WheyLayer® ProjectNews

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Editorial

WHEYLAYER is an exciting 3 year R&D project that is funded under the Research for SME Associations programme. The core aim of this cooperative research project is to replace currently used synthetic barrier layers with whey protein coatings. In other words, we are making plastic out of whey!
Recent studies reveal that whey, a by-product of cheese production, acts as a good oxygen and moisture-barrier film with similar performance to other petro-chemical based layers. In addition, the use of whey coating on plastic films can improve the recyclability and reuse of the plastic layer as the whey protein can be removed enzymatically.

Furthermore, the incorporation of active substances such as antimicrobials and antioxidants into the new **WHEYLAYER**-based packaging solutions will extend the shelf life of packed foodstuffs. This trans-European project wants to arrive at a commercially feasible technique for developing whey coated plastic films, without compromising the barrier performance of conventional plastic films.

This innovative breakthrough looks set to revolutionise the plastics industry and provide a cost effective and environmentally friendly alternative to current plastics in use. All in all, this exciting development has the potential to be one of the biggest breakthroughs in plastics technology and manufacturing in many years. Plastics manufacturing and packaging SMEs all over Europe are eagerly awaiting the final results of this project.
Now that the **WHEYLAYER** project has passed its midway point, the consortium is delighted to present the progress and findings of the project here, in the first issue of the **WHEYLAYER** newsletter. This issue focuses on the dairy industry; a sector that will undoubtedly play a vital role in supplying whey for this new material.

Robert Carroll, PIMEC, project coordinator

CONTENT

A word from the WHEYLAYER industrial partners from the dairy sector

Holmer Wölk, Meierei-Genossenschaft Langenhorn eG.

We are really happy to participate in this European project. Especially as it has opened up the possibility for us to explore a new area that could help us become more competitive.

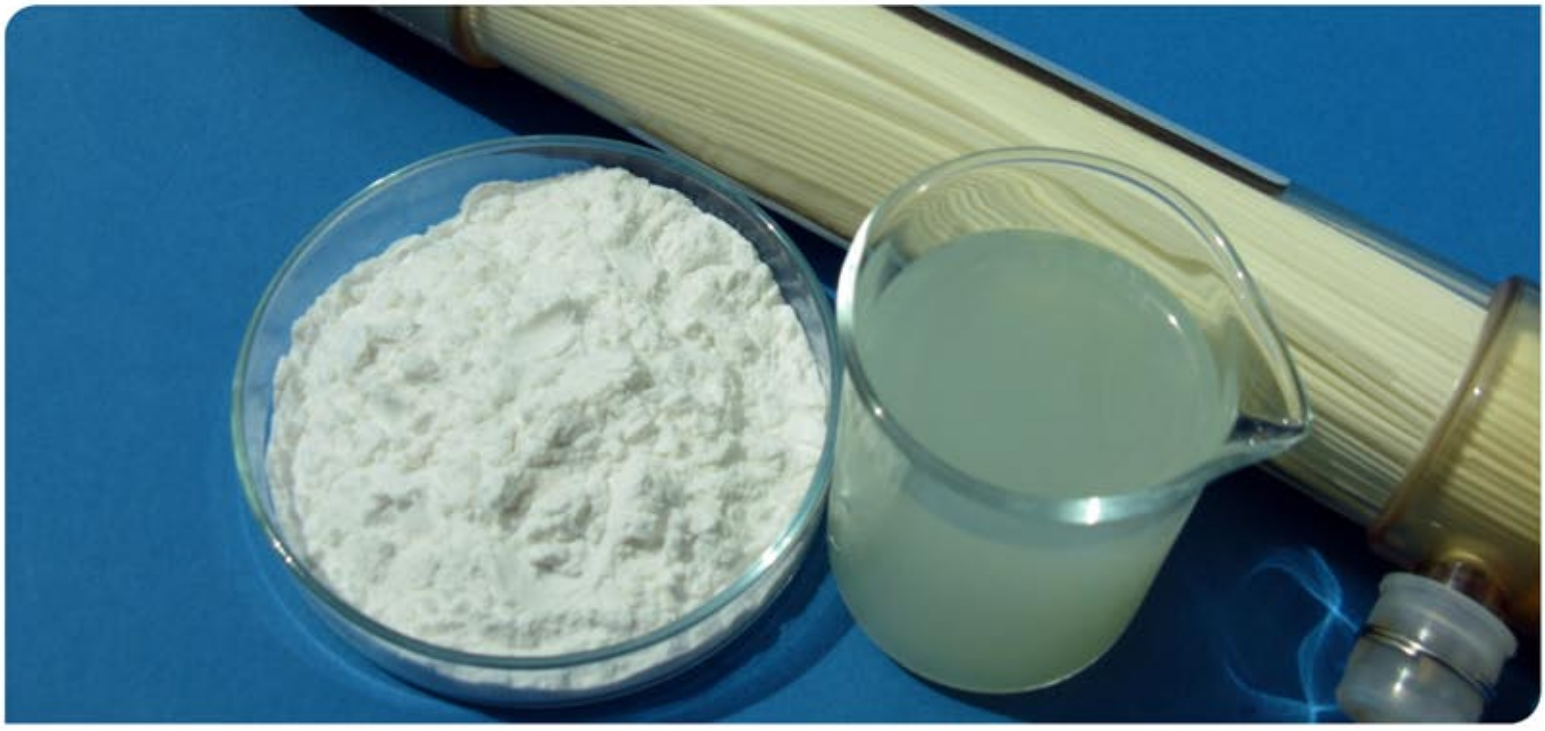
As manufacturers of butter, cream and curd cheese, we currently send the whey we produce to farmers for animal feed. We believe that packaging would be a higher value application for this by-product. Looking forward, we hope to upgrade our processing capabilities so we can produce tailored whey suitable for use in the **WHEYLAYER** material.

Montse Ballcels, Lleters de Catalunya

As an association of dairy farmers and producers of cheese, butter and kefir, our participation in the **WHEYLAYER** project is a great opportunity to generate new added value and solve the problem of whey disposal for our members.

In addition, our dairy members could benefit from using **WHEYLAYER** to package their products. So for us, providing the whey for manufacturing **WHEYLAYER** and then using **WHEYLAYER** as a packaging material of choice would be holistic. **WHEYLAYER** will also increase the recyclability of packaging. This addresses one of the main problems of current multilayer films, which are difficult to separate for recycling and generate large amounts of waste. **WHEYLAYER** will also reduce the need for synthetic petroleum-based materials in packaging by replacing them with a natural and sustainable product of equivalent performance.

Zoom in on…

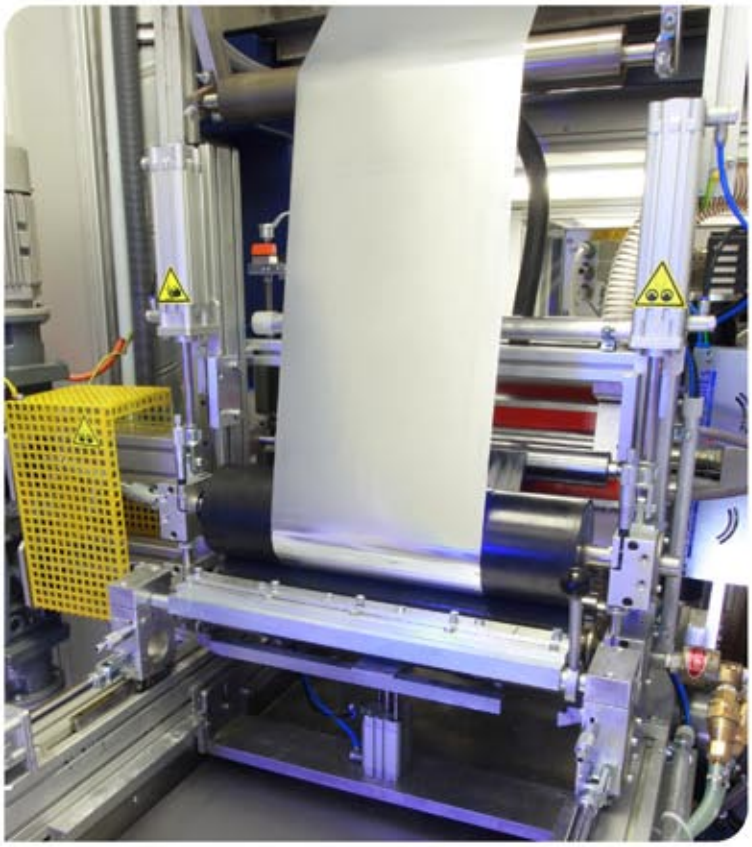


Whey isolation and modification

FRAUNHOFER IVV optimised the barrier properties of whey protein films. To do this, proteins from both sweet and sour whey were initially purified using an eco-efficient membrane filtration process. Subsequently, their molecular compositions and physical properties were analysed and the specific film structure was studied in detail under various conditions. To achieve an effective barrier the proteins must form a fine-stranded network, while agglomerates must be completely absent. In order to fine-tune the film, chemical modification and partial enzymatic hydrolysis were also explored and turned out to be highly efficient in part. Spray drying of purified proteins was found to be a mild process that stabilises the instant product for months.

Formulation Development

Missing protein properties, which are central to the production of a high quality **WHEYLAYER** coating, were introduced by elaborating formulations with additives like plasticizers (Glycerol, Sorbitol, PEG and PG). Their suitable concentrations were investigated and evaluated with respect to rheological behaviour, film forming properties and water resistance. For quantification of the achieved results the mechanical, optical, oxygen and water vapour barrier properties were measured. Future work will focus on the active antimicrobial and antioxidative effects of the coating.



Coating and Laminating

The whey protein formulations developed at FRAUNHOFER IVV were coated onto PET, PE, and PLA film substrates. This work was carried out at both the laboratory and pilot plant scale. A control Coater, which guarantees a reproducible layer thickness, was used for the laboratory-scale work. After coating, the layers were dried by convection in a laboratory drying cabinet. Following the laboratory studies, the process scale-up was investigated. The most promising whey protein formulations were manufactured on a larger scale and coated onto selected substrates using the lacquering and laminating plant at FRAUNHOFER IVV. Using this plant made it possible to successfully manufacture, for the first time, a multilayer packaging film containing a whey protein barrier layer using a roll-to-roll process – a world premiere! The roll-to-roll manufacture is a key prerequisite for meeting the commercialisation needs of the material.

Properties

The oxygen transmission rate (OTR) was measured according to the standard DIN 53380-3 (DIN, 1998) and the water vapour transmission rate (WVTR) was measured according to EN ISO 15106-3 (CEN, 2005). Barrier properties are in the range of OTR Q100 (normalised permeation through a 100μm film) 1-2 [cm^3/m^2 d bar] and of WVTR (Q100) 2-3 [g/m^2 d] respectively, depending on the formulations. These values confirmed the potential of the whey coating to replace synthetic polymers. The transparency, mechanical performance (mainly driven by the substrate) and stability of the films are also very suitable for packaging applications.

» What's next?

Recycling process optimisation and LCA

The biodegradability of the **WHEYLAYER** coating and the recyclability of the resulting laminates are being studied at the University of Pisa. Results to date show that **WHEYLAYER**-based films could be received by current plastic recycling facilities and effectively recycled with the use of small amounts of adapted enzymatic detergent. This is a breakthrough that will enable the independent separation and recycling of the structural layers used in the laminated materials. By the end of the project, semi-industrial scale tests will have been performed to validate this.

The **WHEYLAYER** materials are being designed using a global environmental approach. **WHEYLAYER** indeed contributes to reducing both CO_2 emissions and the consumption of non-renewable resources (raw material and energy) for packaging production. A full life cycle assessment (LCA) study is ongoing and will enable the ecological benefits of **WHEYLAYER**-based vs. conventional materials to be quantified.

Validation of the material for food contact

The use of **WHEYLAYER** materials in contact with food is being validated by ttz Bremerhaven. Firstly, foodstuffs have been packed using **WHEYLAYER**-based films. To date, tests have shown that **WHEYLAYER** has no adverse effects on the sensory properties of the food. Storage tests to validate the efficiency of **WHEYLAYER** are ongoing, as are those of added active compounds for extending food shelf life by, for instance, retarding rancidity and preventing the propagation of microorganisms. In addition, the specific migration of these active compounds, as well as that of plastic substances, is being tested by IRIS to confirm that the new material is non-toxic and complies with legislation.

Scaling up of the process at the industrial partners' sites

Work is currently underway at IRIS to scale-up the **WHEYLAYER** process to fully integrate it into industrial operations and to subsequently reach a manufacturing speed of 20 to 50 meters of film produced per minute. The possibility of manufacturing whey-coated plastics with widely used coating and laminating processes in the food packaging industry affords this novel material great potential for success.

Various demonstration sessions will be organised to familiarise industry with the new material and its manufacturing process. Dates and locations will be announced on the website, as well as in the second issue of the newsletter, which will also contain an update on the progress of the project.

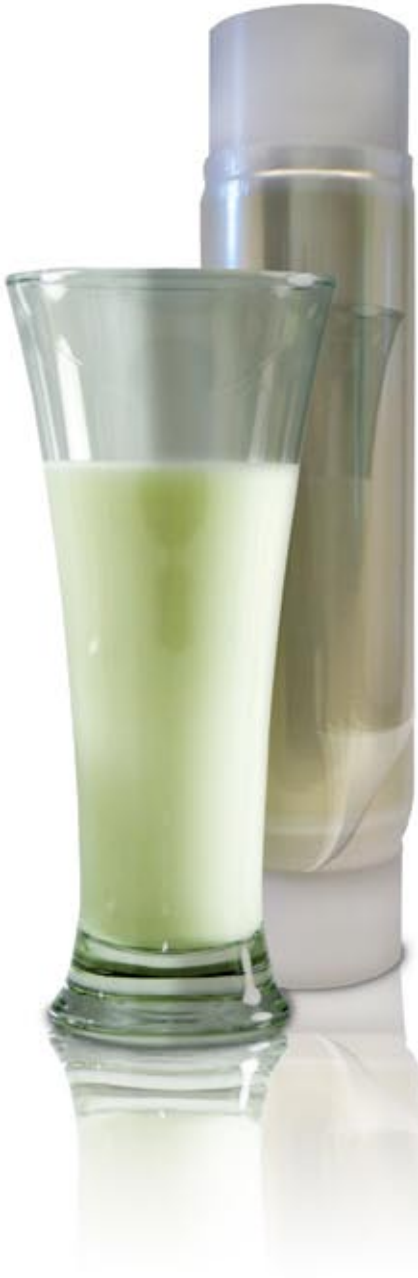
Upcoming events «

The **WHEYLAYER** consortium will participate in the following events:

- **INTERMOPRO**
  (dairy products trade fair)
  Düsseldorf, 12-15 September 2010.
  http://www.intermopro.com/

- **K Trade Show**
  (plastics trade fair)
  Düsseldorf, 27 October - 3 November 2010.
  http://www.k-online.de/

- **Interpack 2011**
  (processing and packaging trade fair)
  Düsseldorf, 12-18 May 2011.
  http://www.interpack.com/



» About the **WHEYLAYER** project

WHEYLAYER is a collaborative 3 year research project that commenced in November 2008 and is being funded by the European Commission's Seventh Framework Programme under "Research for SME-Associations" (Grant Agreement n° 218340-2).

The consortium comprises 14 partners from 7 EU Member States and Turkey and includes research providers, industrial associations and SMEs. It is being coordinated by Catalan SME Association, Patronal de la Petita i Mitjana Empresa de Catalunya (PIMEC).

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www.wheylayer.eu