Effect of Compatibilizers on Surface Roughness, Mechanical, and Thermal Properties of Thermoplastic Composites with High Thermal Conductivity

Silvester Bolka[1*], Teja Pešl[1], Roman Christopher Kerschbaumer[2], Blaž Nardin[1]
Faculty of polymer technology, Ozare 19, 2380 Slovenj Gradec, Slovenia
Polymer Competence Center Leoben GmbH, Roseggerstrasse 12, 8700 Leoben, Austria
**silvester.bolka@ftpo.eu*

In injection moulded gears, friction is one of the most important characteristics, in addition to the size of the parts. Friction causes wear and heating of the gears. One of the most influential factors on friction and hence heating of gears is the surface roughness of the gears. To avoid failures due to heating and friction, thermoplastic composites with high thermal conductivity can be used. In addition to high thermal conductivity, strength and stiffness are also required while maintaining toughness.
In this paper, the in-house produced thermoplastic composites filled with boron nitride are presented. Polycarbonate was used as the thermoplastic matrix due to its low shrinkage. In order to achieve a good combination of thermal, mechanical, and tribological properties, the composites were modified with different types of compatibilizers. In the case of the compatibilizer, two approaches were studied. The first with good interactions with polycarbonate resins to obtain the highest strength and stiffness, the second to obtain the best toughness. Complementary to the mechanical properties, the surface roughness was characterized. In addition, to improving the surface interactions of the filler and matrix, the compatibilizer also affects the thermal conductivity and surface roughness of the injection moulded parts. Various combinations of very high thermal conductivity and lower surface roughness were obtained in the produced composites with the addition of different compatibilizers compared to composites without compatibilizer. Besides the influence on the tribological properties, the differences on the mechanical properties were even more evident. The dynamic mechanical analysis showed very high heat deflection temperatures, but not directly related to the level of the storage modulus. Moreover, the prepared compounds could be a good alternative material for polymeric gears, especially as a combination of gear pairs, due to different combinations of surface roughness, thermal conductivity, strength, stiffness, and glass transition temperature.

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