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Full Length Research

Mechanical Properties of Nypa Palm Leaf in Some Selected Communities in Port Harcourt Local Government area of Rivers State, Nigeria

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The objective of the study was to investigate the mechanical properties such as hardness and bulk density of the Nypa Palm leafs. The Nypa Palm leaf samples were collected from Okujagu-Ama, Abuloma and Amadi - Ama, in Port Harcourt Local Government, Rivers State. The preparation and mechanical properties tests were carried out in Prodec-Fugro, Laboratory. Each of the observed properties of the different grain sizes were analysed and summarized in Tables 1 – 3 in this study. The bulk density of the Nypa Palm is (5.71 – 12.76) x 102kgm^{-3} while the hardness range is (41 – 71) HRC. Density and hardness of the Nypa Palm leaf were also compared to those of existing roofing materials like Aluminum. Other materials compared were Raffia Palm, Pine wood, Oak wood, Bamboo and Maple wood. It was discovered that, the density and hardness of the Nypa Palm leaf samples were lesser than those of the existing roofing materials and this can affect its use as a roofing material. Therefore, it was also concluded that, binders have to be added as well as other treatment materials on the Nypa Palm leaves to make it suitable for roofing, especially as ceiling for buildings.

Key-words: Mechanical-Properties, Nypa-Palm-Leaf, Selected Communities, Port Harcourt.

INTRODUCTION

Nypa Palm is one of the oldest angiosperm and probably the oldest palm specie that grows in the mangrove swamps. According to research findings, fossil of Eocene and Miocene in Europe, South and North America, the Middle East and Brazil suggests that the Nypa Palm had a Pan Tropical distribution 13 to 63 million years ago,(Corner,1988). Today, it is mainly found in the equatorial zone, 10^0Ns, stretching from Sri. Lanka through South-East Asia to North Australia. The largest Nypa Palm stands are found in Indonesia (100,000 ha), in Papua New Guinea (500,000 ha) and the Philippines (8,000 ha), (Ekpunobi and Onuegbu, 2017). The Northern, most natural occurrence is on the Ryuyu Islands of Japan and the Southern, most occurrences are in North Australia. In South-East Asia like India, Malaysia etc, it is also cultivated, (Mclaren and Cameron,

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1990). It was introduced to West Africa (Nigeria in Delta Precisely) at the beginning of the 20th century in about 1901, (Ekpunobi and Onuegbu, 2017). It was brought by foreigners from Europe who planted the Nypa palm as a decorative plant and also because it was believed to be capable of checking erosion, (Aregbeyen, 2015). The Nypa palm also known as the Nypa fruitican is a gregariously growing monecious palm having dichotomously branched underground rhizomatous stem and a crown of leaves just above the surface,(Fong, 1998) . The Nypa palm is not considered a tree although the feather-like leaves can extend up to 9m (30ft) long and form a rosette at each branch tip. The seed is woody and arranged in a cluster or compressed into a ball up to 25cm (10in) across, on a singles stack. The ripe seeds separate from the ball and are floated away on the tide occasionally germinating while still water borne, (Hutchinson and Daizel, 2012). It occurs mostly in areas of brackish water extending upstream into permanent freshwater areas where tidal influence water-level punctuations are able to carry and deposit the seeds. However, the salt water tides are crucial for seed dispersal and deposition of silt. It can also grow as an undershrub, infrequently as a tree, or can dominate in a mixed forest, (Fong, 1998). It can also grow on low flats and depressions near or far from the main water bodies at the base of eroding slopes and cliffs or a sandy ridges or embankments,(Peters, 2015). The swamp soils are muddy and rich in alluvial silt, they have high content of organic salts, calcium and sulphur, iron and manganese, contributing to the typical odour and dark colour.

The objective of this study is to examine the mechanical properties of Nypa Palm in some selected areas in Port Harcourt Local Government Area Rivers State, Nigeria.

MATERIALS AND METHODS

Collection of Materials and Processing

The fresh Nypa palm leaves (raw materials) were obtained from Okujagu-Ama, Abuloma and Amadi-Ama communities in Port Harcourt local government area of Rivers State, with the aid of the villagers and field supervisor. The leaflets were plucked, cut into pieces and exposed to the sun to dry for 4 – 6 weeks. The leaflet ribs were not removed (separated) from the blades.

Sample Preparation

The dried leaves were then ground in the grinding machine which had to be clean to avoid contamination, into fine power. This powder was then sieved using sieve meshes of various sizes. The various sieved products were then weighted using the electronic analytical weighting balance into various masses of 2g, 4g, 6g, 8g, 10g and 12g. The weighted samples were the poured into a mould of diameter 25.52 x 10^{-3}m and compacted in the hydraulic compacting press at a given constant compact pressure of 10mpa. The mechanical properties of the Nypa palm leaves samples were tested using standard machines.

Test Methods: Rockwell hardness Test

A Rockwell hardness tester, model Otto Wolpert Worke LUDWIGSHAFEN C. RL hardness tester with the following particulars: Type tester HT La, machine Nr. 4819: Rom. Nr 259 (Baujahr, 2010), and a GERRUFTAM 30861 were used for this test. Each sample was placed on the anvil of the test machine, the sample and anvil were raised to the indentor until the small pointer of the dial was at the starting point and the large pointer read zero on the black scale of the dial. The indentor is a round steel ball 12.1mm in diameter. At the instance when the sample makes contact with the indentor, there was a fixed minor load of 10.5kg on the indentor. A major load of 62.5kg was applied by tripping the local release lever. The reading on the dial was then recorded. This represents the vertical distance of indentation plus the spring constant correction of the test machine.

Thickness Measurement: - The thickness of the various grain sizes and masses of the samples were measured using vernier calipers.

Bulk Density

The bulk density was obtained from the relation:

Table 1. Physical Parameters of samples fabricated from 100μm grain size in 25.52 x 10^{-3}m diameter mould.

Mass (kg) ± 0.05 x 10^{-3-}	Thickness (m) ± 0.01 x 10^{-3}	Bulk density (e) x 10^{2} kgm^{-3}	Hardness (HRC)
2.00	4.70	8.32	71.00
4.00	7.60	10.22	68.50
6.00	10.11	11.60	60.00
8.00	12.45	12.56	57.50
10.00	15.32	12.76	55.00
12.00	19.25	12.88	52.50

Table 2. Physical Parameters of samples fabricated from 125μm grain size in 25.52 x 10^{-3}m diameter mould.

Mass (kg) ± 0.05 x 10^{-3-}	Thickness (m) ± 0.01 x 10^{-3}	Bulk density (e) x 10^{2} kgm^{-3}	Hardness (HRC)
2.00	5.52	7.08	65.00
4.00	7.81	10.01	62.00
6.00	10.05	11.67	53.50
8.00	13.40	11.72	47.00
10.00	16.73	11.98	44.50
12.00	20.09	12.04	41.00

P = $\frac{m}{\pi r^2 t} xgm.3$ - - - - - - - (5)

Where M = Sample mass (kg)
r = radius of the sample
t = Thickness of the sample

RESULTS AND DISCUSSION

The results obtained from the various machine properties. Tests carried out are shown in the tables below. The tables are based on the various grain sizes of the sample. On compacting in a hydraulic press, tightly bound compact solid samples were obtained. Table 1**,** shows the mechanical properties/parameters of the samples produced from 100μm grain size in a mould of 25.52 x 10^{-3}m diameter. Tables 2 and 3 shows, the same mechanical properties and parameters for specimen produced from 125μm and 300μm grain sizes respectively.

CONCLUSION AND RECOMMENDATION

The minimum thickness obtained of the samples varied from 4.70 x 10^{-3}m for the 2 x 10-3kg mass of 100μm grain size of diameter 25.52 x 10^{-3}m. The best gauge for long span aluminum roofing sheets in 0.45 x 10^{-3}m and also that of ordinary corrugated zinc that is about 0.25 x 10^{-3}m. This shows that the thickness of the Nypa palm leaf would have to be reduced to enable it to be used in place of aluminum or zinc roofing sheets. It was discovered that the density and hardness of the Nypa Palm leaf samples were lesser than those of the existing roofing materials currently in use in the market and this can affect its use as a roofing material. Furthermore, it was also discovered that binders will have to be added as well as other treatments

Table 3. Physical Parameters of samples fabricated from 300μm grain size in 35.52 x 10^{-3}m diameter mould.

Mass (kg) ± 0.05 x 10^{-3-}	Thickness (m) ± 0.01 x 10^{-3}	Bulk density (e) x 10^{2} kgm^{-3}	Hardness (HRC)
2.00	6.85	5.71	58.50
4.00	9.02	8.67	56.00
6.00	13.53	8.86	53.00
8.00	20.09	9.48	50.50
10.00	27.73	9.56	47.55
12.00	33.33	9.74	43.00

materials on the Nypa Palm leaves to make it suitable for roofing, especially as ceiling materials for buildings.

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