

in-built Triggered Enzymes to Recycle Multi-layers: an INnovation for USes in plastic packaging

FOREWORD

As we approach the year's end, TERMINUS reaches its mid-term and within this newsletter reflects on the progress made thus far.

To achieve effective separation of the different layers in a multi-layer packaging, and accomplish the overarching goal of TERMINUS, the technology relies on the versatile characteristics of enzymes.

Selection of enzymes, with sufficient depolymerisation activity is one of the cornerstones of the project. Spearheaded by University of Bologna (UNIBO), the consortium was successful in identifying 3 enzymes with such requirements.

Furthermore, Fachhochschule Nordwestschweiz (FHNW) drives the work involving the development of nanobiocatalysts resistant to the required processing conditions and of nano-reservoir systems for the controlled release of a small molecule necessary to the enzyme activity.

Going forward, project's activities will cover the formulation of TERMINUS multi-layer packaging, as well as the demonstration of its recycling. Thorough analysis and impact on the circular economy will be carried out through life-cycle assessment.

In closing the mid-term mark of the project, we would like to extend our warmest wishes for safe and happy holidays!

TERMINUS Consortium



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UNIVERSITY OF BOLOGNA (UNIBO)

UNIBO is the oldest university in the Western world. Since its origins in 1088, the University of Bologna has been student-centered hosting prominent figures from science and the arts.

UNIBO is very active in all research areas and has successfully participated in 540 projects across the FP7 and Horizon 2020 frameworks.

UNIBO's activities within TERMINUS encompass the design of enzyme-containing multi-layered systems and definition of raw materials to be used in the adhesive and tie layers, development, optimisation and assessment of immobilization systems for the protection of enzymes and triggering strategies, as well as contribution to the development of compounding and the evaluation of enzyme stability in packaging and packaging performance in use.



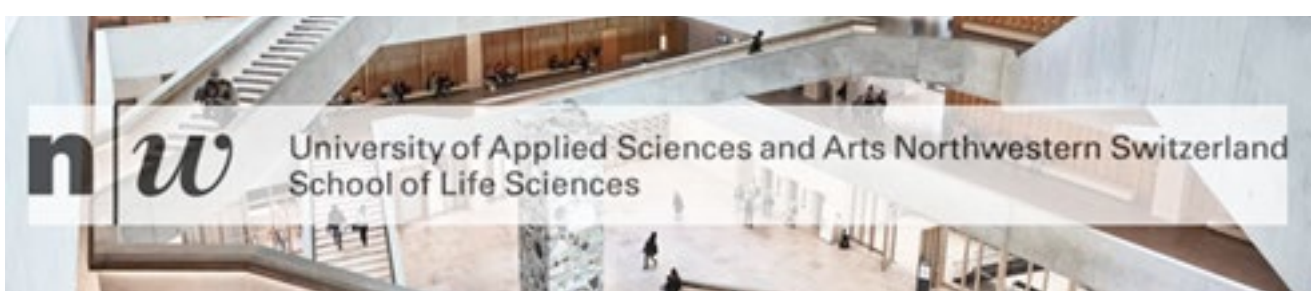
FACHHOCHSCHULE NORDWESTSCHWEIZ (FHNW)

FHNW is one of Switzerland's leading universities of applied sciences, actively involved in teaching, research, continuing education and service provision – both innovative and practice-oriented. In fulfilling its fourfold mandate – education/training, continuing education, applied research and development, and services to third parties – the FHNW puts quality and a focus on the future front and centre.

The nine schools of the FHNW cover a broad spectrum of subjects and enable diverse, interdisciplinary research.

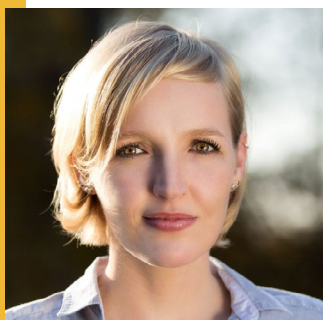
FHNW has developed an enzyme protection strategy that allows for production of robust and stable nanobiocatalysts. In TERMINUS, FHNW strives to adapt this protection strategy to enzymes that can be used to improve the recycling of polymeric materials.

The project's recycling strategy relies on robust nanobiocatalysts embedded in multilayer packaging, for which the enzymatic activity can be triggered using an external stimulus (physical and/or chemical).



STAKEHOLDER ADVISORY BOARD

The first TERMINUS Stakeholder Advisory Board (SAB) meeting took place on September 10. The meeting focused on the progress pertaining to enzymes, and this section provides an outlook into the evaluation by the SAB members.



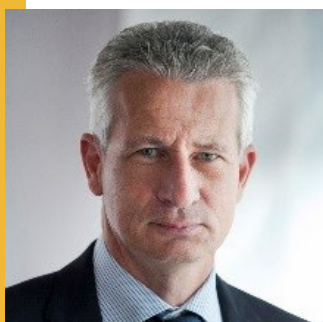
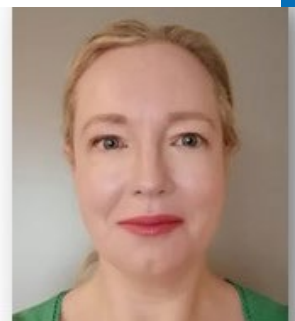
VERA HAYS

Vera Hays is Director Communications and Sustainability at IVK – the German Adhesives Association. She is responsible for issues relating to sustainability, circular economy and communication.

On reviewing TERMINUS, Vera said: *“Since the recycling of multilayer materials is extremely complicated, TERMINUS demonstrates an innovative solution to circumvent this problem. A thoughtful product ecodesign is necessary to keep materials as long as possible in the loop. Adhesives in general are suspected to inhibit a circular economy. We at IVK are looking for innovative solutions to demonstrate, that the use of adhesives brings many advantages and supports a circular economy at the same time.”*

MARGARET FOURNET

Margaret coordinates the Athlone Institute of Technology's new flagship EU-China Horizon 2020 project spearheading the clean-up of the global plastic waste burden, “BioInnovation of a Circular Economy for Plastics”. On TERMINUS, Margaret said: *“It is clear that significant progress has already been achieved in the project. In particular, the ability to deliver post-use multilayer film delamination using triggered enzymatic action from within inter-layer bio-adhesives will provide a significant contribution towards the bio-recyclability and potential to upcycle these materials. This technology offers a novel, highly environmentally-favourable approach, which can provide low carbon footprint solutions to resolve our recalcitrant plastic challenges.”*



ANTONIO PROTOPAPA

Antonio is the R&D Director at Corepla (Italian Consortium for plastic packaging recycling).

Reflecting on TERMINUS, Antonio stated: *“TERMINUS has a great potential to combine biotechnology and chemical/mechanical processes to resolve one of the major issues we are facing these days regarding plastic recovery from waste. It will help achieve the plastic waste targets and so help to reach the final goal of creating a circular economy for packaging materials which otherwise will end up in landfill or energy recovery streams.”*

CLUSTERING ACTIVITIES

Plastics Circularity Multiplier Conference



Plastics Circularity Multiplier

Plastics Circularity Multiplier initiative was launched in 2019, and TERMINUS was among the first projects to join.

This initiative aims to foster and advance value chain collaboration among the EU projects, with the overarching aim of accelerating the transition towards circular plastics economy.

As part of the initiative's work, an online three-day conference was organised with more than 300 participants attending each day. The event took place from 14 to 16 October.

TERMINUS was represented on the event, with Vincent Verney (SIGMA Clermont), speaking on the topic of 'Time control of the circularity of plastic multi-layer packaging'. The full presentation can be viewed on the [TERMINUS website](#).

More information about the event can be found [here](#).



Irish and French led Research Teams kick start a global plastics revolution

TERMINUS joins forces with [BioICEP](#), to advance the progress on the effective management of the global plastic waste issue.

The technology developed through BioICEP will take the individual layers of plastic generated through TERMINUS and break these down further into their chemical constituents (a process known as depolymerisation) using combined green mechano-chemical and enzymatic technology. By combining the outputs from both projects, multi-layer plastic packaging can be upcycled and used for the production of new packaging products, effectively closing the tap on such waste.

On the collaboration, Vincent Verney, TERMINUS coordinator, said: *"This is an excellent opportunity to work together and fuse our considerable research efforts, and ultimately provide new disruptive green technologies to deliver plastic circularity for the future prosperity of our people and the planet."*

More information about the collaboration can be found [here](#).

COMMUNICATION

Enzymes in Plastic recycling: an endurance challenge

Versatility of enzymes and emerging technologies have allowed for their increasing use in numerous fields, as is the case for recycling. Through adequate protection and stabilisation, so-called “super-enzymes” can be created.

Read more about the work of enzymes in TERMINUS in the article published by Cinzia Pezzella (BIOPOX) and Astrid Delorme (Sigma Clermont). The full article can be found [here](#).

Past Events

**The Italian HUB for the BLUEMED initiative
Pilot “Towards a Healthy plastic-free
Mediterranean Sea”**

9 October 2020

**Plastics Circularity Multiplier 10th
International Conference BALTRIB'2019**

14-16 October 2020

Ecomondo 2020

3-15 November 2020

Future Events

Plastic Pouches Europe - 2021

2 to 4 June 2021

**Stay tuned for more information
on TERMINUS webinars!**

RECRUITMENT

Post-Doc position is open at Sigma Clairmont, on circular economy assessment of plastic multilayer packaging. The applicant will have to develop a new methodology by using known circular metrics and new ones by considering the lifetime durability of the material all along its cycle of use (and re-use).

More information about the position can be found [here](#).



TERMINUS website provides general information about the project, as well as the latest news and updates on project results.

www.terminus-h2020.eu

More updates can be found on our social media accounts.



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TERMINUS Project