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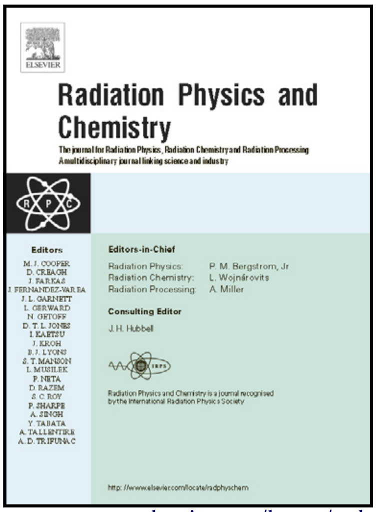

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Effect of Gamma Ray on Poly(lactic acid)/Poly(vinyl acetate-*co*-vinyl alcohol) Blends as Biodegradable Food Packaging Films

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ABSTRACT

Poly(lactic acid) (PLA)/poly(vinyl acetate-*co*-vinyl alcohol) [P(VAc-*co*-VA)] blends as new transparent film packaging materials were prepared at various blend compositions and different vinyl alcohol contents. The blends and pure PLA were irradiated by gamma rays to investigate the extent of changes in the packaging material during gamma ray sterilization process. The miscibility of the blends was dependent on the blend composition and vinyl alcohol content; gamma irradiation had little effect on the extent of miscibility. The glass transition temperature of pure PLA and PLA/P(VAc-*co*-VA) miscible blends reduced after irradiation. On the other hand in PLA/P(VAc-*co*-VA) immiscible blends, while the glass transition temperature of the PLA phase decreased; that of the copolymer phase slightly increased. The reduction in the glass transition was about 10 percent for samples irradiated with 50 kGy indicating dominance of chain scission of PLA molecules at high irradiation dose. The latter was verified by drop in mechanical properties of pure PLA after exposing to gamma irradiation at 50 kGy. Blending of PLA with the copolymer P(VAc-*co*-VA) compensated greatly the adverse effects of irradiation on PLA. The oxygen-barrier property of the blend was superior to the neat PLA and remained almost intact with irradiation. The un-irradiated and irradiated blends had excellent transparency.

Gamma ray doses used for sterilization purposes are usually less than 20 kGy. It was shown that gamma irradiation at 20 kGy had no or little adverse effects on PLA/P(VAc-*co*-VA) blends mechanical and gas barrier properties.

Key words: gamma irradiation; poly(lactic acid); blend; gas permeability

1. INTRODUCTION

Plastics form an important area of global economy. Despite the fact that these polymeric materials are inevitable part of the modern life, however plastic waste is one of the main sources of environmental pollution. An effective way to overcome the problem is development of biodegradable polymers from renewable resources such as poly(lactic acid) (PLA). Although PLA has some desirable properties such as eco-friendly characteristics, high clarity, some properties of PLA such as thermal stability, mechanical properties, and gas barrier properties are inferior to those of petroleum-based polymers. Modification of PLA by copolymerization with other monomers, making composites and nano-composites with various fillers and nanoclay and blending with other polymers are some approaches that have been adopted to improve the properties of PLA (Urayama et al., 2003; Auras et al., 2004; Yu et al., 2006; Lim et al., 2008; Rasal et al., 2010; Park et al. 2003). Blends of PLA with various polymers such as polycaprolactone and thermoplastic starch, polystyrene, polypropylene, polyethylene terephthalate and poly(vinyl acetate-co-vinyl alcohol) have been reported (Biresaw et al., 2004; Chen et al., 2009; Sarazin et al., 2008; Choudhary et al., 2011; Razavi et al., 2012). In previous study we have shown that PLA and (vinyl acetate-vinyl alcohol) copolymer form miscible and immiscible blends depending on the vinyl alcohol