THERMAL PROPERTIES OF IRRADIATED POLYOLEFIN BLENDS FOR WASTE RECYCLING

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ABSTRACT

This study investigates the influence of gamma irradiation on the thermal properties of polyolefins and polymer blends, aimed at improving polyolefin waste recycling. In addition to binary blends of isotactic polypropylene (iPP) and low-density polyethylene (LDPE), several commercial polymer samples were analyzed, including neat LDPE, neat iPP, iPP containing the antioxidant additive Irganox, red-colored iPP, and black-colored high-density polyethylene (HDPE). The study also aimed to evaluate the influence of pigments and additives on radiation-induced changes in thermal behavior of analysed materials. The investigated iPP/LDPE blends with different compositions and commercial polymers were exposed to gamma radiation using a ^{60}Co source at room temperature in air. All samples were irradiated at absorbed doses of 50, 100, and 150 kGy. Thermogravimetric analysis (TG), differential thermal analysis (DTA), and differential scanning calorimetry (DSC) were used to evaluate radiation-induced changes regarding thermal stability and phase transition behavior. The investigated parameters included melting temperature (Tm), crystallization temperature (Tc), heat capacity (Cp), melting enthalpy (Hm), and degree of crystallinity. DSC results showed a general trend of decreasing melting temperature and heat capacity with increasing radiation dose across the investigated polyolefin systems. These changes are associated with competing mechanisms of polymer crosslinking and macromolecular degradation caused by radiation-induced free radical formation within crystalline and amorphous regions of the polymer structure. The obtained results contribute to a better understanding of the thermal behavior of irradiated polyolefin materials and demonstrate the importance of radiation dose optimization for advanced recycling and modification of polymer-based packaging materials.

Keywords: Gamma irradiation, polyolefin blends, polymer degradation, thermal stability, iPP, LDPE.