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DEVELOPMENT OF MATERIAL FOR CIVIL CONSTRUCTION WITH BABASSU PALM FIBERS

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ABSTRACT: Present in the transition space of the Caatinga, Cerrado and Amazon biomes, distributed between the north and northeast regions of Brazil, it hosts a species that carries with it an economic potential already known by local populations: the babassu (Attalea speciosa).This palm is a source of income for families that depend on babassu extraction in the Brazilian states of Maranhão, Piauí and Tocantins. According to studies by Embrapa, the exploitation of babassu coconut (the most used part of the babassu) is just one of the possibilities involving this native raw material. It is for this reason and for its favorable environmental repercussion, in view of the sustainability of its material, that we aim with this research to enable a new application for babassu, using fibers from its leaf, whose characteristics allow its use in civil construction for internal use and environments exteriors in buildings. Thus, this work intends to evaluate the technical viability of manufacturing, on a laboratory scale, a compact sawn wood board, similar to the Oriented Strand Board (OSB), making a considerable reduction in the final value of the work, as it is an abundant material in the region, easy to produce, sustainable and ecological.

KEY WORDS: Plate, Babassu, Civil Construction, Sustainable

1 INTRODUCTION

The generalities about the Palm of Babassu, its impact on the economy with the products already known, research for its use in civil construction and objectives of this research will be addressed.

1.1 GENERAL CHARACTERISTICS OF THE BABASSU PALM TREE

The Babassu Palm is a species that dominates the ecotonal landscapes, which are areas resulting from the contact between two or more border biomes, in the mid-north region of Brazil (Transition between the Amazon, Cerrado and Caatinga), traditionally exploited in an extractive way by thousands of families, mainly in the states of Maranhão, Piauí and Tocantins. The adult babassu palm can reach between 10 and 30 meters in height and its leaves can reach up to 8 meters in length.

Babassu is still used as a source of raw material for the production of charcoal, fibers for basketry, fences, housing roofs, and even for the preparation of porridge and cakes (Silva et al., 2001). Its importance for the family farmer, the socioeconomic issues and land conflicts arising from its exploitation are widely described in the works of May (1990) and Anderson et al. (1991).

1.2 THE IMPORTANCE IN THE ECONOMY

Several economic activities can be developed from babassu, since the tree is fully utilized, and the fruit has the greatest economic potential for technological and industrial use, being able to produce about 64 products, such as coal, ethanol, methanol, cellulose, flour, fatty acids, glycerin, among others.

The babassu almond, due to the quality of its oil, is the part of the plant that currently has the greatest economic importance, although it represents a small proportion in relation to the total mass of the fruit, having produced a quantity of 48,706 tons in 2019 throughout Brazil, with the state of Maranhão responsible for the production of 45,166 tons, corresponding to 92.73% of the total, and moving about 89,363 thousand reais, according to data provided by the Brazilian Institute of Geography and Statistics (IBGE)..

The above demonstrates that babassu stands out as an important species not only for the subsistence of poor families in a wide geographic region of the country, but also as a non-timber extractive product of enormous value for the industry. In addition, because it spontaneously occupies landscapes with little economic expression in the

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national agricultural scenario, babassu is of strategic-territorial importance for the country.

1.3 USE OF THE PALM TREE IN THE CONSTRUCTION SECTOR AND RESEARCH INCENTIVES

Despite its importance as a non-timber extractive product and its potential for generating energy and co-products, in the field of civil construction, which has been reinventing itself and increasingly seeking sustainable materials, there is little published literature, as well as a scarcity of research in order to use this promising material. In the literature, there are only reports of the use of babassu palm leaves being used to form the roofs of low-income families' houses. In recent years, some actions have been initiated aimed at using babassu parts in civil construction, however, there has been discontinuity of work, lack of integration between different areas of knowledge and lack of long-term research and development policies.

In 1980, the State Institute of Babassu (INEB) was created, an agency of the Government of the State of Maranhão. During its four years of existence, INEB coordinated a research program on babassu, in collaboration with what was then CENARGEN (now Embrapa Genetic Resources and Biotechnology) and the New York Botanical Garden (NYBG) (Pinheiro et al., 2005).

Research on babassu was intensified by the creation of the National Research Program (PNP) on Babaçu, coordinated by EMBRAPA, in 1982. The PNP-Babaçu was organized with the aim of contributing to rationalizing and accelerating the use of babassu. The program's long-term goal would be “the gradual transformation of current babassu extractivism into an economically exploitable crop” (EMBRAPA, 1984), but clearly this goal has not yet been reached.

1.4 OBJECTIVE OF THE ARTICLE

Emphasize research on the technical feasibility of manufacturing, on a laboratory scale, particulate panels similar to OSB (Oriented Strand Board), derived from fibers using babassu leaf or coconut bunch cover as input, a residue originating from the removal of The palm leaf or the top of the bunch falls off the palm tree on its own, together with the fruits when they mature, with the aim of manufacturing a low-cost product with a quality equivalent to products that are at the top of the market today, in addition to providing a new product from the babassu palm tree intended for the civil construction area, using engineering to develop ecologically sustainable materials with low environmental impact, and finally, making available and encouraging studies on an endemic palm tree in Brazil with great economic potential.

2 MATERIALS AND MODEL USED

The main material used in the manufacture of the particulate plate was the babassu leaf, representing about 98% of the product composition and the other 2% correspond to the centrifuged latex that was used as a binder to make the product similar to OSB. A hydraulic press, model SL 10/5, was also used to press the layers of sheets and give better compactability to the plate.

2.1 BABASSU

Babassu is a highlight among the palm trees present on Brazilian soil, it is a large species, reaching up to 30m in height, has leaves up to 8m long, slightly arched and pointed in the vertical direction, which fall when reaching their apex. giving way to new ones (Figure 1), it also has cream-yellowish flowers, clustered in long bunches protected by peduncular bracts, which are foliaceous structures associated with the inflorescence of the palm tree that are highly resistant to humidity and fire, and later give rise to origin to oval and brown fruits, with an almond inside.

Figure 1: *Babassu palm trees located in the parking lot of the Federal Institute of Maranhão (IFMA). (Source: Author)*

The occupation of the landscape by babassu occurs vigorously (Figure 2), and seems to be favored by slash-and-burn family farming systems, as well as the formation of pastures (Anderson et al., 1991). Strongly associated with the local culture, babassu is part of the life history of hundreds of communities that collect and break coconuts in a rudimentary way, to sell the almond, an important complement to their income.

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Figure 2: *Great density of palm trees in nature. (Source: Flickr)*

2.2 CENTRIFUGED LIQUID LATEX

Latex is a material extracted directly from the rubber tree, a tree of the genus Hevea, of the Euphorbiaceae family, native to the Amazon rainforest, which stands out for its ability to produce this material (Figure 3). The extraction process begins when the tree trunk reaches a perimeter of 45cm, being measured at a distance of 1 meter over the graft, only then is an incision made in the stem with a special knife, without going beyond the part where the lactiferous vessels, so as not to impair the radial growth of the trunk. When harvested from the tree, latex has an average of 30% rubber, 68% components such as water and substances such as proteins, mineral salts, etc.

Figure 3: *Latex extraction process. (Source: wandee007/shutterstoch.com)*

In this research, Centrifuged Latex 60%, from RICLA colas e resins, a Brazilian company that has been manufacturing adhesive gums since 1989, was used. a) Practicality in use: based on its elasticity and flexibility, practicality is guaranteed in carrying out different types of work, including the manufacture of OSB boards; b) Impermeability: as it is a water-resistant adhesive, latex glue can be used to glue parts that will be exposed to moisture; c) Excellent cost-benefit ratio: it is a material that yields a lot; and d) Ease of adhesion: it showed good adhesion with laminated profiles of babassu leaves.

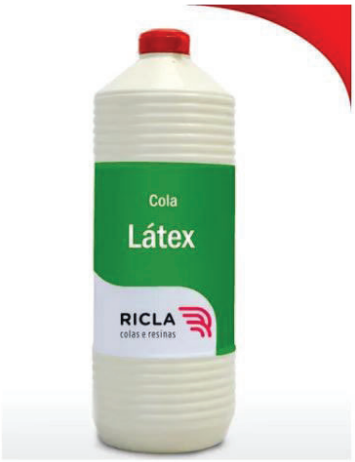

Figure 4: *Binding material used. (Source: Company catalog).*

2.3 ORIENTES STRAND BOARD (OSB)

The industrial scale production of structural particle boards began in the 1970s, in the United States, under the trade name “waferboard”.

The sheets were produced with particles of larger dimensions, in relation to the particles used in “conventional” agglomerates, but with the same random distribution in the mattress formation process.

The width and length of “OSB” sheets are determined by the production technology and not according to the length of the logs, as in the case of plywood. The current context of the Brazilian forest sector demonstrates the consequences of the predatory exploitation of natural forests, mainly caused by the expansion of the agricultural frontier, by mining activities, by the production of charcoal and others. The lack of an exploitation monitoring policy, via sustained management, also contributes to worsening the situation. Within this context, it seems, more and more, that the logical tendency is to use reconstituted wood from the furniture industry and alternative materials of lignocellulosic fibers.

The OSB panel offers resistance for multiple uses and has a wide application in the field of housing construction, in all existing types, and other applications, among which stand out: floors, walls, I-beams, stairs, ceilings, roofs, fencing, sheds, protective trays. Other applications: furniture, loudspeakers, dividers, packaging (Bins and Paillets), finishing in general and design, according to quotes from Revista de madeira, year 16, nº 97, June/2006.

As it is a product recently produced in Brazil, it can be considered that there is little information available on the market about the variables of its processing, mainly in relation to alternative materials not yet explored in the production process.

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3 METHODOLOGY

Analyzing the babassu palm, intriguing characteristics were noted, due to its natural state it presents great resistance to fire and water, making it a very promising material for use in civil construction and in the manufacture of materials used in contact with humidity and temperatures high.

In a field work, the senescent leaves of the palm tree were collected, being removed from the thickest stalk that supports the leaves with the aid of a machete and accommodated in bales that were transported to the Federal Institute of Maranhão (IFMA), Campus Monte Castelo, São Luís (Figure 5).

Figure 5: *Conditioning the raw material in bales for transport to the laboratory. (Source: Author).*

In the civil construction laboratory belonging to the institution, the samples were placed in an oven for drying at a temperature of around 60ºC, during a period of 48 hours. After drying, the material was cut into 14 cm sheets with a natural leaf width of approximately 4 cm, and then we used a brush to spread the 60% centrifuged latex over the leaves, beginning the assembly of the layers that form the panels. After organizing the sheet blades, similar to OSB, the first layer of the panel was taken to the Hydraulic Press SL 10/5, where it was pressed at a pressure of 1.5 ton/cm², for a time of 24 hours. This process was repeated 10 times, forming 10 layers with a thickness of approximately 1 mm (natural thickness of the sheet), which were successively glued and pressed overlapping one by one in crossed directions, respecting the same pressure and time mentioned above, resulting in a plate final with a thickness of 1 cm and dimensions of 50 x 50 cm, weight of 499.28g, total volume of 1250 cm³ and density of 0.399 g/cm³.

Figure 6: *Material cut into 14 cm sheets and natural leaf width of approximately 4 cm. (Source: Author)*

4 RESULTS AND DISCUSSIONS

Babassu is indisputably a raw material of immeasurable value that is still little researched and used. The plate made with the leaf of this palm tree is light, has an excellent design, has low degradation over time, in addition to having a low modulus of elasticity, facilitating its molding. In the initial stage of the first layer, with fibers oriented only in one direction, good flexural strength was observed, being able to significantly support its own weight without excessive deformation. After pressing the ten layers, positioning the fibers crosswise, we obtained a panel with greater resistance than imagined and with very attractive aspects, combining quality and good value for money in a single piece, which will provide satisfaction and pleasure to the consumer public. Due to its characteristics (Table 1), it can be used in civil construction to cover walls in internal and external environments (reconciled with additives), in linings, in decorative details of rooms, in baseboards, among others, making a considerable reduction in the final value of the work because it is a material that is easy to produce, sustainable, renewable and ecological, in addition to collaborating with the preservation of the environment by reducing construction waste, and having the raw material with vast density in the Brazilian territory.

Table 1: *Characteristics of the plate made in the laboratory.*

Material /Character	OSB of Babaçu
Weight	499,28g
Dimension	50x50cm
Average Thickness	1cm
Área	2500cm²
Volume	2500cm³
Density	0,199g/cm³

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5 CONCLUSIONS

For the realization of the plate similar to OSB, we can emphasize that this new material based on leaves of the Babassu Palm tree as the main raw material has a great benefit in the environmental field and a good use for the most diverse purposes, since it is a material low cost to operate and sustainable, in addition to being a renewable raw material, causing the satisfaction of all who come to use these panels (Figure 7). Observing the need to protect the environment, which is suffering a lot with the development of humanity, both with the production of garbage and pollution, and with the exploitation of finite resources in an unbridled way, the importance of studies and discoveries of ecologically sustainable products and low impact on nature is vital for reducing environmental degradation and increasing people's quality of life in the future. Based on this, the exploitation of babassu palm leaf fibers for the preparation of pressed wood panels similar to OSB, with the intention of being used in the field of civil construction, can have a positive impact because it is an ecological product, without generating toxic waste in its manufacture and revolutionizing the means of producing materials for this branch of engineering that is essential for human development and which is currently one of the main degraders of the environment.

The social aspect of this new product can also be emphasized, as there is the possibility of building houses using these panels, thus lowering their final value and contributing to a more sustainable world.

Therefore, Brazil, as the sole owner of this raw material, will be able to take advantage of this product, which at the moment is unexploited, making it a great benefit both for society and for the economy, which will gain a new production line, generating jobs and influencing the GDP (Gross Domestic Product) of this country.

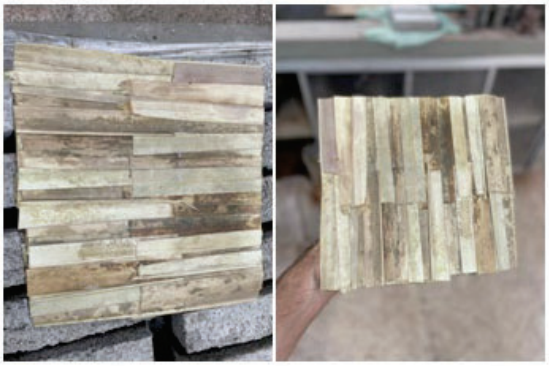

Figure 7: *Samples of completed babassu leaf fiber boards.*

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