Newsletter 03_2021

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Welcome to the third issue of the BIO-PLASTICS EUROPE Newsletter

Eighteen months in, BIO-PLASTICS EUROPE partners have already published eleven research papers, developed five prototypes of bio-based plastics, initiated laboratory and field experiments and started developing a safety protocol for bio-based plastics which will guide both companies and policymakers, all that while engaging stakeholders from the entire bio-based plastics supply chain. We invite you to learn more about our work and objectives in this third edition of our project newsletter. Enjoy reading.

THIS ISSUE

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Testing bio-based plastics compounds and developing safety standards

By Cintia Nunes, Hamburg University of Applied Sciences (HAW), Germany

Identifying suitable alternatives to conventional plastics is part of the European strategy to reduce plastic waste and foster the transition towards a circular economy. BIO-PLASTICS EUROPE is making valuable contributions towards reaching this goal. The project has by now developed five alternative materials to conventional plastics. Nine research papers have been published by project partners and are available for download on our website www.bioplastics-europe.eu/downloads.

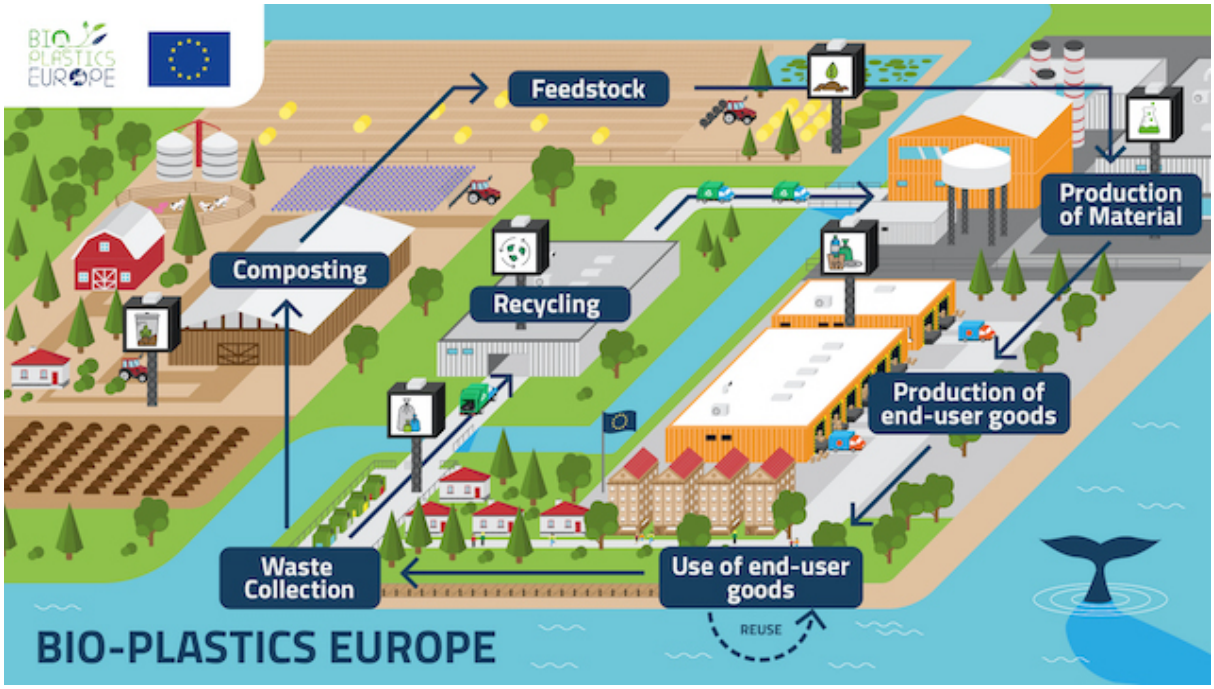

Figure 1. Infographic representing how bio-based plastics can promote circularity in the economy.

This newsletter issue focuses on providing insights on progress towards reaching two of our science-based objectives: understanding the impacts of bio-based plastics on ecosystems by conducting experiments in the field and in the laboratory, and building bio-based plastics safety and sustainability frameworks.

Field tests are being conducted by consortium partners in Italy, Germany, Sweden and Poland on land, in rivers and in marine environments (Mediterranean and North Sea). Controlled conditions tests are being conducted by teams in Estonia, Finland, Germany and Italy. Tests on uptake and effects on marine biota are being conducted by our partners in Germany, Poland and Sweden. All tests are currently running, and we are happy to inform that there is none or little delay attributable to the current COVID-19 pandemic.

Why do we pursue these experiments? One of the most important reasons for conducting them is to assess whether the bio-based plastic prototypes are biodegradable, which means they

would not add to the plastic littering problem. Equipped with scientific evidence, the consortium will formulate sound EU policy recommendations.

Apart from the science background, we intend to formulate policy-making recommendations with inputs of stakeholders from across the supply chain, ranging from feedstock producers to final consumers and compost/recycling firms. BIO-PLASTICS EUROPE is also set to deliver a "Bioplastics Safety Protocol", defining product-specific testing procedures for bio-plastic toys, food packaging and industrial equipment for shipping, fishing and aqua-culture. The purpose of this document is to make sure that no harmful substances are released as part of the use and end-of-life management of bio-based and biodegradable plastics.

Taking a closer look at bio-based plastics in the laboratory

By Stefano Gianazzi, Tecnologie Innovative per il Controllo Ambientale e lo Sviluppo Sostenibile (TICASS) scrl, Italy

The BIOPLASTICS-EUROPE consortium has developed five bio-based materials. Those materials are now being subject to tests both in the laboratory and in the field by nine of our project partners. Here you can have a brief look into the focus of this research.

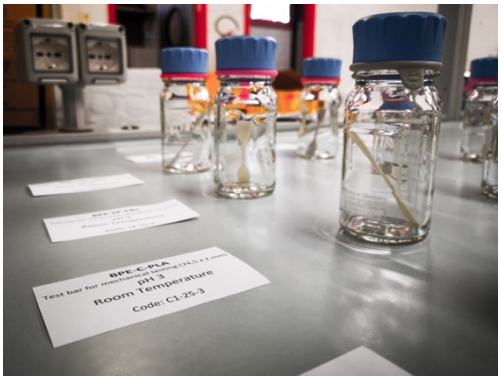

Figure 2: Samples being prepared for Water Up-take testing.

Various experimental tests are being conducted with those bio-based prototypes on field, on biota, and in the laboratory. Overall, these tests aim at studying: 1) the level of degradation of the materials in different environments; 2) their stability under different conditions; and 3) their toxicity on specific organisms.

But before all those activities could start, it was necessary to first develop a testing plan for all consortium partners, defining, for example: which particular tests would be performed and by whom on which materials; the intended application of the materials (cutlery, mulch films, rigid packaging, soft packaging, toys); and characteristics of the samples (such as shape and size).

Each different test is a further step for scientists to better understand how the material behaves. Given the many tests which are being performed, the partners met to discuss the coherence to avoid any gaps or overlaps.
"Fortunately, and thanks to the efforts made by the material manufacturers, Arctic Biomaterials OY (Finland) and Fraunhofer Institute for Structural

Durability and System Reliability LBF (Germany), we received all the requested samples in due time - tells Professor Elisabetta Arato (TICASS) - and our team was able to begin the proper testing activities in the first days of 2021, despite the difficult working conditions due to COVID-19".

TICASS is responsible for carrying on experiments in a controlled environment, that is, in the laboratory.

"We evaluate how water is absorbed by three different compounds, considering different operating conditions such as pH, temperature and alcohol percentage – states Claudia Pastorelli from TICASS – Our experiments also compare recycled conventional plastics to unrecycled bio-based plastics".

Figure 3. Samples are checked for size and shape variations.

After the experiments are conducted, the researchers analyse the data obtained. The team's workflow also depends on how such data is managed. "We manage our research data over two complementary paths. The raw data is managed via MS Excel within the laboratory - explains Stefano Gianazzi, another colleague at TICASS - and the same data set is processed, afterwards, with the R software and then presented as a streamlined chart, which is more useful for communication and dissemination activities" (see Figure 4).

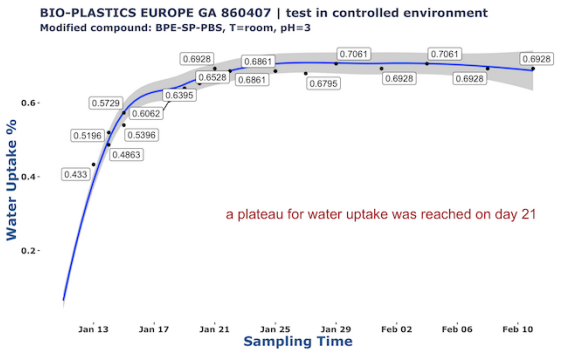

Figure 4. Chart showing how water is absorbed by one of the modified compounds.

Composting experiment: dis-integrating bio-based plastic materials in the lab

By Zhi Kai Chong, Hamburg University of Technology (TUHH), Germany

The BIO-PLASTICS EUROPE team at Hamburg University of Technology (TUHH) conducted experiments on one of the PLA-based materials which had been developed within BIO-PLASTICS EUROPE. PLA is the abbreviation for polylactic acid, a bio-based plastic. The

experiment lasted from September to November 2020, and is briefly described in this article.

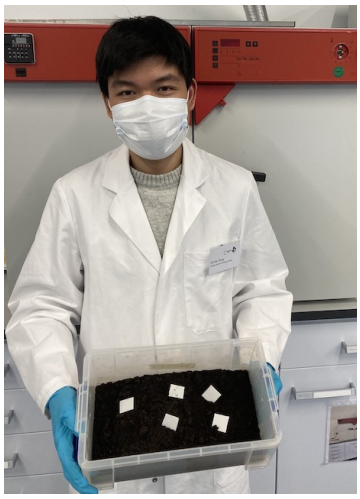

Figure 3. `Pictured: TUHH researcher Zhi Kai Chong preparing the composting experiment.

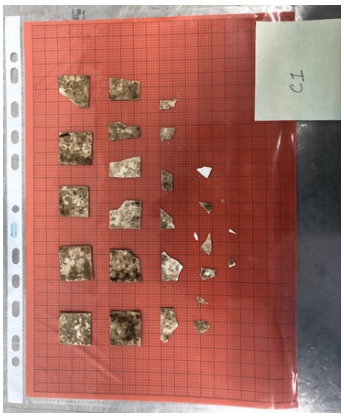

Figure 6. PLA-based material after separated from the synthetic biowaste.

This test simulated one of the phases of the composting process as it usually happens in industrial composting plants. The picture above shows Zhi Kai Chong, a researcher at the Sustainable Resources and Waste Management Group at TUHH, preparing the experiment. In the picture, we can see synthetic biowaste mixed with the PLA compound inside a container. The mix was then placed in a temperature-controlled environment. Water was added regularly to ensure it kept a certain moisture content. After a period, the PLA material is separated from the biowaste, as seen in the following picture, for further testing.

This test was designed to show how much of the PLA-based material will disintegrate when subjected to industrial composting conditions. This material also will be tested with different techniques so that the nature and mechanisms of degradation can be better understood. With this information, the team will be able to provide inputs for an improved management of biodegradable plastics to minimize environmental impacts.. The PLA compound used in this experiment was designed with a specific end-product in mind: rigid packaging. In the following months, the experiment will be repeated with a PBS-based compound.

Zhi Kai Chong believes that working within such a huge research consortium as BIO-PLASTICS EUROPE is very rewarding. “I can easily reach out to partners from different countries for discussions. Through these discussions, it is always interesting and constructive to see the similarities and differences among different regions,” says Chong. Besides, he adds: “It is great to see that science truly connects Europe. For example, we agreed on a common analysis protocol for all partners, tests were done in parallel in different countries, and we can compare our data and results already in the end of the day”.

How can bio-based plastics affect marine organisms?

By Lukas Miksch, Lars Gutow and Reinhard Saborowski, Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), Germany

The BIO-PLASTICS EUROPE team at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI) in Bremerhaven, Germany, is studying what happens to marine organisms such as mussels and shrimps after they ingest microplastics. With this research, they want to understand more about the possible environmental impacts of bio-based plastics.

How did they do it? First, the AWI team made fine powder out of bio-based plastics, with fragments smaller than 200 µm (Figure 7). This material was then fed to the marine organisms.

Figure 8 demonstrates that the microparticles have indeed been ingested by larvae of *Artemia* spec. (Figure 8A), a brine shrimp. It is possible to visually compare the empty gut of a larva (Figure 8B) to the gut of a larva that has ingested fluorescent plastic (polystyrene, PS), which is bright green (Figure 8C). The same happenes with bio-based poly-lactate (PLA) powder, which is not as easy to see as the green fluorescent PS but still visible as a dark mass (Figure 8D). These pictures are evidence that aquatic animals do in fact ingest the microplastics they encounter in their environment.

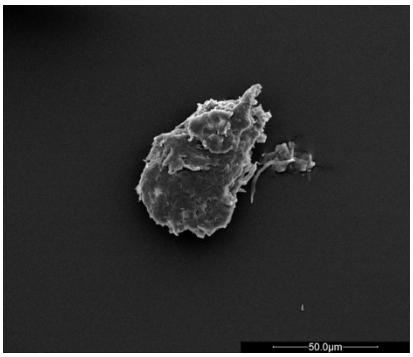

Figure 7. Scanning electron micrograph of a bio-based plastic fragment.

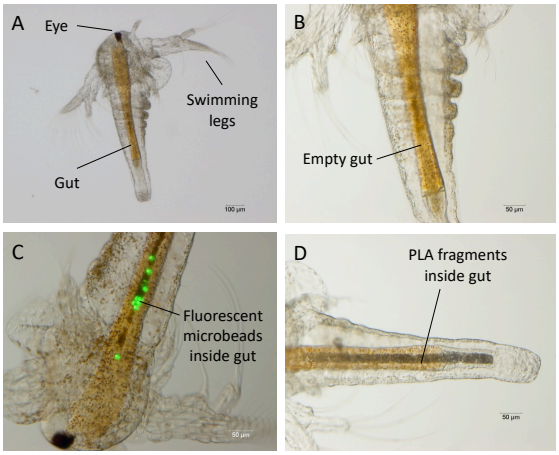

Figure 8. (A) Overview of an Artemia *spec. larva. (B) Close-up of the empty gut of a larva. (C) Fluorescent polystyrene microbeads (9.9 µm) inside the gut of a larva after ingestion. (D) Bio-based polylactic acid (PLA) powder inside the gut of a larva*

Lukas Miksch, PhD student and one of the members of the AWI research team, concludes: "with this being proven, we can start to investigate the effects of the ingested material on those animals." Possible effects relate to the survival, growth, development, metabolism and behavior of marine organisms. Afterwards, the research team can compared those to the effects of conventional, petrol-based plastics. Their overall goal is to discover whether bio-based plastics are more or less harmful to the environment than conventional plastics.

The ongoing progress made in BIOPLASTICS-EUROPE, a consortium with 22 partners, proves that it is possible to have a strong cooperation and fruitful synergies among researchers all over Europe and that, despite the global pandemic, research on bio-based plastics carries on.

Key safety aspects for bio-based plastic products

By Carly Fletcher, Manchester Metropolitan University (MMU), United Kingdom

BIO-PLASTICS EUROPE is concerned with the safety of bio-based plastic products. To make sure that they conform with safety requirements, materials and products are subjected to a range of tests such as those described in the previous three posts. Our team at Manchester Metropolitan University (MMU) is developing a guide to ensure that products made with bio-based plastics are sustainable, allowed in the market, trusted by consumers and of course disposed of correctly.

Safety can be defined as the "recognition and control of hazards". Another way of thinking about safety is to protect from risk that may cause harm. With respect to bio-based or conventional plastic products, several aspects could have an adverse impact on human health and/or the environment, such as:

- Chemical: e.g. migration of elements and chemicals.
- Physical: e.g. choke hazards, sharp edges, etc.
- Mechanical: e.g. performance, finger traps, events leading to food spoilage, etc.
- Flammability: e.g. risk of ignition, flame, etc.
- Hygiene: e.g. cleanliness, bacterial/viral resistance, etc.
- Organoleptic: e.g. changes to smell, taste, appearance, etc.
- Environmental: e.g. ecotoxicity, persistence in the environment, biodegradability, etc.
- Communication: e.g. use of pictograms, logos, declarations, warnings, etc.

The safety of products is ensured though a vast range of policies, regulations (such as the EU General Product Safety Directive), and third-party certification schemes. Additionally, specific rules apply to materials used for manufacturing certain types of products, such as food packaging and toys.

Figure 9. Picture by Laura James on Pexels

But what (if anything) is the difference between products made from conventional plastics and products made from bio-based plastics? There are three main aspects to consider:

- FEEDSTOCK CONFLICTS: Bio-based plastics are claimed to be more

environmentally friendly, since they utilise biomass instead of oil as a feedstock. However, such feedstocks may compete with food production, and utilising organic waste may also have safety impacts;

- PERFORMANCE vs. LIFESPAN: We must consider whether bio-based plastics have a shorter lifespan than conventional plastics, which would impact the mechanical performance of the products;
- BIODEGRADABILITY vs COMPOSTABILITY: Consumers are still confused as to what is meant when a product is defined as "biodegradable" or "compostable". Therefore, we need better communication regarding the optimal method of disposal and waste treatment for bio-based products.

Given those concerns, BIOPLASTICS EUROPE is developing a "safety protocol", which is nothing more than a "guide" which companies can use when deciding whether to manufacture bio-based products. This document is one of the project's most important deliverables and will be available to the public in August 2023.

To write the safety protocol, the MMU team is reviewing existing safety documents, paying regard to the different concerns and opinions expressed by stakeholders across the value chain (such as producers, manufacturers, consumers, and the end-of-life chain). This is crucial for identifying essential issues and receiving advice. "We want to ensure a participatory approach to developing those standards, and ultimately present a user-friendly document" says Dr. Carly Fletcher, MMU's scientific officer working on BIO-PLASTICS EUROPE. To that end, our partners are present in interactive workshops and other events that we organize with stakeholders, as you can read more in the next article by our partner Prospex Institute (PI), Belgium.

Incorporating stakeholders' views is crucial for developing feasible solutions

By Karolina Niemenoja, Prospex Institute (PI), Belgium

BIO-PLASTICS EUROPE is developing robust solutions which are based on science and also on the expertise and insights from key stakeholders. To this end, the project is implementing an over-encompassing stakeholder engagement approach.

"We believe this is the only way to achieve our goal of developing sustainable strategies for bio-based products", says Karolina Niemenoja, Junior consultant at Prospex Institute (PI). A recent example of successful stakeholder engagement were the stakeholder workshops ran in February 2021 by Prospex Institute, in close collaboration with Manchester Metropolitan University (MMU). During these interactive sessions, key representatives from various stakeholder groups had the opportunity to participate in the development of the

safety protocol for bio-based biodegradable plastics. This safety protocol, which is currently being developed by MMU, could become a signposting document or platform to existing standards, regulations and directives within the industry. It will help both established players and companies that are new to the bio-based plastics sector keep up to date with evolving regulations and understand their obligations regarding human health and environmental safety.

Figure 10. Photo by Zen Chung from Pexels

In order to present the work done so far by MMU on the safety protocol and to gather feedback from across the bio-based plastics value chain, a set of two workshop sessions were facilitated online. The first session gathered manufacturers and industry associations, whereas the second session focused on downstream players, that is, consumer associations as well as end-of-life and waste management companies.

The workshops resulted in extremely insightful discussions, which will further guide the development of the safety protocol. To ensure the continuity of the stakeholder engagement, a third workshop will take place in May 2021 to further build on the outcomes of these first two, gathering players from across the entire bio-based plastics value chain.

Save the date: upcoming events at BIO-PLASTICS EUROPE in 2020

- **20 April:** HISCAP ONLINE EVENT "Plastic Waste management in European Cities - Key Role of Associations and NGOs" from 10.00 to 12.00 CET. This event is already open for registrations!

- **29 June:** joint event organized by BIO-PLASTICS EUROPE and SEALIVE "EU Policies and H2020 projects" from 10.00 to 12.00 CET.

To save your virtual seat, please visit our website at www.bioplasticseurope.eu/news-events and register online for any event.

Thank you for reading! We hope that you have enjoyed our third edition of the newsletters and that you will follow us in the future!

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Sincerely yours,
The BIO-PLASTICS EUROPE Project Team

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BIOPLASTICS EUROPE project website: www.bioplasticseurope.eu