70º Congresso Anual
ISSN 1516-392X

PROPRIEDADES DE TRAÇÃO DE COMPÓSITOS DE EPOXY REFORÇADOS COM ALTOS VOLUMES DE FIBRAS DE JUTA*

Anna Carolina Cerqueira Neves[1]
Lázaro de Araújo Rohen[1]
Foluke Salgado de Assis [1]
Luiz Eugênio dos Reis Gomes[2]
Jean Igor Margem[3]
Frederico Muylaert Margem[4]
Sergio Neves Monteiro[5]

Resumo
Fibras naturais estão cada vez mais sendo empregadas como fase de reforço em materiais compósitos com matriz polimérica, pois estas apresentam vantagens ecológicas e econômicas quando comparadas as fibras sintéticas. São fontes renováveis de matéria prima, são biodegradáveis e utilizam menos energia para sua produção. Foram avaliadas propriedades de tração de compósitos de matiz polimérica epóxi reforçada com altos volumes correspondendo a 40% e 50% de volume de fibras de juta contínuas e alinhadas. Os testes foram realizados na maquina universal Instron. A resistência à tração apresentou um aumento crescente com a adição da fase de fibras de juta na matriz.
Palavras-chave: fibra de juta, matriz compósita de epóxi, propriedades de tração.

TENSILE PROPERTIES OF EPOXY COMPOSITES REINFORCED WITH HIGH VOLUMES OF CONTINUOUS JUTE FIBERS

Abstract
Natural fibers are increasingly being employed as a reinforcing phase in composites with polymeric matrix materials is that they have ecological and economical advantages when compared to synthetic fibers. They are renewable raw materials, are biodegradable and use less energy for their production. Tensile properties of composites of polymer hue were evaluated epoxy reinforced with high volume corresponding to 40% and 50% by volume of continuous, aligned fibers of jute. The tests were performed on an Instron Universal Machine. The tensile strength showed a steady increase with the addition of phase jute fibers in the matrix.
Keywords: jute fiber, epoxy matrix composite, tensile properties.

[1] *Graduando(a) em Engenharia Metalúrgica e de Materiais, bolsista de iniciação científica, LAMAV, UENF, Campos dos Goytacazes, Rio de Janeiro, Brasil.*
[2] *Graduando em Engenharia Mecânica, aluno de graduação do Instituto Superior de Ensino do CENSA, ISECENSA, Campos dos Goytacazes, Rio de Janeiro, Brasil*
[3] *Doutor em Ciência e Engenharia de Materiais, LAMAV, UENF, Campos dos Goytacazes, Rio de Janeiro, Brasil.*
[4] *Pós doutorando em Ciência e Engenharia de Materiais, Pós-Doutorando, LAMAV, UENF, Campos dos Goytacazes, Rio de Janeiro, Brasil.*
[5] *Professor PhD, IME, Rio de Janeiro, Rio de Janeiro, Brazil.*

1 INTRODUCTION

In recent decades, environmental issues related to worldwide pollution and climate changes, mainly the global warming, are motivating new paradigms for the development of our society. In the last century, synthetic fibers such as nylon, carbon, aramid and glass fibers gained interest owing to superior strength and precise dimensional control. Natural fibers were then replaced by synthetics in many fields. Natural fibers with vegetable origin, especially lignocellulosic ones, have become very popular for its possible use as reinforcement of polymer matrix composites instead of synthetic fibers, particularly the glass fiber [1-5].
Lignocellulosic fibers as possible substitute for intensive energy-consuming and long term polluting synthetics, specially the glass fiber [6]. A large variety of natural fibers, obtained from cellulose-rich plants, and named lignocellulosic fibers, have been investigated and effectively have applied in engineering composites too [5,7,8]. The lignocellulosic jute fiber has been extensively investigated in several studies, such as polymer composites reinforced by jute [1,9].
Characterization of these composites are being carried out for different polymer matrices and mechanical tests [8,10-19]. It conducted this work tensile test of composite specimens with epoxy DGEBA / TETA matrix reinforced with jute fibers aligned with different percentages in volume 50%-60%, to evaluate their mechanical properties.

2 EXPERIMENTAL PROCEDURE

The jute fiber was supplied by the firm Sisalsul, which commercializes natural lignocellulosic fibers from Brazil. The typical aspect of a jute plantation and a lot of processed fibers are shown in Fig. 1.

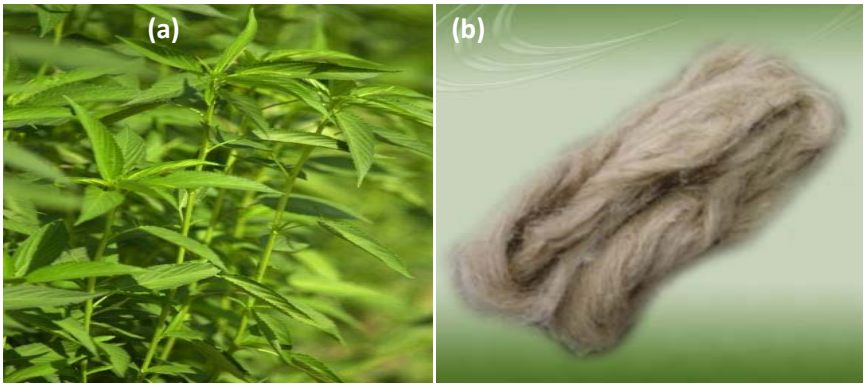

Figure. 1. (a) Typical aspect of jute; (b) bundle of jute fibers used in this investigation.

3 RESULTS E DISCUSSION

Figure 2 exemplifies the typical load vs. extension curves for different composites. These curves were recorded directly from the Instron machine and revealed that the jute fiber reinforced composites apparently present limited plastic deformation. Consequently, these composites, in principle, may be considered as brittle materials

ISSN 1516-392X

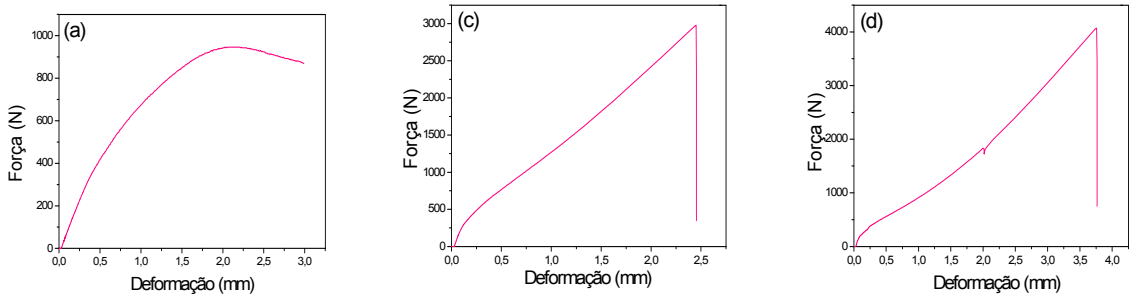

Figure 2. Load *vs.* elongation curves for epoxy composites reinforced with (a) 0%, (b) 40% and (c) 50% of volume fraction of jute fibers.

Figure 3 illustrates the aspect of the ruptured tensile specimens corresponding to each volume fraction of jute fiber considered for composite reinforcement. The rupture become less uniform with increasing amount of fibers. This will be discussed further with the fracture analysis.

Figure 3. Tensile ruptured specimens for each volume fraction of jute fiber incorporated into the epoxy matrix.

From the results of the load *vs.* elongation curves, Fig. 2, the ultimate stress (tensile strength) and elastic modulus were calculated. Table 1 shows the average values for these tensile properties for the different amounts of jute fiber investigated.

Table 1. Tensile properties for the jute fiber reinforced epoxy composites.

Amount of Juta Fiber (vol. %)	***Tensile Strength (MPa)***	***Elastic Modulus (GPa)***
0	31.26 ± 3.28	0.45 ± 0.06
40	62.49 ± 5.66	0.98 ± 0.07
50	68.80 ± 13.86	0.79 ± 0.08

Figure 4 plots the results of tensile strength and elastic modulus in Table 1 as a function of the volume fraction of jute fibers and the variation of the elastic modulus with the volume fraction of jute fiber reinforced with epoxy composites. In this figure it

should be noted that both the composite tensile strength and stiffness significantly increase with the jute fiber incorporated into the epoxy matrix.
In spite of that the stiffness increases when compared to the pure resin, but the composite of 40 % fiber volume showed a higher modulus of elasticity compared to other volume fractions.
These results indicate that the use of jute fibers in epoxy resin composites provides an effective in enhancing the tensile strength of these materials.

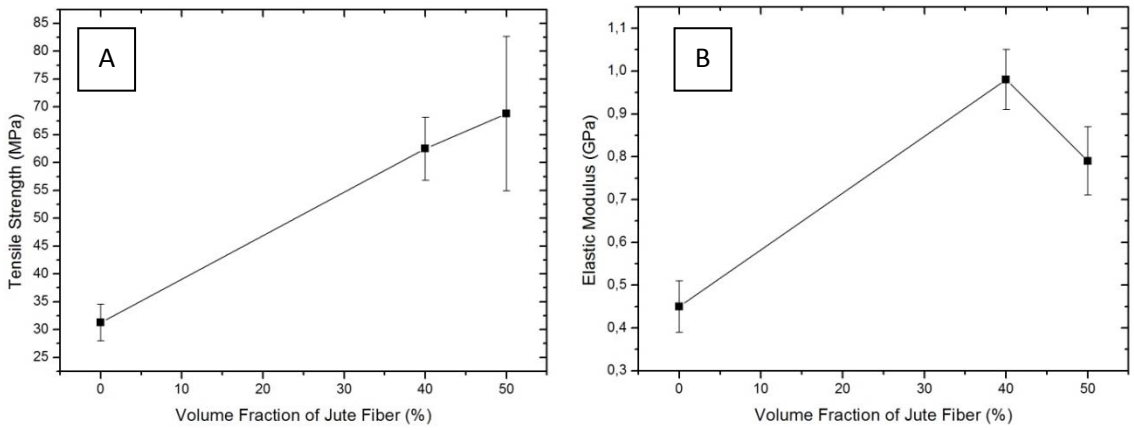

Figure 4 –Tensile strength variation (a) and Variation of the elastic modulus (b) with the volume fraction of jute fiber reinforcing epoxy composites.

4 CONCLUSIONS

- The incorporation of continuous and aligned jute fiber significantly increases the tensile strength and stiffness of DGEBA/TETA epoxy matrix composites.
- An apparent linear increase occurs up to a volume fraction of jute fiber. This corresponds to a better performance than similar composite that were flexural tested.
- Macroscopic evidences indicate that the jute fiber acts as effective barrier for rupture propagation throughout the brittle epoxy matrix, in spite of the weak fiber matrix interface.

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