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Reinforcing Effects of Natural Micro-Particles on the Dynamic Impact Behaviour of Hybrid Bio-Composites Made of Short Kevlar Fibers Reinforced Thermoplastic Composite Armor

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Abstract : Hybrid bio-composites are developed for use in protective armor through positive hybridization offered by reinforcement of high-density polyethylene (HDPE) with Kevlar short fibers and palm wood micro-fillers. The manufacturing process involved a combination of extrusion and compression molding techniques. The mechanical behavior of Kevlar fiber reinforced HDPE with and without palm wood filler additions are compared. The effect of the weight fraction of the added palm wood micro-fillers is also determined. The Young modulus was found to increase as the weight fraction of organic micro-particles increased. However, the flexural strength decreased with increasing weight fraction of added micro-fillers. The interfacial interactions between the components were investigated using scanning electron microscopy. The influence of the size, random alignment and distribution of the natural micro-particles was evaluated. Ballistic impact and dynamic shock loading tests were performed to determine the optimum proportion of Kevlar short fibers and organic micro-fillers needed to improve impact strength of the HDPE. These results indicate a positive hybridization by deposition of organic micro-fillers on the surface of short Kevlar fibers used in reinforcing the thermoplastic matrix leading to enhancement of the mechanical strength and dynamic impact behavior of these materials. Therefore, these hybrid bio-composites can be promising materials for different applications against high velocity impacts.

Keywords : hybrid bio-composites, organic nano-fillers, dynamic shocking loading, ballistic impacts, energy absorption
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