The Beauty of Green – Rethinking an Approach to Bio-Based Extenders in Coatings

Amélie Skopp, Matea Marosevic, Broder Rühmann, Yajing Liu, and Volker Sieber

Chair of Chemistry of Biogenic resources, Technical University of Munich, Campus for Biotechnology and Sustainability, 94315 Straubing, Germany

Introduction

Extenders are an important part of paints and constitute a portion between 10-40% of the paint's material with percentages in the higher part of this range being very common for water-based architectural wall paints. Due to this significant share, the PERFECOAT project pursues activities to develop microbial cell biomass as extenders for paints and coatings. Additionally, biological extenders can be viewed as platform for functionalization to lend special properties to the final coatings. This work summarizes certain aspects of the development of both functionalized and non-functionalized extenders in standard indoor wall paint.

Non-functionalized biomass as extender

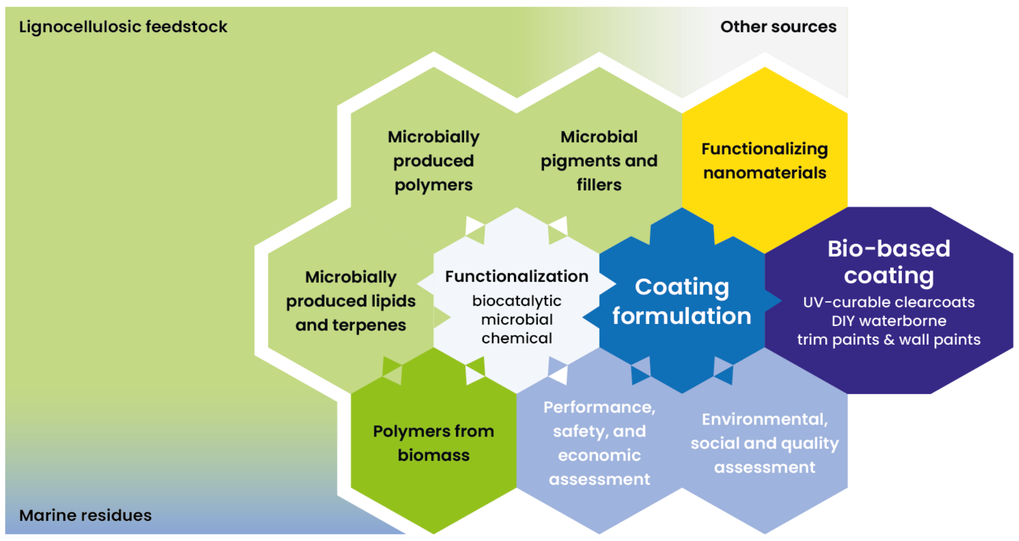

Figure 1: Modular set-up of the PERFECOAT project.

PERFECOAT will be able to offer bio-based coating ingredients from climate neutral sources and processes. To this end, biomass generated within the project will be repurposed as potential extender alternatives.

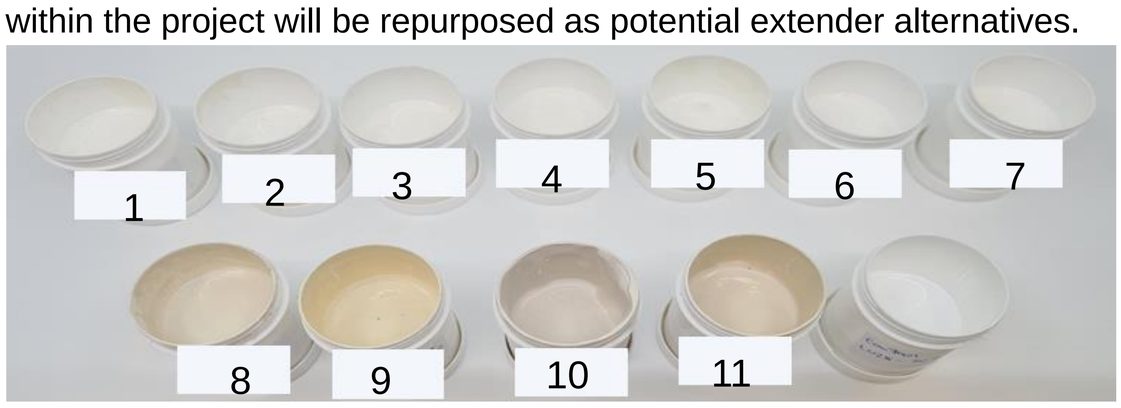

Figure 2: PVC 80 formulations containing bio-based fillers (1-11).

Incorporation of unmodified or partially processed biomass (bottom row, 8-11) as extender substitute affects color and rheology of the resulting formulations. Modification of biomass yields light extender with less impact of formulation rheology (1-7).

Table 1: L*a*b* color coordinates of tested formulations.

Filler identity	L*	a*	b*
Calcium carbonate control	96.78	-0.69	1.28
Modified extender sample 1	94.39	-1.31	3.34
Modified extender sample 2	93.85	-1.4	3.92
Modified extender sample 9	88.73	0.06	8.80
Modified extender sample 11	90.26	0.19	9.97

L*a*b* values were determined for all formulations containing either bio-based extender alternatives or standard calcium carbonate/talcum extender systems. A selection is presented in the table above.

Other performance parameters were determined for these bio-based formulations and summarized on other submissions.

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.

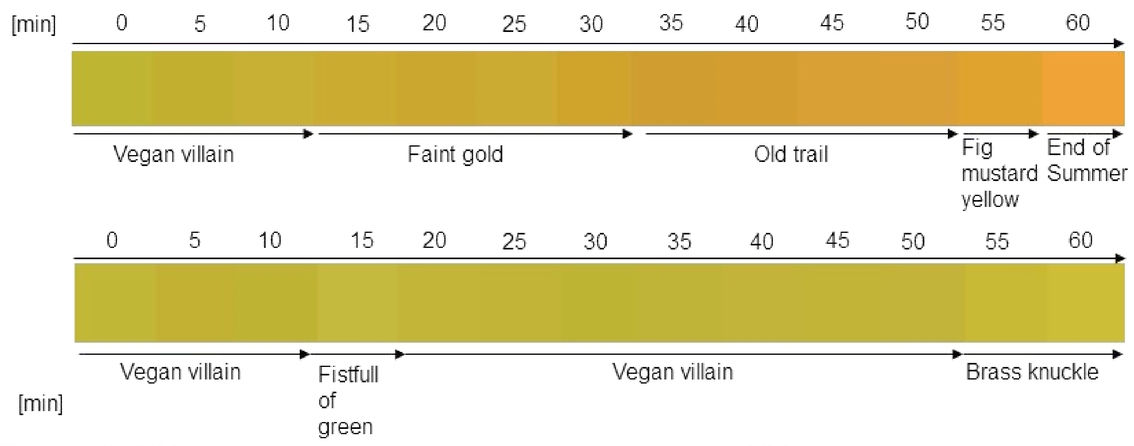

Figure 3: UV-sensing bio-hybrid coatings after after UV exposure (top) or stored in the dark (bottom).

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.

Marosevic, M. et al., 2024, *The Vegan Villain awaits The End of Summer: Functionalized coatings as biohybrid UV-sensors*, in preparation

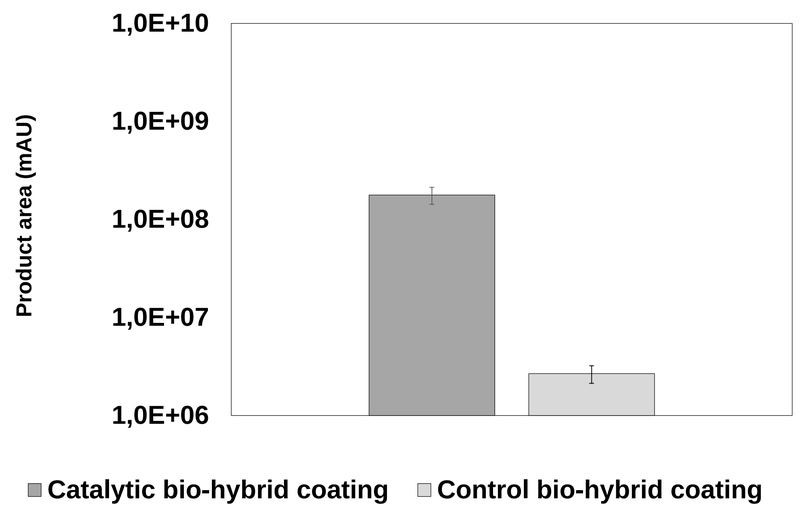

Figure 4: Catalytic bio-hybrid coating able to degrade volatile organic compounds compared to non-functionalized bio-hybrid coating.

Microbial cell mass genetically engineered to degrade halogenated volatile organic compounds lent this property to final dried coatings. The activity was observable for several months storage at ambient conditions.

Skopp A., et al., 2024, *Catalytic Bio-hybrid Coating-based Degradation of Haloalkanes in the Gas-phase*, submitted

Concluding remarks

Using biomass as non-functionalized extender replacement is an interesting approach to increase the amount of bio-based content in coatings and to reduce the reliance on fossil resources. However, further development on these extender is still required to fulfill current performance parameters. Biomass can be integrated into standard indoor wall paints and replace either portions or the entire amount of extenders. Genetically engineered biomass can give rise to formulations and final dried coatings with special functions such as sensing of catalytic abilities. These experiments can be seen as proof-of-concept for larger applications.

This project has received 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.

perfecoat-project.eu