

Natural fiber reinforced biodegradable polymer composites for automotive applications

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There is growing interest in the use of natural fibers as reinforcements for biodegradable polymers because natural fibers have the functional capability to substitute glass fibers that are currently being used in the industry today and also have advantages such as low cost, high specific strength and modulus, low density, ease of fiber surface modification, relative non-abrasiveness, and wide availability. Recently natural fiber reinforced composites (NFC) gain widespread acceptance in the USA automotive industry for door panels, seat backs, headliners, package trays, dashboards, and trunk liners, etc. Due to the ability of natural fibers to provide stiffness enhancement and sound damping at lower cost and density than glass fibers and mineral fillers, in the USA more than 1.5 million vehicles are the substrate of choice for natural fibers such as kenaf, jute, flax, hemp and sisal and thermoplastic polymers such as polypropylene (PP) and polyester. Natural fiber reinforced PP or natural fiber reinforced polyester composites are not sufficiently eco-friendly because of the petroleum-based source. Due to these traditional polymers are becoming more expensive automotive manufacturers are turning to NFC's. Furthermore, rising oil prices and increased activity with regards to environmental pollution prevention have also catalysed the research and development of biodegradable polymers. Natural fiber reinforced renewable resource based laminated composites were prepared from biodegradable poly(lactic acid) (PLA) and untreated or surface-treated kenaf fibers and bamboo fibers by compression molding using the film stacking method. PLA is well known for its highly biocompatible and biodegradable character and has received considerable industrial attention for use as commodity resins, able to replace petrochemical-based polymers, e.g., PP. PLA has better mechanical properties than PP. It was possible to prepare natural fiber reinforced PLA composites by compression molding in nearly the same way as PP. Bamboo fiber reinforced PP composites were also processed and compared to bamboo fiber reinforced PLA composites. This study demonstrated that a laminated composite with good mechanical and thermo-mechanical properties could be successfully developed using kenaf fibers and bamboo as the reinforcing agents and PLA as a matrix. The results of the study showed that the coupling agent improves the compatibility between surface treated fiber and PLA resin. The mechanical and thermo-mechanical properties of PLA based composites were significantly higher than those of the PLA matrix itself. This is believed to be caused by improved interfacial interaction, resulting in high flexural stiffness. Surface treated fiber reinforced PLA composites possessed superior mechanical properties to composites made from as-received fibers. The reinforcement of PLA by means of surface treated fibers significantly improves stiffness. It may be concluded that surface treated natural fibers and PLA matrix can be molded into a value added laminated composite material by using the film stacking method. Overall, biodegradable polymer products based on renewable agricultural feedstock can form the basis for a portfolio of eco-efficient products that can compete currently dominated by products based on petroleum feedstock.