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INFLUENCE OF INTERPHASE CHARACTERISTICS ON THE MECHANICAL PROPERTIES OF POLYPROPYLENE / MALEATED POLYPROPYLENE / GLASS FIBER COMPOSITES

G. S. Bollini, M. H. M. Dias, J. A. Sousa*

Materials Engineering Dept., Universidade Federal de São Carlos, Via Washington Luiz Km 235, São Carlos, SP. 13565-905,Brazil.

**Corresponding author:* jasousa@ufscar.br

Improved mechanical performance of short glass fiber (GF) reinforced polypropylene (PP) composites can be achieved by the combined use of adequate GF coupling agents (aminosilanes) with a maleated-PP (PP-g-MAH) interfacial compatibilizer. However, a good balance of properties such as toughness, stiffness and strength depends not just on the interfacial adhesion and average fiber length, but also on the nature of the interphase of PP-co-siloxane copolymer formed at the fiber-polymer interface. The interphase characteristics are dependent on the sizing chemistry applied to the fiber and are also related to the type and content of MAH functionality and molar mass of PP-g-MAH compatibilizer. Thus, several short GF-reinforced PP composites (PP/35% GF) were prepared with varying PP-g-MAH compatibilizer content and the influence of two different types of aminosilane treated GF, one compatible with PP and the other with polyamide matrices, on the mechanical performance of the composites was investigated through tensile, flexural, notched Izod impact and EWF fracture mechanics properties. An optimum PP-g-MAH content, corresponding to the saturation level of PP-co-siloxane copolymer formed at the fiber-polymer interface, was found to maximize the short-term tensile, flexural and impact strengths of both types of GF-reinforced PP composites. The optimum PP-g-MAH content was much lower for the PP-compatible GF (2%) than for the PA-compatible GF (10%) and the fiber reinforcement efficiency of both types of PP/GF composites was found to be limited by the shear strength of the PP matrix. The short-term strength properties of the PP-g-MAH optimized composites were inversely proportional to the mechanical damping tan delta values (DMTA) of the composites and, consequently, proportional to the degree of interfacial interactions. EWF analysis indicates that the specific essential work of fracture is directly related to the degree of interfacial interactions and the modulus of the PP-co-siloxane copolymer interphase, as determined by nanoindentation AFM microscopy analysis.