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THE INFLUENCE OF SURFACE TREATMENT ON THE MOISTURE ABSORPTION OF COCONUT SHELL FIBER

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Abstract

The use of vegetable fibers as raw matter in the production of consumption goods is an interesting alternative when treating of renewable, light, recyclable and biodegradable resources and mainly of low cost (Satyanarayana - 2000). In Brazil, this important alternative is highlighted as it is a country of great territorial extension with an abundance of vegetable fibers which are not put to rational use. However, the implementation of values in relation to a fiber being used in an appropriate way for a given application is greatly related to the knowledge of its properties.

In this study, the variation in the moisture percentage of the coconut shell fiber was analyzed through submittance to a number of superficial tests: thermal aging and bath with delayer fire. The coconut fiber in its natural state was considered as a standard parameter. To accomplish a mean, a moisture scale was used with a resolution of 0.01 g and difference of 0.7%. Six samples of natural fiber, five of aged fiber and four of delayer fire fiber were used. All of the samples weighed 10 g and were exposed to the temperature of 378 K during periods that varied from 10 to 35 minutes. The test development procedures were specified by equipment manufacturer and took place in the Materials and Fuels Laboratory of UFPB - João Pessoa – PB/Brazil. As a result, conclusions and findings were established.

***Keywords*:** Vegetable fiber, moisture, physic property, surface treatment.

1. Introduction

The knowledge of the properties of the materials is the base of the formation of criteria in choosing a determined application or use (Mendes – 2003). Besides the capacity of the technological transfer, the demand of environmental, economical and social needs request that the new materials can fullfil these requirements.

However, the technological innovations should be within social reach making it possible the all, in a general way, to enjoy the benefits of the researches intentions. To research means to look for alternatives within the challenges that the researcher intends.

Along these lines of reasoning, we have highlighted the importance of the use of vegetable fibers as reinforcement in the production of composite materials. One of the great advantages of this application type is in the environmental preservation aspect, seeing as the discarded fibres are easily re-absorbed by nature through the decomposition process.

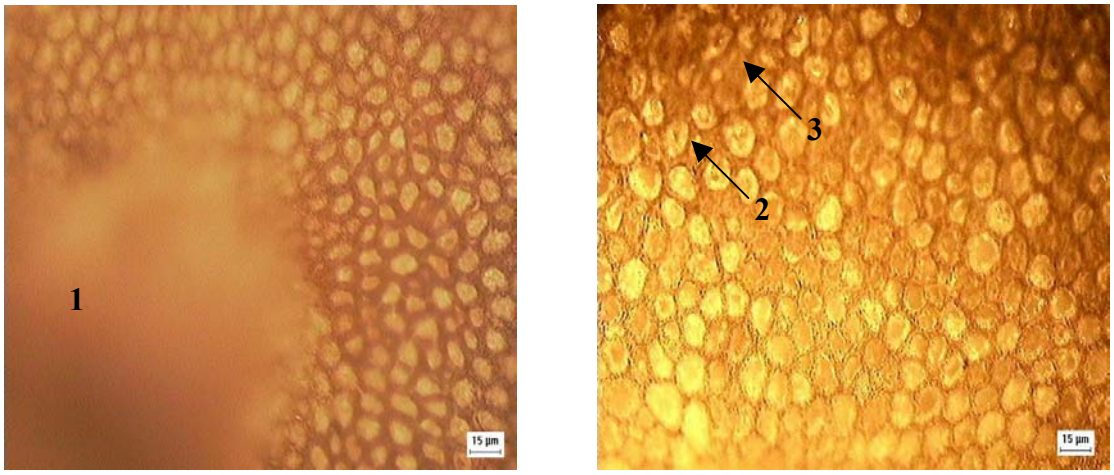
This study dares to explore the characteristics of a raw matter in abundance, of low cost, light, easily processed and that can be used in the production of components for the automotive industry, in the civil construction, in the production of domestic utensils amongst others, giving a new insight and aspect to the application of composite materials (Chou–2000).

The objective of this work is to verify moisture absorbed of the fiber, in relation of the surface treatment of which the fiber was submitted.

2. Methodology

2.1. Raw Material

As analysis material, coconut fiber was used (coconuts nucifera linn) in its dry natural state, found in the municipal district of São José de Mipibú–RN/Brazil. The fibers presented respective diameter and length oscillating between 0.3 to 0.6 mm and 150 to 230 mm. The extraction of the shell`s fibers and cleaning was done manually (Mendes – 2000).The Figure 1 show aspects of the transverse section of the fibers.



(a) (b)

Figure 1. Coconut fiber section (Optical microscope 500x).

1. Central gap; 2. Cell; 3. Celular interface

2.2. Delayed Bathing in Solution

For the bathing in solution test a delayer fire was used in proportion of 320 g/l. Phosphoric solution was added as catalyst in the proportion of 25 g/l. These proportions and procedures were indicated by the manufacturer. The fibers were then bathed in the solution for 30 (thirty) minutes. Next, they were dried off (in a stove) at a temperature 423 K for 5 (five) minutes. Finally, the fibers were washed in solution of hot water (323 K) with carbonate of sodium in order to neutralize excess acidity.

2.3.Thermal Aging

The process of thermal aging consists in submitting the material to a heat source for a period of time, and comparing its behavior in relation to the behavior of the natural fiber. The experiment was undertaken in accordance to the regulations NBR 6104 of ABNT, and therefore the samples were submitted to temperatures of 383 K in a stove under forced convection for a period of 30 days, totaling 720 hours of continuous heating.

2.4. Absorption Analysis

To determine the moisture percentage contained in the coconut fiber, a moisture scale was used with a resolution of 0.01 g and difference of 0.7%. The necessary procedure for the experiment was undertaken in accordance to the manufacturer's manual and consisted in establishing an initial weight of approximately 10 (ten) grams of analysis material, after heating, once exposed the a temperature of 378 K for intervals of 10, 15, 20, 25, 30 and 35 minutes. Having elapsed these intervals of time, a resonant sign indicated the end of the experiment where through a view finder relative values showed the initial weight of the sample, final weight of the sample,% of final solid,% of removed moisture, work

temperature and the period of duration of the experiment. The samples were previously exposed in an enclosure to a relative moisture strip of 60 - 80%. The temperature of the enclosure was of 296 K and the relative moisture of 50 - 65%.

Figure 2. Balances for determination of the moisture.

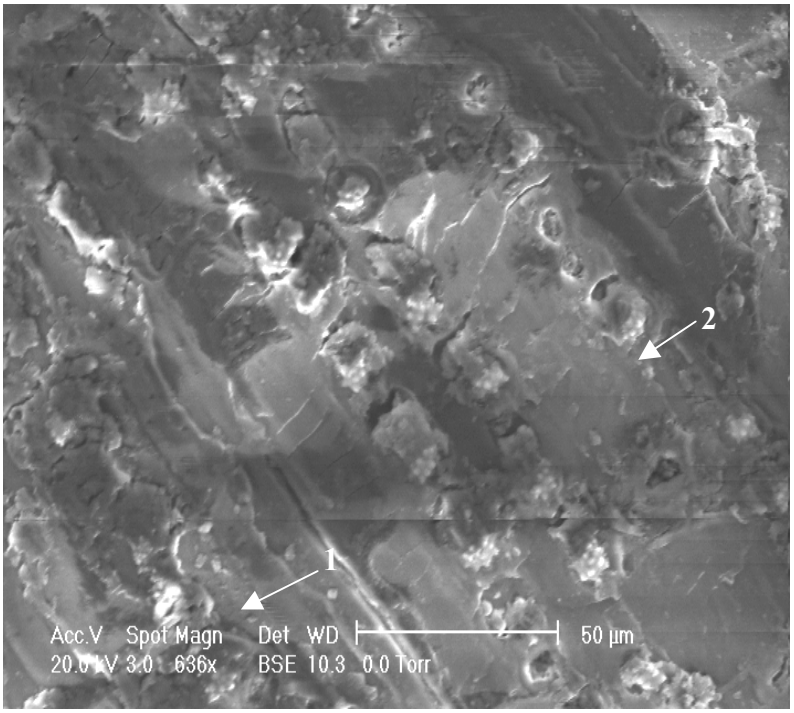
3. Results and discussion

The results of the absorption analysis experiments, where contained moisture of natural coconut shell fiber, thermally aged coconut shell fiber, and bathed in solution shell fiber were compared can be observed in the Tab. 1 and the Fig. 5.

Table 1. Moisture contained in the fiber of the coconut and in some materials.

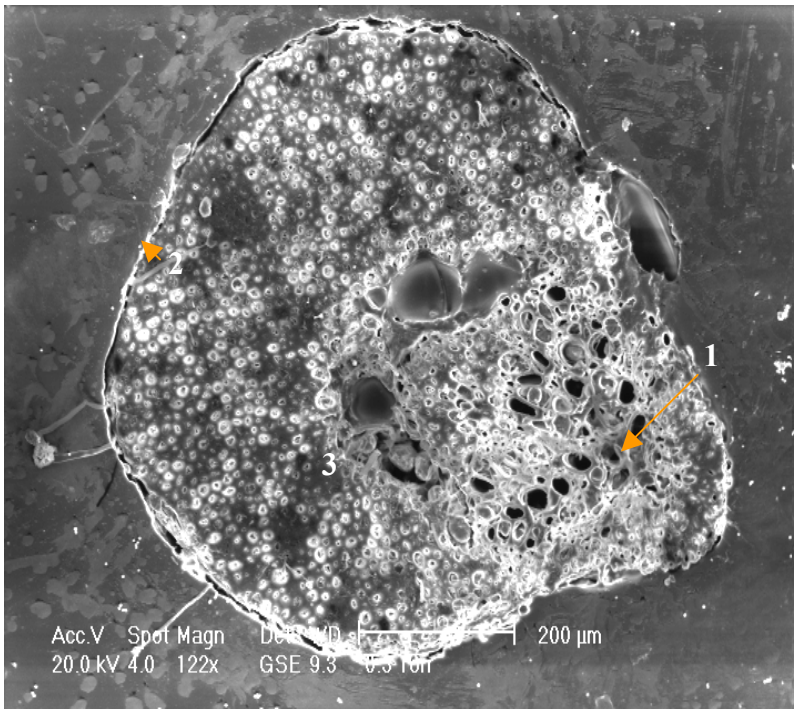
Material	Natural Fiber	Thermally Aged Fiber	Delayer Fire Fiber	Latex	Poliul Foam	Glass Wool
Moisture (%)	12 - 14	8.9 – 10.3	22.2 – 22.8	2.6 – 2.8	3.258	0.124

Table 1. shows an approximate reduction in 26% of the contained moisture in aged fiber in regards to contained moisture in natural fiber. This reduction is associated to the natural contraction of the matter when submitted to a dehydration process, inducing a decrease in the fiber`s pore diameter, lumen and central gap, consequently decreasing the absorption area. Fig. 3 and Fig. 4.



1. Celular interface; 2. Protuberance.

Figure 3. Detail superficial of the coconut fiber (Scanning Electron Microscopy - SEM 636x).



1. Pore; 2. Cell; 3. Central gap.

Figure 4. Traverse Section of the coconut fiber (Scanning Electron Microscopy - SEM 122x).

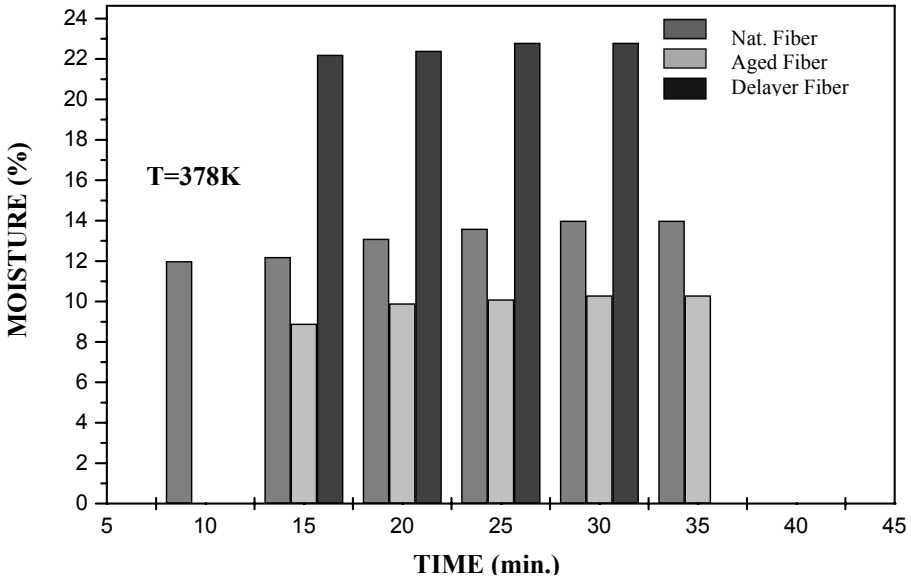


Figure 5. Removed moisture of the fibers x time of exhibition

With regards to the bathed in solution fiber with delayer fire an increase in approximately 73% of the contained moisture was shown when compared to the contained moisture in natural fiber, associated to an observed swelling of the fibers after bathing, consequently increasing the superficial area of absorption.

It is evident through the results that the influence of the superficial treatment upon the fibers moisture absorption, results in differential values depending upon the type of treatment that is applied. In spite of the thermally aged fiber presenting lower contained moisture, this treatment also induced reduction in the fiber`s flexibility, which is not recommended for certain applications. Whereas the fiber with delayer fire, excessive moisture was observed, inducing an increased thermal conductivity and a decrease of useful lifespan due to the probable proliferation of fungus on its surface.

As a conclusion, the natural fiber, which did not suffer any superficial treatment, presents the most appraised characteristics (humidity, flexibility, cost) and more favorable conditions for same applications.

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