FLEX FUNCTION 2 SUSTAIN

European Sustainable Nanotechnology solutions Association

OPEN INNOVATION ECOSYSTEM
FOR SUSTAINABLE
NANO-FUNCTIONALIZED
PLASTIC & PAPER
SURFACES & MEMBRANE

Success Story

SUSTAINPACK

SUSTAINABLE PACKAGING

www.flexfunction2sustain.eu/.com

Innovation Company:

HPX Polymers

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SUCCESS STORY
INTRODUCTION

OBJECTIVE

What was your goal?

Goal. The goal of the SustainPACK pilot case was to develop bio-degradable and/or bio-based and/or recyclable packaging concepts on the basis of polyvinyl alcohol (PVOH) as an oxygen barrier material. The use of PVOH as an adhesive and/or barrier layer was not linked to a process, which is why it was necessary to test and improve the processability of PVOH (with modifications) with different processes, i.e. coating, extrusion, extrusion lamination, and extrusion coating, to achieve the goals.

Activities/objectives/significance. The activities performed during the SustainPACK projects were several trials with PVOH. PVOH was used as a wet chemical coating layer with starch mixtures, as an ingredient of mono-extrusion of bio-polymer blend, as an extrusion layer in co-extrusion trials, as an adhesive for extrusion lamination, as an adhesive for wet chemical lamination and as a layer for extrusion coating. This manifold application for PVOH were performed to meet the objectives of the SustainPACK pilot case, which have been to develop a bio-degradable and/or bio-based and/or recyclable packaging. After the production of several samples, those samples have been investigated regarding their barrier performance, recyclability, bio-degradability, food contact approval, and lamination bond strength. The significance of this pilot case is given since customers currently want to substitute classical packaging materials that are not recyclable with paper- or bio-based versions. There is a huge market opportunity for recyclable, bio-based, and bio-degradable packaging, especially driven by the EU packaging and packaging waster regulation from 2022 for every packaging material to be recyclable until 2030.

CHALLENGES
SOLUTION

CHALLENGES

There were three main challenges identified during this pilot case, two technical and one regarding advertisement of the pilot case. Starting with the two technical challenges, PVOH was supposed to be used as an adhesive, but PVOH-based adhesives cannot be used on classical lamination lines. In classical lamination lines, the order of stations is coating/drying/laminating, but for PVOH-based adhesives, the order needs to be coating/lamination/drying. PVOH needs to contain water during lamination to build up enough tackiness for adhesion. The second technical point was, that PVOH was supposed to be used in extrusion lines and extrudable PVOH needed to be developed. However, the compounding of PVOH to granulate is difficult, since typical compounding lines use water baths for cooling, which is not possible for PVOH since it reacts with water. The third point was a soft challenge, but in comparison to other pilot cases, the SustainPACK pilot case had no specific requirement regarding structure and barrier, but the goal was to get to work with PVOH added by new processes in several green barrier structures. It was sometimes not easy to highlight that the results are impressive (development of PVOH as adhesive, development of water-activated lamination, development of extrudable PVOH), even when the hard data and facts (barrier values, structures, bio-degradability results, food contact) could still be improved.

SOLUTION

There were two solutions found to overcome the first challenge (PVOH as a wet chemical adhesive). First, the Click&Coat System of Coatema offers the possibility to re-arrange the stations of a lamination line allowing a setup like coating/lamination/drying. This offered the possibility to use PVOH solutions as an adhesive. Second, it was found that PVOH-coated surfaces can be activated with water to become tacky again. So to use PVOH as an adhesive it is possible to coat PVOH on a surface and during the lamination step a small amount of water is coated on top of PVOH to activate it before lamination.

The solution to overcome the second challenge was also based on two findings. First, the PVOH can be cooled down after compounding by an isopropanol bath or by an actively cooled silicone band. Second, the fact that melted PVOH has a tacky appearance with low viscosity was solved by the addition of glycerol and mineral talc.

COLLABORATION

PARTNERS OF THE PILOT CASE

Contributed with their planned workload and tasks to the successful work within this pilot case. There is no collaboration to be highlighted. It would not have been possible to develop the process with PVOH without Coatema's Click&Coat line. None of the partners was capable of recycling and bio-degradability tests apart from IPC. HPX could provide the bio-polymer and PVOH granulate necessary for all trials. INL was necessary to test the food contact approval. Fraunhofer FEP did the adhesion trials with the German wheel. Fraunhofer IVV did most of the trials regarding compounding extrusion and lamination and coordinated together with HPX the project. There is no "highlight of collaboration" because the project was performed as planned and every partner did his job in time, the whole project was the highlight

ACHIEVEMENTS **ASSESSMENT**

Achievements

- Formulation for extrudable PVOH found
- Two processes developed to use PVOH as a water-based adhesive: Wet chemical lamination with station order like coating/lamination/drying or activation of PVOH layers by application of water
- Formulation for bio-degradable material for thermoforming applications found
- Biodegradability proven for PVOH containing paper and bio-polymer (PBS) structures
- Biodegradable structure with barrier below 20 $cm^3/(m^2 dbar)$ found
- Positive recycling trials via density separation were performed with PVOH as adhesive with debonding-on-demand properties
- Formulation found that allows the reduction of PVOH in barrier layers without loose of performance by the addition of a starch solution

Assessment

The goals were achieved. We developed a

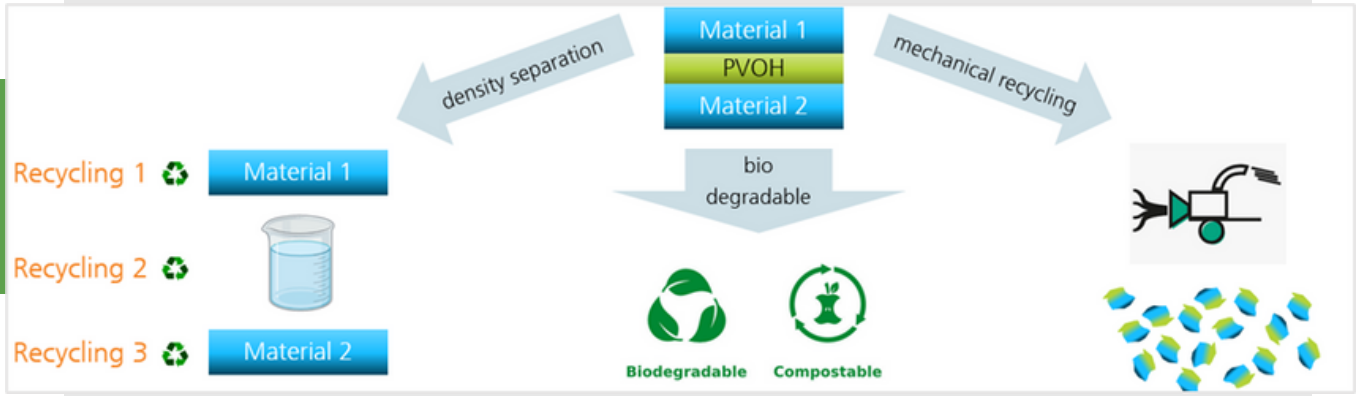
01. Biodegradable structure based on bio-polymers with a high barrier (11 $cm^3/(m^2 \cdot d \cdot bar)$): PBS/PVOH/PBS

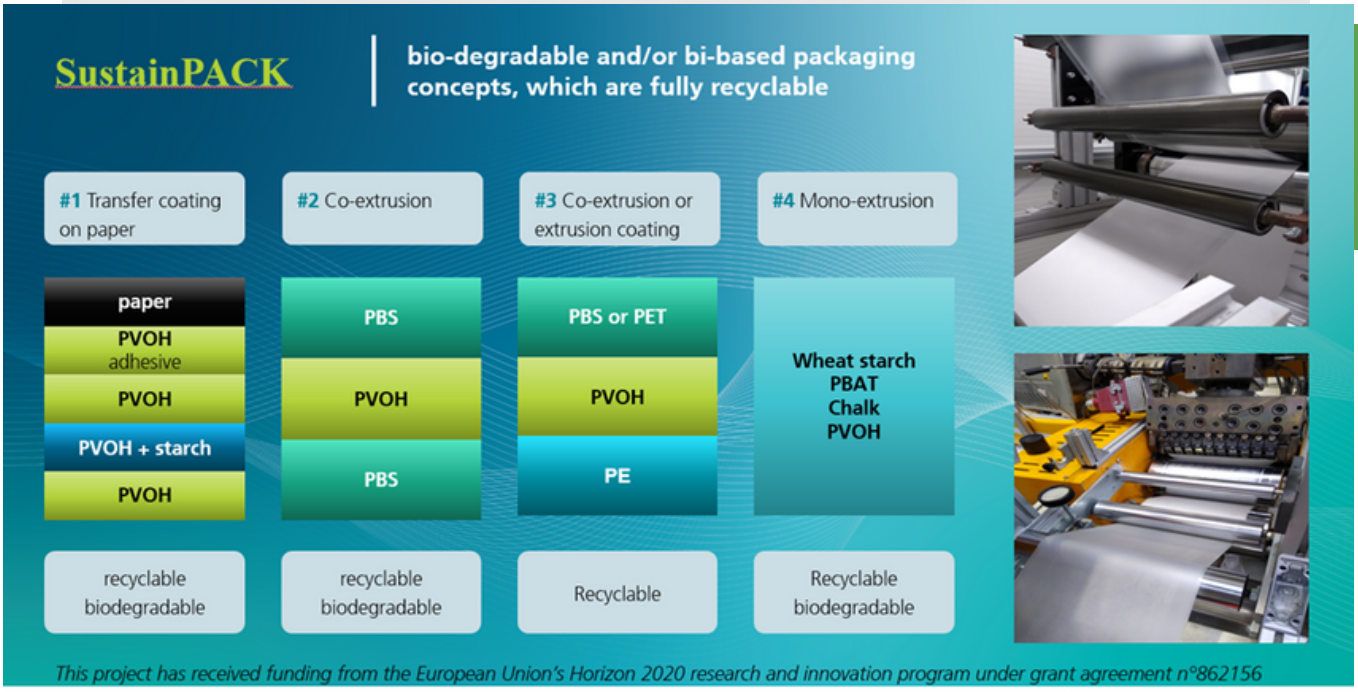
02. Multi-material structure with PVOH acting as an adhesive with delamination-on-demand during recycling test with density separation: PE/PVOH/PET

03. We developed two processes allowing the usage of PVOH as adhesive without additional adhesive, meaning barrier and adhesive in one layer

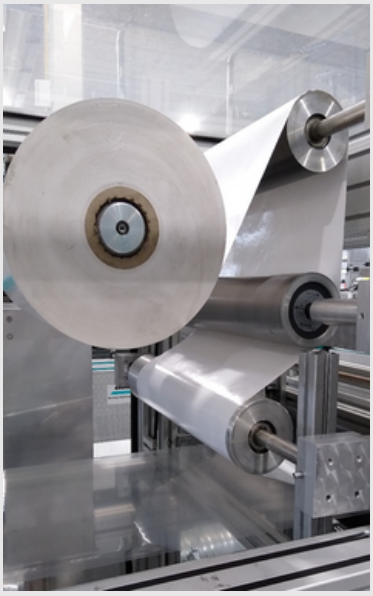
using PVOH as a barrier layer.

VISUAL ELEMENTS





VISUAL ELEMENTS



VISUAL ELEMENTS