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Sisal fiber reinforced high density polyethylene pre-preg for potential application in filament winding

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ABSTRACT

A thermoplastic-penetrated natural fiber belt was developed for potential application in filament winding. Discontinuous sisal fiber bundles were impregnated with high density polyethylene and then connected into continuous pre-pregs via hot-pressing. The interfacial bonding was improved by treating the fibers with sodium hydroxide (NaOH) and three types of coupling agents ($\text{NH}_2\text{C}_3\text{H}_6\text{Si}(\text{OC}_2\text{H}_5)_3$, $\text{C}_2\text{H}_3\text{Si}(\text{OC}_2\text{H}_5)_3$ and $\text{C}_{51}\text{H}_{112}\text{O}_{22}\text{P}_6\text{Ti}$). Tensile properties of the fiber bundles, pre-pregs, and annular specimens were determined. The fiber surface microstructure and the pre-preg interfacial bonding were evaluated via scanning electron microscopy and Fourier transform infrared spectroscopy. Among the four treatments, 2% $\text{C}_2\text{H}_3\text{Si}(\text{OC}_2\text{H}_5)_3$ yielded the most significant improvement in the tensile properties of the pre-pregs and annular specimens. The fiber bundle was less damaged by the coupling agents treatment comparing to NaOH treatment. When the overlap at the end of the sisal fibers was > 11 mm, the presence of the joint had no effect on the tensile strength of the pre-preg. The pre-preg belt containing treated fibers, which was evaluated based on the requirements of filament winding applications, exhibited a high performance.

Keywords: A. Sisal Fiber; A. High Density Polyethylene; A. Pre-preg; B. Interfacial

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