PERFECOAT

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

Bio-based coating formulation and application testing

Bio-based Innovations for Industrial Applications
24 April 2024

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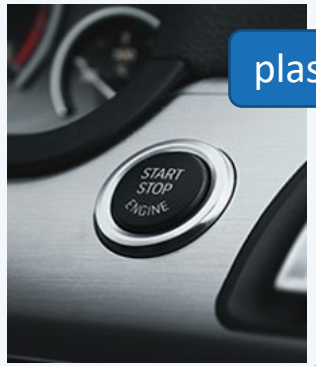
Paint & Coating Fundamentals

Coatings are everywhere!



plastic

glass

mineral substrate

paper

wood

metal

leather

Overview on typical coating components

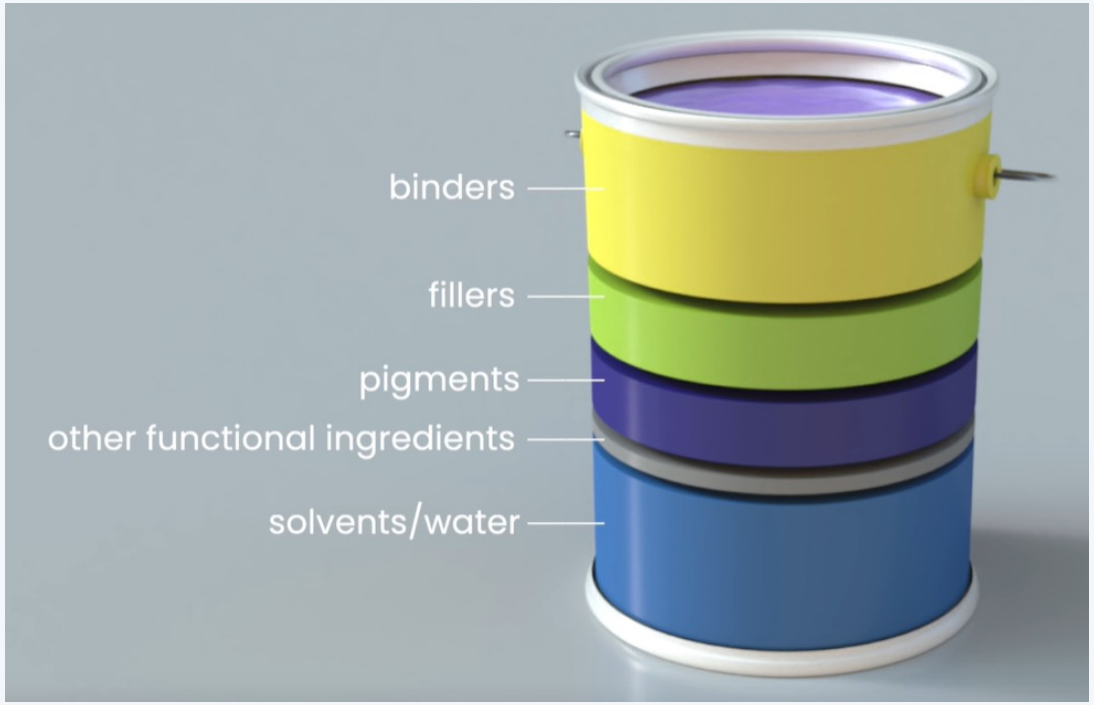
Binders: provide film forming, major impact on durability and mechanical resistance of coatings and mechanical properties.

Fillers: powder material used to fill and give body to the coating, influence mechanical film properties, hiding power, etc.

Pigments: solid, powder particles that provide color to the coating

Additives/functional ingredients: materials used in very small amount to control specific properties and increase the quality of the coatings

Solvents/water: enable a smooth production of the coating and ensure good processability. The PERFECOAT project focuses on the development of water-based or solvent-free coatings



Testing of basic properties

Bio-based fillers: Assessment of the basic properties within an architectural coating formulation
Key properties: Decorative aspect / White color / Mechanical resistance

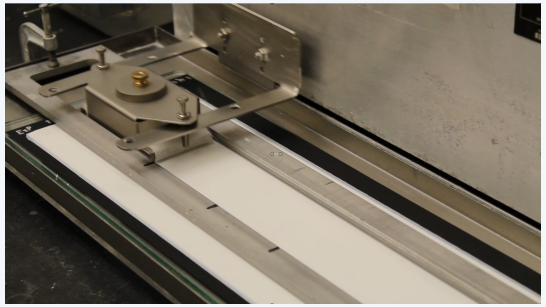
Test formulation

Matt wall paint	Amount in g
Water	42,76
TEGO® Dispers 711W	0,25
TEGO® Foamex 18	0,25
CALGON® N	0,05
NATROSOL™ 250BR	0,60
KRONOS® 2190	6,70
SOCAL® P3	12,56
LUZENAC® OOC	5,02
OMYACARB® 5 GU	23,44
ACRONAL® S790	8,37
TOTAL	100,00

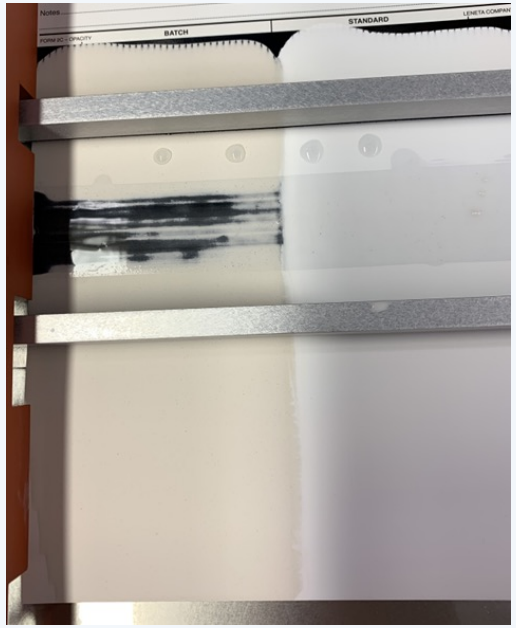
High filler content of 41%

Test equipment

Wet scrub tester



Test result



Color change and lower abrasion resistance of the prototype bio-based filler (left side) compared to the standard (right side)

Testing of basic properties

Micro fibrillated cellulose (MFC) for Architectural Coatings

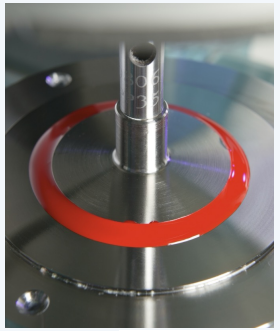
Evaluation of the effect of bio-based fibers (EXILVA®) on rheology and cracking resistance in architectural coatings

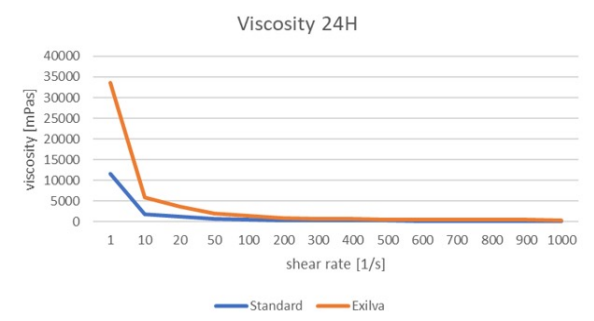
Test formulation

Component	Standard	Exilva
Water	27.6	24,4
CALGON® N	0.1	0.1
Defoamer	0.3	0.3
TEGO® Dispers 715 W	0.3	0.3
TYLOSE® MH 30.000 YP 4	0.4	0
Ammonium hydroxide sol.(25 %)	0.1	0
Exilva F01 V, 10% a.m.		3.6
TIOXIDE® R-TC 90	9.0	9.0
OMYACARB® 10 GU	8.0	8.0
OMYACARB® 2 GU	8.0	8.0
OMYACARB® Extra CL	5.0	5.0
LUZENAC® OOC	2.0	2.0
SOCAL® P3	5.0	5.0
Dissolver 30 min.		
ACRONAL® S 790	32.0	32.0
Texanol	2.0	2.0
ACTICIDE® MBS	0.2	0.2
Acrysol RM2020		1.7
Total	100.00	100.00

Test equipment & result rheology

Use of bio-based MFC allows to adjust the rheological profile in the desired way





Test result

Favourable cracking resistance of thick films

Testing of basic properties

Bio-based pigments in water-based architectural coatings – architectural paints are often white but end consumers also want to be able to obtain various colors

Test formulation for a water-based pigment preparation

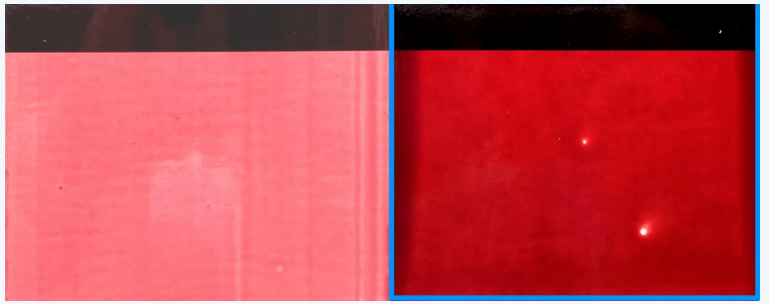
Component	Amount [g]
Demin. Water	44.4
ZETASPERSE® 3800	22.5
TEGO® Foamex 810	1.0
AMP-90	2.0
Pigment	30.0
Parmetol K6	0.1
Total	100.0
AsoP [%]	30

Test equipment

Ultrasonic dispersion method established for small quantity bio-based pigment samples

Test result

Bio-based pigments provide quite intensive colors



Challenge:
Stability of color after long-term storage

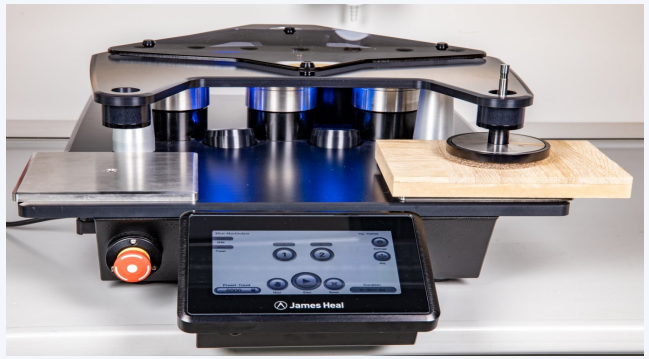
Testing of basic properties

Bio-based filler / functional additive for UV-curable wood coatings

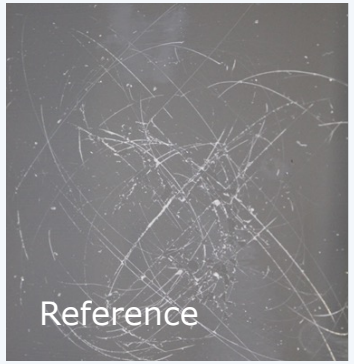
Test formulation

Component	Amount (g)
Ebecryl 5129 (resin)	30
TPGDA (reactive diluent)	33
TMPEOTA (ethoxylated trimethylolpropane, triacrylate - resin)	30
TEGO Rad 2100 (surface control)	0.6
Genocure MBF (initiator)	2.2
Darocure 1173 (Initiator)	2.2
i-Propanol (Diluent)	2.0

Test equipment:
Mini Martindale abrasion tester



Test result

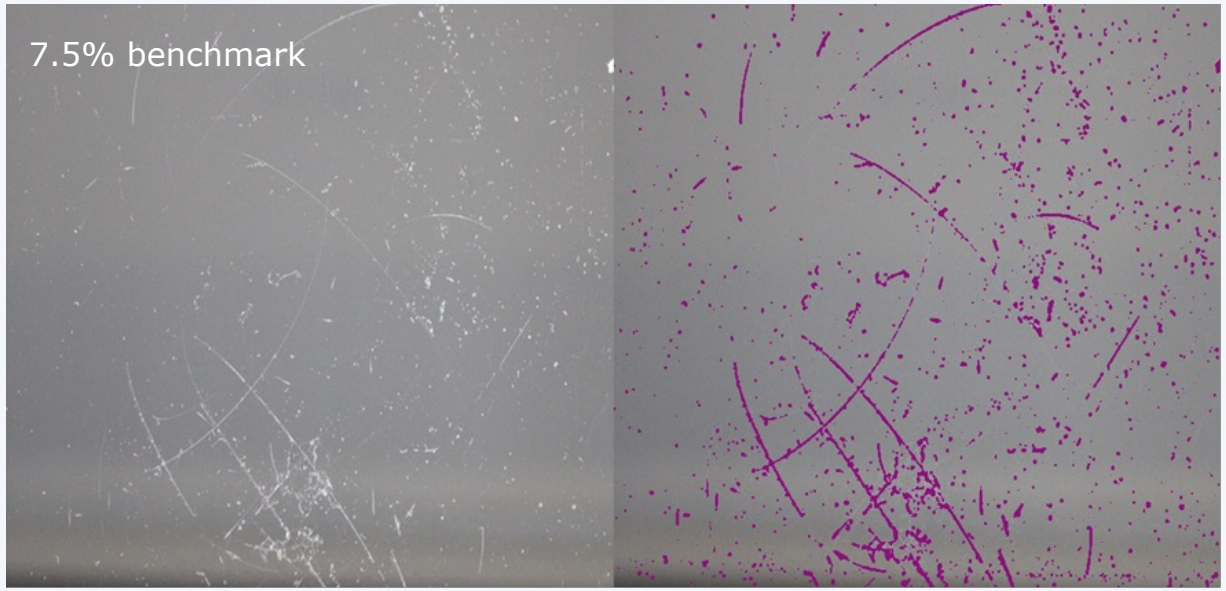


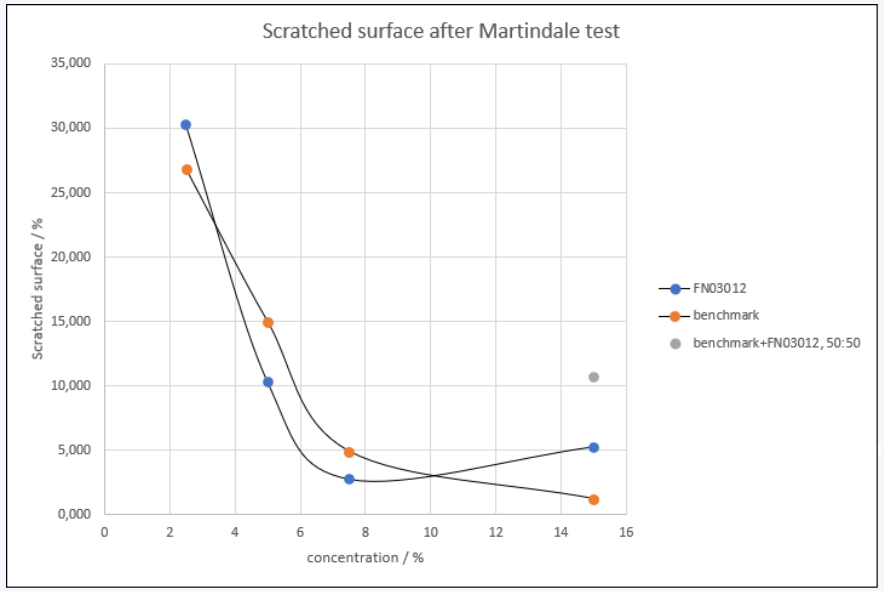
The addition of POSS to the UV wood coating enhances the mechanical resistance

- Less scratches are seen at the surface compared to a reference without POSS

Polyoctahedral silsesquioxanes (POSS) as Filler for UV coatings

Quantitative assessment of scratch resistance





FN03012

- Quantitative assessment of percentage of scratched surface using Evonik proprietary Defect Detection Tool software
- Effect of FN03012 comparable to benchmark
- Optimum concentration around 7.5%
- No synergy between benchmark and POSS

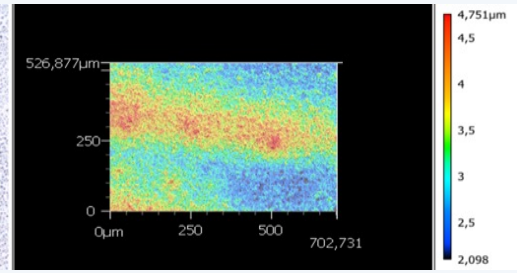
Biomass as Fillers for UV curable wood coating

Assessment of basic properties in model UV-curable coating: Scratch resistance and Matting effect

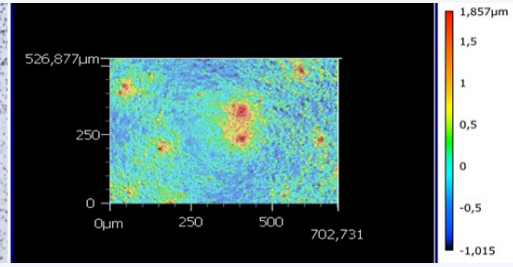
Analyze surface topography with Keyence VK-X 3100 profilometer

Martindale test

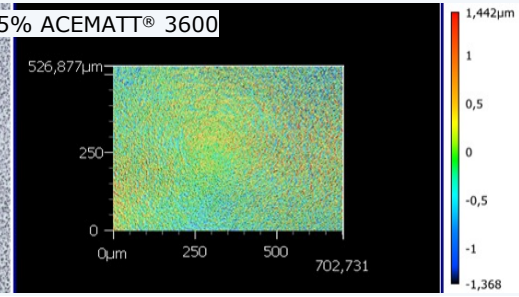
15% ACEMATT® 3600



30% Yeast 3 /10% Carnauba V2



15% Yeast 3 /10% Carnauba V2 + 15% ACEMATT® 3600



Yeast samples (Technische Universität München):
Was treated/bleach and unbleached yeast

Test:
Analyze surface topography with Keyence VK-X 3100 profilometer
Scratch resistance tested with mini-Martindale tester
Gloss measurement
Resistance to water and Ethanol test

Results:
Although the use of wax treated yeast in UV-curable coatings does not give the desired level of matting and scrub resistance, combination with ACEMATT® 3600 can give acceptable gloss and scrub resistance with higher level of bio-based content in formulation.

	gloss		Martindale / rough pad	Chemical resistance H_2O (PMMA panels)		Chemical resistance H_2O + Ethanol 1:1 (wood panels)	
	60°	85°	50 rubs	2 h	4 h	2 h	4 h
15% ACEMATT® 3600	23.4	80.7	light damage	ok	ok	ok	ok
30% yeast 3	42.5	82.5	damaged	ok	ok	very soft	very soft
15% yeast 3 + 15% ACEMATT® 3600	27.1	81.9	light damaged	ok	ok	soft	soft

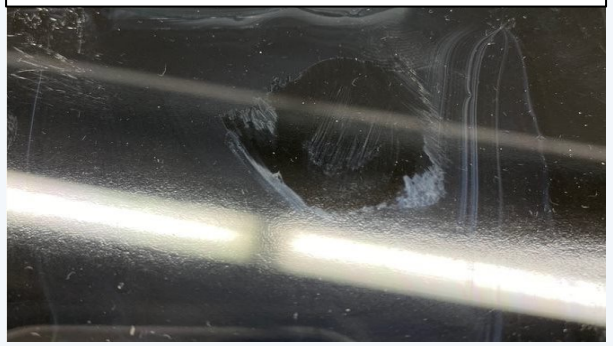
Testing of basic properties

Binders for water-based respectively UV-curable formulations
Oligosaccharides & their film forming properties – modification needed to meet requirements of coating application

Draw-down of aqueous alginate solution shows good film formation

Water resistance test (a water droplet is placed onto dried film and removed after short waiting time)

Alginate (2% solution)



Xanthan Gum (2% solution)

Challenge: water resistance of non-modified oligosaccharides
The film is degraded due to water redissolution

Summary

- Samples of multiple bio-based components for coating formulations were assessed regarding key properties
- Bio-based pigments could be processed & provide good color development but long-term stability of color not sufficient yet
- Incorporation of bio-based fillers could be easily achieved but mechanical resistance needs improvement
- Bio-based micro fibrillated cellulose shows expected rheology modification as well as benefits in mud cracking performance
- Addition of modified POSS leads to benefits in resistance
- Binder development is a more complex task

Thank you for your attention !