

BIO-ADDITIVES IN PLA TO BROADEN ITS USE

Enhancing mechanical properties and flame retardancy using biodegradable additives

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Introduction

PLA, also known as poly lactic acid, is a biodegradable plastic from renewable sources, but its poor thermal qualities have hindered the use of PLA in more industries. By blending in biodegradable additives this study aims to broaden the possibilities of the application of PLA composites. And thus opening doors to a more sustainable future.



PLA filament rolls (left) [1] and a PLA single use packaging container (right)

As of today, PLA is mostly used as a 3D printing filament and a packaging material; It also has some uses in the medical world because it is non-toxic. [2] Good flame retardancy could make PLA usable as a renewable and biodegradable construction material.

Method

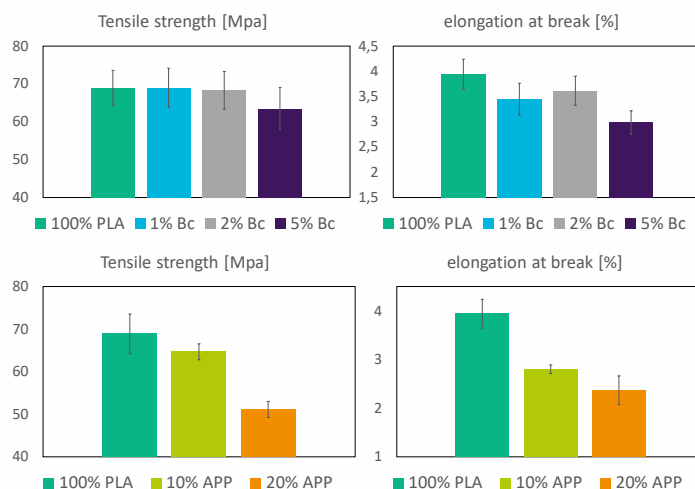
PLA has mostly been mixed with biochar, for its low cost and good biodegradability. A modified version of biochar had also been used, promising good thermal properties. Furthermore, ammonium polyphosphate, a flame retardant commonly used in plastics, has also been blended with the PLA.

Tensile bars have been made with varying compositions. All of these have been tested for mechanical properties such as tensile strength, Young's modulus and elongation as well as thermal properties such as melting- and transition temperature. A flame test has also been performed.



Results

Results from this experiment indicate that biochar gives PLA a lower elongation and tensile strength at higher concentrations. It has no visible effect on flame retardancy.



The addition of APP in PLA raises the Young's modulus in trade of lower elongation and tensile strength. Although these results might not be desirable, the addition of APP does give huge benefits to the flame retardancy of PLA. Samples containing APP don't drip while melting and didn't keep burning after the flame was removed.

Conclusions and further research

The addition of biochar as an additive in PLA makes for a slightly more brittle composite in conjunction with a lower melting temperature and glass transition temperature.

Adding APP into the PLA makes for a weaker and more brittle composite. However, good flame retardancy could redeem these qualities. Further research needs to be done to truly test the effect of these additives for the flame retardancy of PLA.

References

1. Bio Based Press, Ook groene kunststoffen hebben lange aanlooptijden, 2024, www.biobasedpress.com
2. V DeStefano, S Khan, A Tabada, Applications of PLA in modern medicine, 2020, www.sciencedirect.com