Preparation and characterization of Polylactide/biochar composites

Effect of biochar on thermal stability of PLA

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Introduction

Polylactic acid (PLA) is a biodegradable and bio-based plastic that has gained significant attention as a more sustainable alternative to conventional petroleum-based plastics. However, despite its eco-friendly attributes, PLA has limitations in its low biodegradability, thermal and mechanical properties [1].

Our previous work showed that biochar can be used as a filler to improve the modulus of PLA. The objective of this research is to investigate the effect of biochar size on thermal properties of PLA. The aim is to develop a final product suitable for use in the agricultural sector as a replacement for carbon black [2].



Results

Figure 3 shows that the biochar particle size decreased to 1 μ m after ball milling. For wood biochar, the addition of biochar does not affect the thermal stability of PLA, and reducing the biochar size from 32 μ m to 1 μ m did not change the thermal stability of PLA (Figure 4). However, the biochar size has a significant impact on the dispersion of biochar within the PLA matrix, which consequently changes the color of the PLA/biochar composites. PLA/biochar composites with smaller biochar particles exhibited a darker black color (Figure 5).





Figure 1 The three different types of biochar used in this research.

Method

For the process we start to grind the biochar to a smaller particle size.

Second the composite was processed with the extruder. The PLA and biochar are added to the extruder and a composite was made with injection molding.

At last, the composite has been tested for thermal properties using thermogravimetric analysis (TGA).



Figure 4 Effect of biochar particle size on PLA thermal stability



Figure 5 PLA/3 wt% biochar film (left. biochar size: 32 um rihgt. biochar size: 1 um)





Figure 2 The process of preparing and testing the PLA/biochar composite

Reducing wood biochar particle size to 1 μ m via ball milling does not affect the thermal stability of PLA. However, smaller wood biochar particles significantly improve dispersion in the PLA matrix, resulting in composites with a darker black color.

Further research includes investigating the effect of biochar types and amounts on the thermal and mechanical properties of PLA.

References

- 1. PLA composites: From production to properties. M. Murariu and P. Dubois. Sweden 2023
- 2. Effect of carbon-rich biochar on mechanical properties of PLA biochar composites. K. Aup-Ngoen and M. Noipitak. Thailand 2019.







