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Impact of Workability in Aracaura Columaris (Christmas tree) Seed Acs as Partial Replacement of Coarse Aggregate in Concrete.

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ABSTRACT: *A research on workability contribution of Aracaura Columaris (Christmas tree) Seed ASC as partial replacement of coarse aggregate in concrete was carried out. The compressive strength and workability of the Aracaura Columaris (Christmas tree) seed ACS in concrete were determined. Sixty (60) cubes of 1:2:4 mix design ratio were measured in 150x 150 x 150mm with varying percentages by weigh of normal concrete aggregate in the orders 100:0, 95:5, 90:10, 85:15 and 80:20 were casted and cured in water. Tests after 7, 14, 21 and 28days were carried out. The compressive strength test shows that at 5% ratio at 28days, of strength of 24.05N/mm^2 was achieved at 1:2:4 concrete mix ratio. The values of the compressive strength at 28days for partial replacement in ASC in concrete at 5% can be use for lightweight concrete and also for non load bearing concrete works.*

KEYWORDS*: Coarse aggregate, Compressive Strength, Concrete and Workability*

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I. INTRODUCTION

The use of local building materials in the construction industry as partial replacement in concrete has been in existence in some countries in Africa, Asia and some parts of South America. In Africa, like Nigeria, Ghana and South Africa and Asia, like Malaysia and India. Aracauira Columaris (Christmas tree) seeds (ACS) are not common materials in the construction industry, it may be as a result of non-availability in large quantities like granite, gravel (coarse aggregate) and sharp sand (fine aggregate).Concrete is a massive and weighty construction material used commonly in both building and civil engineering construction works worldwide, [2]. [4], shows that many experimental works have been carried out to improve the properties of the concrete by adding new materials: the materials may be natural, recycled or synthetic. The growing concern of resource depletion and global pollution has challenged many researchers to seek and develop new materials relying on renewable resources, [3] In Nigeria, the major construction material is concrete. The use of Christmas tree seeds as partial replacement for concrete is imperative because it will cut down the cost of project without loses of strength. The amount of aracaura columaries (Christmas tree) seeds (ACS) remain in the environment as waste, so utilization of those materials for construction will be an important step in replacement of concrete to a large extent in building and construction industry.

So many researchers have carried out many research works on materials replacement using industrial and agricultural waste in concrete production. [8], carried out performance of palm kernel shells as partial replacement for coarse aggregate in asphalt concrete. [6] also carried out crushed palm kernel shell as a partial replacement of aggregate in asphaltic concrete.

Agricultural and industrial wastes have created waste management and pollution problems. However, the use of agricultural and industrial waste to complement other traditional materials in construction provides both in practical and economical advantage.

Et.al [3], conducted an experimental study on the improvement of strength of concrete with partial replacement of coarse aggregate with coconut shell and coir fibres. The study compared the test for compressive strength, splitting tension strength; temperature resistance, chemical resistance and PH test of sample were performance. The result concluded that concrete with coarse aggregate partially replaced with coconut shell and coir fibres shows lesser strength but can be recommended for low cost construction with addition of fly ash.

Et.al [4] investigated machine crushed animal bones as partial replacement of coarse aggregates in light weight concrete. The physical and mechanical properties were determined, compressive strength tests showed that approximately 50% of the crushed animal bones in replacement for normal aggregate were quite satisfactory with no compromise in compressive strength requirement for concrete mix ratio 1: 1.5: 3.

[1], conducted a research on exploratory study of date seed as coarse aggregates in concrete production. The paper investigated the suitability of date seed (DS) as partial or full replacement of crushed granite (CG) in concrete production. Physical and mechanical properties of DS and CG were determined and compared. The research concluded that the date seed (DS) can partially be used to replaced crushed granite (CG) in production of light weight concrete where it is abundantly available and can be recommended as an alternative materials (partial replacement) to coarse aggregate. A study conducted by [9] about crushed Doum palm shell as partial replacement of coarse aggregate in concrete. Physical and mechanical properties of crushed granite (CG) and crushed doum palm shell (CDPS) were determined and compared. The result of the test indicated that the compressive strength of concrete as well as the bulk density of the CDPS increases up to a maximum valve corresponding to 10% replacement of CG with CDPS after which it progressively decreased.

II. MATERIALS AND METHOD

2.1 MATERIALS:

The following materials were used for the experiment.

2.1.1 Aracaura Columaris (Christmas tree Seed) was collected from two different higher institutions both were Federal polytechnic Ilaro, Ogun State and Lagos State polytechnic, Ikorodu, Lagos Nigeria.

2.1.2 Cement: Ordinary Portland Cement (OPC) the cement is locally available in Nigeria (DANGOTE Cement Brand) in 50kg was used for the experiment which was obtained from ilaro Ogun State Nigeria.

2.1.3 Water: portable water from Civil Engineering Laboratory of the Federal polytechnic Ilaro Ogun State Nigeria was used for the experiment as it was clean and free from impurities.

2.1.4 Coarse Aggregate (Granite): Crushed granite stone was obtained from a crushed Raton Quarry along Lagos/ Ibadan express way Ogun State Nigeria.

2.1.5 Fine Aggregate (sand): sand used for the experiment was obtained from Ogun- River in Abeokuta, Ogun State Nigeria; the sand used was free from salt and fully sharp for the experiment.

2.2 METHOD

The research was approached by batching operation in volume. The mixes ratio was 1: 2: 4 (cement; fine sand; coarse aggregate or Aracuara columaries (Christmas tree) seed (ACS), cements were measured in 14.5kg, fine sand were 28kg and coarse aggregate were measured in 59kg on physical weighed scale from Civil Engineering Laboratory of Federal polytechnic Ilaro, Ogun State. A water cement ratio of, 0.5, 0.55, 0.60, 0.65 and 0.70 respectively were obtained to meet the required water cement ratio for the actual mixes. W/c ratio of 0.55 was adopted for 1:2:4 mix. The tests were conducted in line with the methods prescribed in the BS codes.

The concrete plastic moulds were used for the experiment, cleaned and oiled before each moulds were used. Total of sixty (60) concrete cubes of 150mm x 150mm x 150mm were produced with a mix ratio of 1:2:4 which was done in batching. The concrete cubes were de-moulded after 24 hours of casting. The de-moulded concrete cubes were move into curing tank. The cubes were removed from curing tank at the end of 7^{th}, 14^{th}, 21^{st} and 28^{th} day and air dried for about 3 hours before testing. The cubes were weighed after removing from curing tank and weighed again after air dried.testing and the density of the cubes at different time was measured a day to the period of testing The partial replacement of granite with Aracaura Columaries (ACS) were in percentage of 0%, 5%, 10%,15% and 20% for each of the percentage, total of three (3) cubes were produced. Compressive strength of the cubes were tested in accordance to [5] with the use of matest digital compression machine.

Fig. 1. Lubricating of moulds

Fig .2. Aracaura Columaries on physical weigh Scale

Fig. 3. Cement on physical weigh scale

Fig. 4. Placing the mixed concrete into the Moulds

Fig. 5. Granite on the physical weigh scale

Fig. 6. Sharp Sand on the physical weigh scale

Fig. 7. Slump test of the concrete

Fig. 8. Mixing of concrete

Fig. 9. Fresh concrete in the moulds

Fig. 10. Concrete cubes air dried after removing from

III. RESULTS AND DISCUSION

TABLE 1: Compressive Strength of Aracaura Columaris (Christmas tree) Seed

	N/mm²			
ACS%	**7days**	**14days**	**21days**	**28days**
0	14.5	21.5	22.3	24.5
5	5.1	8.6	12.5	17.5
10	3.2	6.3	8.5	10.5
15	2.5	4.8	5.5	7.2
20	2.2	3.5	5.45	6.9

Source: Experiment 2018

3.1. Compressive strength: The results presented in Table 1 shows that the compressive strength of aracaura columaries (Christmas tree) seeds as partial replacement of concrete reduces as the percentage of ACS increases in replacement. The low strength of the performance of concrete containing ACS in due to reduction in bonding strength between the aggregates as a result of inadequate cement paste to bonded the larger specific surface area of the ASC that was low in density. Therefore this research discover the proportion and determined the strength of aracaura columaries (Christmas tree) seeds ASC as partial replacement of coarse aggregate in concrete influence the workability and the strength performance of the concrete.

From table 1 the observation of the strength of ASC was achieved at 5% on 28 days, compared to other agricultural waste product used as partial replacement for coarse aggregate in concrete, et. Al [7] concluded that at 10% crushed rubber seeds shell as partial replacement in coarse aggregate in concrete attained it's compressive strength at 28 days which is suitable in application of concrete production, also from another study, (Et.al [9]) mentioned that at 28 days compressive strength of concrete produced using crushed Doum palm shell as partial replacement in coarse aggregate in concrete at 10% attained it's strength.

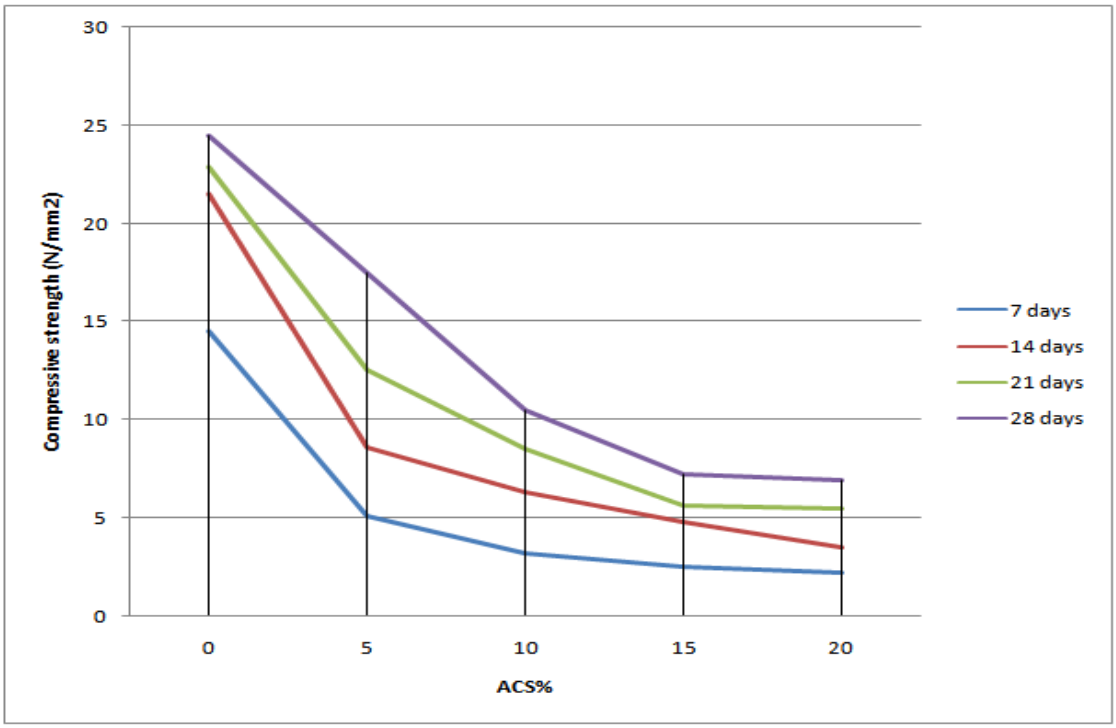

Figure.2 Graph of Compressive Strength against percentage of Aracaura Columaris in concrete Cubes

TABLE.2 Varying Percentages of Aracaura Columaris in concrete in slump test

ACS %	Water/ Cement ratio	slump (mm)
0	0.5	35
5	0.55	40
10	0.6	45
15	0.65	35
20	0.7	32

Source: Experiment 2018

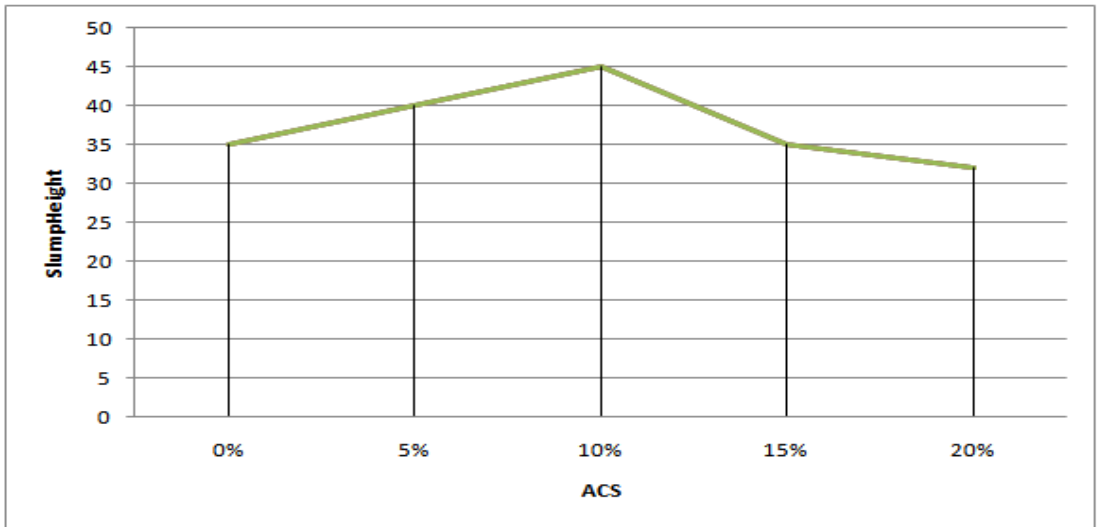

Figure.3 Graph of Slump Height against Percentage of Aracaura Columaris in concrete cubes

3.2 Workability: The workability of concrete batched at different percentages of ACS using slump test shows in table 2 and presented I ''Fig 3''. The mix samples with water/ cement ratio at different variation was low in at control and high at 10% of replacement. It is observed that the workability of concrete increased as the percentage of ACS increases up to a maximum value of 45mm at 10% replacement. At a point where the workability reduced, observed an agreement with the findings of [9].

IV. CONCLUSIONS AND RECOMMENDATION

From the result presented in this research its show the aracaura columaris (Christmas tree) seeds ASC as partial replacement of coarse aggregate in concrete can be used. The replacement of the aracuara columaris (Christmas tree) seeds ACS which attained its compressive strength at 17.50N/mm^2 at 28days can be use for light weight concrete and non load bearing concrete at 5%. However, to increase the strength of the aracuara columaris (Christmas tree) seeds ACS, it is recommended that the future investigation can be focus on chemical and physical properties of the material used as partial replacement in concrete production.

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