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Comparative Effect Of Selected Aggregate On The Construction Of Un-Hollow Block In Oyo State, Nigeria

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Abstract: *The study presents a comparative analysis on the strength, water absorption and cost of un-hollow block using selected materials in replacement of the control materials which was aimed at comparing the strength and cost of production. Test was performed to compare the strength, water absorption and cost of three selected material (sawdust, river sand, granite) in replacement of control measure (stone-dust, cement) were used. The cement and aggregate replacement materials were at different proportion and percentage during mixing for each treatment where cement measure was mixed in each treatment at the ratio 2:2:1 for aggregate used. The test was performed for water absorption, compressive strength and costing of concrete un-hollow. Data obtained from the water absorption test show that treatment 3 (st6ne dust, river sand, saw dust and cement) has the highest absorption value of 12%, while treatment 2 (₦4,050) has the lowest cost value to the control cost value.*

Keywords: Un-hollow block, Water absorption, Sawdust, River sand, Granite.

Introduction

The high and rising cost of building construction in developing countries has been source of concern to government and private building developers. Concrete is a very good construction material made by mixing cement, coarse aggregate (gravel or crushed stone), fine aggregate (sand) and water either in designed or prescribed proportions. While designing masonry constructions one of the critical mechanical features is compressive strength and deformations. Mechanic properties of masonry to a great extend depend on constitution of masonry units construction (LST EN, 1996), (Mohamad *et al*., 2007), hollowness, type of materials and mortar of the bed joints (Hendry *et al*., 1992, Khalaf, 1996, Köksal, *et al*., 2005), (Steadman *et al.,* 1995). It is strong in compression and has some resistance to some chemical and biological attack like termites etc. while other materials, which is strong in tension, is incorporated in it. Thus, Koksal *et al*., 2005, gave masonry strength based on unit block strength and the type of mortar. This account for its wide spread use in civil engineering structure such as buildings, un-hollow block sculptural work, dams etc (Smith, 2009).

Concrete un-hollow block is a widely used construction substance which consists of cement material, fine aggregate, aggregate and required quantity of water. The fine aggregate is usually natural sand properties, the aggregate affects the durability and performance of concrete. The most commonly used fine aggregates is natural river sand, granite, sawdust, stone dust, rice husk. Fine and coarse aggregate constitute about 75% of total volume of the concrete. It is therefore important to obtain right type and good quality aggregate, because the aggregate form the main matrix of concrete (Srinivasa, *et al*., 20l5). Un-hollow concrete blocks are becoming very popular in the urban area. The implementation of waste sawdust does not only help in the area of waste management but also save concrete materials since a large demand has been placed on the building materials industry, especially in the last decades. Sawdust is an industrial waste in timber industry and it constitutes a nuisance to both health and environment when not properly managed. Sawdust should be washed and cleaned before use as a concrete constitute because of large amount of bark which affect setting and hydration of cement. Sawdust can be used as alternative substitute for fine aggregates in concrete production (Ganiron, 2013).

Stone dust is such an alternative materials which can be effectively used in construction as partial replacement of natural sand. Stone dust is well appreciated in term of strength and economy over normal sand, starting from medium grade concrete (Mahzuzet *et al*., 2011). Hence, if the strength of granite dust is proved adequately. Therefore, granite dust may be an alternative to natural sand for construction work. In the present study, granite dust was chosen as a fine aggregate and Portland cement as a binding agent was added to the mixture, the present study highlight the strength behavior of concrete blocks containing granite dust as a fine aggregates associated with variable mixture of Portland cement. The objective of this study is to compare the effect of selected aggregates on the construction of un-hollow block. The justification of the study is that the most commonly used fine aggregates are natural river sand, granite, sawdust, stone dust, and some agricultural waste product. Fine and coarse aggregate constitute about 75 % of total volume of the concrete. It is therefore, important to obtain right type and good quality aggregate (Srinivas, *et al.*, 2015).

Methodology

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The aggregates were homogenously mixed together according to the standard proportion of each treatment combination. The inner surfaces of the sample moulds used were lubricated with diesel for easy demoulding to avoid cracking. The mortal method which involves the preparation of cement soup was used for casting purposes. The prepared mortar (slurry) was poured into the lubricated mold and manual vibration was done immediately the aggregate mixes were been poured and continuously vibrated. The casted double tee sample of concrete un-hollow block was left for 48 hours to set properly before demoulding.

Treatment combinations

	Stone Dust	**River Sand**	**Saw Dust**	**Granite**	**Cement**
T_1	175kg (7hp)	______	_______	_______	½ hp
T_2	50kg (2hp)	125kg (5hp)	______	_______	½ hp
T_3	50kg (2hp)	50Kg (2hp)	50kg (2hp)	______	½ hp
T_4	_______	50Kg (2hp)	______	100kg	½ hp

*hp stands for head pan

Parameter assessed

The following parameters were assessed;

Water absorption: Water absorption of each treatment was determined by weighing on a weighing balance and their value recorded, as the dry weight (Md). Each treatment was submerged in water for 24 hours, after which the treatments was taken out of the water and their surface was wiped with cloth to remove excess water. The weight was determined by weighing and recorded as the saturated weight (Ms). The percentage water absorbed, otherwise known as 'Water absorption' was then calculated using the relation below:

$$A = \frac{Ms - Md}{Md} \times 100\% \quad \text{……………………………………………..Equ 1.}$$

Where:

A = Water absorption

Md = Dry weight (Before Immersion)

Ms = Saturated weight (After immersion).

Compressive strength test: The compressive strength for each treatment was determined as the quotient of the breaking force of the area of impact:

$$CS = \frac{PC}{AC} \quad \text{………………………..Equ 2.}$$

Where;

C = Compressive strength of the treatment

PC = The load on the treatment at failure

AC O = Calculated area of the bearing surface on the test treatments

Cost implication: The cost of producing each treatment was also estimated and the best sample was selected.

Testing procedure

Two (2) samples were selected randomly from each treatment for testing. The compressive strength test of each sample (paver) was carried out at Oyo state ministry of transports, Agodi Ibadan, Oyo State, Nigeria, using Digital Compressive machine.

Data analysis

Descriptive analysis was used to analysis the data collected.

Result and discussion

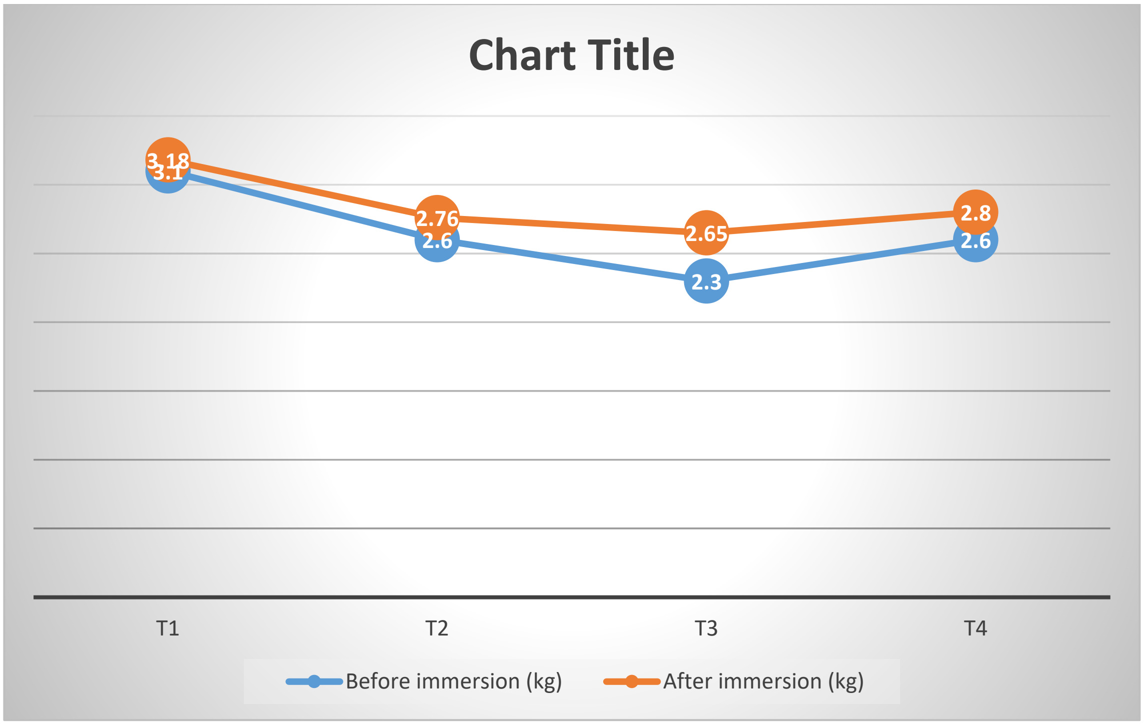

Figure 1: Mean weight of each treatment aggregate before and after immersion in water

Figure 1 shows the mean weight of each treatment aggregate before and after immersion, it was revealed that T_1 (stone dust and cement) has the highest mean value of 3.10 kg before immersion and 3.18 kg after immersion, followed by T_4 (cement, river sand and granite) and T_2 (stone dust, river sand and cement) with the same initial value of 2.60 kg before immersion and 2.80 kg and 2.76 kg after immersion respectively, followed by T_3 (stone dust, river sand, saw dust and cement) with the value of 2.30 kg before immersion and 2.80 kg after immersion. From figure 1, it was shown that T_1 was the least.

Table 1: Compression strength (kN)

Treatment	Compressive strength
T_1	148.4^b
T_2	108.1^c
T_3	75.1^d
T_4	304.1^c

Table 1 shows the compression strength of the treatment in kilo Newton. Compression tests on soft bricks in strong mortar have shown that tri-axial compression exists in bricks, which is coupled with axial compression with lateral tension in mortar (Kaushik *et al.*, 2007). The compression test showed that T_4 (river sand + granite + cement) has the highest compressive strength value of 304.1 kN, follow by T_1 (stone dust + cement) which is the control with the compressive strength value of 3 48.4 kN. T_2 (stone dust + river sand + cement) with the strength of 108.9 kN and T_3 (river sand + stone dust + saw dust + cement) was revealed to have the lowest compressive strength of 75.1 kN.

TREATMENTS (%)	WATER ABSORPTION

Table 2: Water absorption percentage (%)

T_1	5^c
T_2	2^c
T_3	12^a
T_4	4^d

Note: In table 2, the values for the same letters are not significantly difference and values with different letters are significantly difference.

Furthermore, table 2 show the water absorption percentage of each of the treatment. According to (ASTM, 2013) the average absorption of the test samples shall not be greater than 5% T_1 (stone dust and cement) which is the control has the absorption value of 5%, T_2 (stone dust, river sand and cement) has the absorption value of 2%. T_3 (stone dust, saw dust, river sand and cement) has the absorption value of 12%, T_4 (granite, river sand and cement) has the absorption value of 4%.

Total cost of producing each of the treatment

Table 3: Cost of producing treatment 1

Treatment 1

Variable	**Amount (₦)**
Stone dust	2100
Cement	1200
Mould	500
Shovel	150
Head pan	150
Hand towel	100
Diesel	50
Workmanship	500
Transportation	200
Total	**4,950**

Table 4: Cost of producing Treatment 2

Treatment 2

Variable	**Amount (₦)**
Stone dust	1200
Cement	1200
Mould	500
Shovel	150
Head pan	150
Hand towel	100
Diesel	50
Workmanship	500
Transportation	200
Total	**4,050**

Table 5: Cost of producing treatment 3

Treatment 3

Variable	**Amount (₦)**
Stone dust	1200
Cement	1200
Mould	400
Shovel	500
Head pan	150
Hand towel	100
Diesel	50
Workmanship	500
Transportation	200
Total	**4,450**

Table 6: Cost of producing treatment 4

Treatment 4

Variable	**Amount (₦)**
Stone dust	2000
Cement	1200
Sawdust	400
Mould	500
Shovel	150
Head pan	150
Hand towel	100
Diesel	50
Workmanship	500
Transportation	200
Total	**4,850**

Conclusion

The study revealed the weight, water absorption, costing, on the production of concrete un-hollow block using different aggregate. Based on the parameters assessed, a possibility exists for the partial replacement of river sand, stone dust, saw dust and cement in production of light weight concrete un-hollow block. T_1 (stone dust + cement) meet up to the standard percentage of the water absorption value according to ASTM, 2013. Also, T_2 performed well in terms of water absorption percentage. Also in terms of compressive strength, T_4 has the highest value of strength (304.l kN).

In addition, the cost of producing T_2 was cheaper (₦4,050) compare to the cost of producing other treatments examined.

This study was based on providing substitute for stone dust that will be suitable without comprising the standard qualities of un-hollow block, the following recommendations are made for further studies. The use of T_2 (stone dust + River sand +cement), considering the cost of producing un-hollow block is more preferable than using high amount of money on other treatments.

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