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FARM STRUCTURES AND RURAL ELECTRIFICATION
PALM KERNEL SHELLS AS COARSE AGGREGATES FOR LIGHT WEIGHT CONCRETE:

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ABSTRACT

The escalating cost of conventional building material has given rise to the need to source for alternative ones. In souring for such alternatives, the durability, availability and cost of the potential material should be considered. Palm kernel shell (PKS) a by-product in the process of palm kernel oil extraction found in abundance in southern and grossly underutilized was considered of potential as a coarse aggregate for light weight concrete. In order to confirm the assumed potential, it was considered necessary to determine the density and compressive strength of concrete cubes manufactured from PKS.

Coarse aggregates made us of crushed granite and PKS mixed in varied proportions were used to cast 150mm x 150 mm concrete cubes of 1: 3: 6 mix batch by weight. The cubes were removed from moulds 24hr after casting and immersed in water for seven days to cure. The density and compressive strength of the cubes were then decreased. Expectedly, the density and crushing strength of cubes decreased with increase in the amount of PKS in the cubes but the density range of 1520 to 2234kg/m^3 and strength values of 0.44 to 3.89N/mm^2 obtained were good enough for light weight concrete. PKS has great potential as a material for coarse aggregate in concrete work; the use of which could considerably reduce the construction cost of building and promote environmental sanitation

KEY WORDS: Aggregates, Concrete, Construction, Kernel, Shell.

1. INTRODUCTION

The widening gap between the demand and supply, and hence the increasing cost of conventional building material such as concrete necessitates the search for suitable alternative once that would be readily available and at an affordable cost. Concrete is a mixture of sand, coarse aggregate and a cementous material batch in appropriate ratio depending on the end-use and mixed with water. Because of the high compressive strength and ease of handling of both concrete and the individual components; they are among the most popular conventional materials of construction. They are used in the construction industry especially for roads, urban and rural buildings, and farm structures. In farm structures, concrete is used for silos; floors of livestock buildings, machine sheds, warehouse and workshop; dam; Irrigation canals, sewage treatment plants, bridges and culverts. The versatility of concrete as a material of construction has given rise to a great competition between the farming environment and other users for the limited available material and because of the poor economy of the rural farmers, especially in , the cost of the material is often beyond the reach of farmers who require it for the construction of farm structures.

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Concrete will continue to play a dominant role in the construction of farm structures and if this must be achieved for a poor economy such as that obtainable in the n rural farming communities, efforts must be made to provide the material at a price affordable by the rural farmers. Coarse aggregate is one of the most important components of concrete as it is the strength provider. In most instances, crushed granite is used as coarse aggregates but in view of the demand foe the granite stone for other uses; it is necessary to consider other material as coarse aggregate in concrete work. One of such material that is being considered is palm kernel shell (PKS).

PKS is the stony endocarp of the oil palm fruit (Elias Guinness) which is obtained by cracking the nut to obtain the kernel in the course of extracting palm kernel oil from the fruit. The material is available in abundance at the processing center for the little available space thereby constituting a nuisance to the oil millers. Its only present significant use is as a fuel mainly in the rural areas for domestic use and in the furnaces of the local blacksmiths. The availability; durability as demonstrated by long period of resistance's to decay in dumps and strength in dictated by substantial energy requirement to crack the nut and size reduction of the shell informs the author to consider the material as a coarse aggregate for light weight concrete. This paper discusses the results of an investigation carried out determine the potentials of palm kernel shell as a coarse aggregate for light weight concrete.

2. MATERIALS AND METHODS

2.1 Particle size analysis

A particle size analysis was carried out on both the crushed granites and palm kernel shell to determine the proportions of the different size of particles in the coarse aggregates. The particle size analysis showed that about 70% of the crushed granite were between 14 – 20 mm while about72% of the palm kernel shell were between 5- 10 mm. From practical experience, smaller sized particles of broken PKS are known to be stronger than bigger ones and hence this mixture of crushed granite and PKS was considered better than one in which both aggregates are of the same size. The use of smaller size PKS will further reduce the amount of fine sand since they will act void fillers.

2.2 density of palm kernel shell

For materials to be used as coarse aggregates for light weight concrete, the density should be in the range 400 to 800 kg/m^3 (Okedokun, 1998). It was therefore necessary to ascertain that the density of PKS fall into this range. The bulk density of PKS was found to 525kg /m^3 which falls within the range.

2.3 Mix design

Concrete can either be batched by volume or weight but batching by weight was adopted in this work. Adam (1974) gave the formula for calculating the mass of cement (Mc) in a concrete cube as:

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$$Mc = C \times Vr \times d \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where C =Cement ratio in the mixture and is 1

Vr =Void ratio, 1.5

Vm =Volume of mould

D =Density of cement

For light weight aggregates, the cement: coarse aggregate ratio of between 1:6 and 1:10 is recommended (Adams 1974). A1:3:6 mix by weight was therefore chosen for this work. The components of each batch designed to fill three moulds of 150mm x150mm x 150mm was calculated as 2.2kg of cement; 6.6kg of sand and 13.2kg of coarse aggregates. The coarse aggregates in each of each batch designed to fill three moulds of 150mm x 150 mm x 150mm was calculated as 2.2 kg of cement; 6.6kg of sand and 13.2kg of coarse aggregates. The coarse aggregates in each batch was made up of palm kernel shell and crushed granite. The percentages of the palm kernel shell in each were 20,40, 60, 80, and 100, respectively

2.4 Cube casting

The relevant equipment comprising of a set sieves, trowel, curing tank; moulds (150mm x 150mm x 150mm), shovel, slump cone, weighting balance, tapping rod, spanner, measuring cylinder and ruler were got ready.

The various components were measured, mixed in accordance with normal concrete preparation procedure and filled into the moulds. The water / cement ratio for each batch was determined by trial mix until a workable paste was achieved. This was occasioned by the varying percentages of palm kernel shell which gave different volume for the coarse aggregates and hence the water requirement.

Cubes were left in the moulds for 24hr under shade after which they were removed and immersed in the curing tank for seven days

2.5 Testing

The cured cubes were tested for density and compressive strength. The compressive strength test was done using 15 – tonne Compression Testing machine.

2.6 Observation

It was observed that the amount of cement and sand needed for effective mixing, the left over from a batch after filling three moulds and water/cement ratio were than what was obtained by calculation and they also increased with increasing percentage of PKS in the batch. This is as a result of the low density of PKS which require more volume of the material to cater for the substituted weight of crushed granite. This increased volume demands more cement, sand and water for thorough mixing and expected leaves more left over after filling the moulds.

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4. RESULTS AND DISCUSSION

The densities and compressive strength of the various cubes are presented in Table in Table 1 and shown graphically in figs. 1 and 2. The density decreases with increase in the percentage of PKS in the cube. This should be expected because the low density PKS progressively occupy a substantial volume of the cubes as the percentage increase.

The compressive strength values decreased with increasing percentage of PKS in the cube. Weight Concrete (Neville and Brooks, 1991). Some the compressive strength of a concrete cube is a function of the coarse aggregate materials, the use of PKS, a material of lower strength than crushed granite, the resulting cube a lower compressive strength.

Potential Benefits of this Work

With an evidence of a possible use of PKS as a coarse aggregate for Light Weight concrete, the following benefits can be expected.

(1) the use of PKS will reduce the cost of producing concrete for some building components.

(ii) the products are useful in Farm Structures even for structural walls as the load sustained is usually not very heavy. This is besides its use for insulation in other non-structural walls.

(iii) It will promote environmental sanitation, as the various garbage heaps of PKS will now find However some of the results obtained are above the minimum value of 0.7 N/mm^2 recommended for Light good uses.

3. CONCLUSIONS

From the compressive strength test carried out on concrete cubes manufactured from PKS, there is evidence that Palm Kernel Shells have potentials for use as a coarse aggregate for Light Weight Concrete. This type of concrete will be useful for Farm Structures which are usually subjected to light loads.

4. RECOMMENDATIONS

This work has been mainly interested in the compressive strength of cubes manufactured from PKS but it is recognised that the serve life of the cubes would be affected by the chemical composition of the Palm Kernel Shell. While it is recommended that further tests of different mixes and of longer periods be carried out, it is equally recommended that the engineering properties of the material be examined.

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Table 1: Densities and Compressive Strength of Concrete Cubes from different mixes of Crushed granite and Palm Kernel Shells

% of Coarse aggregates made up of PKS	Density in kg/M^3	Compressive strength (N/mm^2)
0	2453	9.26
20	2234	3.89
40	1893	1.55
60	1689	0.89
80	1565	0.67
100	1520	0.44

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