EB energy effect on mechanical properties of Ecovio® irradiated shopping bags

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Background

According to United Nations, "Plastic pollution poses major risks to the environment and human health" In this sense, alternative technologies have been developed to decrease degradation time and to produce polymers from renewable sources in order to reduce significantly the time of permanence in the environment. In this sense, Ecovio® composed of biodegradable aliphatic-aromatic Ecoflex® copolymer and polylactic acid (PLA) has increased applications of use. Besides that, for circular economy pursue nuclear technology can be beneficial by improving recycled post-consumer electron beam processed bags. Advanced research has shown that through irradiation in several different dose ranges, mechanical properties of these polymers and efficiency in the reuse in production process, or above certain radiation absorbed doses, degradability process can be improved. The changes induced by ionizing radiation alter Ecovio® chemical structure, thus modifying their degradation time while improving properties during needed time for farming.

Methodology

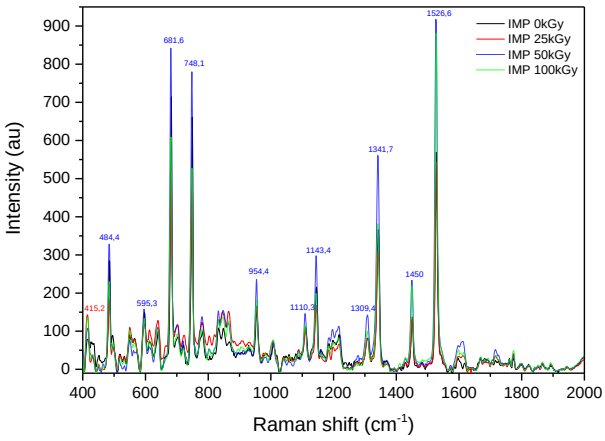
Ecovio®, with 55% PBAT and 45% PLA bags supplied by Romapack, stacked in 10 bags radiation absorbed doses 25, 50 and 100 kGy in Dynamitron electron accelerator (1.5 MeV) and, another set of piled bags EB irradiated in Rodothon® TT200 (10 MeV). Mechanical properties were measured by using a universal test machine (Instron 5567 model) at RT with a load cell of 1 kN. Rectangular (1 × 4 cm^2) specimen. Raman spectra by Horiba JobinYvon, XploRA-PLUS, laser 785 nm, 85 mW, objective 50x, LabSpec6.

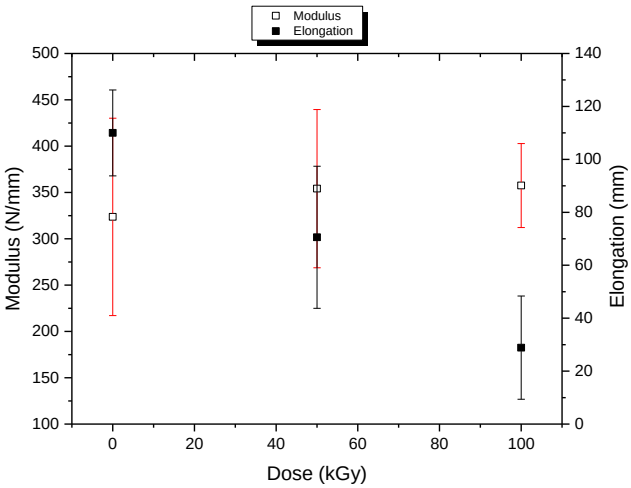
Results

Young´s modulus seem not to be significantly affected by increasing EB radiation absorbed dose of IPEN irradiated bags, by the other side, elongation at break decreased significantly with increasing dose in the range studied. Higher energy EB radiation promoted less variation among tested specimen of the same dose compared to 1.5 MeV EB irradiation. Printed samples showed poorer resistance than without print region. It was possible to observe variation of PLA groups bands by Raman spectra, indicating some degradation must have occurred with increasing radiation absorbed dose.

Conclusion.

It was possible to observe that higher energy of EB (10 MeV) improved mechanical properties of Ecovio® irradiated bags, up to 65-80kGy compared to lower energy (1.5 MeV). All tested samples irradiated with 100 kGy presented poor mechanical properties. This indicates that up to a certain dose of radiation Ecovio® recycled bags could be reused in the fabrication plant maybe of mulch films and, with higher doses, it will favor its biodegradation in soil.


IMP 0kGy
IMP 25kGy
IMP 50kGy
IMP 100kGy
Intensity (au)
Raman shift (cm-1)
415,2
484,4
595,3
681,6
748,1
954,4
1110,3
1143,4
1309,4
1341,7
1450
1526,6


Modulus
Elongation
Modulus (N/mm)
Elongation (mm)
Dose (kGy)