P25. EFFECTS OF BIO-$CACO_3$ NANOPARTICLES AND GRAPHENE NANOSHEETS ON PROPERTIES OF PBAT/PLA FLEXIBLE FILMS TREATED BY IONIZING RADIATION

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Currently, flexible plastic packaging is widely used instead of rigid and semi-rigid plastic packaging. Flexible packaging is in general not recyclable, practically non-degradable, consequently not selectively collected and representing a serious global environmental problem. Therefore, the development of biodegradable flexible packaging can be an important alternative to minimize the quantities of plastic waste material disposed of to landfill throughout the world. The target of this study was to develop flexible film composites based on PBAT/PLA blends reinforced with bio-$CaCO_3$ nanoparticle (30 wt. %) and graphene nanoosheets (0.1-0.2 wt. %). Composite films were prepared using a twin-screw extruder machine and blown extrusion process and treated by gamma radiation at radiation dose up to 25 kGy. The composite films were characterized by mechanical tests, XRD, MVTR, OTR, TG, DSC, FE-SEM and TEM analysis. In addition, the microbiologic tests in order to evaluate the efficiency of ionizing radiation treatment on reduction of the original level of contamination of the composite films were also carried out. The results showed that the incorporation of bio-$CaCO_3$ nanoparticle and graphene oxide nanoosheets in PBAT/PLA Blend drastically improved the mechanical and oxygen barrier properties of PBAT/PLA flexible film. The gain in tensile strength at break due to bio-$CaCO_3$ addition was of about 60 %, when compared with PBAT/PLA blend film. Some tests results of PBAT/PLA reinforced with bio-$CaCO_3$ are presented in Table I. In addition, the incorporation of only 0.1 wt. % of graphene nanoosheets improved the mechanical properties of PBAT/PLA/Bio-$CaCO_3$ flexible film and led to an important gain of the oxygen barrier.

Table I – Results of $CaCO_3$ micro addition on penetration resistance, surface tension, tensile properties, vapor transmission rate (MVTR) and oxygen transmission rate (OTR) of PBAT/PLA blend.

Flexible Films	Penetration resistance (N)	Penetration Distance (mm)	Surface tension (mN/m)	Tensile strength at break (MPa)	Elongation at break (%)	MVTR[(b)] (g/m^2.day) (23°C; 85 % RH)	OTR[(c)] (cc/m^2.day) (23 ° C)
1 [(a)]	3.0	8.2	51.0	7.6 ± 0.4	210 ± 12	142	1117[(e)] 1207[(f)]
2 [(g)]	5.0	7.4	51.3	11.9 ± 0.6	199.9 ± 13	123	962[(e)] 1107[(f)]

(a) 1=PBAT/PLA thickness: 60 µm; *(b) Vapor transmission rate; (c) Oxygen transmission rate; (d)iPLA (5 wt. %) electron-beam irradiated at 150 kGy; (e) 0 % Relative Humidity; (f) 90 % Relative Humidity; (g) 90 % Relative Humidit.; (g) 2=PBAT/PLA/$CaCO_3$; thickness:* 60 µm

References

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