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Foreign Scholar: Dr. Monika Dobrzynska Mizera

Italian Proponent: Dott.ssa Maria Laura Di Lorenzo

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Final Report

Polypropylene-based composites modified with sorbitol derivatives and siloxane-silsesquioxane resin

In the frame of the International short-term mobility Program for scientists from Italian and Foreign Institutions, during the visit of Dr. Monika Dobrzynska Mizera from April 4 to April 15, 2016 at Istituto per i Polimeri, Compositi e Biomateriali (CNR) in Pozzuoli, polypropylene-based composites containing a sorbitol derivative and a siloxane-silsesquioxane resin were investigated.

Isotactic polypropylene (iPP) is one of the most widely used thermoplastic due to its good mechanical properties, low cost and ease of processing. Nucleating agents are often added to iPP formulation, to attain products with high transparency. Sorbitol derivatives are widely used to fasten crystallization rate of iPP, due to their high efficiency. The addition of sorbitols allows to shorten the cycle time and reduces production cost in injection molding, but may be a drawback in case of extrusion, since a too high crystallization rate limits production of oriented goods. In order to tailor efficiency of sorbitol, a siloxane-silsesquioxane resin containing phenyl functionalities (SiOPh) was mixed to iPP containing also a commercial sorbitol derivative, namely Millad 3988 (DMDBS). The influence of composition on material properties was investigated. It was found that addition of SiOPh allows to attenuate nucleation efficiency of the sorbitol derivative, and tailor crystallization kinetics of iPP. Incorporation of SiOPh into the polypropylene matrix already modified with the sorbitol significantly affects formulation of sorbitol fibrillar network, due to synergistic interaction between active functional groups of both modifiers. This in turn, allows to extend extrusion time since formulation of any ordered and oriented chain segments is delayed. Hence, higher draw ratio enables to produce oriented films and fibers with enhanced mechanical properties. Furthermore, transparency is improved compared to plain iPP. The modified samples are also stiffer, with an increased Young's modulus values upon the addition of sorbitol-based modifier. Hence, combining isotactic polypropylene with sorbitol-based derivative and siloxane-silsesquioxane allows to obtain iPP with enhanced mechanical and optical properties, with a formulation tailored for extrusion processes.

The experimental results detailed above will be disseminated via publication in an international refereed journal, and the manuscript is almost ready for submission.

Italian Proponent

Dott.ssa Maria Laura Di Lorenzo

