11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Stiffer Polyethylene Composites Reinforced with Jute Fabrics

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Abstract –This paper presents the characterization of the flexural modulus of continuous and aligned jute fabrics obtained from both new and used sackcloth, up to 40 wt %, incorporated into recycled polyethylene composites. These environmentally friendly composites were bend tested and the fracture surface analyzed by SEM. The fabric from the new sackcloth showed greater damage tolerance than that from the used one. In general, the flexural modulus increased steadily with increasing jute fabric content up to 20-30 wt.%, a result that could be explained using fractographic studies on ruptured specimens.

Sackcloth made of jute fabric is used around the world to store and transport staples such as potato and cotton. With continuous use the sackcloth frays out and is thus regarded as a waste. Is this case, the sackcloth is disposed as garbage or burnt, which contributes to local pollution as well as to the emission of greenhouse gases responsible for global warming. The possibility of using the fabric from jute sackcloth as composite reinforcement would be a proper environmental solution [1].

In this work, environmentally friendly composites with recycled polyethylene (PE) matrix reinforced with different amounts of continuous and aligned jute fabric pieces, sectioned out from either new or used sackcloth, were investigated for their stiffness measured by the flexural modulus. Composites were fabricated by thermal compression molding at 160^{o}C with amounts up to 40 wt.% of both new and used jute fabrics. Rectangular 114x25x10 mm specimens were three-point bend tested according to the ASTM D 790 norm. The fracture surface was analyzed by SEM after gold sputtering the samples.

Figure 1 shows the variation of the flexural modulus for the PE composites with the amount of jute fabric. The relatively lower values for the used jute fabric composites can be explained by the existence of weaved damages. In fact, a damage model proposed by Godfrey and Rossetos [2] permitted to determine the damage tolerance parameter, $\hat{p}_u$, which is 1278 for the new and 491 for the used jute fabric. This indicates that the used jute fabric has smaller damage tolerance and, at least partially, could be a reason for composite reinforced with new jute fabric, Fig. 1, to be stiffer than those with used jute fiber.

Figure 2 presents SEM micrographs of the ruptured surface of PE composites reinforced with 30 wt.% of (a) new and (b) used jute fabric. In both cases, a massive participation of jute fibers from the fabric yarns is evident. Moreover, fibers in the interlaced fabric are well adhered and hold firmly the PE matrix. This contributes to the increase in the flexural modulus, Fig.1, with the amount of reinforcing jute fabric in the composites. The more heterogeneous aspect of the fibers and corresponding yarns in the used fabric composite, Fig. 2(b), as compared to that of the new jute fabric composite, Fig. 2(a), is apparently associated with pre-existing weave damage in the former and corroborates the results in Fig. 1.

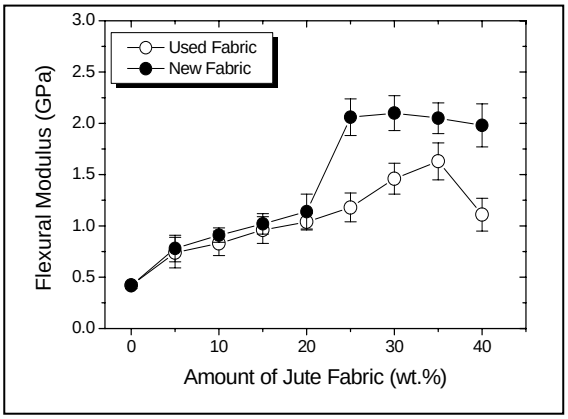

Figure 1: Flexural modulus of recycled polyethylene composites as a function of the amount of jute fabric.

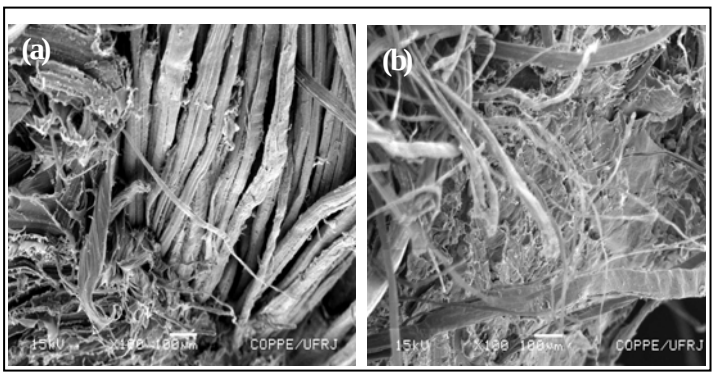

Figure 2: SEM micrographs of the fracture surface after bend test of PE composites with 30 wt.% of (a) new and (b) used jute fabric.

References

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