CONFERENCE PAPERS IN ENGLISH

SECTION 1.

TECHNICAL SCIENCES

USE OF BROKEN AND UNBROKEN BLACK AFRICAN OLIVE SEED AS PARTIAL REPLACEMENT FOR COARSE AGGREGATE IN CONCRETE

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Abstract. An experimental study on the compressive strength of concrete using broken and unbroken black African olive seeds (BAOS) as partial replacements for coarse aggregate in concrete production is presented. Preliminary tests such as slump, impact factor, sieve analysis of aggregates and workability of the fresh concrete among others were conducted. The percentage replacement of BAOS was varied from 0 %, 5 %, 10 %, 15 %, 20 %, 25 % and through 30 % while mixing the concrete in the ratio 1:2:4 with a water/cement ratio of 0.5. A total of 140 concrete cubes specimens for both broken and unbroken BAOS of 150 mm x 150 mm x 150 mm sizes were cast and cured for 7 days and 28 days respectively. The result shows that at 28 day curing, maximum compressive strength of concrete for broken BAOS percentage replacements is found to be 19.46 N/mm^2, but a little lower than the control (19.90 N/mm^2), while that of unbroken BAOS is 20.70 N/mm^2a little higher than the control (19.90 N/mm^2) all at 28 day curing. The results suggest an increase in compressive strength only for unbroken BAOS. It shows that both broken and unbroken BAOS concrete appear to belong to light weight concrete with percentage replacements up to 15 % for unbroken BAOS and 10 % for broken BAOS by maintaining a compressive strength of concrete 17 N/mm^2 and above as required by the British Standard.

1.0 Introduction

Aggregate occupies three quarter of the volume of concrete indicating a higher proportion than their constituent materials required for concrete works [1]. This inevitably leads to a continuous and increasing demand of natural materials used for concrete production. Parallel to the need for the utilization of the natural resources emerges a growing concern for protecting the environment and a need to preserve natural resources, such as aggregate, by using alternative materials that are either recycled or discarded as a waste [2].

Recent researches have reported that coconut shell, palm kernel shell, periwinkle, cockle shell, broken bones can be used in the production of light weight concretes. These alternative aggregates from plant sources are readily available as agro-wastes and can be used where feasible as partial replacements for cement to produce concrete mixtures [3]. Large amount of agro wastes produced yearly are disposed either by burning or dumped where dumping sites exist, thereby creating emissions and pollution that spread in the atmosphere, causing environmental and health hazards to living including humans.

1.1 Black African Olive Seed for coarse aggregate;

Canariumschweinfurthii otherwise known as African *Canarium* or black olive have been extensively utilized by traditional societies for its fruits and oil contents. In the savannah part of Nigeria they are often cultivated for its fruit which are edible, dark greenish, ellipsoid but slightly three – angled and it oil is been extracted and use for cooking [4].

Researchers researched on the use of unbroken black African olive seed (UBAOS, Figure 1) as material for concrete such as; thermal insulation in bricks and using olive mill waste-water (OMS) as an additive for the development of construction materials. On the other hand using black African olive seed as a partial replacement of coarse aggregate will reduce the volume of solid wastes which will provide neat environment, reduce pollution and the cost of disposing these waste through the utilization of recycling of this agricultural wastes.

Figure 1. Unbroken Black African Olive Seed (UBAOS)

Figure 2. Broken Black African Olive Seed (BBAOS)

In this study UBAOS (Figure 1) and BBAOS (Figure 2) are considered as replacements for coarse aggregate and their effect on the compressive strength of concrete examined.

2.0 Materials and Method

2.1 Materials

The materials used were coarse aggregates (gravel), Fine aggregate (sand), Portland cement, Water, cement, unbroken and broken BAOS.

The cement used was ordinary Portland cement which was bought from a building material store in Gidan-Kwano, Minna.

Sand: The sand used was clean, sharp river sand that was free of clay, loam, dirt, organic matters and found passing through 5 mm standard sieves specified in [5].

Water: The water used was fresh, colourless, odourless, tasteless and drinkable potable water that was free from organic matter of any kind. This complies with the specification in [6].

Cement: Dangote brand of Ordinary Portland cement procured from Gidan Mangoro, in Minna, Niger State of Nigeria, was used as the main binder. It conforms to type 1 cement as specified by [7].

Gravel: The gravel used was brought from Kpakungu Minna, also found clean and the sizes were mainly percentage passing through 20.00 mm B.S sieve specified by specified by [5].

3.2 Preliminary Tests

The preliminary test involve in this study include sieve analysis, specific gravity of aggregates, slump test of fresh concrete and compressive tests of cured concrete among others. These tests were conducted in accordance with [8].

Casting and Compaction of Concrete Mix: In casting the cube, the mix ratio employed was 1:2:4 with constant water cement ratio of 0.5. The mold was cleaned with oil to ensure easy stripping and the mold was nailed to ensure that it was tight. The freshly mixed concrete was scooped into the mold of dimensions (150 mm x 150 mm x 150 mm) in three layers; each layer was tamped 25 times with tamping rod. After the cubes have been casted, they were kept in a laboratory for 24 hours and after which they were de-molded and transferred to the curing tank for a period of 7 and 28 days.

Compressive Strength Test: The cubes to be tested were removed from curing tank and crushed for their respective compressive strength according to [8].

3.0 RESULTS AND DISCUSSIONS

3.1 Results

The results of tests carried out such as specific gravity, moisture content, bulk density, porosity, sieve analysis of aggregate and olive seed, void ratio, compaction factor test, and compressive strength test are shown in Figures 3, 4, 5, 6 and Tables 1, 2, 3 respectively.

Sieve Analysis: From the sieve analysis in Table 1, the fineness modulus calculated or determined for sand is 2.63 which fall within the given range of 2.6 to 2.9 for medium sand. A sand having a fineness modulus more than 3.2 will be unsuitable for making satisfactory concrete [9], therefore the sand used is suitable for a good concrete.

A closer look at the results obtained for moisture content expressed in the calculations reveals that both sand and quarry dust have a slightly higher moisture intake than gravel. That is, for sand (3.4 %), black African olive seed (0.7 %) and gravel (0.6 %). This implies that there would be a little additional amount of water introduced into the respective concrete mix proportions which enhances workability.

Specific gravity: the specific gravity obtained for sand, gravel, UBAOS and BBAOS are presented on Table 1. The values are 2.62, 2.58, 1.13 and 1.27 for sand, gravel, UBBAOS and BBAOS respectively falling within the range specified by standards. It can be deduced that the particles are uniformly graded in accordance to [5] although that of the BAOS may not totally conform to standards. A range of 2.6–2.7 is specified by [1].

Void ratio: For a quality grade concrete, it is often required that the void spaces created by coarse aggregates be filled with mortar to improve hardness and strength development and minimize honey-combing. As shown on Table 1, the results were obtained as void ratio for sand, gravel and unbroken black olive seed respectively 0.39, 0.42, and 0.41.

Impact Value: From Table 1, the impact value result 10.9, 47.0 and 11.33 for coarse aggregate, UBAOS and BBAOS respectively, which clearly shows that the unbroken African olive seed resist more impact than other aggregates.

Water absorption: The results obtained from water absorption test shows that crushed granite have a lower water absorption rate of 0.57, while ceramic tiles have an absorption rate of 8.17. This implies that increase in unbroken black olive seed requires increase in water – cement ratio to obtain same workability for crushed granite.

Bulk density and porosity: According to [1], the ratio of uncompacted to compacted bulk density should fall within the range of 0.87–0.96, the result obtained thereof for sand, gravel, UBBAOS and BBAOS gravel were 0.92, 0.90, 0.91, 0.95 respectively. The above results agree appreciably with [1] specification, which implies that the aggregates are well-packed and densely composed.

Compaction factor: The values obtained for compaction factor in this study were as show in Table 1 fall within the require range of 0.80–0.96 as stipulated by [9]. Thus even with the increase of the unbroken black African olive seed, the concrete still remain workable. 0 % and 5 % replacement fall within the range of 2.0–3.0 as a very good workable concrete as postulated by [9]. But as the percentage of replacement with BAOS increase the workability of the concrete reduce gradually.

Slump: The slump type associated with all the tests performed for the various percentage replacements is the True Slump (Table 2). Slump is affected by the water/cement ratio and based on these values; the concrete is workable as there was no total collapse of the slump.

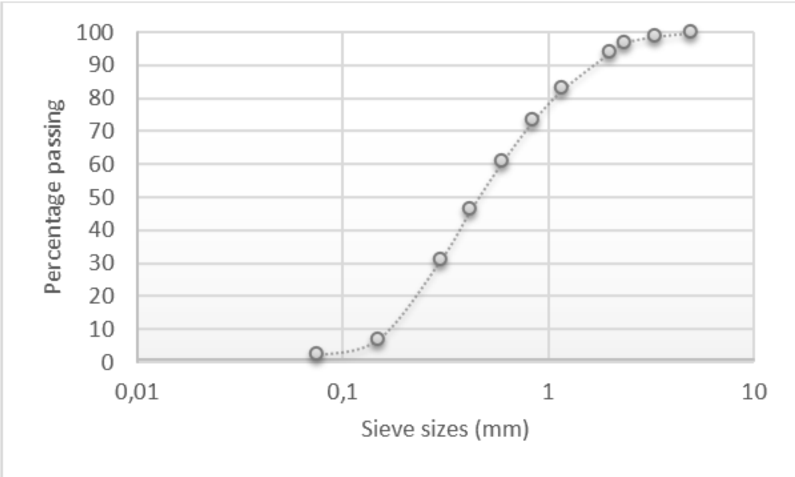

Figure 4. Sieve Analysis of Fine Aggregate

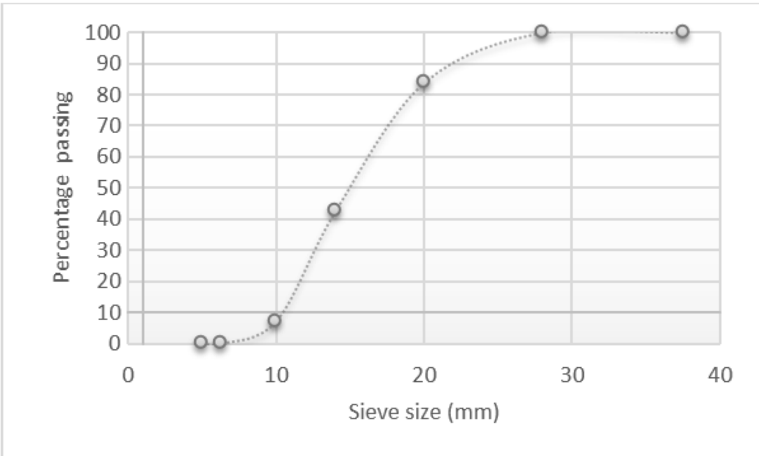

Figure 5. Sieve Analysis of Coarse Aggregate

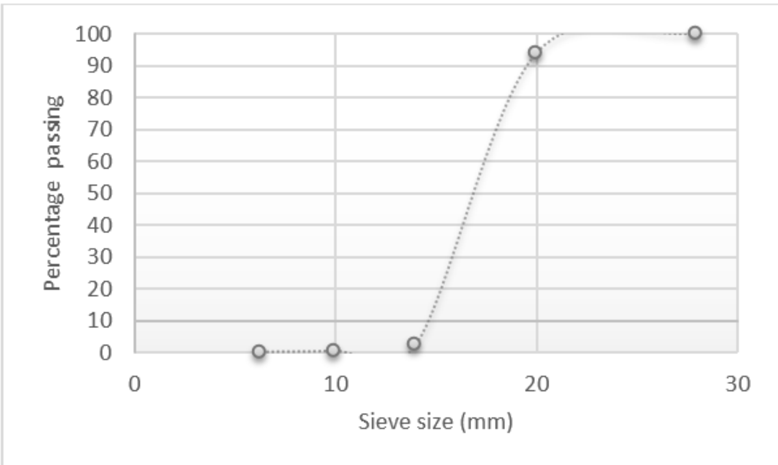

Figure 6. Sieve analysis of UBAOS

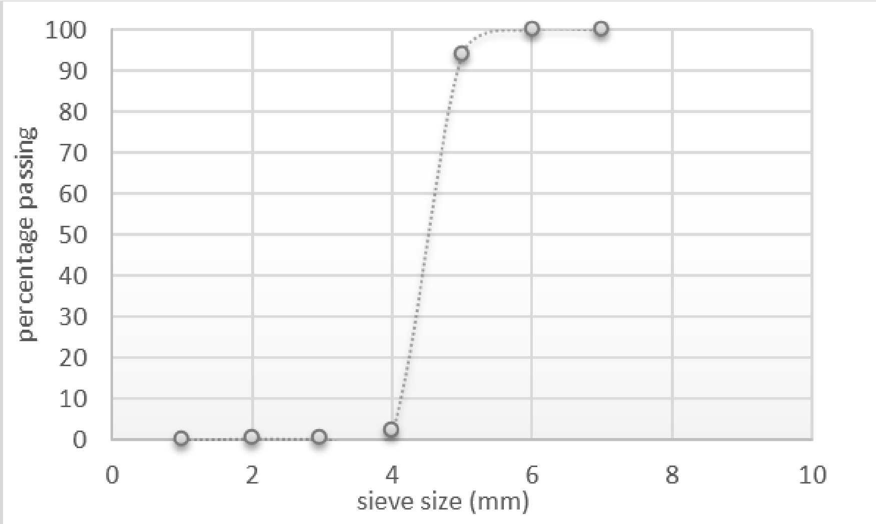

Figure 7. Sieve analysis of BBAOS

Table 1.

Physical properties of aggregates

Serial No.	Test		Fine aggregate	Coarse aggregate	Unbroken BAOS	Broken BAOS	Requirements
1	Void ratio		0.42	0.39	0.41	0.4	Satisfactory
2	Porosity		0.91	0.92	0.88	0.85	Satisfactory
3	Bulk density (Kg/m^3):	Un-compacted	1825.46	1769.23	670.56	1233.60	Satisfactory
		Compacted	1985.96	1965.78	732.94	1303.26	
4	Specific gravity		2.62	2.58	1.13	1.27	Satisfactory
5	Impact value (%)			10.90	47.0	11.33	Satisfactory
6	Water absorption (%)		1.23	1.14	8.17	3.31	Satisfactory
7	Fineness modulus (FM)		2.63	3.57	4.02	3.03	Satisfactory

Table 2.

Slump of fresh UBAOS and BBAOS concrete

Percentage replacements	Slump (mm): Unbroken BAOS concrete	Slump (mm): Broken BAOS concrete	Requirement
0 % BAOS+100 % granite	20	60	Satisfactory
5 % BAOS+95 % granite	20	60	
10 % BAOS+90 % granite	17	48	
15 % BAOS+85 % granite	15	10	
20 % BAOS+80 % granite	14	18	
25 % BAOS+75 % granite	13	28	
30 % BAOS+70 % granite	10	10	

Table 3.

Average compressive strength of UBAOS and BBAOS

Serial number	Percentage replacement	Compressive strength (N/mm^2)			
		UBAOS		BBAOS	
		7 days curing	28 days curing	7 days curing	28 days curing
1	0	16.64	19.90	16.46	19.90
2	5	15.29	20.70	15.71	19.46
3	10	13.62	18.22	12.94	16.73
4	15	13.09	17.78	12.09	15.58
5	20	11.34	16.14	8.75	8.79
6	25	9.46	15.41	4.89	7.42
7	30	5.40	13.87	6.42	6.76

3.2 Compressive Strength of UBAOS and BBAOS

The average compressive strengths for each percentage replacements are presented on Table 3 for 7 days and 28 days curing. The maximum compressive strength attained at 28 curing days for both UBAOS and BBAOS were 20.70 N/mm^2 and 19.46 N/mm^2 respectively at 5 % replacement. Additional replacements up to 30 %, only tend to decrease the strength of the concrete, as indicated on the table. Hence the optimal strength for UBAOS and BBAOS is at 5 % replacement, however it was higher in UBAOS replacement even though both maintained a control compressive strength of 19.90 N/mm^2. The result on Table 3 still shows that the minimum strength attained were as low as 13.87 N/mm^2 and 6.76 N/mm^2 for BAOS and BBAOS respectively at 30 % replacement. Compressive strength for both at 7 days curing were generally low, indicating a similar trend for normal coarse aggregate in conventional concrete where due to continued hydration of cement, concrete gains more strength at a greater curing age [10].

This then follows, that the only optimal compressive strength attained at 5 % replacement (20.70 N/mm^2) of UBAOS is acceptable for normal concrete, while further replacements up to 25 % for UBAOS and 15 % for BBAOS classified them under lightweight concrete respectively. It was earlier observed during weighing of concrete cubes, that there was a trend of gradual decrease in the average density of the concrete accompanied with decrease in the average compressive strength of concrete, as the percentage replacement for UBAOS and BBAOS increases beyond 5 %. The lower the density of concrete, the lower is the compressive strength [11].

4.0 Conclusions and Recommendation

The experimental study on compressive strength of concrete using unbroken BAOS as partial replacement for coarse aggregate is presented and the following conclusions can be deduced:

1. The workability of the fresh concrete decreases with subsequent increase in quantity of UBAOS and BAOS replacements. The workability of the concrete reduces with increase in percentage of replacement BAOS for cement. The highest slump was obtained at 0 % and 5 % replacements up to 20 % replacement;
2. The maximum compressive strength was 20.70 N/mm^2 at 5 % replacement of crushed granite with UBAOS, while that of BBAOS was 19.46 N/mm^2 observed at 5 % replacement but a little below control (19.90 N/mm^2);
3. The compressive strength of the concrete reduces, as the percentage replacement for BBAOS in the concrete increases, but was generally above BS requirement for light weight concrete at 5 %, 10 % and 15 % replacements at 28 days curing

Based on the study presented, BAOS concrete is for usage as lightweight concrete, provided the BAOS percentage content does not exceed 15 % replacement for cement.

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EFFECT OF PERCENTAGE REPLACEMENT OF CEMENT WITH RICE HUSK ASH ON THE COMPRESSIVE STRENGTH OF 56-DAYS AGED CONCRETE

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