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Effect of silane-modified nanoclay on the wear behavior of a chopped strand mat-epoxy composite

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Abstract
The effect of silane-modified Na^+-montmorillonite (S-MMT) nanoclay on the wear behavior of E-glass chopped strand mat (CSM)/epoxy composite was investigated. The surface of Na^+-MMT was organically modified with 3-aminopropyltrimethoxy silane (3-APTMS). The modified nanoclays were characterized by X-ray diffraction (XRD) analysis. Different weight percentages of S-MMT (1-7 wt.% at a step of 2 wt.%) were dispersed in epoxy using mechanical stirring and ultrasonication techniques. The S-MMT/epoxy nanocomposites were then used to manufacture the multiscale composites using hand-layup route. The friction and wear behavior of composites under dry sliding condition (distance of 1000 m) were investigated using a pin-on-disk wear tester at 20 N normal load. The results showed that at filler content 5 wt.% of S-MMT, wear rate and friction coefficient of fibrous composite were improved significantly. Furthermore, the silanization of Na^+-MMT reduced the wear rate and friction coefficient of final composite compared to that specimen containing the same amount of unmodified Na^+-MMT. In conclusion, this study suggests that the addition of S-MMT nanoclay is a promising method to improve the wear properties of the fibrous composite structures.

Keywords*:* Fibrous composite, Nanoclay, Silanization, Wear rate, Coefficient of friction.

Introduction
Fiber-reinforced polymers (FRPs) are used in a variety of applications because of their excellent properties, such as low density, excellent specific strength and stiffness, high fatigue and corrosion resistance, and easy to fabricate [1]. Fibers are usually embedded to the polymeric matrix in the form of continues (unidirectional and woven cloth) [2,3] or discontinues (chopped fiber and random mat) [4,5].
Using nanoclay particles as filler within the polymeric matrix has attracted considerable attention due to the improved mechanical, thermal and physical properties of the resultant material. In recent years, intensive research efforts have been devoted to the study of the response of nanoclay-reinforced polymers to various loads (tensile, compression, bending and impact). It is believed that the effect of nanoclay particles on the mechanical properties of the polymers is considerable [6,7]. The improvements are due to the high surface-to-volume ratio of the nanoclay particles.
It is well known that the mechanical properties of nonoclay-enhanced polymeric composites are significantly affected by dispersion quality of nanofillers in the matrix [8,9]. One should take into