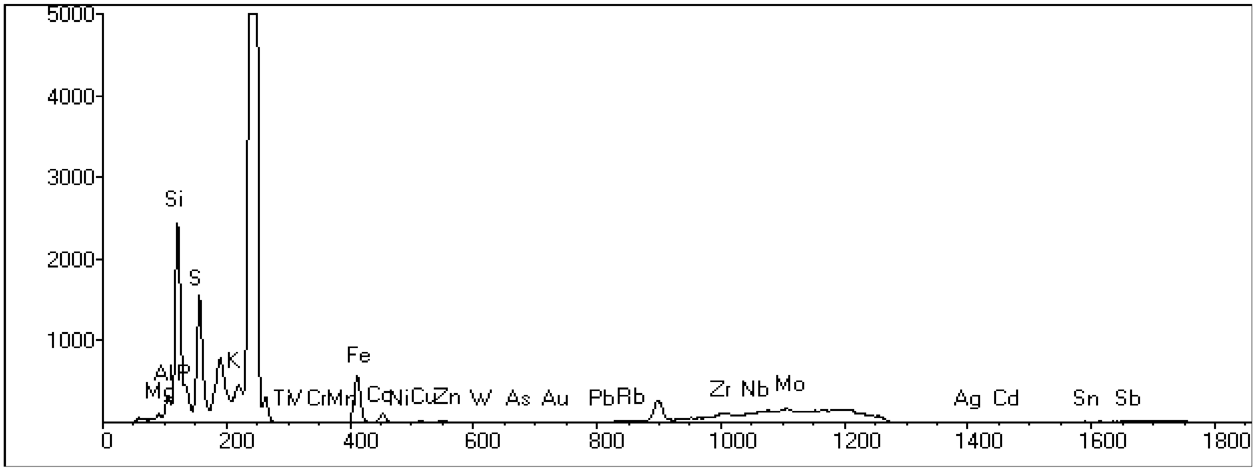

Figure 3 Graph Showing the Chemical Analysis of Dangote Cement

Table 7 Chemical Analysis of BUA Cement

Element	Content
Mg	0.0000
Al	0.8026
Si	3.3471
P	0.4398
S	1.7534
K	2.3453
Ca	4.0510
Ti	0.0000
V	0.0058
Cr	0.0050
Mn	0.0271
Co	0.0175
Fe	2.6734
Ni	0.0695
Cu	0.0771
Zn	0.2813
As	0.0000
Pb	0.0131
W	0.6477
Au	0.0000
Ag	0.0011
Rb	0.0282

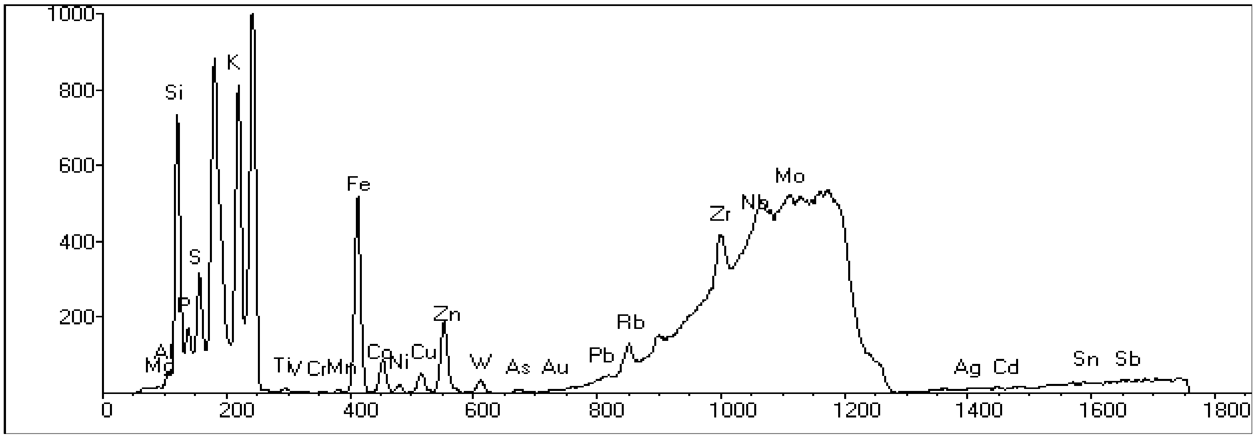

Figure 4 Graph Showing the Chemical Analysis of BUA Cement

Setting Time of the Cement Sample

Table 8 shows the results of the initial and final setting time of each sample, this shows that the water absorption, (initial and final setting time) of the sample containing more of palm kernel shell ash took longer time compare to the sample that contains more of periwinkle shell ash, which implies that the presence of palm kernel shell ash increases the water absorption and setting time. This is because the factors that influence setting time of concrete are volume of cement, water requirement, temperature of the paste and the reactivity of the pozzolan. However, the cement produced from mixture of palm kernel shell ash ad periwinkle shell ash, do not absorb water as fast as Dangote and BUA cement, thereby retarding hydration processes in the PKSA and PSA concrete (PKSA and PSA) concretes retain water for a longer period before it starts to dry up slowly.

Table 8 The setting type of various proportion of sample mixed

Sample	Initial time (mins)	Final setting time (mins)
A	60	252
B	49	223
C	45	307
D	40	141
E	48	269

Density of the Samples

Table 9 revealed that the density decreased with increasing percentage of periwinkle shell ash as concrete from sample E has the least density and for each samples, the density increased with curing age. This is because density is a reflection of weight as, concretes gain strength and weight with curing age due to hydration process. Generally, concrete produced palm kernel shell ash and periwinkle shell ash cement, are lighter than concrete produce from Dangote and BUA cement, due to its slow strength and weight development, and the volume of Dangote cement and BUA cement in the concretes determines the porosity and the degree of compaction of the concretes.

Table 9 The Density of the Various Samples Cured for 7, 14 and 21 Days

Sample	Curing age (Days)	Density of sample gm/cc
A	7	1.421
A	14	1.623
A	21	1.812
B	7	1.408
B	14	1.605
B	21	1.742

C	7	1.382
C	14	1.518
C	21	1.651
D	7	1.354
D	14	1.472
D	21	1.585
E	7	1.312
E	14	1.401
E	21	1.524

Compressive Strength of the Concrete for each Sample

The results obtained from the determination of compressive strength of concrete for the samples are presented in Table 10. The compressive strength increased with increasing proportion of periwinkle shell ash, thus, concrete from sample D with ratio 4:1 for periwinkle shell ash to palm kernel shell ash respectively, have the highest compressive strength, also the result shows that the compressive strength increased with increasing curing age for each concrete samples which is an indication that the crushing strength increases with curing age increase. This means that concrete from mixture of palm kernel shell ash and periwinkle shell ash cement get stronger with time, and that it is suitable for construction in which much strength is not required at the initial stage. Concrete derives its strength from the reaction between silica and the calcium hydroxide liberated during the hydration of cement. The compressive obtained from all the samples are low as a result of the limited quantity of calcium, silicate hydrate, due to relative proportion reviewed in the chemical analysis of periwinkle shell ash and palm kernel shell ash in Table 4 and 5.

Table 10 The Compressive Strength of Various samples Cured for 7, 14 and 21 Days in a Cylindrical Mold

Sample	Curring age(days)	Guace reading	Stress N/mm^2
A	7	150	0.420
A	14	153	0.429
A	21	195	0.546
B	7	155	0.434
B	14	194	0.543
B	21	205	0.572
C	7	160	0.448
C	14	192	0.537
C	21	205	0.574
D	7	185	0.518
D	14	195	0.546
D	21	210	0.588
E	7	170	0.466
E	14	190	0.532
E	21	200	0.560

Chemical Analysis of Sample D

From the result obtained from the compressive strength of concrete from each sample, it revealed that concrete from sample D have higher compressive strength compared to concrete from other samples. Therefore, the best proportion of producing cement from periwinkle shell ash and palm kernel shell ash is ratio 4:1. Sample D was analysed to ascertain the chemical constituent, and the result is shown in Table 11.

Table 11 Shows the Chemical Analysis of PKSA/PSA of Sample D with Additives

Element	Content
Mg	**0.1083**

Al	0.5141
Si	0.7779
P	0.2853
S	0.6757
K	0.0000
Ca	65.6634
Ti	0.0000
V	0.0011
Cr	0.0000
Mn	0.0072
Co	0.0008
Fe	0.2819
Ni	0.0172
Cu	0.0181
Zn	0.0335
As	0.0000
Pb	0.0029
W	0.0134
Au	0.0000
Ag	0.0030
Rb	0.0009

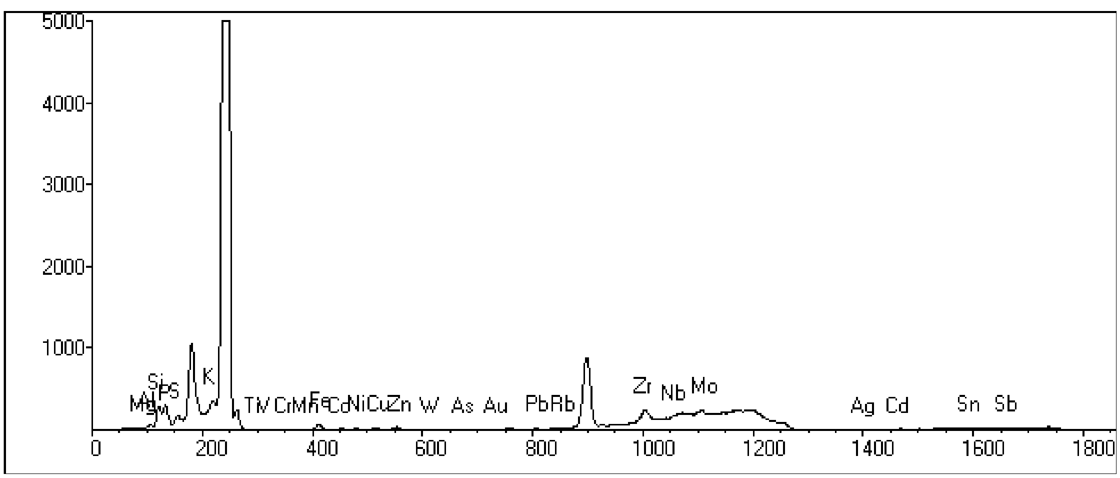

Figure 6 Graph Showing the Chemical Analysis of PKSA/PSA of Sample D with Additive

Compressive Strength of Concrete Cube Casted from Mixture of Sample D and Additive Cement

Table 12 show the result of compressive strength test for concrete from sample, casted in a wooden cube, and cured for 7, 14 and 21 days. The compressive strength increased with increasing age of curing, but the compressive strength in general is low compared to the compressive strength of concrete from Dangote cement.

Table 12 Shows the compressive strength for mixture of sample D and Additive cured for 7, 14 and 21 days

Curing age(Days)	Gauge reading	Stress N/mm^2
7	2050.9	4.512

14	2191.4	4.821
21	2169.23	5.213

Chemical Analysis of Sample D Containing Several Additives

The result obtained from Table 11 shows that the percentage of calcium Ca, Aluminum Al and Silica are low compared to that obtained in Table 6 and 7. 20g of CaO, 15g of $A1_2O_3$ and 18g of SIO_2 were added to 100g of sample D, and the mixture was analyzed to verify the chemical composition, and the result shown in Table 13. The result was compare to Table 6, and for the entire component, the compositions are within the range of Dangote and BUA cement.

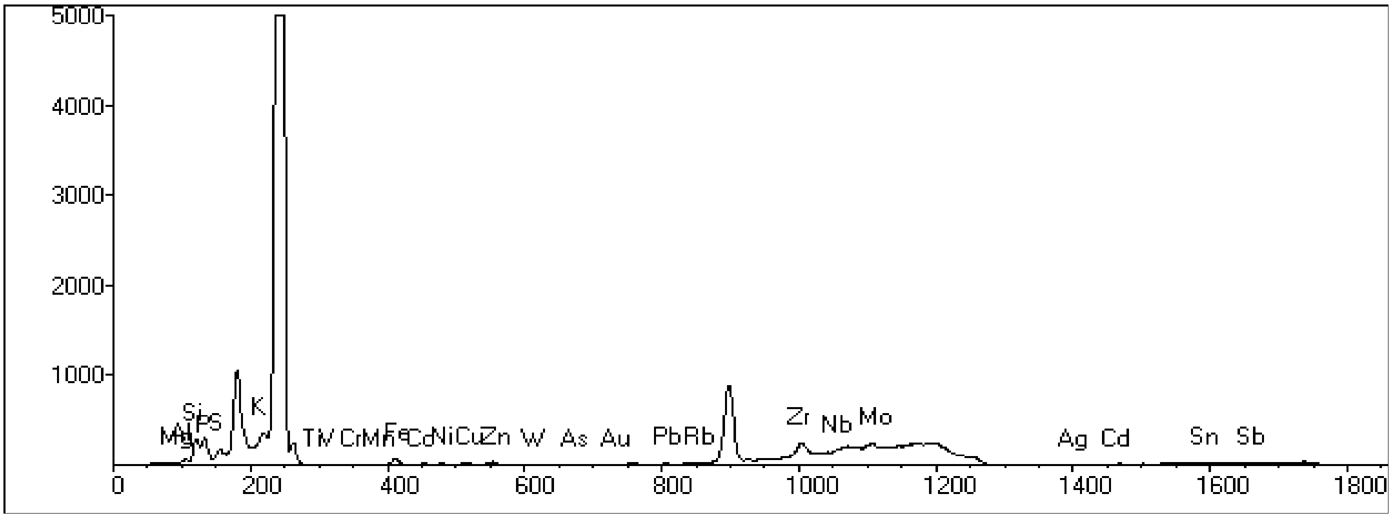

Figure 5 Showing the Chemical Analysis of Mixture of Sample D and Additive Cured for 7, 14 and 21 days

Table 13 Showing the Chemical Analysis of Mixture of Sample D and Additive Cured for 7, 14 and 21 Days

Element	Content
Mg	0.4712
Al	1.9216
Si	2.9280
P	0.1643
S	0.7757
K	0.0000
Ca	63.5214
Ti	0.0000
V	0.0003
Cr	0.0000
Mn	0.0043
Co	0.0005
Fe	0.9218
Ni	0.0043
Cu	0.0122
Zn	0.0042
As	0.0000
Pb	0.0014

W	0.0022
Au	0.0000
Ag	0.0002
Rb	0.0008

Compressive Strength of Dangote Cement and BUA Cement Concrete

Table 14 Shows the Compressive Strength of BUA and Dangote Cement Cured for 7, 14 and 21 Days

Periods (days)	BUA Cement	Dangote Cement
7	24.0	18.67
14	25.78	24.89
21	26.67	28.44

Comparison of compressive of Dangote and BUA cement

Table 15 Show the Comparison of the Formulated Cement (PKSA/PSA), BUA Cement, Dangote Cement with Minimum values for British Standard

Period (Days)	BUA Cement	Dangote Cement	PKSA/PSA cement	Minimum Values For British Standard (BS12)
7	24.0	18.67	4.512	16
14	25.78	24.89	4.821	19
21	26.67	28.44	5.213	21

4. CONCLUSION

Palm kernel shell and periwinkle shell contains all the main chemical constituents of cement, though in varying qualities compare to that of Dangote and BVA cement which implies that cement can be produce from mixture of Palm kernel shell and periwinkle shell, if the right percentage are used and calculated amount of additive to compensate for the deficiency are added. The compressive strength of the concrete produced from palm kernel and periwinkle cement is highest when the periwinkle shell ash and palm kernel shell ash are mixed in ratio 4:1, the results shows that the compressive strength increase with increase in the amount of periwinkle shell. The compressive strength of the concrete increase as the age of curing increases for each of the sample. The use of palm kernel shell and periwinkle shell in cement production will reduce the cost of construction of roads, buildings, housing etc. as the raw materials are available locally and arising from the mining of clay, and the disposal of palm kernel shell and periwinkle shell. The research work, have provide an insight for further research on the possibility of blending two or more pozzolan (palm kernel shell and periwinkle shell) to produce cement, as oppose previous investigation where single pozzolan are study to ascertain the extend it can replaced cement in concrete works.

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Conflicts of Interest: The authors declare no conflict of interest.

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