EVOLUTION OF HIGH-IMPACT POLYPROPYLENE MORPHOLOGY AND ITS RELATION TO MECHANICAL PROPERTIES

Klára Jindrová[a], Martina Podivinská[a], Alexandr Zubov[a], Miloš Svoboda[b], Juraj Kosek[a,b]

[a]University of Chemistry and Technology Prague; Department of Chemical Engineering
Technická 5, 166 28 Prague 6, Czech Republic
[b]Research Centre New Technologies, University of West Bohemia
Univerzitní 8, 306 14 Pilsen, Czech Republic

Morphology and especially the rubber content and distribution in high impact polypropylene (hiPP) are the crucial factors for the determination of material mechanical properties such as toughness and impact resistance. The final properties are influenced by the size of rubbery droplets and their compatibility with the iPP matrix. The hiPP morphology is affected during each stage of its evolution. During the polymerization, the polymer powder with the semi-continuous rubbery network is predetermined by the replication phenomenon, where the forming polymer particle copies the catalyst architecture and the rubber phase grows on the catalyst fragments distributed in the homopolymer particle. Thus the principally controlling parameters affecting the particle morphology are the catalyst itself, reaction conditions and the rubber content [1]. On the other hand, during the particle melting in the extruder, the phase separation takes place and the final morphology is governed by the rubber composition and molar weight (i.e., by the viscosity ratio between the polymer matrix and the rubber).

The suitable set of accurate characterization methods has to be employed to comprehensively map the heterophase polymer morphology and the appropriate statistical descriptors then allow to objectively describe the polymer overall morphology [2]. For the hiPP morphology mapping, the combination of X-Ray microCT, AFM and confocal Raman microscopy is employed.

This contribution explains the influence of rubber content and composition (i.e., ethylene/propylene ratio) and of various viscosity ratios between the rubber and the polypropylene matrix on the hiPP morphology. The morphology evolution upon thermal treatment including the phase separation was studied for a wide range of melting times and melting temperatures. Finally, the influence of hiPP morphology on its mechanical properties is demonstrated with respect to various rubber characteristics.

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[1] Smolná, K., Gregor T., Buráň Z., Kosek J.: *Formation and Distribution of Rubbery Phase in High Impact Polypropylene Particles.* Macromolecular Materials and Engineering, 2016. **301**(4): p. 390-400.

[2] Smolná, K., Gregor T., Kosek J.: *Morphological analysis of high-impact polypropylene using X-ray microCT and AFM.* European Polymer Journal, 2013. **49**(12): p. 3966-3976.