Effect of biochar on PLA pyrolysis behaviour

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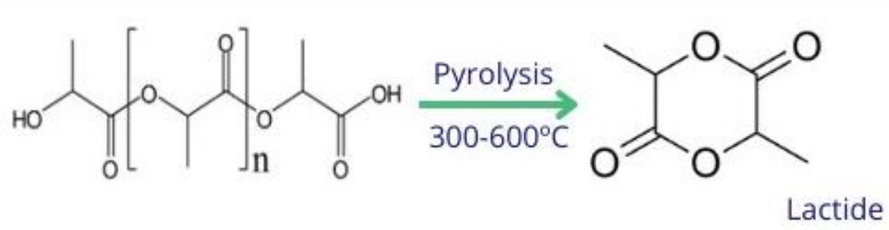
Introduction

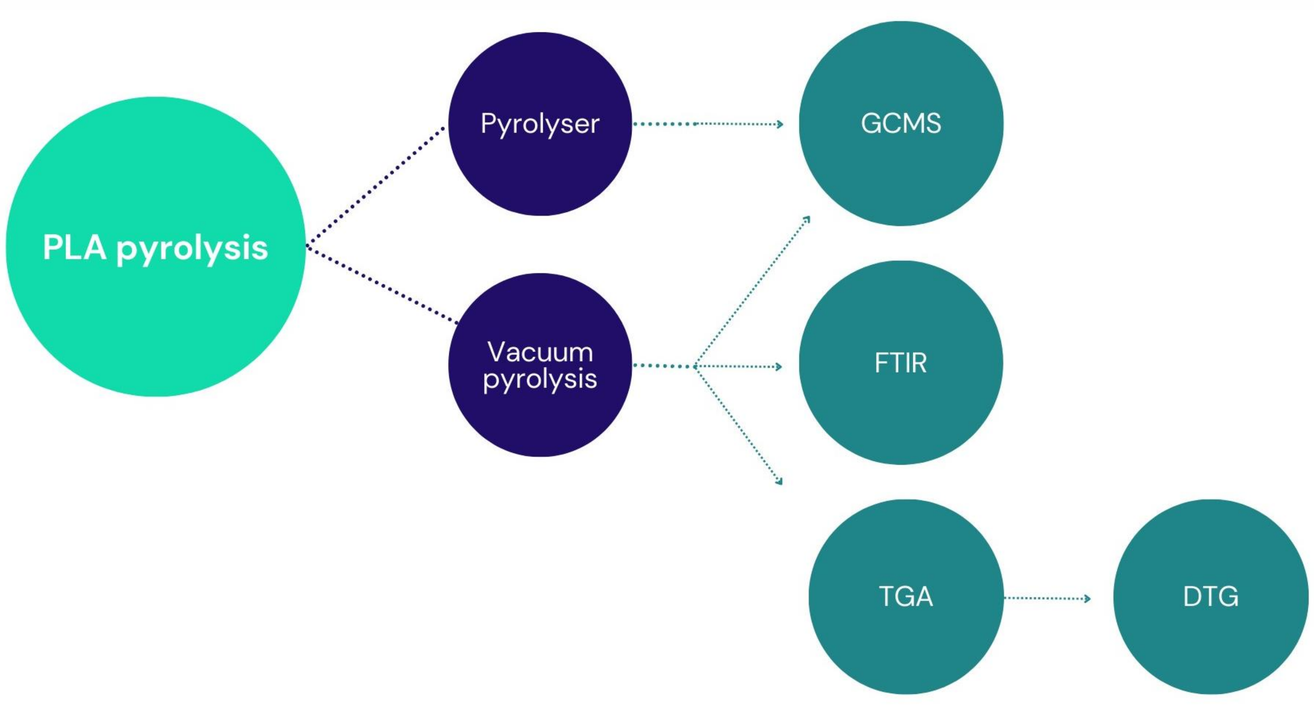
Polylactic acid (PLA) is a bioplastic that presents difficulty on its degradation in natural conditions, so its end of life is studied. The aim of this project is to figure out the best way to recover the monomers, such as lactide. [1]

Pyrolysis is a thermal chemical recycling process which was studied thoroughly and a lot of different tests have been made to deduce the best processing conditions for the degradation of PLA.



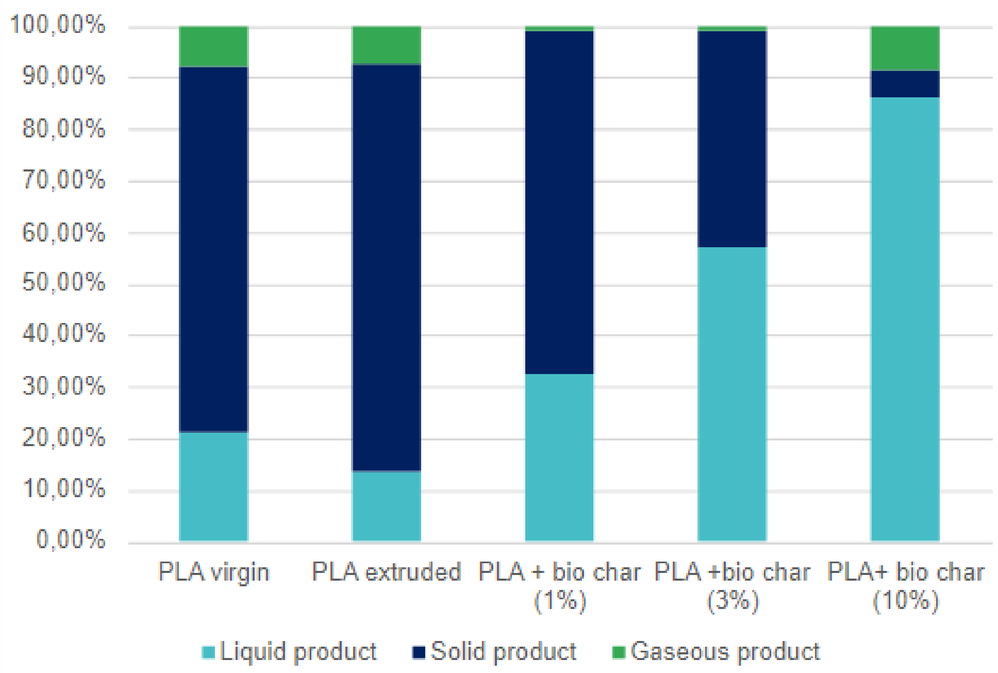
Biochar is a high-carbon, fine-grained solid produced through biomass pyrolysis. With the aim to enhance PLA properties and decrease its degradation temperature, the PLA composite made with biochar is evaluated, such as its behaviour as a catalyst on the degradation. [2]

Methodology



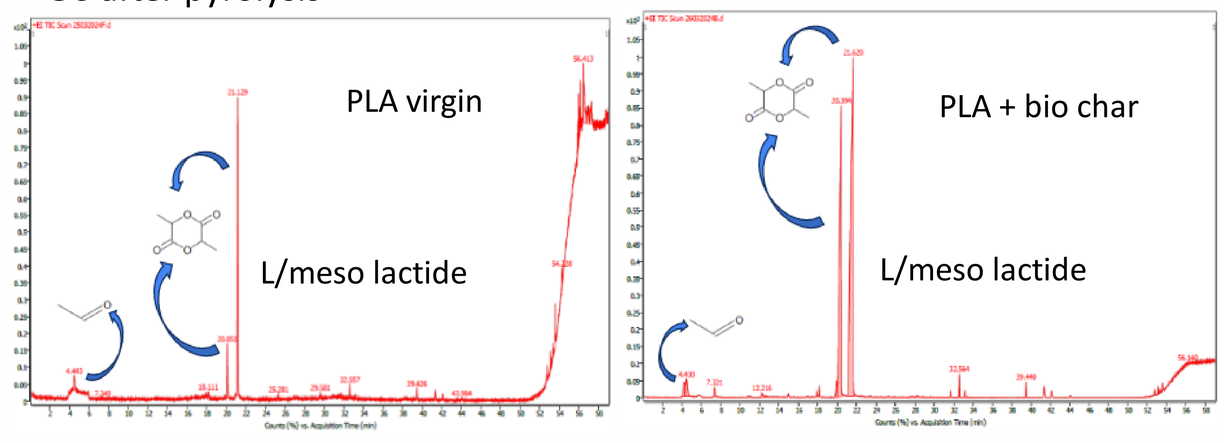
Results

Yield vacuum distillation



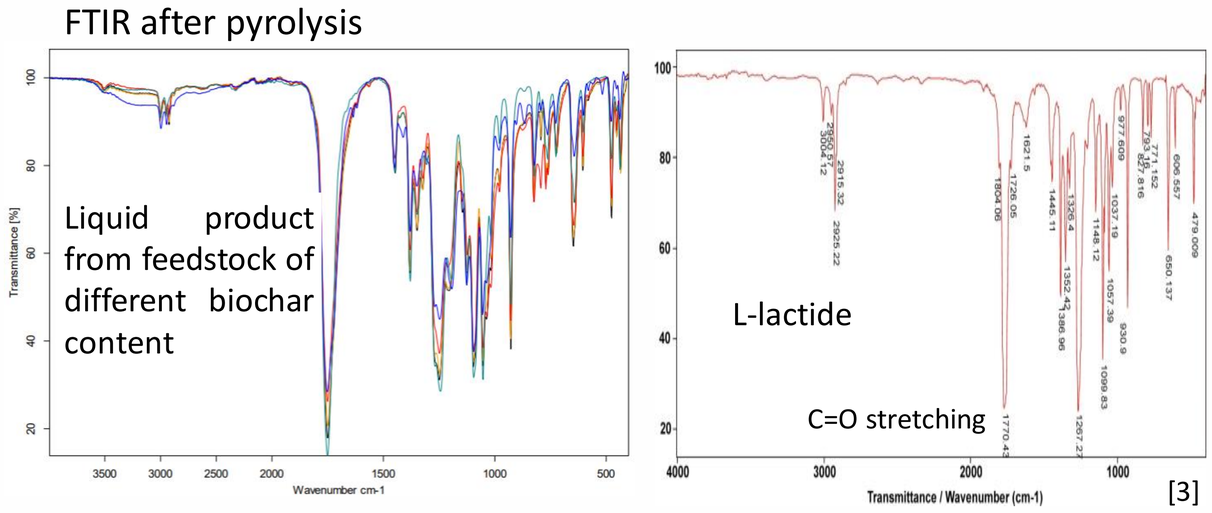
Effect of biochar on PLA vacuum distillation product yield

GC after pyrolysis



Effect of biochar on PLA pyrolysis product distribution and peak intensity

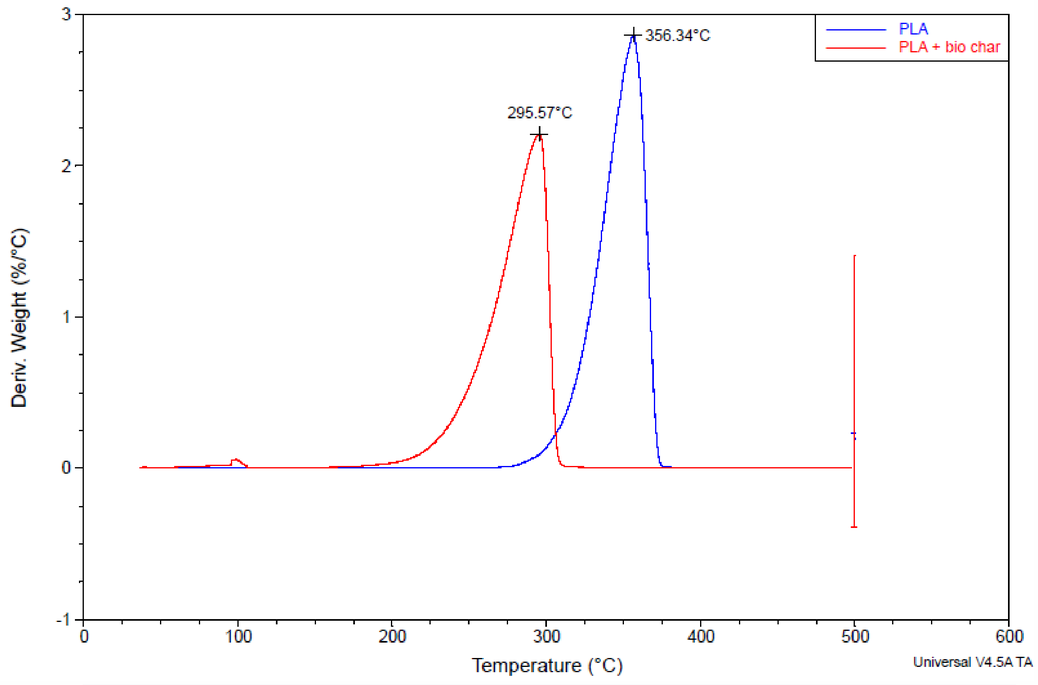
FTIR after pyrolysis



[3]

Comparison between the spectra of the pyrolysis liquid product from feedstock of different biochar content and L-lactide from literature

DTG after pyrolysis



Effect of biochar on PLA degradation temperature

Conclusion

- Thermogravimetric analysis suggests a catalytic effect of biochar on PLA degradation, resulting in decreased degradation temperature compared to pure PLA.
- The results of the vacuum distillation (300 °C, 10 mbar) showed that biochar significantly increases the pyrolysis liquid product yield while reducing the solid yield.
- The main component of the pyrolysis oil is lactide.
- Biochar changes the pyrolysis product distribution, as the peak intensity of lactide increases with its presence.

References

[1] Castro-Aguirre, E., Iniguez-Franco, F., Samsudin, H., Fang, X., & Auras, R. (2016). Poly (lactic acid)—Mass production, processing, industrial applications, and end of life. Advanced drug delivery reviews, 107, 333-366.

[2] Lee, J., Kim, K. H., & Kwon, E. E. (2017). Biochar as a catalyst. Renewable and Sustainable Energy Reviews, 77, 70-79.

[3] Nikolic, L., Ristic, I., Adnadjevic, B., Nikolic, V., Jovanovic, J., Stankovic, M. (2010). Novel Microwave-Assisted Synthesis of Poly(D,L-lactide): The Influence of Monomer/Initiator Molar Ratio on the Product Properties. Sensors.