Polylactide-polyhydroxybutirate blends as bonding agent in multi-layered composites

Eduardo Robles[1], René Herrera[1], Grzegorz Kowaluk[2], Oihana Gordobil[1], Jalel Labidi[1]

[1]Biorefinery Processes Group, Chemical and Environmental Engineering Department, University of the Basque Country UPV/EHU, Plaza Europa 1. 20018. Donostia, Spain
[2]Department of Technology and Entrepreneurship in Wood Industry, Division of Composite Wood Products Engineering, Warsaw University of Life Sciences, Nowoursynowska Str. 159, 02-776 Warsaw, Poland

http://www.ehu.eus/es/web/biorp/home

jerobles001@ehu.eus

Polylactide-polydroxybutirate blends as bonding agent in multi-layered composites

Eduardo Robles*

Coauthors: René Herrera[a], Grzegorz Kowaluk[b], Oihana Gordobil[a], Jalel Labidi[a]

International Conference on Biobased Materials and Composites
06-07 September 2017
Zagreb, Croatia

Introduction and Background

Structural composites based on multilayered structures have gained attention because of their good mechanical properties and overall mechanical stability because of the stress-transfer between individual layers (ply) and the bonding agent (resin). However the composition of these materials presents challenges as the traditional resins used as bonding agent contain phenolic and formaldehyde components that can be hazardous for humans, therefore methods that substitute or eliminate the use of these substances are of great interest for research.

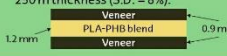
In this work the study of composite materials including bio-based polymers as matrix was studied, these materials result environmentally friendly and low-cost but with similar properties than those of wood or plastic based. The blend of two or more polymers with different properties to produce composite materials is a well known strategy to obtain specific physical properties without the need of complex polymeric system. Ideally, such blending can offer diverse structured morphologies either isotropic or anisotropic; therefore a wide range of materials can be built bespoke. The present work presents the evaluation of a polylactide (PLA) polyidroxybutirate (PHB) blend as bonding layer in a multilayered bio-composite. Polymer blends were obtained through hot melt mixture inside a twin screw extruder in a constant ratio of 30 % PHB and 70 % of PLA.

Strategy

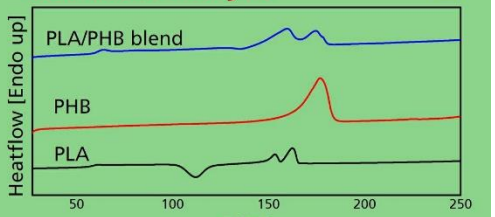
Manufacture process

PLA-PHB masterbatch was blended in 75:25 w/w which has been proven a good ratio in several works (Dasan, Bhat, and Faiz 2017; Arrieta et al. 2015). Composites were manufactured using a twin-screw extruder (LabTech Engineering M250) being mixed at 180 °C and 30 rpm and extruded with a 3-step screw having screw speed of 200-100-100 rpm and temperature profile of 185-190-195 °C. All blends were extruded twice to warrantee dispersion and then pelletized.

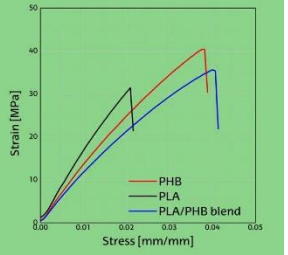
Pellets were then press-moulded at 185 °C and 10 bar into sheets with 250 m thickness (S.D. = 8%).



Results and analysis



Results for thermal analysis are presented in Figure 1, for further thermal processing 180 °C were used to warrantee the complete melting of the polymer blend. Moreover, melting temperature of the blend was also altered, as the calorimetric analysis shows 2 different peaks at 159 °C and 174 °C, which are concurrent with the melting temperatures of the used PLA (162 °C) and PHB (177 °C).



	Tg [°C]	Tc [°C]	Tm1 [°C]	Tm2 [°C]
PLLA-PDLA	59.05	111.95	153.3	162.41
PHB	-	54.55	177	-
PLA/PHB	61.29	96.77	159.65	174.48

Conclusions

The addition of smaller particles had minor influence in the surface slightly increasing water absorption in B, this is counteracted by the addition of modified CNF to the external layers who act as a reinforcement to the composites as a barrier against water, this is further enhanced with surface modifications, the surface modification which proved to be more versatile under mechanical surface tests is the one with fatty acids (BF), as it acts both as a bonding agent between modified nanofibers and the lower layer, and as a surface protector for the composite.

Summary

References

Arrieta, M P, E Fortunati, F Dominici, J López, and J M Kenny. 2015. Bionanocomposite Films Based on Plasticized PLA–PHB / Cellulose Nanocrystal Blends. Carbohydrate Polymers 121: 265–75.

Dasan, Y K, A H Bhat, and Ahmad Faiz. 2017. Polymer Blend of PLA/PHBV Based Bionanocomposites Reinforced with Nanocrystalline Cellulose for Potential Application as Packaging Material. Carbohydrate Polymers 157: 1323–32.

For furter information:

[a] Biorefinery Processes Research Group, Chemical & Environmental Engineering Department, University of the Basque Country UPV/EHU, Plaza Europa 1, 20018, San Sebastian, Spain

[b] Department of Technology and Entrepreneurship in Wood Industry, Division of Composite Wood Products Engineering, Warsaw University of Life Sciences, Nowoursynowska Str. 159, 02-776 Warsaw, Poland

Scan for vCard

Acknowledgements

CAMPUS OF INTERNATIONAL EXCELLENCE

Faculty of Engineering, Gipuzkoa

Thank you!
Eskerrik asko

jerobles001@ehu.eus