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An Experimental Investigation on Wooden Brick by Sawdust, Cement and Limestone

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ABSTRACT

Clay bricks are widely used for building construction in Banladhash Due to rapid urbanization, use of clay bricks is increasing exponentially which leads to air pollution, as well as huge degradation of topsoil from the agricultural lands. Besides, clay bricks increase dead load of structure as they are heavy. In order to minimize these problems, techniques must be innovated for production of low-cost lightweight and eco-friendly bricks. In this study, an attempt was taken to assess the potentiality of locally available saw dust instead of clay to produce lightweight eco-friendly bricks. Total 16 different ratios of cement, saw dust and sand have been taken to prepare samples of saw dust bricks. Compressive strength, unit weight, water absorption rate, fire sensibility and cost of production per brick were analysed for each type of bricks and compared. The result shows that the compressive strength of bricks was satisfactory for lower percentage of saw- dust. Unit weight of saw dust bricks were reduced by 2 – 42.8 % than that of clay brick and water absorption rate was very low. There was no significant difference between strength of burnt and the unburnt saw dust bricks. Price of saw dust bricks is not higher than that of clay brick.

Keywords: Sawdust, sawmilling, compressive strength, density, composites, cement.

I. INTRODUCTION

The wood utilisation industry in Uganda is characterised by poor harvesting and processing methods, limited value addition and high wastage (Kambugu, et al, 2005).

There are currently 130 sawmills operating in Ugandawith installed capacities of about 3,000 m^3 of logs per year (Forest Department, 2002). Mostof them are the small mobile circular or band saw type with an average recovery of 45% (Jacovelli and Carvalho, 1999). Thus over 50%of the round wood processed is wasted as sawdust, slabs and off cuts. These wastes seldom have commercial use.Sawdust is one of the major underutilized by- products from sawmilling operations in Uganda (Plate 1). The wood loss in Uganda in the formof sawdust is estimated to be 18-20 % of the log volume (Ministry of Water Lands, and Environment, 2002). According to some timber dealers in Kampala suburbs, by December 2005, one cubic meter of Pine timber cost about Uganda shillings 430,000. This implies that on average about Uganda shillings 77,400 was lostper cubic meter in the form of saw dust. The underlying reasons for the inefficiency and waste in the saw milling industry included the use of inappropriate processing technologies, poor maintenance of sawmill machinery, poor management and lack of proper technical skills by the sawmill operators (Kambugu, 2004).

Lack of information on appropriate equipment required to process the small, poor quality plantation logs, has forced entrepreneurs to import a wide range of mobile sawmill machinery, which include rolling-table sawmills, band sawmills, and dimensional swivel sawmills. Most of the sawmill machinery imported is suitable for processing large hardwood logs as opposed to the small softwood plantation logs (Carvalho and Pickles, 1994; Jacovelli and Carvalho, 1999). These saw mills use thick saw blades that cut wood with a wide kerf thereby producing large quantities of sawdust (Plate 1). In addition, there are several types of small mobile sawmills that have been fabricated locally without considering their sawing efficiency.

1.2 METHODOLOGY

- Literature collections
- Study of Literature Review
- Properties of Material

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- Casting
- Testing of Specimen
- Results and Discussion
- Conclusion

1.3 OBJECTIVE

1. To carry out the literature review for detailed study on partial replacement of sand by saw dust as fine aggregate.
2. To mix saw dust sample with sand in 10%, 20%, 30% and 40% and record the detail observations to check efficient percentage of the saw-dust that can be replaced by sand in the construction field.
3. To find the particle size distribution by sieve analysis for getting an idea of the gradtion of the proportionate mixture of sawdust.
4. To find the chemical composition of sawdust by automated spectrometer in order to find its suitability for the use in concrete mixture.
5. To find the specific gravity of the saw-dust mix in order to use it for mix-design of concrete.
6. To find out the compressive strength test at different percentages of mixing saw dust (10%, 20%, 30% and 40%) in the concrete preparation at the end of 28 days using cubic moulds to check the optimum percentage sawdust that can be replaced in conventional concrete mix.
7. To carry out the tensile strength & flexural strength test at the end of 28 days using prism and cylindrical moulds for the sample in order to check the tension and flexural crack in the beam.
8. Finally an attempt has been made to analyze and compare the above results obtained with understand the feasibility of using sawdust as partial replacement of fine aggregate in construction industry.

1.4 SCOPE

- The scope of the learn about is constrained to the following aspects. The workability, compressive strength, of sawdust in of different combine proportions with constant w/c ratio have been investigated.
- Usage of limestone helps in quick setting of cement in bricks
- Sawdust and limestone acts as an effective replacement of cement because of its pozzolanic and mechanical strength.
- Control hardening of cement.
- To achieve the better replacementof fine aggregate.
- To investigate the sawdust can be used as a better replacement of fine aggregate.

II. MATERIAL PROPERTIES

2.1 MATERIAL UESD

a) Cement (OPC 53)
b) Saw Dust
c) Lime Stone Powder
d) Mixing of water.

2.1.1 Cement

OPC53 Grade conforming IS12269:1987, Minimum cement content:320 kg/m3 (IS456:2000), Specific gravity ofCement: 3.02

S. No	Test for Cement	Apparatus	Value Obtained
1.	Standard consistence test	Vicat apparatus	26.5%
2.	Initial setting time	Vicat apparatus	30 minutes
3.	Final setting time	Vicat apparatus	230 minutes

Fig. 1. Cement

2.1.2 Saw Dust

Saw dust is produced by cutting or chopping the log & thin flat sheet of wood. Saw- dust is partially mixed with sand by 10%, 20%, 30%, and 40% and its different characteristics as a fine aggregate were tested as per specification of IS: 383-1970. The Chemical properties are given in Table 3.5

Table-3.5: Physical properties of saw dust

Material	FM	Unit Weight
Saw dust	2.45	210.56 kg/m^3

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Fig.,2.Sawdust

2.1.3 Limestone

Limestone is a common type of carbonate sedimentary rock. It is composed mostly of the minerals calcite and aragonite, which are different crystal from of calcium carbonate. Limestone forms when minerals precipitate out of water containing dissolved calcium.

Fig.3 Limestone Powder

2.1.4 Water

According to IS 3025, water to be used for mixing and curing should be free from injurious or deleterious materials. Portable Water is generally considered satisfactory. In the present investigation, available water within the campus is used for both mixing and curing purposes

III. MIX DESIGN

3.1 Materials and mix design

Following materials were used in the preparation concrete (i) Ordinary portland cement (ii)Sawdust (iii)limestone (iv) Tap wate (v) Ordinary portland cement of 53 Grade satisfying the requirements of IS12269:1987.

The specific gravity of cement is 3.12. Natural sand is used as fine aggregates(F.A). Properties of fine aggregates was 2.43. the fine aggregates belong to zone II of IS 383:1970

IV. TESTING OF SPECIMEN

4.1 Compressive Strength

Compressive Strength can be defined as the measure maximum resistance of a concrete to axial loading. The specimens used in the compressive test are: 230 mm x 100 mm x 100 mm. There are three specimen were used in the compression testing for each mixes. The compression testing machine used for testing the cube specimens is of standard make. The capacity of testing machine is 2000 KN. The machine has a facility to control the rate of loading with a control valve. The plates are cleaned before the testing of cubes. After the required period of curing, the cube specimens are removed from curing tank and cleaned to wipe off the surface water. It is placed on machines such that the load is placed centrally. The smooth surface of specimen is placed on the bearing surfaces.

CASTING OF SPECIMENS

Size of specimen (230mmx100x100mm)

TESTING OF SPECIMENS

a) Compressive strength test
b) Water Absorption test
c) Fire sensibility test

Compressive strength test

Compressive strength has been tested in two phases: one was before burning the bricks and another was after burning. Compressive strength test was done according to the ASTM standard C67-03a [16]. 3 brick samples were tested from each mix ratio and then the corresponding results were averaged to obtain the final compressive strength. The readings were taken after formation of cracks on the brick surface. Some failure modes are shown in figure- 3

Water absorption test

After unmolding, the dry weight of the saw dust bricks was measured. Then the saw dust bricks were submerged into curing tank. Using the recorded weights of the saw dust bricks after 7, 14, 21 and 28 days, the absorption rates were determined for all 16 mix ratios according to ASTM C20 method [17].

Fire sensibility test

As wood is a flammable material, Digital Muffle Furnace was used to check fire sensitivity of the bricks. Ignition temperature of wood placed in an oven is 700°F (371.1°C). At this temperature wood catches fire almost immediately. At oven temperatures of 450°- 500°F (232.2°C- 260°C), the wood gradually chars and usually ignites after several hours [18]. Considering these facts temperature at muffle furnace was kept 350°C. The inner textures of the burnt and unburnt bricks are shown in figures- 4 and 5 respectively.

Testing

The bricks were then weighed and tested in accordance with Nigerian Standards for sandcrete blocks (NIS, 2004) and National Building Code (2007).

Three specimens from each mix proportion were crushed in the California Bearing Ration (CBR) (a compressive testing machine) to determine their

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dry compressive strength and also three specimens from each mix proportion were tested for compressive strength in the wet state. Similarly three specimens from each mix proportion, cured using open air drying in the shade, as the second curing methods were tested to ascertain their compressive strengths. Furthermore, three bricks from each mix proportion were submerged in water to check for percentage water absorption and dimensional stability. There was no sampling since all the specimens produced were used

In testing for compression, the brick cubes were placed between metal plates and placed between the centres of the plates of the compressive testing machine. The load was then applied axially and without shock till failure occurred. The maximum or failure loads of the bricks were then recorded.

V. RESULTS

The results for the study were obtained from the answers from the research questions.

Similarly, the mean compressive strengths of different mix ratios of composite bricks cured using room drying method are 0.01N/mm2 for ratio 1:3:3, 0.01N/mm2 for ratio 1:2:4, 0.00N/mm2 for ratio 1:4:2, 0.01N/mm2 for ratio 2:1:1, 0.02N/mm2 for ratio 2:1:2, 0.015N/mm2 for ratio 2:2:1, 0.01N/mm2 for ratio 3:1:1, 0.015N/mm2 for ratio 3:2:1, and 0.02 N/mm2 for ratio 3:1:2 respectively. The greatest mean compressive strength of the composite bricks, cured using room drying method, is observed to be 0.02N/mm2. The 0.02N/mm2 strength is derived using mixture ratios of 2:1:2 and 3:1:2.

VI. DISCUSSION OF FINDINGS

The findings on composite (Cement: Sawdust : Limestone) bricks shows that the highest mean dry compressive strength of composite bricks was 0.025 N/mm2 derived at the mix ratio of 2:1:2 and 2:2:1. The highest mean wet compressive strength of composite bricks was found to be 0.02 N/mm2 using the mix ratio of 2:1:2 and 3:1:2. This also means that both curing methods produced optimal compressive strength.

VII. CONCLUSION

1. The sawdust mixed fine aggregate (10%,20%,30% and 40%) shows mostly the same properties as that of normal fine aggregate and therefore it is understood as a well graded aggregate based on C_u and C_c values and also sieve size analysis curve.
2. The suitability of using coarse and fine aggregate in the concrete mixture was confirmed with their physical properties test.
3. Based on the chemical observations of the saw dust it was found that sawdust can be used as partial replacement of sand in making of concrete such that it will not cause any further leaching issues or does not react with any chemical composition of cement, fine aggregate, coarse aggregate.
4. It has been observed that upon increasing the saw dust percentage replacement the workability, compressive strength, split tensile strength and flexural strength of the concrete decreases after 10% possibly due to higher moisture holding capacity of sawdust as mentioned in different literatures also.

REFERENCES

[1]. Akande, J.A. (2001) Briquetting sawdust and low density coal for sustainable livelihood. Proceedings of the 28th Annual Conference of Forestry Association of Nigeria, Akure 4th-8th Nov. (eds J. Abu, P. Oni and L. Popoola) Pp. 127-137.

[2]. Badejo, S.O.O. (2002). Manufacturing of building materials from sawdust. Invited paper presented at National workshop on "An Investors' Forum" jointly organized by Raw Materials Research and Development Council, Abuja and Forestry Research Institute of Nigeria, Ibadan, at conference centre, FRIN Ibadan.

[3]. Brozovsky, J & Zach, J. (2007). Non-destructive testing of solid brick compression strength in structures IV conferencia pana – mericana de END. Buernos Aires October 2007.

[4]. Nigeria Industrial Standard (2004). Standard for sandcrete blocks. NIS 87: 2004. Approved by Standards Organization of Nigeria, Abuja, Nigeria.

[5]. RMRDC (2003b), Multi-Disciplinary committee report of a techno- economic survey on Wood and Wood Products Sector (4th Update). Raw Materials Research and Development Council, Abuja.

[6]. Turgut, P and Algin, H.M (2007) Limestone dust and wood sawdust as brick materials. Building and Environment vol. 42(9), 3399-3433. (from Science Direct).