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POTENTIAL APPLICATION OF NEW BIODEGADABLE CORK COMPOSITES: MORPHOLOGY AND SOIL DEGRADATION TESTS

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KEYWORDS
Biocomposites, cork, degradation properties.

ABSTRACT
Cork is a natural fibre with increasing interest and a high potential of application. Combined with biodegradable polymers may allow the creation of new bio-based cork-polymer composite (CPC) materials. The mechanical, morphology and its biodegradability in soil were investigated. The objective was to create and characterize the new biocomposite materials with the characteristics promoted by cork such as aesthetics, improved stiffness and reduced cost and transfer the developed technology to industrial partners.

INTRODUCTION

Biocomposites consists of biodegradable polymer as matrix material and usually biofibre as reinforcement element (Moanty A.K. et al. 2000). Cork is the bark of an oak tree known botanically as *Quercus Suber L.* that found several applications such as a sealant in wine bottles (Silva, S.P. et al. 2005) or in novel composite materials (Fernandes et al. 2011). Polycaprolactone (PCL) is biodegradable and biocompatible polyester with a potential application from agricultural usage to biomedical field. Due to its high price, PCL has limited applications and blending it with other materials from natural or synthetic origin can solve this problem. PCL mixed with starch (SPCL) lowers its cost and increases the biodegradability. The combination of natural and/or biodegradable polymers with the unique properties of cork can open a wide range of new applications to the market with environmental benefits.

Materials and Methods

Cork with particle size of 0.5-1mm, density of 166 ± 21 kg.m^{-3} was compound with PCL and SPCL, using a twin-screw extrusion system. After that injection molding was used to create tensile specimens bars according to the standard ASTM D 638. The specimens were tested in terms of tensile properties, morphology and soil degradation tests using a soil with organic material >70% and containing 60% of humidity, was monitored during a period of 6 months.

Results and discussion

The table 1 presents the compositions in terms of weight used to process the novel bio-based composites.

Table 1: Composition of the developed bio-composites

Specimens	HDPE (wt.%)	Cork (wt.%)
PCL	100	0
PCL + Ck	70	30
SPCL	100	0
SPCL + Ck	70	30

Mechanical and morphological results (Figure 1 and 2) confirmed that the presence of starch accelerates the biodegradability of the tested materials. The presence of cork promotes stability to the composites and in the presence of starch it acts as physical support of the matrix reducing the degradation rate of the process.

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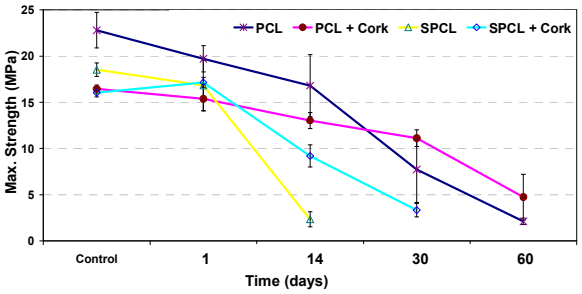

Figure 1: Tensile strength properties of the bio-composites after soil degradation tests during 60 days.

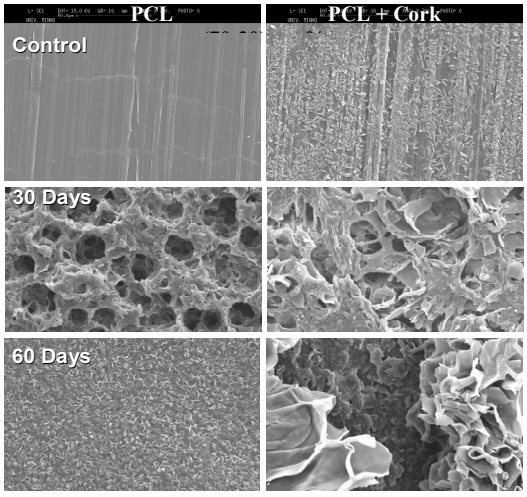

Figure 2: Morphology after soil the degradation tests.

Figure 3: Bio-based cork pellets and scale-up of the final solution with application as biodegradable cap.

As shown in Figure 3 the developed bio-based cork composites with and without 1% of red pigment. The composites present potential to be used as cap in wine closure with improved environmental benefits.

Conclusions

The following conclusions can be made base on the results presented in this work. The mechanical results have shown that the addition of cork improved the stiffness and reduced the tensile strength of the bio-based cork composites. The decrease on the mechanical properties is due to the low interfacial adhesion between cork and the matrix. In terms of soil tests, the starch accelerated the biodegradability off the composites while the addition of cork reduces the biodegradability rate. The morphology of the bio-based cork composites is in agreement with the mechanical properties. Based on this and other studies containing natural materials from renewable resources, the novel bio-based composites comprising cork will open a wide range of innovative applications.

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