Mechanical Caracterisation of Glass and Jute/Epoxy Composites

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Résumé

Ce travail étudie les propriétés mécaniques des composites hybrides époxy renforcés de fibres de verre et de jute. Les composites à fibres hybrides, un secteur des composites naturels, répondent à ces exigences. Ces composites sont fabriqués en utilisant la technique de moulage sous vide. La résine MEDAPOXY STR ainsi que le durcisseur HY951 sont utilisés comme liant tout au long de la couche. Les stratifiés en fibre de verre sont placés en surface des deux côtés afin d'avoir de bonnes propriétés mécaniques en surface. La fraction volumique des fibres est de 40% alors que la résine est de 60%. Les résultats des tests montrent que le composite naturel hybride possède d'excellentes propriétés sous traction et en flexion. Les résultats obtenus montrent aussi que l'utilisation des composites hybrides s'avère intéressante et peut être dans certaines applications industrielles un bon compromis permettant de profiter des avantages des fibres naturelles telles que les caractéristiques spécifiques.

Abstract:

This work investigates the mechanical properties of jute/glass fibers reinforced epoxy hybrid composites. Hybrid fiber composites, a sector ofnatural composites meets these requirements. These composites are fabricated using vacuum molding technique. MEDAPOXY STR resin alongside with HY951 hardener is used as the binding agent throughout the layer. Glass fiber laminates are used on both sides for improving the surface finish and surface hardness.The volume fraction of fibers is 40% while the resin is 60% . Test results shows that thehybrid natural composite has excellent properties under tensile and flexural loading. The results obtained also show that the use of hybrid composites is interesting and may be in some industrial applications a good compromise to take advantage of the benefits of natural fibers such as specific characteristics.

Keywords : mechanical properties, mechanical testing, vacuum molding, jute and glass fibers.

1 Introduction

jute fiber is considered to be oneof the most promising materials because of its wide commercial availability in the required form at a low cost. The energy consumption during the production of these fibers is high and is associated with the emission of harmful Volatile Organic Compounds (VOCs) during their implementation. There is currently no economically viable solution for the reprocessing of traditional fiber-reinforced composites at the end of their life without the transfer of pollution. An alternative is to use natural fibers, which are derived from renewable resources, biocompostables end of life, and therefore more environmentally friendly. Thus, by replacing the synthetic fibers with plant environmental impact of the reinforcements. Natural fibers offer promising prospects thanks to their interesting specific properties as well as their biodegradability. To this end, we find some interesting work on natural fiber composites such as those of Baley et al [1, 2] who studied the mechanical properties of composites based on flax fibers, as well as the different methods to improve adhesion between the flax fiber and the matrix. Zitoune et al [3] did work on jute fiber composites concerning their mechanical and structural behaviors under static loading in tension and bending, they found a difference between the mechanical properties in the sense chain and the sense frame. Liang et al [4] are interested in studying the uni-axial tensile and plane shear behavior of the flax / epoxy composite. They observed that the tensile curves consist of two linear parts. The Young's modulus is calculated on the first part of the answer. However, the second linearity represents the behavior until rupture. Charlet et al [5] studied the morphology of natural fibers and the influence of the different variabilities (diameter, origin ...) on the mechanical properties, they showed in particular that the breaking stress and the Young's modulus of Flax fibers from the upper and middle of the stem are higher than those from the fibers from the bottom of the stem. In the end Symington et al [6], and Lamy et al [7] were interested in the effect of different treatments on the mechanical properties of a composite with flax fibers, they found that the different chemical treatments increase the adhesion between the fiber and the matrix and consequently increase of the mechanical properties of these composites.

2 Materials and methods of testing

2.1 Materials

The composite substrate consists of an epoxy laminating system with durcisseur. It is composed of 08 layers stacked, considering several combinations between the folds of jute and glass fibers. three composite plates were elaborated using lay-up molding process according to different proportions of jute and glass fibers.The areal density of fabrics is 265 g / cm² for glass and 216.83 g / cm² for jute.

2.2 Tensile test

The tensile tests were carried out on an Instron model 5980 universal machine. The biasing speed is 2 mm / min. Longitudinal deformation is measured with an extensometer, according to standard NF EN ISO 527-4.

2.3 Flexural test

The bending tests were carried out on an Instron 5980 machine. The geometry of the specimens is carried out according to the AFNOR NF ISO 57-105 standard (equivalent to the ASTMD 790-84a standard).

3 Results and Discussion

3.1 Tensile test

The tensile tests on the various composites presents linear curve for the 0% jute and 50% jute, but for the 100% jute the behaviour is non linear (Fig. 1).

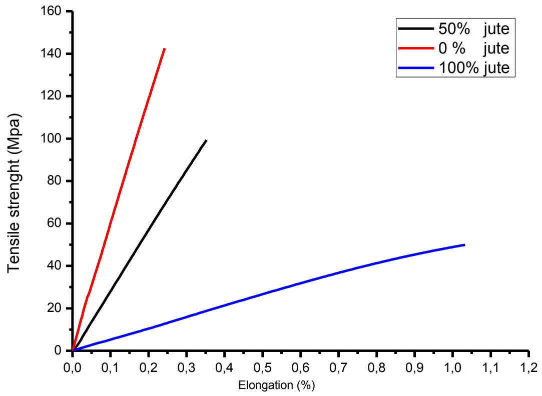

Fig.1. The tensile curves of the various composites.

The experimental properties of tensile testing from a universal testing machine, Young's modulus, tensile strength and elongation at break for different composites and their hybrid composites are shown in the table 1.

composites	Young's modulus (GPa)	Tensile strength σ_r (MPa)	Elongation (%)
0% jute	16.6±0.66	168.66±9.06	3.74±0.29
50% jute	4.86±0.44	71.08±1.08	4.018±0.18
100% jute	2.53±0.28	35.66±1.29	11.03±1.18

Table 1. Tensile properties of composites

Average values of young's modulus, Tensile strength of composite presented in table 1 show an increase in mechanical properties (module of Young, Tensile strength) and decrease in elongation at breaking after the hybridization between glass and jute fibers.

3.2 Flexural test

Figure 2 shows the tensile curves obtained by considering the different composites tested, the curves show a slightly linear appearance except for the 100% jute composite where the curve is completely nonlinear.

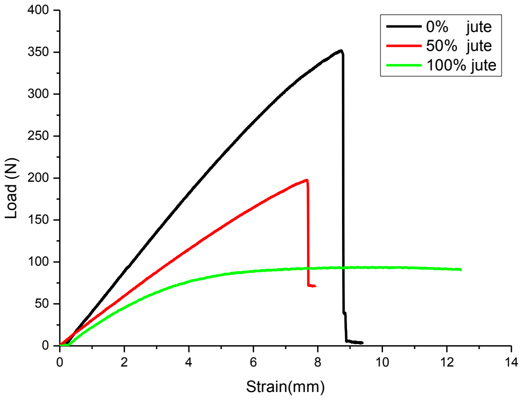

Fig. 2. The flexural curves of the various composites.

Table 2 summarizes the average of flexural properties of jute-glass reinforced epoxy composites.

composites	flexural modulus (GPa)	flexural strength σ_r (MPa)	strain (mm)
0% jute	41.16±3	176.66±23.	3.36±0.5
50% jute	7.39±0.5	89.59±7.2	3.3±0.21
100% jute	2.72±0.4	57.82±8.9	2.72±2.9

Table 2.Flexural properties of the composites

Hybridization between jute and glass fibers yielded an improvements in mechanical properties such as flexural modulus and flexural strenght. This improvement in flexural properties after the hybridization of the two fibers leads to high capacity in front of the shear and compressive strength.

4 Conclusion

This work consists first of all in developing plates made of thermosetting matrix composite materials (epoxy) reinforced with vegetable fibers of jute and glass,while varying the proportions of each of the two fiber types. tensile and flexural properties of jute fiber composites are increased with the addition of glass fibers. The mechanical properties of the fabricated hybrid composites were found to increase substantially with increasing glass fibers proportion.

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