Mechanical Behaviors, Using Local Sponge (*Acanthus montanus*) As An Alternative Fibers In Production Of Plaster Of Paris (P O P) For Casting Of Celling Board.

ABSTRACT

Local sponge fiber (*Acanthusmontanus*) and synthetic string were used as in this study as reinforcements for ceiling material. This local sponge fiber, are known to possess adequate strength and rigidity as well as being available in large quantity and relatively low cost, they also, require low level of energy during production processes. Therefore, it was used as an alternative to the usual Synthetic string always used for Plaster of Paris for ceiling board. The fibers, whose mass fraction were the variables in this research, were cut into appropriate small sizes and blended with cement and water. The resultant sludge was thereafter decanted into molds while the surplus water was drained which allowed the molten composite to be hardened. Flexural test, Impact test and Hardness test were carried out on the various samples. The flexural strength of local sponge is higher at 0.10% and 0.20% than that of Synthetic string. The result of these tests established the possibility of utilizing the local sponge fiber as alternative fortification in Plaster of Paris for the purpose of ceiling board.

Keyword: Plaster of Paris, acanthus montanus, composites, mechanical behavior

1.0 INTRODUCTION

Fibers have been described as thread-like materials which come in strands resembling hair strands. They appears as unbrokenwire-like structures and in distinct long units which isanalogous to pieces of strand. They have been known to be used as a part of composite materials with various applications. Fiber as a unique raw material has been found to be very useful in producing arrays of materials leading to improvement in the economy of a nation, including the industrialization processand contribute immensely to the wellbeing of the human population (Munawa.*et al,* 2007). Recently, the need for affordable housing worldwide has inspired a lot of studies into cementitious matrix composite. Diverse research groups in many tropical countries have carried out extensive researches on fibre reinforced cementitious composites materials. Indeed, in fibres, there is a chance of developing environmentally sustainable and cost efficient building materials. The goal for developing such alternative technology is to promote sustainable building material (Bilba*et al*., 2003)

Recently in the world, there is an increase in the demand for fibres and fibre-based products for panel manufacturing. With the global pursuit of affordable housing system for all coupled with the effort of the federal government of Nigeria to make housing accessible to all in the rural and urban areas, several proposals on reduction of the cost of orthodox building materialshave been made. Among those suggestions is the possibility of obtaining and usage of alternative construction materials developed fromlocal sources including agricultural wastes.

In developing nations around the world such as Nigeria,agreat amount of fibre is generatedas wastes every day. Agricultural fibers are wasted and thrown into landfill which also contributed to environmental hazard (Adeyeye*et al*., 2009). Due to the environmental implications offibredisposal during burning and in landfill,there is the need to exploit the alternative use of these fibrewastes. One of the best ways to do this is to integrate the fiber as component in cement bonded particle board [CBP] manufacturing. This will go a long way in addressing the environmental problems arising from fibers disposal but will also bring in money for those who handles these waste and reduce the rate of deforestation as a result of fibre harvesting from trees (Yuhazri and Dan, 2007; Oladele *et al*., 2009).

Cement bonded particles are coconut fiber based panels that have higher dimensional stability when subjected todifferent ranges of relative humidity. They have been reported to be very useful materials in construction and possess several advantages above other materials used in the production of panels having unique properties (Zhou and Kamdem, 2002). This has made the fibresmore suitable for use especially in developing countries. This acceptance of the cementous bonded particles may have been informed by its relative reliability, its capacity for resistance to decomposition, fire attack and insect;also, its strength and resilience during natural disasters have been documented (Papadopoulus, 2008). These properties of cement bonded particle hasmade it a very useful material for construction of several part of a building such as floor, roof, ceiling, cladding and shutters (Sulastiningsih*et al.,* 2000).

Fibers are often used in the manufacture of other materials. Fiber of synthetic string used as a component of composite materials, or when matted into sheets, used to make products such as paper, papyrus, or felt. Natural fibers include those produced by plants, animals and geological processes, can be classified according to their origin. Man-made fibers or chemical fibers are fibers whose chemical composition, structure and properties are significantly modified during the manufacturing process (Hans-J.Koslowski, 2009, Oladele et al,.2012). An example of Natural fiber is local sponge. Local sponge are multicellular organism that have bodies full of pores and channels allowing water to circulate through them, consisting of thin layers of cells. Sponges are similar to other animals in that they are multicellular, heterotrophic, lack cell walls and produce sperm cells. They have unspecialized cells that can transform into other types and that often migrate between the main cell layers and the mesohyl in the process. Sponges make up the Poriferan phylum, they are known to be sessile metazoans i.e. they are multicellularnon-motile animals that have a single opening for both intake and exit of water as well as other wastes.They possess internal cavitiesthat are furrowed with flagellated cells. Sponge does not have nervous, digestive or circulatory systems. Local sponge can be binded together with the use of cement; the word cement can be traced back to the Roman term opus caementicium, used to describe masonry resembling modern concrete that was made from crush rock with burnt lime as binder. The major significantrole of cement is in the formulation of mortar and as binders in concrete which helps to reinforce the strength of buildings and other structures. Depending on the capacity of the cement to set in the presence of water, it may be classified as non-hydraulic or hydraulic. Cementitious composite appears to be alikewith cement-based concrete material, the main difference is that when subjected to pressure or strain, it may be deformed or bend.These composites are recognized as pliable concretewhich adopts polymer fibre reinforcements to mould thesemortar-based complexes. Cementitious composite possessstrainingpotential that ranges from 3 to7%, compared to 0.1% for ordinary cement. Cementitious composite can be mixed with local sponge for making ceiling application, ceilings can be made of multiple different materials like gypsum, acoustic tile, tin, plaster, foam and wood e.t.c. Some ways in which ceiling can be decorated include painting, plaster textures, lighting, exposed contrasting beams and molding. Ceilings can also be used for hanging some decorations or appliances such as ceiling fans, chandeliers (Meyers-Levy and Zhu, 2007). Local sponge is used as an alternative requirement for plaster of Paris because of its special attributes such as being able to be stored for long time, its strength and stiffness as well as being readily available at a cheap priceand it requires very low amount of energy forproduction. The boards produced will be turned, cut into specimen sizes and subjected to tests (flexural test, impact and Hardness test) in accordance with the procedures stipulated in ASTM. Several studies have been reported about cement bonded particle building materials used for coating walls and ceiling. It is our view that the exploration of these useful fibers could promote wider use and provides solution to inadequacy of affordable housing in Nigeria which has been largely due to inability to develop low cost building materials(Aladenika*et al*., 2019).


Figure 1: Synthetic string fibre.Figure 2: Local Sponge fibre

2.0 MATERIALS AND METHODS

The raw materials required for this work was sourced locally. About 10 liters of water was poured inside a cleaned large wash basin and 500 g of white cement was continuously added to the water with thorough mixing until semi-solid mixture was formed. Then the flat glass was placed horizontally on the floor and water poured on the glass which serves as the lubricant. The glass was divided into the size of the needed board (ASTM, 1995). The fibre sample of synthetic string and local sponge were weighed using electronic balance.The semi-solid mixture was then poured on the glass, according to the way the glass was divided. This was left for about 10 minutes for it to solidify little bit; after which the fiber for each of the fibers used was added to surface of the solidified mixture on the glass which was later left for 30 minutes for it to be solidified. The scrapper was then used to remove the board formed on the glass so as to prevent it from breaking. Thissteps were repeated for the variousvolumes of the fibre fraction of 0.10%, 0.20%, 0.30% and 0.40% for every sample of fibre, local sponge and Synthetic string used. The formulated boards wereclipped and cut into appropriate sizes then tested in line with standard methods described in ASTMD1034-93. The flexural of the cement board will be determined using Ottowolpert- werke GMBH D-6700 universal testing machine. Likewise Hardness and impact text were carried out.

3.0RESULTS AND DISCUSSION

The figures below show the results of tensile, flexure, impact and hardnesstest.

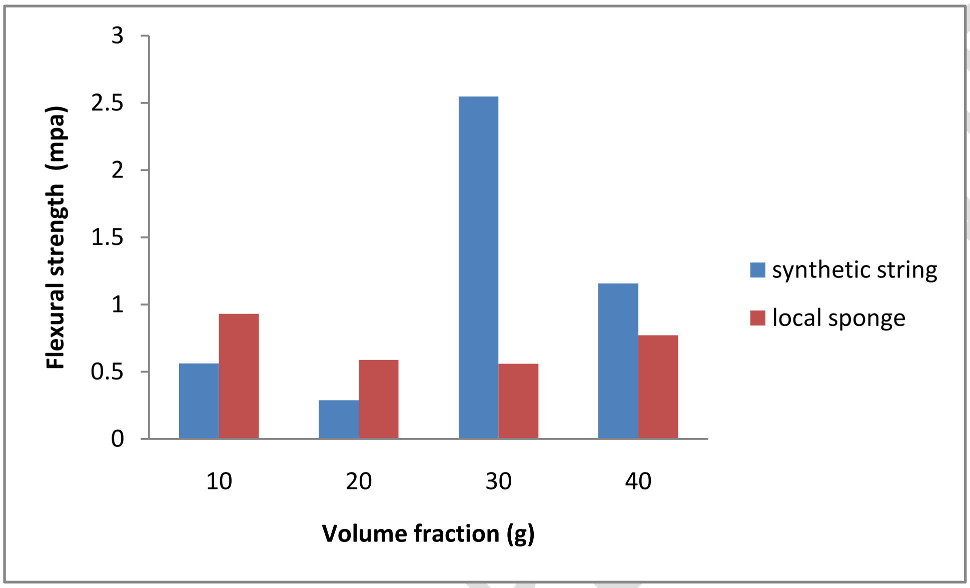

Figure 3: Effect of fibre on Flexural strength.

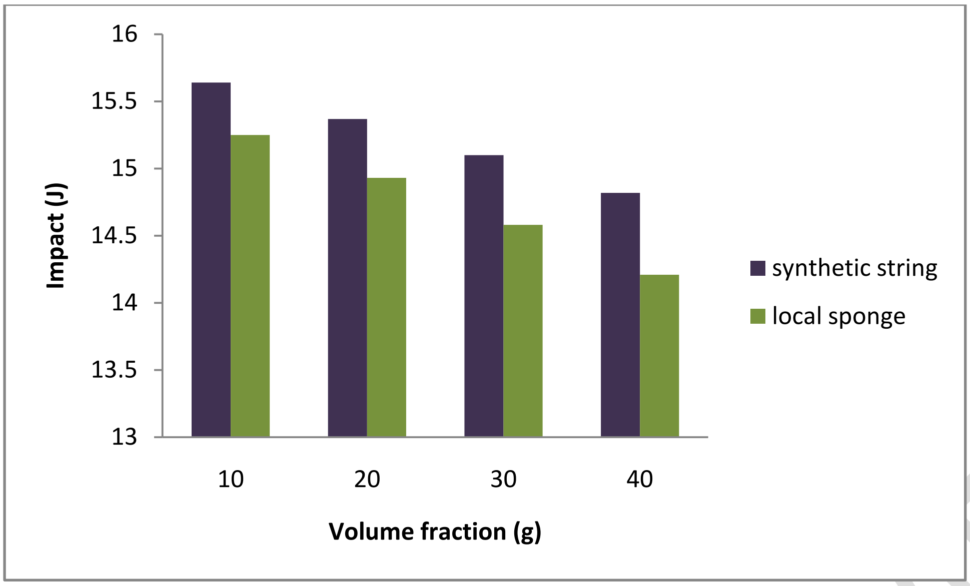

Figure 4: Effect of fibre on Impact.

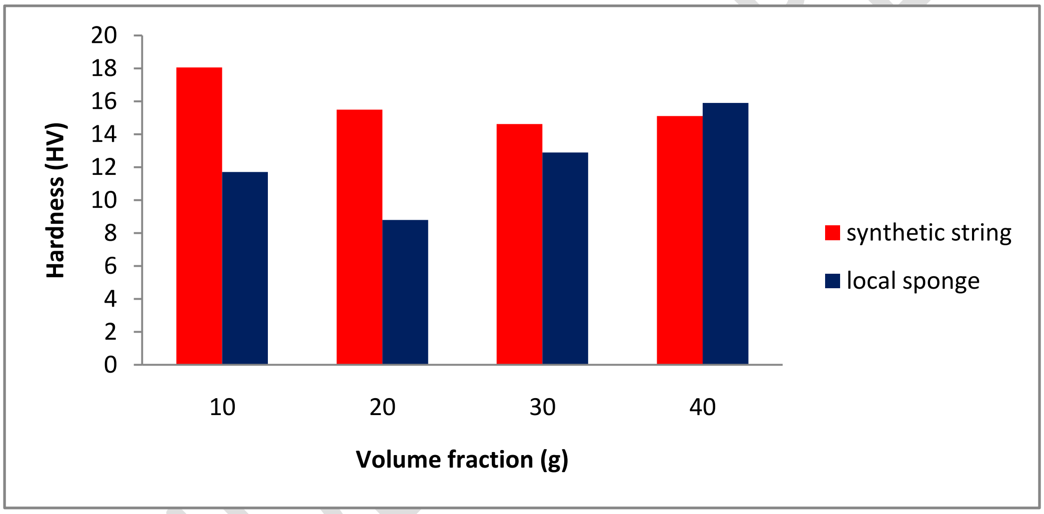

Figure 5: Effect of fibre on micro Hardness.

Flexural Test.

Flexural strength is defined as a materials ability to resist deformation under load. Flexural test is conducted as per ASTM D6700 Standard using universal Testing Machine. Flexural strength of local Sponge is higher at low fibre loads of 0.10% and 0.20% than that of synthetic String at that fibres loads while Flexural strength of synthetic string is higher than local sponge at 0.30% and 0.40% respectively. Thus, varying the volume fraction of the fibres have effect of the strength of the Plaster of Paris (Adeyeye*et al*., 2009).

Impact Strength.

A pendulum type impact testing machine is generally used for conducting notched bar impacts test. The impact tests are carried out as per ASTM D 256 using an impact tester. This is a kinetic energy needed to initiate fracture and continue the fracture until the specimen is broken. The Impact of synthetic string is higher in all percentage volume fractions. It can also be seen that in Impact values across the percentage volume fractions are decreasing and the different between the synthetic string and local sponge is small, which can be consider for replacement and it is supported by earlier works (Aladenika*et al*., 2019).

Micro hardness test.

The micro hardness test was carried out by forcing a diamond cone indenter into the surface of the specimen to create an impression (indentation). The hardness values were summed to get an average for each specimen. The micro hardness tester was used to perform the experiment. Micro Hardness values of the Synthetic String is higher than that of local Sponge in 0.10%, 0.20% and 0.30% volume fraction, except for 0,40% which is otherwise. It can also be seen that the hardness values increase on 0.30% and 0.40% volume fractions. These results are in consonance with the values reported in the literatures (Oladele *et al*., 2009).

4.0 Conclusion.

Conclusively, in the results from the analysis of the mechanical properties of sponge and synthetic fibres reinforced composites will greatly influenced by the fiber percentages with the observed strength from impact, flexural, hardness,of the plaster of paris (POP), based composites for celling application. From the results generated the flexural strength of local sponge is higher at 0.10% and 0.20% than that of Synthetic string. It can also be seen that the Impact values ranges different between Synthetic string and local sponge across the percentage volume fraction is small. Micro hardness values at 0.40% volume fraction exhibited higher value than that of local sponge. Therefore using local sponge as the alternative fibers in production of Plaster of Paris can be established.

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