Novel packaging films and textiles with tailored end of life and performance based on bio-based copolymers and coatings

Newsletter October 2022

Contents

BIOnTop Key figures

Funded by the call topic: BBI.2018.SO3.R10 - *Develop bio-based packaging products that are biodegradable/ compostable and/or recyclable*

Funded by: BBI JU
Research and Innovation action: start at TRL 3-4, target by the end of the project is TRL 5-6

Start and end date: 1/06/2019 – 31/05/2023
Budget: 5,4M€ (BBI-JU contribution is 4,2M€)

Consortium: 21 partners (4 Research and Technology Organisations, 9 SMEs, 6 Large Industries, a consumers' association and a pan EU industry association)
7 Biobased Industries
From 8 EU countries

+Advisory board
+ External Advisory Board "Dissemination and mobilisation of stakeholders"

BIOnTop aims to develop **novel bio-based and compostable packaging and textiles** through **experimental research on copolymers and compounds with customized biodegradability and multifunctional coating solutions**.

The 4-year research project gathers 170 experts from research institutes, the mechanical engineering sector, food and packaging companies, and trade bodies from 8 EU countries.

Updates from BIOnTop

A short update on the achievements of BIOnTop so far:

- Copolymers based on lactic acid with improved home-compostability in comparison to commercial PLA have been obtained. Furthermore, formulations of bio-blends and bio-composites for the different applications of the project which perform as home-compostable materials have been developed as well. These developed materials together with the investigations on plasticisers, chain extenders and fibers had led to the final formulations for BIOnTop final prototypes.
- New water barrier and repellence bio-based coatings have also been developed for films, trays and textiles. Additionally, PLA hotmelt and waterborne PLA emulsion with low processing temperature was successfully developed, lamination of PLA film to PLA substrate was demonstrated as possible resulting in a material presenting excellent liquid repellence, a PLA emulsion with good abrasion resistance, good flexibility and good cleanability towards water, wine, coffee and tea but bad washing resistance was obtained and PLA plastisol with excellent abrasion resistance, tuneable biodegradability and mediocre flexibility was developed.
- Spectroscopic analysis of the developed copolymers has been performed. The results make possible material sorting for the products which EoL is expected to be recycling. Reprocessability of final formulations was studied and demonstrated at laboratory scale. A strategy for the recycling and reprocessing of BIONTOP materials has been established upon these results.
- A comprehensive biodegradation study under home composting conditions has been performed over the developed bio-based copolymers, bends, composites and coatings.
- First trials on the obtention of multilayer films have been performed. Monofilament extrusion has been developed for several biodegradable blends.
- The first stage of the stakeholder analysis has been accomplished and a survey on consumers perception has been performed, leading to public Deliverable *D7.4 - Interim report on BIOnTop value chain and consumer perception.*

Features on BIOnTop results and collaborations

Feature 1: Waterborne PLA & PHA dispersions for textile coating

Bioplastics magazine published a feature on the work of CENTEXBEL

Centexbel is proud to have won the **Techtextil Innovation award 2022** in the category “new approaches to sustainability & circular economy” with a breakthrough innovation in biobased coatings. This invention introduces a novel method of applying PLA or PHA coatings and prints on textiles using a waterborne formulation. The advantage of this approach is that it completely avoids the use of organic solvents or specialized equipment, resulting in a reasonable pricing and decreased environmental impact. Due to the innovative character this development was patented under EP3875545A1.

Coatings and prints prepared with this PLA or PHA dispersion need a thermal treatment: After the treatment, the coatings and prints show improved flexibility, wash resistance and application temperature. The formulation has already been successfully adapted for use on wallpaper and coated flax fabric used in the production of thermoplastic composites. In addition to these industrial processes, Centexbel demonstrated that these dispersions can be used in carpet backing, artificial leather and barrier coatings. On top of that, improvements are ongoing for use in fashion and Centexbel is continuously looking for further opportunities for cooperation.

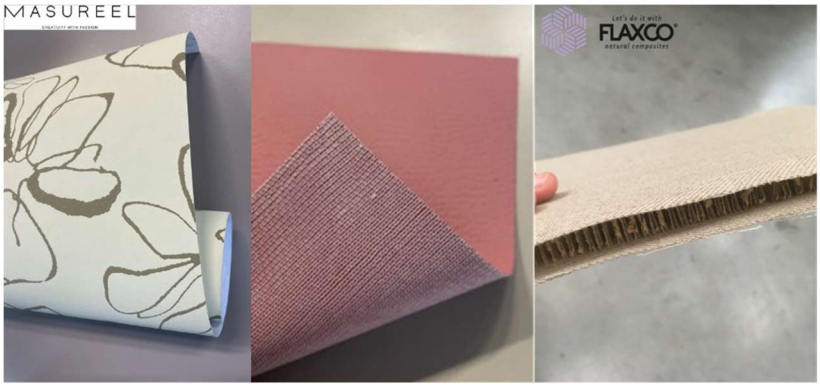


Figure 1: Wallpaper print (Masureel), artificial leather (Centexbel) and thermoplastic composite (Flaxco). Credits: Willem Uyttendaele(CENTEXBEL), MASUREEL and FLAXCO.

This development was made within the **BIOnTop and HEREWEAR** projects. Both have received funding from the Bio Based Industries Joint Undertaking under the European Union’s Horizon 2020 research and innovation programme under grant agreement No 837761 and the Horizon 2020 programme under grant agreement No 101000632. Centexbel promotes the use of biobased coatings through **its Biocoat initiative** that is a joint project of Sirris and Centexbel. It is part of the COOCK collective R&D and collective knowledge transfer initiative of VLAIO under the grant agreement HBC.2019.2493

Read the full feature: https://www.bioplasticsmagazine.de/202205/flipbook_05-2022.html

BIOnTop CENTEXBEL contact: Willem Uyttendaele wu@centexbel.be

Feature 2: BIOnTop at the Biodegradation Webinar

On 12 October 2022, BIOnTop Steven Verstichel and Astrid Van Houtte (OWS) shared results at the webinar organised by the CHAMPION project, a BBI JU funded project. The series of events organise by CHAMPION focuses on Bio-polymer biodegradability: State-of-play and examples from practice.

One of the most commonly used biodegradable, biobased materials is **PLA** (poly lactic acid). This polymer is currently most price competitive compared to other bioplastics and has a relevant production capacity. **Still, PLA needs a thermal trigger before hydrolysis starts and biodegradation takes place.** This temperature is typically 55°C or more. As such it is suitable for industrial composting, but not for home composting with only mild temperatures. **One of the goals of BIOnTop is to make PLA also compostable under home composting conditions**. It was demonstrated at OWS that, depending on the type, PLA can be made home compostable **by blending with other biodegradable polyesters such as PCL and PBSA**. Moreover, by playing with the amount of PCL or PBSA the biodegradation rate can be tuned. The lower the PCL or PBSA content the longer it takes for the biodegradation to start and the slower the biodegradation rate. This is a promising tool for applications in which biodegradation might only occur after its usage as e.g. for plant guards, fishing nets, mulching films.

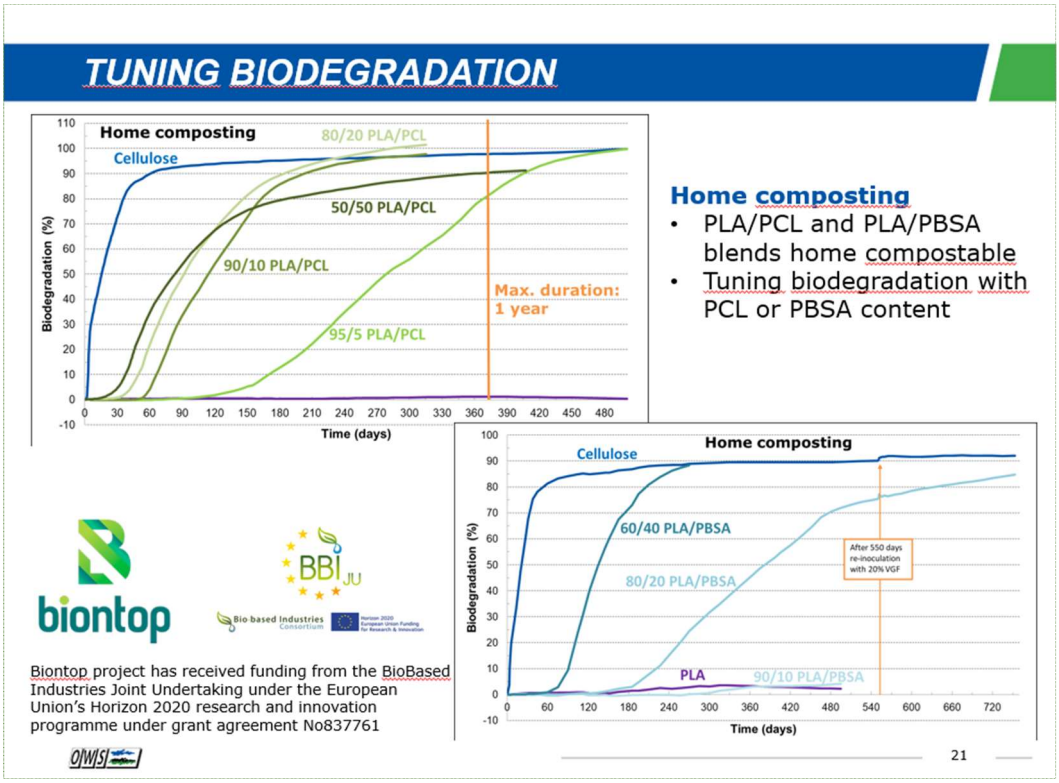


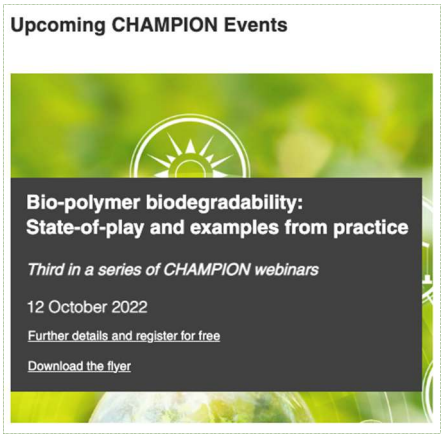
Figure 2: Home composting and the tuning of biodegradation. Credits: Steven Verstichel (OWS)

BIOnTop OWS contact: Steven Verstichel steven.verstichel@ows.be & Astrid Van Houtte (OWS)

About The CHAMPION Project: CHAMPION is a Research and Innovation Action (RIA) aiming to **replace conventional polymers with novel bio-based polymers for their application in coatings, textiles, home care uses and structural adhesives**.

CHAMPION has been awarded a grant by Horizon 2020 BBI JU.
CHAMPION project includes 14 partners from 6 European countries coordinated by the University of York.
Regular workshops are organised by the CHAMPION project.

Find out more: https://www.champion-project.eu/events



Feature 3: Circular Economy: Bioplastics versus black plastics

By 2022, a significant share of used plastics – in some countries more than two thirds – will be incinerated or sent to landfill, and only a small share will be recycled (30%). In this context, there is an urgent need to find biodegradable substitute materials for black plastics that cannot be recovered today by traditional optical and sorting techniques, while maintaining their functional properties in industrial applications.

In this context, David Nettleton (david.nettleton@iris-eng.com) presented last July at **SIMULTECH 2022**, its research "Biodegradation prediction and modelling for decision support", a mathematical AI model that allows predicting the biodegradation of natural materials (eg. Bioplastics) of food origin that are candidates to replace carbon compounds currently used in the automotive industry, electronics, plastic bags, among others.
The term bioplastic is a complex one, encompassing materials that come from renewable sources and materials that are biodegradable. While many plastics, under certain natural or man-made conditions, are degradable, not all are recoverable. In particular, black plastics, because of their pigment or colour, escape the traditional infrared systems used in the recycling industry for their separation.

The work being carried out by **IRIS Technology** aims to develop a range of bioplastics and complementary coatings and validate their use in food and personal care packaging, determining their environmental impact and the economic viability of an extended substitution project in the industry.
BIOnTop IRIS contact: Cristina Fernandez cfernandez@iris-eng.com

Policy Updates

Several regulatory and policy development at European Union level is of particular interest for BIOnTop. European Bioplastics e.V. (EUBP), one of the project partner of BIOnTop, monitors and analyses policy developments to inform project partners and stakeholders of the most relevant news in this field. Below are the most relevant developments as of now.

EU adopts new rules on recycled plastic materials

In October 2022, the new **Commission Regulation (EU) 2022/1616** on recycled plastic materials and articles intended for contact with food became effective. The new Regulation includes innovative novel plastic recycling technologies under development and updates and simplifies existing regulations on the topic.

The **main innovations** this new Regulation introduces are:

1. New requirements for the development of a novel technology.
2. Provisions for monitoring and reporting contamination levels, assessing new technologies and deciding whether to adopt them.
3. Provisions regarding market placement of novel technologies.

Whenever a novel technology is developed, the competent authority in the developer's territory, as well as the Commission, **needs to be notified.** The novel technology must be also **registered** in the **Union register of technologies, recyclers, recycling processes, recycling schemes, and decontamination installations**. The register will contain in depth information about the novel technology and the properties of the recycling technologies, the developer, the installations, etc. Lastly, a detailed report - excluding aspects of commercial relevance, if justifiable – will need to be published by the developer.

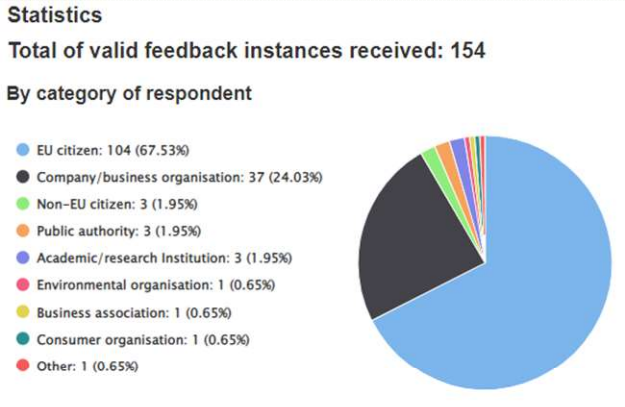
The developer must also publish an online report every 6 months, based on the latest information from all installations using the novel technology. The **European Food Safety Authority (EFSA)** will, from now on, **provide an opinion on whether novel recycling technologies are suitable to be used as a basis for recycling processes,** based on the kind of plastic input they are intended for.

The new Regulation allows the placement on the market of recycled plastic materials and articles created using novel technologies under strict conditions and for a limited time to encourage the development of these novel technologies. Therefore, d**evelopers will be able to collect data on a lot of samples, reducing uncertainty about the characterisation of the plastic input and recycled plastic materials.**

Recycled plastic used in Food Contact Materials must still comply with the same rules on composition as newly manufactured ones **(Regulation (EU) No 10/2011).**

Have your say: EU open public consultation on Food Contact Materials

As part of the ongoing revision of the EU Rules on Food Contact Materials, the European Commission launched a **public consultation** on 5 October 2022 open to citizens and stakeholders **until 11 January 2023.** So far, more than 154 organizations and citizens have responded to the consultation.



The adoption of the new rules is expected in the second quarter of 2023.

For more information on the new regulation and its application check the dedicated website of the European Commission: **https://food.ec.europa.eu/safety/chemical-safety/food-contact-materials/plastic-recycling_en#questions-and-answers**

Upcoming EU proposals for the 2022 New Circular Economy Action Plan

The European Commission is expected to publish the proposals for the **2022 New Circular Economy Action Plan** due by 30 November 2022.

The package will include:

- The Policy Framework for bio-based, biodegradable and compostable plastics.
- The proposal for a revision of the Packaging and Packaging Waste Directive PPWD.
- The proposal for a Regulation on Substantiating Environmental Claims.

Questions on policy updates?
BIOnTop EUBP contact: Estela López-Hermoso **lopez-hermoso@european-bioplastics.org**

Recent peer-reviewed publications and conference proceedings

Biodegradation Prediction and Modelling for Decision Support

David Nettleton, Cristina Fernandez-Avila, Sara Sánchez-Esteva, Steven Verstichel, Maria Coltelli, Helena Marti-Soler, Laura Aliotta and Vito Gigante
Published in: Proceedings of the 12th International Conference on Simulation and Modeling

Methodologies, Technologies and Applications - SIMULTECH, 2022, Page(s) 26-35, ISSN 2184-2841Publisher: Springer Nature DOI: 10.5220/0011136200003274

Abstract: In this paper we describe the functionality of a decision support modelling approach to select appropriate biomaterial blends depending on their mechanical/chemical properties on the one hand, and their biodegradation behaviour, on the other. Firstly, a Case Based Reasoning (CBR) approach is applied to predict expected biodegradation behaviour over time, based on historical examples and using a weighted distance metric on the material properties in order to calculate the trend curve of the new case. Secondly, a Multi-Agent System (MAS) is applied to dynamically simulate the biodegradation curve, in which the two main agents, bacteria and plastic, interact to reproduce the biodegradation kinetics over time. The results of the interpolation are very promising with a good approximation to the real curve time series and % biodegradation, and the Multi-Agent System successfully simulates the different trend curves over time. The system has been confirmed as useful by materials expert end-users, who participated in the project, in order to evaluate a priori new blends “in silico”, and identify and select the most promising, before conducting the long duration biodegradation experiments in the real environment.

Essential Work of Fracture and Evaluation of the Interfacial Adhesion of Plasticized PLA/PBSA Blends with the Addition of Wheat Bran By-Product

Laura Aliotta; Alessandro Vannozzi; Patrizia Cinelli; Maria-Beatrice Coltelli; Andrea Lazzeri Published in: Polymers, Vol 14, Iss 615, p 615 (2022), 1, 2022, Page(s) 615-634, ISSN 2073-4360 Publisher: MDPI DOI: https://doi.org/10.3390/polym14030615

Abstract: In this work biocomposites based on plasticized poly(lactic acid) (PLA)–poly(butylene succinate-co-adipate) (PBSA) matrix containing wheat bran fiber (a low value by-product of food industry) were investigated. The effect of the bran addition on the mechanical properties is strictly correlated to the fiber-matrix adhesion and several analytical models, based on static and dynamic tests, were applied in order to estimate the interfacial shear strength of the biocomposites. Finally, the essential work of fracture approach was carried out to investigate the effect of the bran addition on composite fracture toughness.

Wheat bran addition as potential alternative to control the plasticizer migration into PLA/PBSA blends

Aliotta, L., Vannozzi, A., Cinelli, P. *et al.* . *J Mater Sci* **57**, 14511–14527 (2022). https://doi.org/10.1007/s10853-022-07534-9

Abstract: Wheat bran (WB) was investigated as potential filler for controlling the plasticizer migration in poly(lactic acid) (PLA)/poly(butylene succinate adipate) (PBSA) binary blends (with 60 wt.% of PLA and 40 wt.% of PBSA). The migration process of three different biobased and biodegradable plasticizers [Triacetin (TA), acetyl tri-n-butyl citrate (ATBC) and oligomeric lactic acid (OLA)] was investigated adding them at a fixed amount of 10 wt.%. TA revealed the greater mass loss over the time as confirmed from the calculation of the diffusion coefficients. The addition of WB in different amount (from 10 to 30 wt.%) revealed its tendency to influence the diffusion process in a manner strictly dependent on its content. The great dimensions of the WB, however, weaken the material suggesting to adopt a preliminary dimensional reduction of the filler to mitigate the negative effect observed on the mechanical properties. From this study emerged the WB potential to be used as filler for controlling the plasticizer migration, thus suggesting a possible valorization of this waste byproduct in biobased and biodegradable materials.

Improvement of Interfacial Adhesion and Thermomechanical Properties of PLA Based Composites with Wheat/Rice Bran

Vito Gigante, Laura Aliotta, Ilaria Canesi, Marco Sandroni, Andrea Lazzeri, Maria-Beatrice Coltelli, Patrizia Cinelli. Published in: Polymers 2022, 14(16) 3389 https://doi.org/10.3390/polym14163389

Abstract: The present work aims to enhance the use of agricultural byproducts for the production of bio-composites by melt extrusion. It is well known that in the production of such bio-composites, the weak point is the filler-matrix interface, for this reason the adhesion between a polylactic acid (PLA)/poly(butylene succinate)(PBSA) blend and rice and wheat bran platelets was enhanced by a treatment method applied on the fillers using a suitable beeswax. Moreover, the coupling action of beeswax and inorganic fillers (such as talc and calcium carbonate) were investigated to improve the thermo-mechanical properties of the final composites. Through rheological (MFI), morphological (SEM), thermal (TGA, DSC), mechanical (Tensile, Impact), thermomechanical (HDT) characterizations and the application of analytical models, the optimum among the tested formulations was then selected.

Meet BIOnTop at these events

- 13 – 15 November 2022 // 11th International Conference on Fiber & Polymer Biotechnology // Graz, Austria.
- 24 – 25 November 2022 // API 2022 - 4th International Congress Advances in the Packaging Industry "Sustainability: Products and Processes" // Neaples, Italy. Meet: Andrea Lazzeri andrea.lazzeri@planetbioplastics.com
- 1 December 2022 // 9th Biorizon Annual Event on Bio-Aromatics // Online event
- 6 December 2022 // "**BIOnTop Breakfast with the Expert" enjoy a briefing with the expert Dr. Corina Reichert at breakfast time. This is organised by EUBP in collaboration with** partners ASU and ENCO at 8.30 am. Alongside the 17th European Bioplastics Conference. // Berlin, Germany. Register for the event via mail: **euprojects@european-bioplastics.org**
- 6-7 December 2022 // 17th European Bioplastics Conference // Berlin, Germany – hybrid event. Meet the entire EUBP team: **euprojects@european-bioplastics.org**

BIOnTop Tech watch

For other relevant news, have a look on the BIOnTop tech watch.

BIOnTop has received funding from the Bio-based Industries Joint Undertaking (JU) under grant agreement NoNr. 837761. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.