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TIRE RUBBER/SISAL FIBER COMPOSITES: EFFECT OF THE CHEMICAL TREATMENT AND FIBER LENGTH ON VISCOELASTIC PROPERTIES

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Introduction

Economical recycling of used tires and utilization of new materials from renewable resources are a great challenge today. However, few studies have been done on using powdered tire rubber for composites [1-3]. In this work, the effects of fiber treatments (mercerization and acetylation), fiber length, and temperature on the mechanical and dynamic mechanical properties of tire rubber/sisal fiber composites were studied.

Experimental

The sisal fibers used in this work were from the variety *Agave sisalana.* Borcol Ind. de Borracha Ltda (Sorocaba, S.P., Brazil) supplied the powdered tire rubber having 320 μm average particle size. Sisal fibers were washed in distilled water at 80 ± 2 °C for 1 hour. The washed sisal fibers were mercerized with 5% NaOH at 80° C for 5 hours. Acetylation treatment has done according to methods reported by Chand *et al.* [4]. Randomly oriented composite sheets were prepared by hot-press molding at 10.000 kgf, at 200 °C for 3 hours [3]. The viscoelastic properties were measured at a frequency of 10 Hz and at a heating rate of 1 ºC/min using Rheometric Scientific DMTA IV. Mechanical properties were obtained according ASTM D 412.

Results and Discussion

Mechanical and dynamic-mechanical properties of tire rubber/5% with raw sisal fiber composites having different fiber lengths are shown in Figure 1. The composite performance reaches its maximum value when the fiber length is 10 mm and decreases with longer fiber, probably because of fiber entanglement. At greater fiber length, fiber dispersion in the rubber matrix becomes very difficult. The influence of fiber length indicates that 10 mm is the length critical in obtaining maximum dynamic moduli and optimal mechanical properties.

The mercerization/acetylation treatment of the fibers improved the performance of the composites, Figure 2 and Table 1. The storage modulus of mercerized/acetylated treated composites were higher than those of the raw and mercerized treated composites. This is due to the improved fiber/matrix interface adhesive joint.

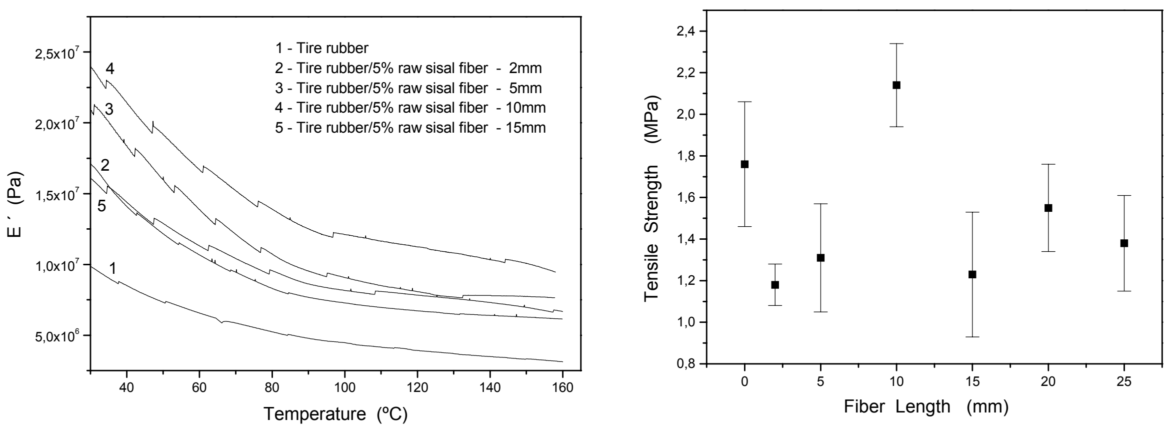

Figure 1 – Storage tensile modulus (E´) vs. temperature (ºC), frequency 10 Hz, and tensile strength for tire rubber/5% raw sisal fiber composites with different fiber lengths.

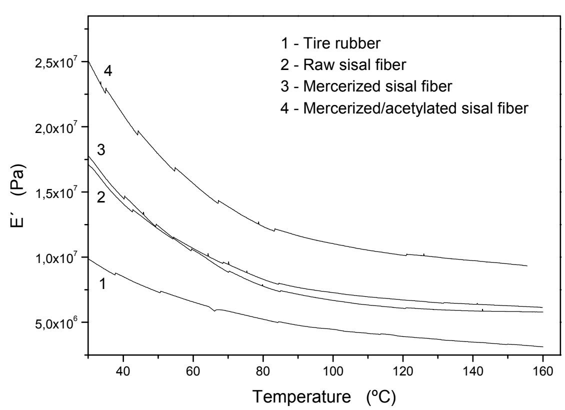

Figure 2 – Storage tensile modulus (E´) vs. temperature (ºC), frequency 10 Hz., for tire rubber/sisal fiber composites.

Table 1 - Mechanical properties for tire rubber/sisal fiber composites. A=Tire rubber, B=Tire rubber/raw sisal fiber, C=Tire rubber/mercerized sisal fiber, D=Tire rubber/mercerized-acetylated sisal fiber composites.

	Modulus (MPa)	Tensile strength (MPa)	Elongation (%)
A	5,0 ± 1	1,76 ± 0,3	57 ± 6
B	13 ± 2	2,24 ± 0,3	53 ± 8
C	12 ± 6	2,39 ± 0,3	48 ± 14
D	11 ± 2	2,70 ± 0,4	60 ± 7

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