International Journal of Academic Pedagogical Research (IJAPR)
ISSN: 2643-9123
Vol. 5 Issue 9, September - 2021, Pages: 49-52

Suitability Of Palm Kernel Shell And Sawdust In The Production Of Unhollow Blocks

Aluko, K. A.[1], Aderemi, A.M.[2], Majekodunmi, O.A.[1], Amoran, S.A.[3], Ogunwale, O.G.[4], Oyewole, O.O.[4], Adewoye, A.A.[1]

1. Horticulture and Landscape Technology Department, Federal College of Forestry, Ibadan, Nigeria.
2. Agricultural Technology Department, Federal College of Forestry, Ibadan, Nigeria.
3. National Horticultural Research Institute of Nigeria.
4. Agricultural Extension and Management, Federal College of Forestry, Ibadan, Nigeria.

Correspondence author's email – aderemi.am@frin.gov.ng
Phone no: 08035637542, 08079713340

Abstract: *One of the major challenges facing the construction industry is the growing concern over resource depletion, this is because the industry relies heavily on conventional materials such as cement, granite and sand for the production of concrete. The high and increasing cost of these materials has greatly hindered the development of shelter and other infrastructural facilities in developing countries. That has made the search for alternative materials that meet the performance standards of conventional materials imperative. The materials such as stone dust, palm kernel shells, sawdust and so on, used for this study were locally sourced for and the treatments of the study were as follows:* T_1 *= Stone dust (4hp) + 25 kg of cement (control),* T_2 *= Stone dust (2hp) + Grinded Palm kernel shell (2hp) + 25 kg of cement,* T_3 *= Stone dust (2hp) + Saw dust (2hp) + 25 kg of cement,* T_4 *= Grinded Palm kernel shell (2hp) + Saw dust (2hp) + 25 kg of cement. The results showed that* T_2 *(stone dust + palm kernel shell + cement) performed better with a value of 4% compare to the value of* T_1 *(stone dust + cement) with a value of 3% and respectively have the optimum compressive strength value of 13.20 KN/m*^{2} *compared to the value of* T_1 *(stone dust + cement) with the control mix value of 14.3 KN/m*^{3}*. In conclusion,* T_2 *(stone dust + palm kernel shell + cement) was recommended as a partial replacement for stone dust in the production of unhollow block which will reduce the negative impact of this agricultural waste on our environment.*

Keyword: Stone dust, Palm kernel shell, Sawdust, Cement, Unhollow block.

Introduction

Over the years, concrete has been a mixture of water, cement or binder and aggregates and is a commonly used material for construction. The strength of concrete depends on aggregate type, size and source (Chunchu *et al*, 2019; Hassan, 2014). The aggregates are divided into two major divisions by size; fine and coarse. The fine aggregates are sizes not larger than 5 mm while the coarse aggregate are sizes of at least 5 mm (Elices *et al.*, 2008). There has been concern about the best aggregate sizes to be adopted in the manufacturing of concrete in the Nigerian construction industry. Compressive strength of concrete is the value of test strength below which not more than a prescribed percentage of the test results should fall. However, the prospect of using Palm kernel shell and other agricultural waste as an alternative to the convention sand sounds promising.

Moreso, effort to produce affordable houses which will impose less environmental stresses and make construction sustainable has necessitated research to the use of alternative materials. Osei and Jackson (2012) should be locally available and can replace conventional ones used in construction; the materials should be cheap, readily available and contribute to stress reduction on the environment. Alengaram, et al., (2010), stated that in many developing and underdeveloped countries in Asia and Africa, the research on the use of industrial waste materials such as Oil Palm Kernel Shell (OPKS) from palm oil production is envisaged. Consequently, the quest for alternative cheaper materials and utilization of industrial waste and by-product materials in infrastructure development is proven economically viable when environmental factors are considered and these materials meet appropriate performance specifications and standards.

Ramli (2003) indicated that the requirement for vegetable oil and wooden shaves are constantly increasing; hence more cultivation of oil palm and deforestation are forecast in the future. Consequently, the production of agricultural waste result on waste by products such as saw dust (SD), Palm Kernel Shell (PKS), Palm Kernel Fiber (PKF), Palm Oil Mill Effluent (POME), Rice Hull (RH) and Empty Fruits Bunches (EFB). Stockpiling these wastes have created storage problem to the factories as large quantities of them are produced every day. Similarly, these wastes are mostly stockpile in open fields and have negative impact on the environment.

Furthermore, large quantities of material from quarries or pits can cause loss of valuable or scenic land, dust and noise emissions and extra-traffic on unsuitable rural roads. It is reported that over 90% of physical infrastructure in Nigeria, Ghana and other African countries are being constructed using sandcrete blocks (Anosike and Oyebade, 2012). Sandcrete blocks according to Joshua and Lawal (2011), are constructional masonry units that have been generally accepted to the extent that when an average individual thinks of building, the default mindset is the use of sandcrete blocks.

Saw dust is a byproduct or waste product of wood working operations such as sawing, milling, planning, routing, drilling and sanding. These operations can be performed by wood working machinery, portable power tools or by the use of hand tools. It has been researched that the use of sawdust in cement bonded particle board [CBPB] has been successful so far (Owonubi and Badejo 2000). The general objective of this study is to determine the effect of different aggregate material on the strength property of unhollow block.

One of the major challenges facing the construction industry is the growing concern over resource depletion. This is because the industry relies heavily on conventional materials such as cement, granite and sand for the production of concrete. The high and increasing cost of these materials has greatly hindered the development of shelter and other infrastructural facilities in developing countries. That has made the search for alternative materials that meet the performance standards of the conventional materials imperative.

In addition, following a normal growth in population, the amount and type of waste materials have increased accordingly. Many of the non-decaying waste materials like rice hull, palm kernel shell, fly ash e.t.c will remain in the environment for hundreds, perhaps thousands of years. The non-decaying waste materials cause a waste disposal crisis, thereby contributing to the environmental problems. However, the environmental impact can be reduced by making more sustainable use of this waste. This is known as the Waste Hierarchy. Its aim is to reduce, reuse, or recycle waste, the latter being the preferred option of waste disposal.

Materials and method

The experiment was carried out at the Horticulture and Landscape Technology Department of Federal College of Forestry, Ibadan, Oyo State, Nigeria. The materials used are the following; Cement (Elephant), Stone dust, unhollow block metal mold, saw dust, diesel, Water, Head pan, protective wears (rain boot, a pair of hand glove), weighing balance scale, shovel, recording materials (book and pen), and universal testing tensile machine.

Saw dust was gotten from Oke-bola sawmill and metal mould was rented from Horticulture and Landscape Technology Department of Federal College of Forestry, Jericho, Ibadan. Stone dust was gotten from a road side Horticulturist along Aleshinloye Road, Ibadan, while head pan, and shovel were gotten from a road side horticulturist. All other materials were purchase at Ogunpa market, Ibadan.

Treatment combination

Below are the mixed proportions of the different aggregate for the production of unhollow block. Prior to mixing, all the components were weighed according to the standard mix proportions of 1:8 (BS, 2014).
T_1 = Stone dust (4hp) + 25 kg of cement (control).
T_2 = Stone dust (2hp) + Grinded Palm kernel shell (2hp) + 25 kg of cement.
T_3 = Stone dust (2hp) + Saw dust (2hp) + 25 kg of cement
T_4 = Grinded Palm kernel shell (2hp) + Saw dust (2hp) + 25 kg of cement
* hp = headpan

Research Methodology

Production method of unhollow block

The mixing was done on an impermeable surface made free from all harmful materials which could alter the properties of the mix by sweeping. The measured aggregates samples according to each treatment combinations were spread using a shovel to a reasonably large surface area, which was mixed thoroughly until a uniform mix was obtained. Water was poured and mixed together with the aggregates to make it slurry (not too watery) which was batched into the metal mold (45cm x 15cm x 15cm) and vibrated before demolding which took place few minutes after molding. Each treatment samples which was replicated two times were taken to the laboratory to test for their compressive strength property.

Parameters assessed

The following parameters were assessed:
Water absorption: Water absorption of each treatment was determined after being weighed and their values were recorded as dry weight (Md). Each treatment was submerged in water for 48 hours, after which the treatments were taken out of the water. Their surfaces were wiped with cloth to remove excess water. The weight was determined and recorded as the saturated weight (Ms). The percentage water absorbed otherwise known as 'Water Absorption' was then calculated using the relation (Adewoye, 2011);

A = $\frac{Ms-Md}{Md} \times 100$ …..(equation 1)

Where;
A = Water Absorption
Md = Dry Weight

Ms = Saturated weight

Compressive test

The area and volume of the unhollow block were calculated using length and breath and height. Three samples were tested from each treatment and each block was weighed using giant weighing balance (kg), strength properties were also tested by universal tensile testing machine at ministry of public works, infrastructure and transport, Ibadan.

Results and Discussion

Table 1: Water absorption percentage of unhollow block

Treatments	Water Absorption (%)
T_1	3
T_2	4
T_3	8
T_4	12

It was revealed on table 2 that T_2 (stone dust + palm kernel shell + cement) performed better with a value of 4% compare to the value of T_1 (stone dust + cement) with a value of 3% which was in accordance with BS 1881 part 120/BS. EN 12504 part: 2000 (water absorption must not be greater or lesser than 3% - 5%).

Table 2: Compressive Strength (Mpa) Percentage of Unhollow Block

Treatments	Compressive Strength Cube (KN/m^3)
T_1	14.30
T_2	13.20
T_3	12.41
T_4	11.10

Table 2 shows the compressive strength test assessed on each of the four treatment samples. It was revealed that T_2 (stone dust + palm kernel shell + cement) mix performed better than other treatment with the optimum compressive strength value of 13.20 KN/m^3 compare to the value of T_1 (stone dust + cement) with the control mix value of 14.30 KN/m^3 which was in accordance with the BS 1881 part 120/BS. EN 12504 part: 2001 (optimum compressive strength must not be below or above 13.00 - 14.50 KN/m^3).

Conclusion

It was shown that T_2 (stone dust + palm kernel shell + cement) performed better with a value of 4% compare to the value of T_1 (stone dust + cement) with a value of 3% which was in accordance with BS 1881 part 120/BS. EN 12504 part: 2000 (water absorption must not be greater or lesser than 3% - 5%) and respectively has the optimum compressive strength value of 13.20 KN/m^2 compared to the value of T_1 (stone dust + cement) with the control mix value of 14.3 KN/m^3 which was in accordance with the BS 1881 part 120/BS. EN12504 part: 2001 (optimum compressive strength must not be below or above 13.00 - 14.50 KN/m^3). Stone dust, palm kernel shell with cement gives nearly same results with the British Standard preferable due to the permeability level of the materials (Palm kernel shell) and its irregular particle shape. Palm kernel shell offers important economic advantages in the tropical region where the availability of stone dust is getting scarce and expensive. So, palm kernel shell can effectively be used to partially replace stone dust and reduce the negative impact this causes our environment.

According to the results, T_2 (stone dust + palm kernel shell + cement) was recommended as a partial replacement for stone dust in the production of unhollow block which will reduce the negative impact this agricultural waste on our environment.

Plate 1: Samples of unhollow block

References

Alengaram, U.J., Jumaat, M.Z., Mahmud, H.(2010). Influence of Cementitious Materials and Unit Weight of Concrete. Accessed on 10th September, Material (Pp. 555-560). Springer, Singapore.

Anosike, M.N., Oyebade, A.A.(2011). Sandcrete Block and Quality Management in Nigeria Building Industry. Journal of Engineering, Project and Production Management, 2(1), 37- 46.

BS 1881-120, 83rd Edition, July 31, 1989. Method for Determination of the Compressive Strength of concrete cores. BSI, London.

BS. EN 12504 part: 2000, Testing Concrete in Structures - Part 1: Cored Specimens – Taking, Examining and Testing in Compression, BSI, London.

BS.EN 12504 part: 2001, Testing Concrete in Structures-Non-Destructive Testing. Determination of Rebound Number. BSI, London.

Chunchu, B. R. K., Putta, J. (2019). Effect of Recycled Plastic Granules as a Partial Substitute for Natural Resources Sand on the Durability of SCC. Resources, 8(3). Pp 1-14. https://doi.org/10.3390/resources8030133.

Elices, M., Rocco, C.G., 2008. Effect of Aggregate Size on the Fracture and Mechanical Properties of a Simple Concrete. Engineering Fracture Mechanics, 75(13), pp.3839-3851.

Hassan N.S. (2014): Effect of Grading and Types of Coarse Aggregates on the Compressive Strength Journal of Engineering, Project and Production Management, 2(1), 37-46.

Osei, D.Y., Jackson, E.N. (2012). Compressive Strength and Workability of Concrete using Natural Pozzolana as Partial Replacement of Ordinary Portland Cement. Advances in Applied Science Research, 2012, 3 (6):3658-3662.

Owonubi, J.J., Badejo, S.O.O. (2000) Industrial Scale Wood Waste Conversion into Building Materials at FRIN, Ibadan. A Paper Presented at the 38th Annual Conference of Science Association of Nigeria 10th – 14th December 2000.

Ramli, A. T., Rahman, A. T. A. and Lee, M. H. Statistical Prediction of Terrestrial Gamma Radiation Dose Rate Based on Geological Features and Soil Types in Kota Tinggi district, Malaysia. Applied Radiation and Isotopes. 2003. 59(5-6): 393-405.