



**High Performance Bio-based Functional Coatings
for Wood and Decorative Applications**



PERFE COAT

High Performance Bio-based
Functional Coatings for Wood and
Decorative Applications

**Bio-based innovations for
industrial applications**

BIP Meeting Centre, Brussels

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This project receives funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022370. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.



Sustainability is the development that **meets the needs of the present without compromising** the ability of future generations to meet their own needs.

For us, this involves the development of fossil free materials (e.g. bio-plastic, bio-based coatings) and chemicals, use of energy (e.g. bio-fuels), better solutions for agriculture and food/feed resources and CCUS technologies.

Increasing Bio-renewable Content in Coatings Raw Materials

Innovative bio-based ingredients
 Substituting raw materials derived from fossil fuels as well as from 1st generation-based biomass and plants used for oil production.





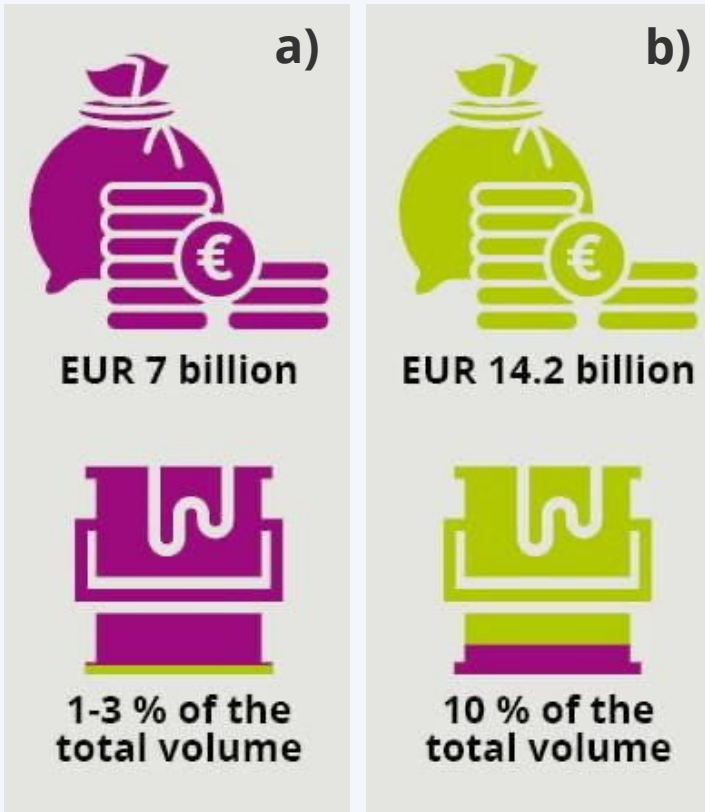
*"**Bioeconomy** is the production and utilization of biological resources - including knowledge - to provide products, processes and services in all sectors within the framework of a sustainable economy."* Source: Bioeconomy Concept and Elements. [German Bioeconomy Council \(2015\)](#).

The PERFECOAT project was initiated in the framework of Sustainable growth and based on the principles of bioeconomy with the specific target of addressing the coating market.

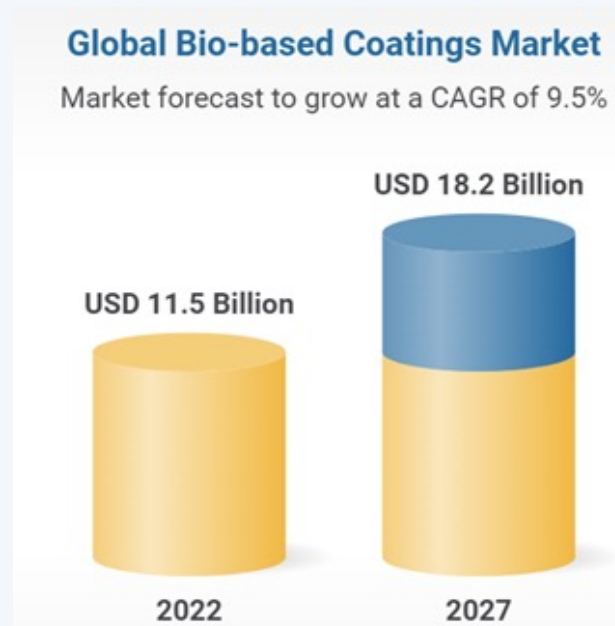
Why coatings?

Only 5% of the coating and paints market share by sales values is occupied by bio-based systems. **The demand for bio-based paints and coatings is set to increase.**

Why coatings? Only 5% of the coating and paints market share by sales values is occupied by bio-based systems. **The demand for bio-based paints and coatings is set to increase.**



a) Market size in EUR and market share of 100 % bio-based systems. b) Market size of formulations with a merely higher content of bio-based raw materials. Source: [EC Technology Forum | Bio-based Coatings](#) in October 2019 in Berlin



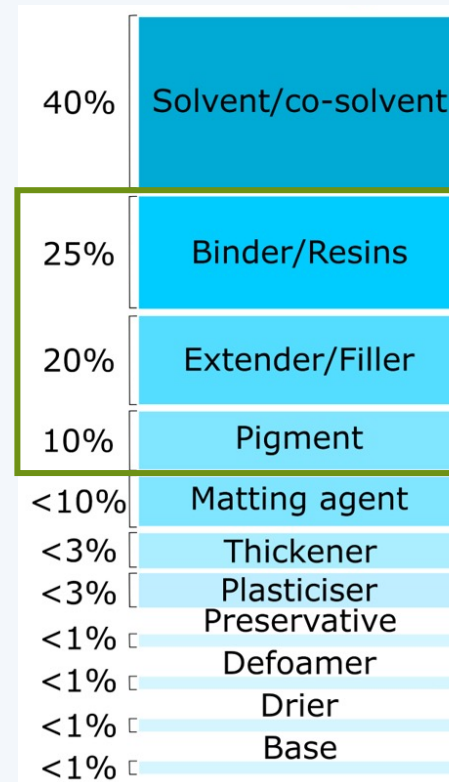
The bio-based coatings market is projected to grow from USD 11.5 billion in 2022 to USD 18.2 billion by 2027, at a CAGR of 9.5% between 2022 and 2027.

Source: www.researchandmarkets.com/reports/5636774

How R&D and advancements in Biotech can fill the gaps and contribute to the sustainable future of chemical and coating industries

Within the coating R&D there is an interest in **alternative raw materials** and novel advanced **bio-based building blocks**. However, all these alternatives must be carefully assessed to match (and possibly surpass) the quality and performance of the existing solutions.

Introduction of bio-based ingredients in existing formulations



General composition of coatings

The ambition of PERFECOAT is to identify alternatives to replace major components

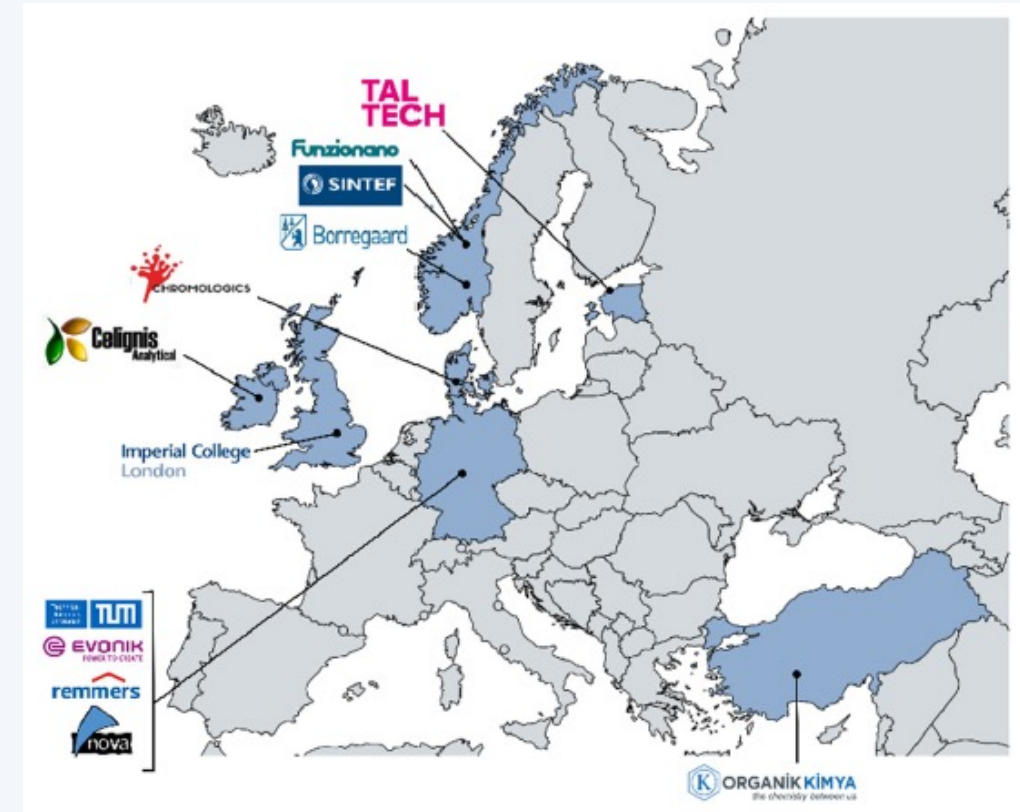


TOWARDS A SUSTAINABLE COATING INDUSTRY





The development of the PERFE COAT project



The goal of the **PERFE COAT** project is to develop and validate a new generation of industrial wood and decorative coatings with at least 25% bio-based components that meet and even surpass the current quality and sustainability standards. Our concept is based on a **flexible platform of novel technologies to produce and functionalize new, bio-based bulk coating components and assemble them into new coating formulations.**

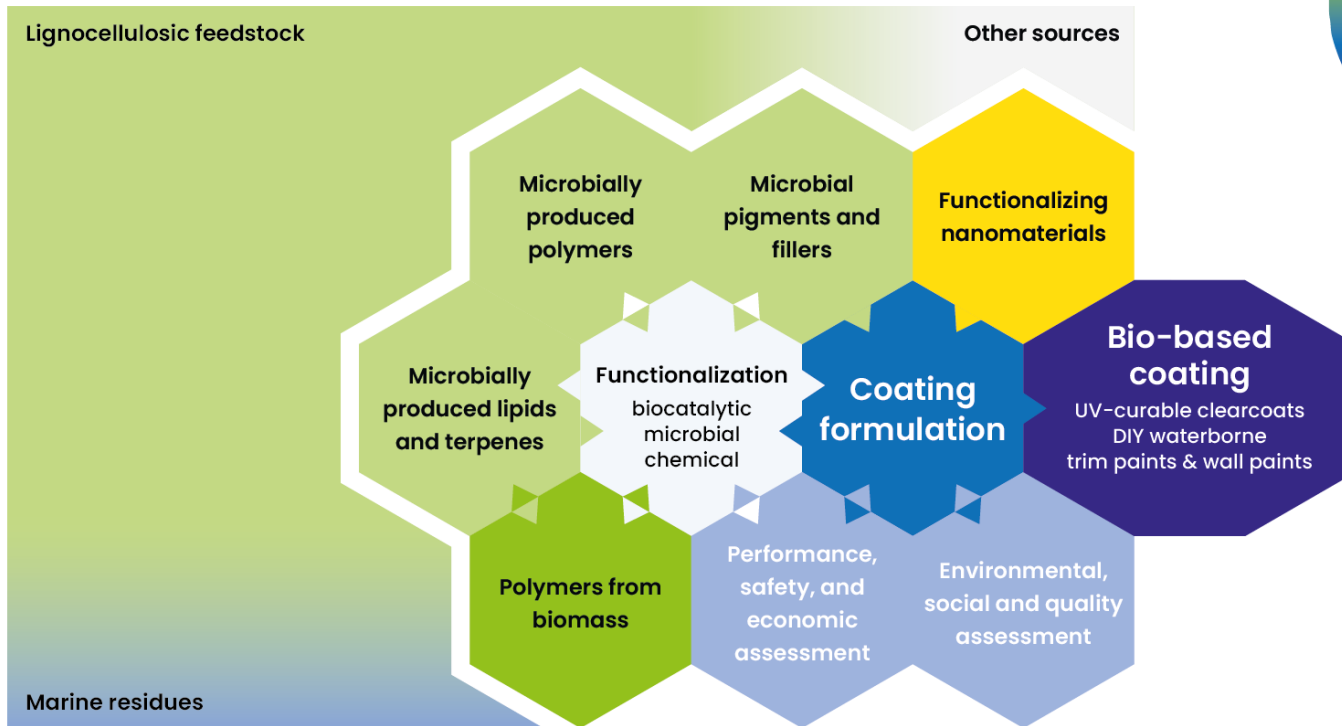


12 Partners from 7 countries
 3 Universities; 1 RTOs; 4 SMEs; 4 LE
Project coordination: SINTEF AS

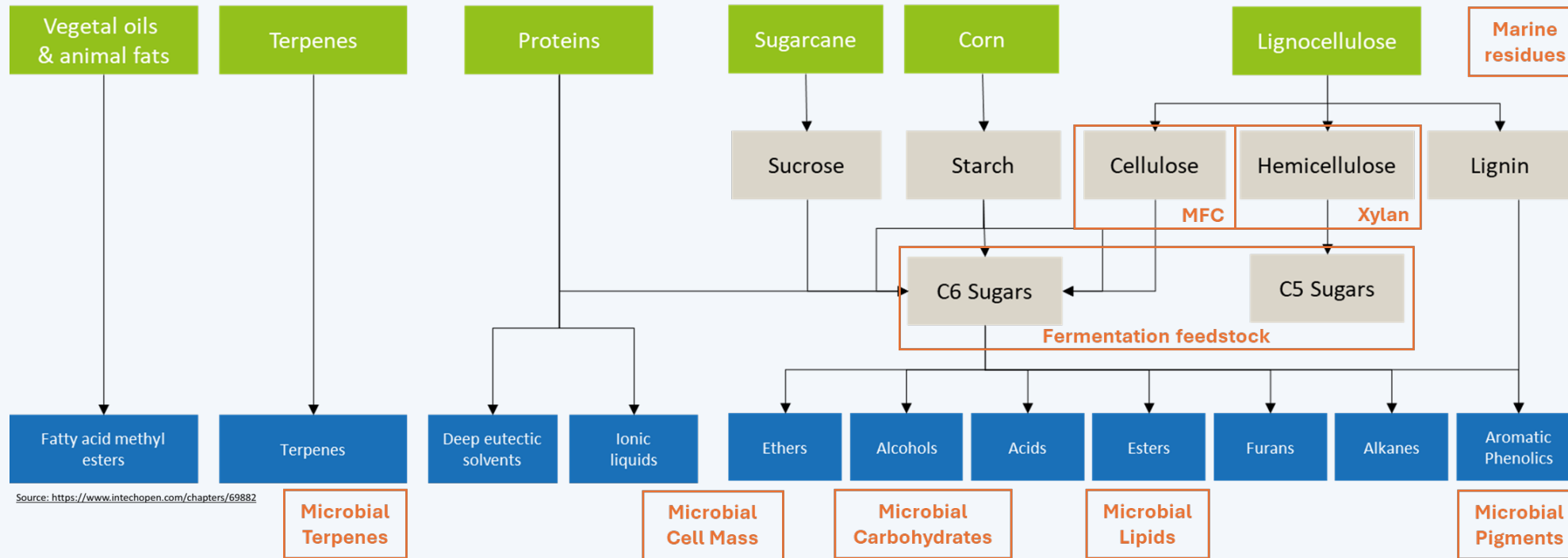
 <p>Term 01 May 2021 – 30 April 2024</p>	 <p>BBI JU contribution € 4,999,567.50</p>	 <p>Type of action Research & Innovation Action</p>	 <p>Feedstock origin Forest-based & Agri-based</p>
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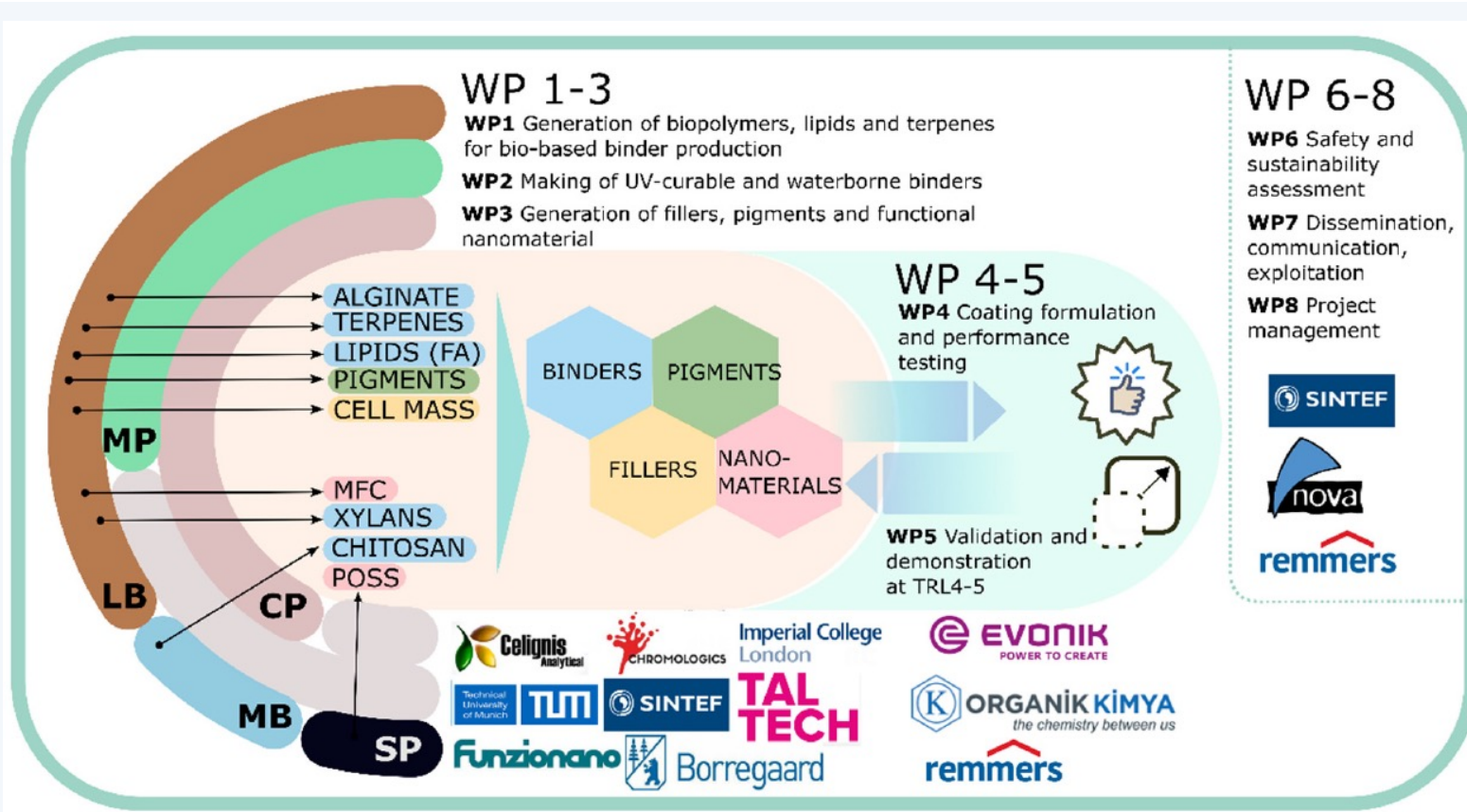
Modular Approach for the PERFE COAT Coatings Development and Validation



To answer the clear need for innovation and new breakthrough technology in this field, the **PERFE COAT** consortium is building and operating a **modular and flexible technology platform for producing innovative bio-based binders, fillers and pigments** from a range of **biopolymers** and **functionalised materials**.



The PERFE COAT project **applies biotechnology to produce microbial polymers**, lipids, terpenes, pigments, and cell mass from biomass sugars, as well as biopolymers through chemoenzymatic extraction from lignocellulose and marine residues. **Chemical upgrading of these base compounds, guided by rigorous testing provides the required physical and chemical properties and activation for use as bio-based ingredients in new paint formulations with desired performances.**



Land-based biomass LB, marine biomass MB, synthetic production SP, microbial production MP, chemoenzymatic processing CP.

The overall concept of **PERFE COAT** is to develop a **complete value chain (from substrate provision to industrial scaleup and quality assessments) by creating a flexible platform**. Starting with a very high initial bio-based content of close to 100% is crucial since, during the process of coating testing and optimization, part of the bio-based share may need to be traded to meet the performance requirements for each demonstrator.



THE PERFE COAT PROJECT

A lot more to learned about PERFE COAT today!



10:55 – 12:15	Session 2: Making Bio-based Compounds
10:55	Oscar Bedzo and Lalitha Gottumukkala (Celignis) Developing Bio-based Binders for Wood Coatings
11:25	Amelie Skopp (Technische Universität München) and Anders Odum (Chromologics SA) Developing Bio-based Paint Ingredients: from Fillers to Pigments and Functional Additives
13:15 – 14:25	Session 3: Sustainability, Safety and Toxicity
13:15	Harrie Besselink (BioDetection Systems) and Andy Booth (SINTEF) Safety and Toxicity Assessments and Methodology
13:35	Ángel Puente (nova-Institute) and Assiya Kenzhagaliyeva (SINTEF Digital) Environmental and Social Sustainability Assessment
14:25 – 15:50	Session 4: Industrial Applications
15:15	Simone Schulte (Evonik Coating Additives) Bio-based Coating Formulation and Application Testing



Bio-based Industries Consortium



Development of Biobased Pigments and Functional Materials

Anders Odum¹, Young Kyung Park¹, Piotr P. Rypkiet², Rodrigo Ledesma Amaro³, Juan Yang⁴, Brigitte Vilgases⁵, Brian Wabunde⁶, Bernd Jan, de Gans⁷, and Eren Elk⁸
¹Chromologics, Denmark, ²Imperial College London, UK, ³SINTEF Industry, Norway, ⁴Biovision Technology Norway, ⁵Evonik Operations GmbH, Germany, ⁶Organik Kimya, Turkey

Background and objective

The increasing interest in biobased coatings, opens the way for a need of natural colorants, that can perform adequately in the harsh product conditions and comply with the long lifecycle of the products. Since most current natural colorants cannot yet fit up to these requirements, as applications like paints, coatings, inks or home care products synthetic colorants are still used. There is already a clear trend in the market space towards more sustainable and biobased dye in the industry. In addition, innovations such as Polymeric oligomeric oligoacrylate (POSS) will provide additional functionalities to the biobased coating formulations. Focus will be to introduce the resistance, strengthening UV-curing and hydrophobic properties in the developed bio-based POSS, improve barrier properties (POSS) and enhance the rheological properties of formulations.

Biobased pigments developed at Chromologics

Chromologics has developed a new natural color, Antonex using a filamentous fungi. In Perfecto Coat Chromologics has further developed a larger variety of Antonex, coupling chromophore to aluminum, make the new pigment Meta Red complex.

Biobased pigments developed at SINTEF and Biovision

Synthesis of POSS - a new dye system. 21 steps preparation of novel POSS up to a controlled gel process. Potential use of POSS.

PERFE COAT - High Performance Bio-based Functional Coatings for Wood and Decorative Applications

INTRODUCTION

The pursuit of a climate-neutral Europe and a truly circular economy requires attention to virtually all fields of production if fossil-based materials are to be eliminated. This relates not only to manufactured goods but also the paints and coatings used to protect them; of the almost 1 million tonnes of paints and coatings produced in Europe each year, more than 80% are derived from fossil resources. Reducing the impact of these coatings would represent a major advance in Europe's climate ambitions. To address this challenge, the PERFE COAT project develops and validates a new generation of industrial wood and decorative coatings with significantly more than 25% bio-based components. The project addresses three important markets for coatings: high-volume, UV curable clear coatings, waterborne trim paints for do-it-yourself (DIY), and waterborne wall paints. These coatings target reaching, and even surpassing, the current quality and sustainability standards.

ABOUT THE PERFE COAT PROJECT

PERFE COAT will be able to offer bio-based coating ingredients from climate neutral sources and processes.

THE PERFE COAT OBJECTIVES

The overarching objective of the PERFE COAT project is to develop novel sustainable coatings that will ultimately be available to the public. Within this, the project will pursue a number of specific objectives.

- From an environmental perspective, the PERFE COAT project will contribute to reducing Europe's greenhouse gas emissions by developing new industrial bio-based coatings for wood with more than 25% of bio-based components produced from climate neutral sources and processes.

Bio-based coating formula

Coatings are everywhere - from architectural coatings to UV curable wood coatings.

Architectural coatings	UV curable wood coatings
Water-based emulsion coatings	UV curable epoxy coatings
UV curable epoxy coatings	UV curable acrylic coatings
UV curable acrylic coatings	UV curable polyurethane coatings
UV curable polyurethane coatings	UV curable polyurethane coatings

Biobased pigments in water-based architectural coatings - architectural pigments are often white but not sustainable they need to be replaced with bio-based pigments.

Biobased pigments in water-based architectural coatings	Architectural pigments available with bio-based pigments
White pigment (TiO2)	White pigment (TiO2)
Yellow pigment (Fe2O3)	Yellow pigment (Fe2O3)
Orange pigment (Fe2O3)	Orange pigment (Fe2O3)
Red pigment (Fe2O3)	Red pigment (Fe2O3)
Black pigment (C)	Black pigment (C)

Biobased pigments in UV curable coatings

UV curable coatings are often white but not sustainable they need to be replaced with bio-based pigments.

Biobased pigments in UV curable coatings	UV curable coatings available with bio-based pigments
White pigment (TiO2)	White pigment (TiO2)
Yellow pigment (Fe2O3)	Yellow pigment (Fe2O3)
Orange pigment (Fe2O3)	Orange pigment (Fe2O3)
Red pigment (Fe2O3)	Red pigment (Fe2O3)
Black pigment (C)	Black pigment (C)

Development of Microbial Alginate and Oils Productions for Bio-based Binders

Susan Maleki¹, Trine Muren², Tone Haugen³, Francesca Di Bartolomeo⁴, Alexander Wenzler⁵, Petri-Jaan Lahtvee⁶, Srđjan Gavrilović⁷, Juliano Salecotti⁸, De Waegh⁹, Michael Bahr¹⁰, Rodrigo Ledesma Amaro¹¹, Ragn Hagelin¹², Young Kyung Park¹³, Javiera Lopez¹⁴
¹SINTEF Industry, Trondheim, Norway, ²Tallinn University of Technology, Tallinn, Estonia, ³Evonik Operations GmbH, Essen, Germany, ⁴Imperial College London, UK

Introduction

The PERFE COAT project focuses on developing sustainable bio-based binders through the production and utilization of biopolymers as key ingredients for binder formulation. Vegetable oil-based polymers to replace fossil-based plasticisers and binders in coatings and other materials are gaining increased attention. However, vegetable oil based binders through the production and utilization of biopolymers as key ingredients for binder formulation. Vegetable oil-based polymers to replace fossil-based plasticisers and binders in coatings and other materials are gaining increased attention. However, vegetable oil based binders through the production and utilization of biopolymers as key ingredients for binder formulation.

Microbial Alginate

Figure 1: Microbial alginate is a natural polymer of repeating units of D-mannuronic and L-gulonic acid. It is widely used in food applications, however, it is also used in coatings and the overall molecular weight of microbial alginate can differ based on the specific bacterial strain and growth conditions. The choice for alginate in coatings, however, encompasses various reactions and applications due to its versatile properties.

Figure 2: Chromopsis yields are highly affected by growing conditions and require optimization for maximum production. The ability to engineer the growth and drying media properties makes the production platform more suitable for growing sustainable industrially relevant microbial pigments.

Results-Alginate

Figure 3: Chromopsis yields, b) Alginate production yield, c) Alginate development and d) Molecular weight increase observed during 24h culture in different media.

1 to Bio-based Extenders in Coatings

Iker Sieber
Haberling, 94335 Straubing, Germany

Functionalized biological extenders

Functionalization of microbial cell mass could potentially increase the value of adding them as extenders in paints and coatings. The final functionalities of the dried coatings were assessed as either bio-hybrid UV-sensing coatings or catalytically active coatings able to degrade VOCs.

Figure 1: UV-sensing bio-hybrid coatings after after UV exposure (top) or stored in the dark (bottom). Genetically modified biomass employed as extender alternative was able to imbue the dried coating with UV-B (400 nm) sensing abilities in a stable and reproducible manner by changing visible color from green to orange (top strip) compared to coatings stored in the dark (bottom strip, see above). This functionality was sustained for several weeks.

Figure 2: PVC 80 formulations containing bio-based fillers (1-11).



Our funding agencies



Circular Bio-based Europe
Joint Undertaking



SINTEF coordination team

Alexander Wentzel; Christian Simon; Susan Maleki

SINTEF research team

Trine Muren; Tone Haugen; Morten Frøseth;
Terje Didriksen; Juan Yang; Kamal Azrague and team; Andy Booth and team.

Our industry partners



Our research partners



Imperial College London

Our communication partner



Bio-based Innovations for Industrial Applications

24 April 2024, 09:00 – 17:00 CET

BIP Meeting Center,
Rue Royale 2-4, B-1000 Brussels

Free Registration • In-person Event



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Thanks for your attention!



High Performance Bio-based Functional Coatings for Wood and Decorative Applications

Paint it bio-based.



Bio-based coatings and paint developed in PERFE COAT
perfecoat-project.eu

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Visit our website! <http://www.perfecoat-project.eu/>
 Get all the updates by signing up for our newsletter!



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