Bionanopolys

HIGHLIGHTS NO. 4

WELCOME

Welcome to the fourth newsletter issue of the Bionanopolys Open Innovation Test Bed (OITB) project!

Every six months we would like to keep you posted about our project activities, about previous and upcoming events, where to meet our consortium members and we invite you to gain insights into specific aspects of Bionanopolys implementation.

Enjoy reading, feel free to share this issue with your colleagues and don't hesitate to drop us a line in case you have any question or cooperation request.

CONTENT

THE IDEA OF BIOECONOMY

AND BIONANOPOLYS' ANSWER

Bioeconomy is on everyone's lips. It describes the transformation from a fossil-based to a bio-based industry and paves the way to a more sustainable future. Bioeconomy is relevant in many areas: it is applicable to the production of pharmaceuticals, food and feed ingredients, or materials such as textiles, paper or plastic packaging. The theory sounds nice, but in reality, companies face a big challenge: sooner or later, producers are almost forced to change their production processes to a more environmentally friendly approach – and that costs time and money. Let's find out, if an open innovation test-bed can help meet this challenge.

WHY DO WE NEED A BIOECONOMY CONCEPT?

It is obvious that the world's population is growing steadily, but fossil resources are no longer sufficient. In addition, a growing population produces more and more waste. To help on solving these problems, a circular approach is needed that allows us to use waste as a resource on the one hand, to circulate products and materials and produce recyclable materials on the other. But of course, this romantic idea also has a downside and new challenges arise. To name just a few examples:

- Existing infrastructure must be (expensively) adapted to implement a new concept.
- When using natural and renewable resources, biodiversity must be preserved and we must avoid excessive resource extraction.
- A sustainable supply chain must be ensured.

Therefore, the development of bio-based materials requires a holistic approach that not only focuses on the product itself, but also evaluates the sustainability and economics behind it.

THE BENEFITS OF BIONANOMATERIALS

In the case of bionanomaterials – the central topic of Bionanopolys – the requirements are the same. Bionanomaterials are made from biomolecules, derived from specific raw materials such as biomass. These biomolecule building blocks are nanometer-scale in size and allow chemical and physical properties to be altered, making them ideal candidates for innovative and novel applications. The advantages of using these materials include, for example, lower toxicity and higher biocompatibility. This nanotechnology is applicable in many fields, such as packaging, construction, automotive, textile or cosmetics industries. But how do you find out if these innovative materials and novel solutions are suitable for your own approach? And how can you as a company, an SME or a research group with a limited budget cover the side effects and all assessments?

LET'S JOIN FORCES AND SAVE TIME & MONEY

The Bionanopolys Open-Innovation-Test-Bed (OITB) brings together experts in bionanomaterial development across Europe. This network offers a solution to your approach and provides a range of tailored cutting-edge technical and non-technical services, that will complement and boost your own expertise. Together, we do not need to reinvent the wheel, but we do need to leave enough room for novel ideas and innovation, while solving other issues, for which experts already exist, quickly and efficiently. Aspects such as quality control, monitoring, modelling, assessments related to safety or life cycle analysis, or any kind of business support are important for a holistic approach. All these aspects are part of the Bionanopolys service portfolio and complement the 14 pilot lines for the production of bionanomaterials that can be accessed to test a specific idea or approach. As part of the Bionanopolys project, a first test-run will be offered, where some ideas will be awarded free access to the Bionanopolys services through an open call, starting in February 2023.

Stay tuned!

LET'S SHED A LIGHT ON BIONANOPOLYS' PILOT PLANTS!

BIOMASS

FUNCTIONAL NANOCAPSULES PRODUCTION

Written by Sara Fernandes (CeNTI)

Nanocapsules consist of an external polymeric membrane and an inner part composed of a liquid or polymeric matrix containing a functional (bio)active compound. They are one of the most studied systems for the delivery and/or controlled release of a core material. This is due to their size, which allows them to adopt a wide range of applications with extremely high efficient reproducibility. There are numerous reports in the literature of capsules for various fields, such as biomedical, pharmaceutical, cosmetic, textile and packaging applications. However, many of the reported systems for controlled release still refer to microcapsules, whose particle size and surface properties can cause some difficulties in terms of their homogeneous dispersion in matrices and the mechanical properties of the final product.

The production of most capsule systems uses fossil-based polymers for the encapsulating shell, as well as toxic organic solvents for their processing. Therefore, the development of nanoscale encapsulated systems, using natural and bio-based materials, and environmentally friendly processes, is a promising approach to overcome the aforementioned problems.

Aligned with this topic, CeNTI has installed a pilot plant for the production of functional nanocapsules, which includes several nanoemulsion technologies and downstream steps. The formation of a proper and stable emulsion is a critical step in the production of nanocapsules. When pilot scale is needed, conventional homogenization equipment may not be the most effective. So, CeNTI's pi-

lot plant has a mechanical or ultrasonic homogenization system that works through recirculation cells connected to the pilot-scale reactor, and can process large volumes without forgoing time or the expected results, namely particle sizes below 100 nm. The next step is usually the removal of the organic solvents, which is usually done using a rotary evaporator. For this step, the reactor is already equipped with a distillation system that can operate under vacuum, or even with a rotary evaporator that can be fed automatically and work continuously, which significantly decreases the process time and the need to transport large volumes of the dispersion. At this stage of nanocapsule production, the nanocapsules are in a water dispersion that can be used as it is.

Additionally, CeNTI's pilot plant also offers the possibility of concentrating the dispersion or even obtaining the nanocapsules in powder form by using technologies such as crossflow filtration, centrifugation, and freeze-drying. Furthermore, as part of the Bionanopolys project, the nanocapsules dispersion can also be dried by spray-drying technology at ITENE, which allows a relatively faster drying process and helps to maintain the stability of the more sensitive functional/active compounds.
Herein, CeNTI has developed and implemented a production of bio-sourced cellulosic nanoencapsulated systems for the delivery of antioxidant and antimicrobial (essential) oils.

Within the Bionanopolys ecosystem, the produced bio-based nanocapsules with added-value functionalities can contribute to extend the shelf-life of goods in paper or plastic packaging, provide textile products with antioxidant and antimicrobial functions, and ensure the controlled release of the active core agent in cosmetic formulations. These types of systems offer significant benefits when used as additives for several industrial sectors, as they provide the necessary properties that can greatly improve the specifications and performance of the products offered.

BIONANOCOMPOSITES

REAL TIME MONITORING FOR BIONANOCOMPOSITE DEVELOPMENT

Written by Alexandra Poch (IRIS)

Real time monitoring of parameters of interest regarding different processes becomes crucial to characterise the behaviour of the production systems, find new ways of optimisation and identify certain malfunctions. For this reason, IRIS aims to implement different sensors adapted to the needs of targeted pilot lines in the framework of BIONANOPOLYS project. The company provides services as technology provider in the framework of this project. Concretely, IRIS provides monitoring systems based in photonics (NIR spectroscopy) enabling to upgrade the capabilities of targeted processes in terms of optimization, reliability and quality control. The services provided include:

(1) Collection/characterization of samples from the processes studied and support on the definition of the monitoring needs;
(2) development of chemometric models from the data collected;
(3) development and installation of tailor-made monitoring systems based in photonics able to predict the composition of different process flows and monitor relevant parameters from the process and materials.

On the mid and long-term, the BIONANOPOLYS project will enable IRIS to improve the capabilities and functionalities of their monitoring solutions and increase the number of applications of the NIR technology as monitoring solution in a wide variety of sectors.

COMPLEMENTARY SERVICES

SAFETY REGULATIONS AND LIFE CYCLE ASSESSMENT

Written by Dominik Jasinski (Particula Group)

Nanotechnologies and nanomaterials have created a high interest in recent years due to their unusual mechanical, electrical, optical and magnetic properties and a wide range of potential usages that could produce advancements in medical treatment, pharmaceutical technologies, food transportation and electronics. However, as their production and utilization proceed to develop, so do worries about its effect on people (e.g. health and safety threat to exposed workers and consumers) and the environment. Once enter into human body (either through the skin, gastro-intestinal track or lung), nanomaterials can cause inflammation, expanded susceptibility to infectious diseases, or even to immune system diseases or cancer. Furthermore, nanoparticles have demonstrated to be toxic to other living beings and biological systems once discharged into the environment (air, and water). There are also potential safety hazards involving nanomaterials, such as fire, explosion and other unanticipated reactions. Hence, the mass application of nanomaterials requires the management of health, safety and environmental aspects during their production, manipulation, storage, incorporation, use and disposal.

NANOTECHNOLOGIES AND REGULATIONS

Up until this point, neither engineered nanoparticles nor the materials that contain them are exposed to any extraordinary regulations in Europe, although the Framework Directive 89/391/EEC[1], the Chemical Agent Directive 98/24/EC[2], and the Carcinogen and Mutagen Directive 2004/37/EC[3] on worker protection also apply to nanomaterials. Furthermore, nanomaterials are covered by the same rigorous regulatory framework that ensures the safe use of all chemicals and mixtures, e.g. the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)[4] and Classification, Labelling and Packaging (CLP) regulations[5]. In addition to REACH and CLP, there is also sector-specific legislation in the EU for specific groups of products. They cover, for example, biocides, plant protection products, cosmetics, pharmaceuticals, toys, food, and electronic goods. Hence, despite our incomplete knowledge on the peculiarities of testing and assessing health and environmental effects of nanomaterials, the existing legislation enforce that the hazardous properties of nanoforms of substances have to be assessed and their safe use needs to be ensured with respect to production, handling of or labelling.

RESPONSIBLE DEVELOPMENT IN BIONANOPOLYS

Our philosophy in BIONANOPOLYS project is that the responsible development of nanomaterials and nanoproducts has to result in their safe as well as functional production, use, and disposal at the end-of-life cycle. The Open Innovation Test Bed (OITB) that is being established in the project aims to assure and promote the responsible and safe use of nanomaterials along the entire value chain of industrial innovation processes, from occupational and environmental exposure to consumer safety and regulation aspects and end-of-life disposal. The OITB offers a range of safety and environmental assessment services, such as: (1) hazard profiling (human and environmental); (2) occupational exposure assessment studies; (3) environmental release estimations and assessment along the value chain; (4) definition and validation of proven risk management measures to control the exposure and reduce release of nanomaterials to the environment, (5) regulatory assessment and development of safety protocols for specific product applications (e.g. food and cosmetics); (6) end-of-life assessment to ensure recyclability, compostability and biodegradability of the manufactured nano-based materials and products.

OITB SERVICES FOR A HOLISTIC APPROACH

The OITB services represent a new proactive approach to improve both safety and efficacy of nanotechnology based on pre-regulatory safety and environmental assessment. Anyone that comprehend the importance of safety of nanomaterials can benefit from these services and thus

contribute to the successful promotion of nanotechnology in their new applications. In the absence of nano-safety harmonized standards to satisfy the mandatory environmental, health and safety requirements, the OITB services can assist in taking ideas from nanotechnology research and proof of concept to production scale by anticipating the exposure potential, sampling and evaluating emissions and exposure, recommending control mechanisms and establishing an effective environmental, health and safety programs. They can also help in maintaining a long-term sustainable growth by reducing injury and illness and improving overall employee well-being and staying abreast of changing legal requirements and practice advancements in nanotechnology.

[1] https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1
[2] https://osha.europa.eu/en/legislation/directives/exposure-to-chemical-agents-and-chemical-safety
[3] https://osha.europa.eu/en/legislation/directive/directive-200437ec-carcinogens-or-mutagens-work
[4] https://echa.europa.eu/regulations/reach/legislation

HIGHLIGHTS FROM THE PAST 6 MONTHS

The Bionanopolys team is preparing for the open call, which will be released in February 2023. Therefore, it is high time to make Bionanopolys more and more popular and to raise awareness about the benefits of our Open-innovation Test-bed. First of all, we started another newsletter series that is particularly addressing SMEs and companies, who are interested in making use of the OITB with their own project idea.

The first edition of **Bionanopolys OITB news** was released in October 2022, find it here.

In July 2022, partners acib GmbH and the Ambrosia Lab had an interview with **COSSMA**, a magazine about trends in cosmetics. Get the written article here.

Furthermore, our Bionanopolys partners were eager to share their knowledge in various **blog articles:**

- CEA described the importance of characterization, process monitoring and modelling activities.
- In a blog post from AITEX, the application potential of Bionanopolys is discussed and the reader gets an overview about the current use cases.
- EBAN gave useful insights into the essentials for a business plan and advised on doing a business model canvas. The article gives a summary of the workshop that took place in July 2022.

Also in terms of **events**, the Bionanopolys team continued to communicate the project and to disseminate information about the open call.

- 15th Pannonian International Symposium on Catalysis, Poland, 4th – 8th September 2022, Oral presentation, PWR
- European/Japanese Molecular Liquid Group Conference, Barcelona/ Spain, 12th September 2022, Poster presentation, PWR
- 1st Austrian Composting Congress, Wieselburg, Austria, 3rd – 4th November 2022, Exhibition Table, ACIB
- "Meet the project" series of Biorefine Cluster Europe, virtual meeting, 7th November 2022, Oral presentation, ITENE
- Greener Manufacturing Europe Show, Cologne, Germany, 9th November 2022, Presentation and Panel discussion with other OITB projects, ITENE
- European Summit of Industrial Biotechnology (esib), Graz, Austria, 14th – 16th November 2022, Exhibition table, ACIB

HIGHLIGHTS FROM THE PAST 6 MONTHS

From 6th to 7th October, the **General Assembly meeting** took in place at the premises of ITENE in Valencia, Spain. For many project members it was the first occasion to meet the project partners in person.

UPCOMING EVENTS

Bionanopolys International Stakeholder Workshop

Brussels, Belgium, February 2023

date will be communicated soon

International Textile Conference 2022

Aachen-Dresden-Dekendorf, Germany

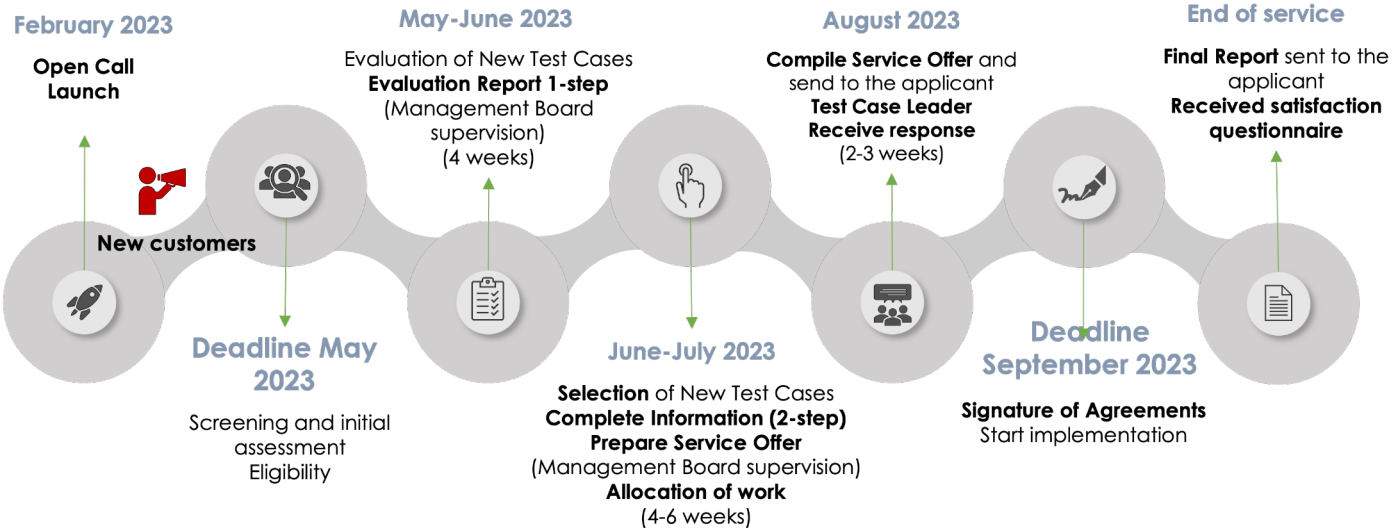
1st – 2nd December 2022, CENTI

38th International Conference of the Polymer Processing Society

St. Gallen, Switzerland

22nd – 26th May 2023

OPEN CALL TIMELINE



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