Evaluation of Mechanical Properties Through the Nondestructive Test in Polymer Composites Reinforced by Natural Jute Fibers

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1.Introduction

The development of sustainable materials has been investigated to reduce environmental impacts related to global warming. At first these materials from renewable sources can be found in great abundance in nature and are an excellent alternative for artificial fibers derived from petroleum applied to fiber reinforced composites. In addition, vegetable fibers have a great potential for application in the automotive, civil construction and textile industries, which is an important factor in reducing energy costs and weight of components in addition to by generating a recyclable and non-toxic product [1-3].

Natural fibers are produced in several countries and increase the social character in their cultivation. Although Brazil is a country with natural resources available, large areas of planting and various species of plants, the country is not among the first to develop sustainable technology, but can take the lead in developing these materials. For example, several projects are in progress in the Amazon region and in the Northeast that cultivate these plants, taking into account environmental and economic sustainability [4,5].

In this context, natural fibers of lignocellulose origin (jute, sisal, banana) are used as a reinforcing element in thermoset epoxy composites, among the vegetable fibers, jute is one of the most used fibers due to its low density and excellent mechanical properties.

Hart-Smith et al [6], investigated the influence of defects on shear stress transfer in composites. Ramesh et al [7], investigated the effect of orientation and proportion of hybrid composites containing glass fiber, sisal and jute on the polyester matrix, and the results showed that orientation and proportion influence the mechanical properties and water absorption. De Rosa et al [8], investigated the post-impact residual properties of hybrid composites containing glass fiber and jute, and the results show that NDT (Nondestructive testing) techniques provide means of comparison to determine areas damaged by impact. Poudel et al [9], studied different methods of repair in composites applied in the aerospace industry, and the thermographic results identified several patches that contained voids and cracks.

In this work the hand lay up technique was used to make the composites, arranged in the form of a 5-layer. The aim of this study is to investigate the compaction conditions of the layers, through the non-destructive test of thermography to detect the voids and delamination in the polymer and the short-beam test (ASTM D2344), allows to identify the beginning of the delamination and the interaction between fiber and matrix for production of a high quality composite.

2.Results

The results obtained by the tests indicated that the quality of the manufacturing process of the composites directly influences its mechanical properties. The thermographic test showed that regions with defects present a temperature gradient different from the other regions, simplifying the defect mapping process, therefore the decrease in mechanical properties demonstrated in the short-beam test is due to the defect present in the composite [10].

3. Conclusion

The results of the experimental study showed that the thermographic technique validates the location of the defects and the beginning of the composites delamination process, thereby the short-beam test presented better mechanical properties for the composites that presented minimum percentages of defects.

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