APPLICATION OF BIO-BASED POLY(BUTADIENE-MYRCENE) COPOLYMERS IN THE SYNTHESIS OF HIGH IMPACT POLYSTYRENE: EVALUATING THE INFLUENCE OF THE TERPENIC UNIT ON THE MORPHOLOGICAL AND MECHANICAL PROPERTIES

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Due to the ongoing climatological crisis, the transition from non-renewable to sustainable materials has become imperative. Consequently, the use of renewable materials to produce biobased polymers has significantly increased. In this context, a diverse group of compounds known as “terpenes” has been studied for their potential as monomeric precursors. Among these, b-myrcene has been successfully (co)polymerized to synthesized rubbers, which with tailored properties can be suitable for applications such as tires, packaging, and impact modifiers in styrenic resins. This study focuses on the application of poly(butadiene-myrcene) as bio-based impact modifier for polystyrene, evaluating the effect of the terpenic unit within the copolymer on the morphological and mechanical properties of the resulting HIPS. The copolymers were synthesized via coordination polymerization at varying myrcene compositions of 20, 35, and 50 wt%, using a ternary catalytic system. These elastomeric copolymers were then used as impact modifiers for polystyrene by polymerizing styrene in a mass/mass process in the presence of the copolymers to produce high impact polystyrene (HIPS). The poly(butadiene-myrcene) copolymers were characterized by Gel Permeation Chromatography (GPC) and Carbon Nuclear Magnetic resonance (^{1}H NMR and ^{13}C NMR). The resulting copolymers exhibited a broad molecular weight distribution and a high molecular weight with a cis-1,4 isomer content greater than 92%. The HIPS were evaluated through tensile, impact and hardness tests to study their mechanical performance, as well as gloss (optical property), morphology (using STEM), flow index (MFI) and dynamic mechanical analysis (DMA). Regarding the morphological properties of HIPS, a decrease in the particle size of the elastomeric phase was observed with increasing myrcene content in the copolymer. Additionally, a lower myrcene content (20 wt%) resulted in a salame morphology, whereas higher terpene content led to a core-shell structure. HIPS incorporating poly(butadiene-myrcene) copolymers as impact modifiers showed high gloss, good toughness and flowability. Furthermore, the HIPS demonstrated increased stiffness (Young's modulus), elongation at break, yield strength and improved flexural strength. The impact strength of the HIPS ranges from 0.44 to 1.22 ft-lbf/in.

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