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The Use of Wood By-Products for Making Concrete Blocks

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Abstract: In this research, sawdust concrete with nominal mixes 1:1:2, 1:1½:3 and 1:2:4 were subjected to the following tests; particle size distribution, compressive strength, water absorption and density. This was done to examine the suitability of wood by-products for concrete blocks production. The 28-day compressive strength of nominal mixes 1:1:2 and 1:1½:3 were 18.33 and 8.78N mm^{-2}, respectively, while their 28-day absorption values were 5.69 and 8.97%, respectively and the densities were 2133 and 2914 kg m^{-3}. These values indicated that wood by-products (sawdust) could be used for concrete blocks production. The successful utilization of wood by-products helps not only in reducing the amount of wastes requiring disposal but also in eliminating the pollution of the environment caused by burning the wastes.

Key words: Wood, by-products, concrete blocks, absorption, density, pollution

INTRODUCTION

The safe disposal of waste in Nigeria is a major problem at the Federal, State and Local government levels. This trend made many researchers worked extensively on the use of waste materials for construction works. The various types of waste materials for construction can be divided according to the source in four major categories vis-a-vis agriculture, domestic, industrial and mineral wastes (Collins and Ciesielski, 1994). The major wood by-products i.e., sawdust has been classified as agricultural vegetative lightweight aggregate alongside other aggregates like cork, straw, seaweed etc (Washa, 1956). Vast quantities of wood by-products are obtained in sawmills across the nation, with only small quantities used by rural families as fuel for cooking and by poultry farmers as animal beddings. The use of wood by-products in construction works has benefits not only in reducing the amount of waste requiring disposal but can also provide construction materials with significant savings over new ones.

Wood wastes have been used for exotic purposes such as soil reinforcement (Ramachandran, 1981). Sawdust especially has been used extensively in England to make such products as precast units for portable housing, flooring, sub flooring, precast building units and cement lumber (Washa, 1956). It has also been reported that it performed well in certain floors and wall applications (Ramanchandran, 1981). Particle boards were manufactured from small wood chips or industrial and agricultural wastes such as bagasse, coconut husks, grass, bean pods in the presence of adhesives (Adeyemi, 2002). New decorative face sawdust cement boards for ceiling sheets, sawdust cement floor/wall tiles for house flooring and wall cladding and sawdust-cement partitioning boards were developed at the Forestry Research Institute of Nigeria(FRIN), Ibadan (Owonibi and Badejo, 2001).

The aim of the present investigation is to examine the use of wood by-products for concrete blocks in load and non load bearing walls. Therefore, the particle size distribution of sawdust and sand were determined. Also the compressive strength, water absorption and density of the concrete were evaluated on concrete blocks produced from the nominal mixes 1:1:2, 1:1½:3 and 1:2:4 at ages 1, 3, 7, 14, 21, 28 and 35days.

MATERIALS AND METHODS

The materials used for the concrete blocks were wood by-products (sawdust), sand, Ordinary Portland cement with brand name Elephant and water. The nominal mixes employed were1:1:2, 1:1½:3 and 1:2:4 with constant water-cement ratio of 0.6. The proportioning, mixing and production of test specimens have been fully described (Ogundipe, 2006).

Particle size distribution: The test was carried out in accordance with (BS 1377, 1990), for dry sieving, TEST 7(B).

Compressive strength test: The test was carried out in accordance with American Society for Testing and Materials, C-39 (ASTM, 1983).

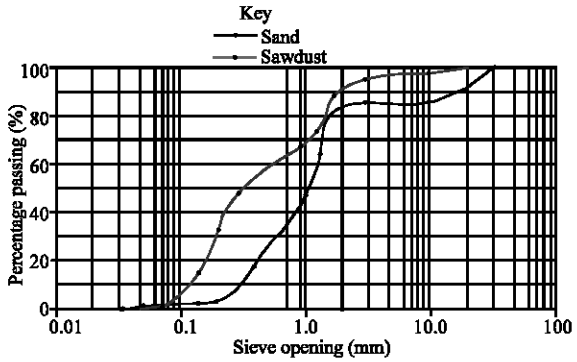

Fig. 1: Particle size distribution curves of sand and sawdust

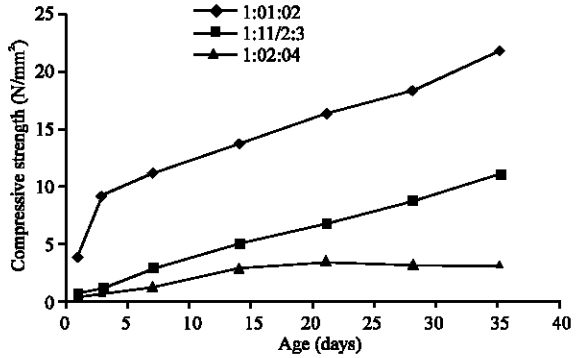

Fig. 2: Compressive strength against age

$$\text{Compressive strength} = P/A$$

Water absorption test: The test was carried out in accordance with American Society for Testing and Materials D1037-8 (ASTM, 1983).

Density: The density of the concrete was obtained by determining its weight and dividing by the volume as below:

$$\text{Density kg m}^{-3} = \frac{\text{Concrete block weight}}{\text{Volume}}$$

RESULTS AND DISCUSSION

Particle size distribution: Figure 1 shows the particle size distribution of both sawdust and sand. It complied with grading zone II said to be good for concrete work (FGN, 1997).

Compressive strength: Figure 2 shows the compressive strength of the mixes with age. The compressive strength values for mix ratio 1:1:2 range from 3.89 at the first day to 21.78 N mm^{-2} at the 35th day, while that of 1:1:3 range form 0.70-11.11 N mm^{-2}and 1:2:4 from 0.45-3.05 N mm^{-2}.

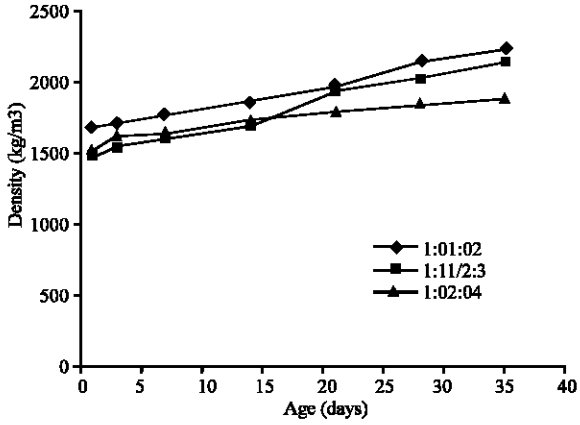

Fig. 3: Density against age

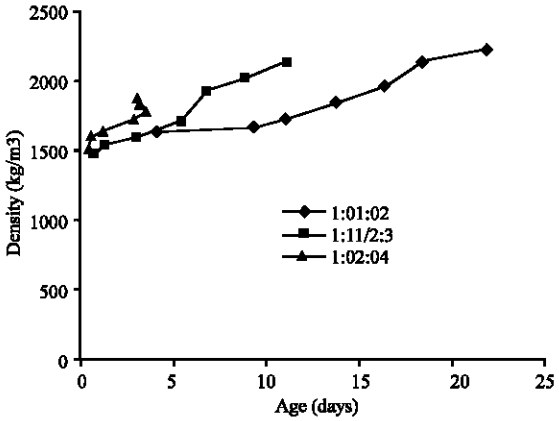

Fig. 4: Density against compressive strength

At ages 7 and 28days for nominal mix 1:1:2, the compressive strengths recorded were 11.11 and 18.33 N mm^{-2}, respectively. These values met the requirement for grade 12N mm^{-2} mass concrete with 7 and 28-day strength of 7 and 10 N mm^{-2}, respectively, making it suitable for concrete blocks for use in load and non load and non-load bearing walls. The nominal mix 1:1½:3 with 28-day strength of 8.78 N mm^{-2} could be used as grade 7 lightweight concrete for concrete blocks in non load bearing walls (FGN, 1997).

Density: Figure 3 and 4 show the density of the mixes with age and the density with compressive strength, respectively. The density of the nominal mix 1:1:2 ranges from 1630-2222 kg m^{-3} at age 1-35days, while that of 1:1½:3 ranges from 1481-2133 kg m^{-3} and lastly that of nominal mix 1:2:4 ranges from 1511-1867 kg m^{-3}. The 28-day densities were 2133, 2014 and 1832 kg m^{-3}. These show that the compressive strength of the concrete blocks increased with increasing density and density in turn in increased with age.

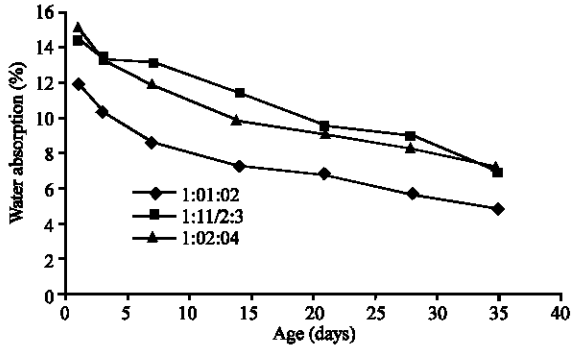

Fig. 5: Water absorption against age

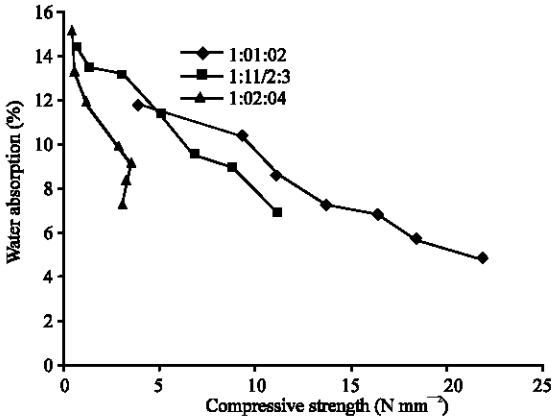

Fig. 6: Water absorption against compressive strength

Water absorption: Figure 5 and 6 show the water absorption with age and water absorption with the compressive strength, respectively. These indicate that the water absorption decreased with age and the compressive strength decreased with increasing water absorption. The 28-day values for mixes 1:1:2, 1:1½:3 and 1:2:4 were 5.69, 8.97 and 8.29%, respectively. Their values of less than 10% indicated that they could be used for concrete blocks in both load and non-load bearing walls, as most good concretes have water absorption values below 10% (Neville, 1981).

CONCLUSION

In this research, wood by-products were examined for use in concrete blocks. The results show that wood by-products (sawdust) could be used with other concrete materials like ordinary Portland cement, fine aggregate (sand) and water to produce concrete blocks for use in both load and non-load bearing walls. The nominal mixes 1:1:2 and 1:1:3 were found to be appropriate for this application.

The use of sawdust in concrete blocks production is an effective and economical disposal method of the wood by products generated in sawmills across the nation. The present way of disposing these wastes is open burning. It is always accompanied with pollution of the environment, thereby endangering human life. Its use would meet the present needs of the populace without compromising the ability of the future generations to meet their own needs because it is available in large quantities in all the tropical countries.

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