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Synthesis and soil biodegradability of PET-*co*-PLLA obtained by chemical way.

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Abstract – Poly(ethylene terephthalate) (PET) is one of the principal rejects of post-consumer plastics in the world. In face of this, this work presents a study of bulk polymerization of PET post-consumer with poly(acid L-lactic acid) (PLLA) aiming to obtain new aliphatic-aromatics copolyesters (PET-*co*-PLLA) potentially biodegradable in soil by chemical recycling in different weight proportions of PET and PLLA. After the synthesis and characterization of copolymers it was carried out the degradation process in soil. This method showed up adequate to synthesize copolymers of PET-*co*-PLLA and the analysis demonstrated that the raise of PET rate decreases the biodegradability of the copolymers.

The excellent thermal and mechanical properties of poly(ethylene terephthalate) (PET) besides the great chemical stability are indispensable characteristics for their applications. As a result of these properties, the PET is responsible for a great accumulation of this material in landfill sites, causing serious impacts in the environment [1]. In face of this and seeking for a solution, a lot of efforts are being made to developing new ways to reuse the PET post-consumer through mechanical and chemical recycling. In addition, the biodegradable polymers show as an interesting area to reduce the accumulation of plastic waste in the environment. For this reason, the chemical recycling of PET post-consumer with aliphatic polyesters had been studied to help solving this problem [2,3].

Therefore, this work presents a study of bulk polymerization of PET post-consumer with poly(L-lactic acid) (PLLA) aiming to synthesize new aliphatic-aromatics copolyesters potentially biodegradable in soil (PET-*co*-PLLA). The PET post-consumer was obtained from soda packaging which ones were cut in small bits, washed with water and acetone, thereafter dried at 100ºC during 8 hours. The PLLA was obtained by a polycondensation reaction of L-lactic acid in a glass reactor with N_2 atmosphere and mechanical stirring utilizing a straight condenser. The copolymerization was carried up in a glass reactor with N_2 atmosphere and mechanical stirring at 190ºC. Different proportions of PET and PLLA were added among 10 and 90% in weight and the temperature was gradually increased until melting. After that, the additives were added in the fluid mass which was shed in silicone molds.

As a result, this method showed up adequate to synthesize copolymers of PET-*co*-PLLA and it could be confirmed through of ^{1}H RMN analyses. The visual analyses (Fig. 1) and the others analyses as well, demonstrated that the raise of PET rate decreases the biodegradability of the copolymers. The ^{1}H RMN analyses of PET-*co*-PLLA 50/50 show a decrease in the medium molecular weight (M_n) with the time of soil soil biodegradation (Tab. 1), indicating that the copolymer suffered scission of molecular chain.

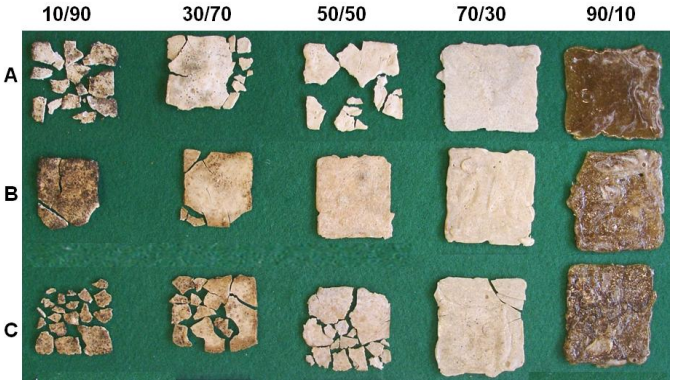

Figure 1: Visual analyses of PET-*co*-PLLA copolymers after biodegradation in soil: A) 15 days; B) 45 days; C) 90 days.

PET-*co*-PLLA (50/50 wt%)	M_n PET-*co*-PLLA (g.mol^{-1})
0 days	4392,70
15 days	2002,56
45 days	1072,92
90 days	766,85

Table 1: M_n of PET-*co*-PLLA 50/50 before and after biodegradation in soil obtained by ^{1}H RMN.

References

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