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Compressive Strength of Concrete Using Palm Oil Nut Shell as Light Weight Aggregate

Hamisu Bara'u Imam[1], Nura Usman[2]

[1,2]Department of Civil Engineering, Hassan Usman Katsina Polytechnic
P.M.B. 2052, Katsina, Nigeria

Abstract: **This research work tested concrete cubes made of palm oil shell as partial replacement for course aggregate as 5%, 10%, and 15% in a mix ratio of 1:3:6 to determine the most suitable palm oil shell percentage replacement to attain acceptable compressive strength. Concrete cubes were cast, cured and crushed at the age of 7, 14, and 28 days. From the results obtained, the maximum compressive strength for control cubes was 26.37N/mm2, 18.00N/mm2, 14.30N/mm2 and 16.89N/mm2 for 0%, 5%, 10%, and 15% respectively after 28 days. This suggests that, the maximum compressive strength of control cube for 28 days is higher than the compressive strength for 5%, 10%, and 15% mix. The 5% and 15% mix gained more strength as the curing age increases while 10% mix dropped in strength after 14 and 28 days of curing. It is therefore discovered that palm oil shell can be used as partial replacement of aggregate in producing lightweight concrete and as construction material in low-cost building.**

Keywords: **Palm oil shell, light weight aggregate, concrete, compressive strength, insulation of buildings.**

1. INTRODUCTION

Light weight concrete is not a new invention in concrete technology, it has been known since ancient times, [1]. Kenneth has reported that Light weight concrete has many and varied applications including multi-story building frames and floors, bridges, offshore oil platforms, and pre-stressed or pre-cast elements of all types [2]. He also presented that Structural lightweight aggregate concrete solves weight and durability problems in buildings and exposed structures. Lightweight concrete has strength comparable to normal weight concrete, yet is typically 25% to 35% lighter.

Light weight concrete contains aggregate that are all light weight or a combination of light weight and normal weight aggregates. The use of light weight aggregate is becoming necessary especially when building structures are to be erected on soil of poor bearing capacity and even for economic reasons. This can help to mitigate building structural failures as a result of foundation failure.

In this study, palm oil nut shell which is hard and light in weight has been used as partial replacement in concrete to be used in low-cost building with a view to reduce cost of production and motivate the interest of low income earner to have the hope in owning personal residential building.

Nigeria is blessed with Palm oil tree as one of assets with high economic value in the nation, and its importance is realized and potentials fully harnessed. Palm kernel tree can be sourced from oil palm plantation scattered in the rain forest region in southern Nigeria which include Ekiti, Edo, Ondo, Anambra, Cross River, Oyo, Abia and Enugu. The product is usually available in large quantity during raining season from May to September and extends to December [3].

The palm nut shell is used as a source of fuel for the boilers. Residual shell is disposed of as gravel for roads maintenance. Blacksmiths also buy the shells to use as fuel material in their casting and forging operations. Palm nut shell is also used in the preparation of pozzolana, a cement substitute material that has been developed by the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana [4].

[5] while referring to density-strength relationship, drew a conclusion that the higher the density of the light weight aggregate concrete mixture the higher the strength

1.1 Type of Light Weight Concrete

There are several types of light weight concrete and these are low density, moderate strength and structural concrete. Low density concrete is employed chiefly for insulation purposes with low unit weight, seldom exceeding 800kg/m^3. Heat insulation value is high and the compressive strength is low in the range of 0.69 and 8.89N/mm^2. The use of moderate strength concrete requires a fair degree of compressive strength and sometimes used as fill material. Most light weight aggregate is produced form materials such as clay, shale or slate. Blast furnace slag, natural pumice, vermiculite, and perlite can be used as substitutes.

1.2 Palm Oil Shell as Coarse Aggregate

The concrete obtained from using palm oil shell aggregate satisfies the minimum requirements of concrete. Concrete using palm shell resulted in acceptable strength required for structural concrete. Palm oil shell may be used as construction material at the same time solves the environmental problem of reducing the generation of solid waste.

1.3 Uses of Light weight concrete

The benefits of using lightweight aggregate concrete include:

i. Reduction in dead loads making savings in foundations and reinforcement.
ii. Improved thermal properties.
iii. Improved fire resistance.
iv. Savings in transporting and handling precast units on site.
v. Reduction in formwork and propping.

2. MATERIALS

Materials used in this research work are Portland cement produced by Dangote Cement Company, sand, crushed stone, palm oil shell and water.

3. METHODOLOGY

3.1 Batching

The materials (cement, sand and crushed stone) were measured by volume in the ratio 1:2:4. Percentages 5%, 10%, 15% of crushed stone were removed and replaced with equivalent percentage of palm oil shell.

3.2 Mixing

Cement and sand were mixed dry on a mixing tray until a uniform mix was attained. The material was sprayed and the crush stone and the palm oil shell were then added followed by water on a water cement ratio of 0.55. Immediately after adding the water, the whole material was mix thoroughly until to consistency.

3.3 Casting of cubes

Moulds were cleaned and lubricated. The concrete mix was cast into a total number of 36 moulds and compacted in three layers. Each layer was given twenty-five strokes which were uniformly distributed. A straight edge was used to level off the concrete in the mould.

3.4 Curing

The top of each cube was covered with an impervious sheet immediately and placed on non vibrating surface for 24 hours. They were also marked on the top for identification. The cubes were then immersed in curing tank until period of testing.

3.5 Testing

The cubes were removed from the curing tank and allowed to drain sufficiently before weighing. The compressive strength of the cubes of each mix ratio was determined using compression machine at different ages of 7, 14 and 28 days. The value of applied load was recorded and the compressive strength was determined in N/mm^2.

4. RESULT

Table 1 below shows the average value of the compressive strength of the concrete cubes.

Table 1: average strength of concrete

Age (Days)	Strength (kN/m^2)			
	0%	**5%**	**10%**	**15%**
7	15.18	15.57	15.34	14.07
14	16.45	15.93	14.07	16.67
28	26.37	18.00	14.30	16.89

5. DISCUSSION OF RESULT

Replacement of aggregate with palm nut shell at 5% and 15% indicate progressive development of concrete strength with age with values from 15.57 N/mm^2 to 18.00N/mm^2 and 14.07N/mm^2 to 16.89N/mm^2 respectively. However, the strength of concrete produced from 10% partial replacement shows decline with age from 15.34N/mm^2 to 14.30N/mm^2. The result indicate that the replacement of aggregate can be made for up to15% but with reduced strength of about 36%. The concrete produced from this mix can be used in elements which bear light weight loads or insulation of buildings as established by [6].

6. CONCLUSION

In conclusion, it is discovered that the use of palm oil nut shell in cement concrete can help in waste reduction. It can therefore be used as construction material in low cost buildings since it has attained compressive strength of 18N/mm2.

7. ACKNOWLEDGEMENTS

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