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

Formulation & Testing

Reality Check for New (Greener) Ingredients

Webinar 3

2024-15-13

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.

Formulation & Testing

Content

Formulation of paints and coatings

Introduction to wall and trim paint testing

Testing UV curable wood coatings

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

Formulation of paints and coatings

Webinar 3

Christine Louis, Evonik Coating Additives

2024-05-13

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.

Main ingredients

Binders

Solvents

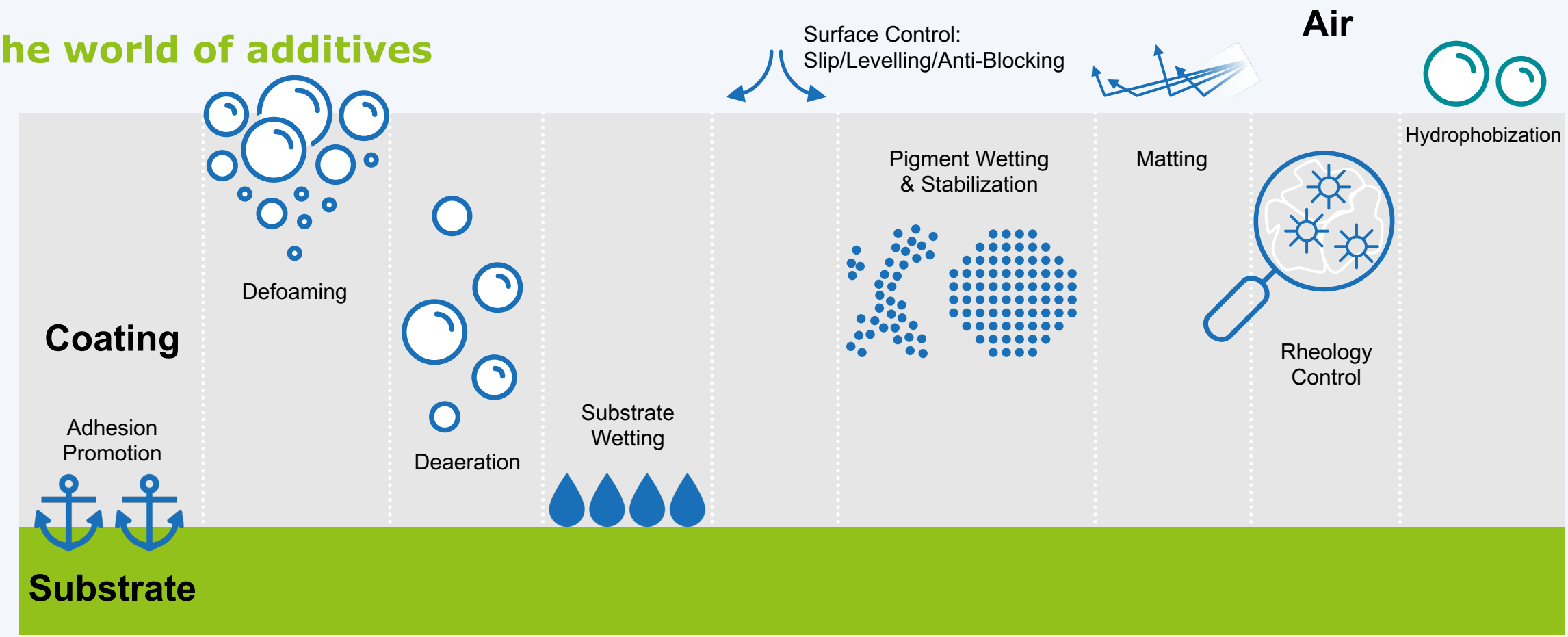
Pigments

Fillers

Additives

Formulation & Testing

The world of additives



Formulation of Architectural Coatings

Architectural coatings guide formulation

Description: interior matt wall paint

Parameters	Values
PVC	60,3%
VOC (g/l) wet	14
VOC (g/l) dry	35
Density (wet, calcul.)	1,513 g/ml
Total Solids	57,9%
Vol. Solids	39,3%

1st Step: Grind

2nd Step: Letdown

Ingredients	Function	Dosage (g)
Water	Solvent	279,0
Natrosol™ 250 HR	HEC thickener	4,0
NaOH 48 %	pH stabiliser	2,0
DISPERSANT K 850	Polycarboxylate dispersant	6,0
CALGON® N (%10 sol.)	Polyphosphate dispersant	5,0
TEGO® Foamex 825	Defoamer	2,0
KRONOS® 2310	Titanium dioxide	145,0
OMYACARB® 2µ	Calcium carbonate	123,0
OMYACARB® 5µ	Calcium carbonate	153,0
Talc	Extender	40,0
Propylene Glycol	Solvent	9,0
ORGAL® P 036V (50% s.c.)	Acrylic emulsion binder	**220,0**
Water	Solvent	10,0
TEGO® Foamex 825	Defoamer	1,0
ACTICIDE® MV	Biocide	1,0
TEGO® Viscoplus 3030	Associative thickener	adjust
Total		**1.000,0**

Formulation of Trim Paint

Trim paint guide formulation

Description: Interior/exterior semi-gloss trim paint for wooden substrate

Parameters	Values
PVC	25,1%
VOC (g/l) wet	19
VOC (g/l) dry	52
Density (wet, calcul.)	1,294 g/ml
Total Solids	47,9%
Vol. Solids	35,6%

1st Step: Grind

2nd Step: Letdown

Ingredients	Function	Dosage (g)
Water	Solvent	110,0
TEGO® Dispers 755W	Dispersant	4,5
TEGO® Foamex 812	Defoamer	3,0
Viscoplus® 3010	Associative thickener	7,0
KRONOS® 2310	Titanium dioxide	200,0
Kaolin	Filler	50,0
ORGAL® P 838W (46% s.c.)	Acrylic emulsion binder	**476,7**
DPnB	Solvent	7,2
DPM	Solvent	7,2
TEGO® Wet 296	Wetting agent	0,1
TEGO® Foamex 1488	Defoamer	1,0
Water	Solvent	126,7
Acticide MV	Biocide	1,0
Viscoplus 3030: Water : PG (1:1:1)	Associative thickener	5,6
Total		**1.000,0**

Formulation of UV Coatings

UV-Sealer, transparent for roller-coating guide formulation

Key parameters:

-Viscosity: 500-3000 mPas

-Reactivity: 1x Hg 120 W/cm @ 20 m/min line-speed

-Hardness vs. flexibility

Ingredients	Function	Dosage
Epoxyacrylate	main resin / 60 Pas / f=2	**25%**
TMPEOTA	diluting oligomer / 100 mPas / f=3	**40%**
Inorganic extenders	e.g. talcum, calciumcarbonate	**30%**
Additives	e.g. defoamer, dispersing agent	**1%**
Photoinitiator	e.g. IRGACURE® 184	**4%**

Formulation of UV Coatings

UV-Sealer, transparent for roller-coating guide formulation

Key parameters:

-Viscosity: 300-900 mPas

-Reactivity: 1x Hg 120 W/cm @ 30 m/min line-speed

-Hardness vs. flexibility

-Chemical resistance+

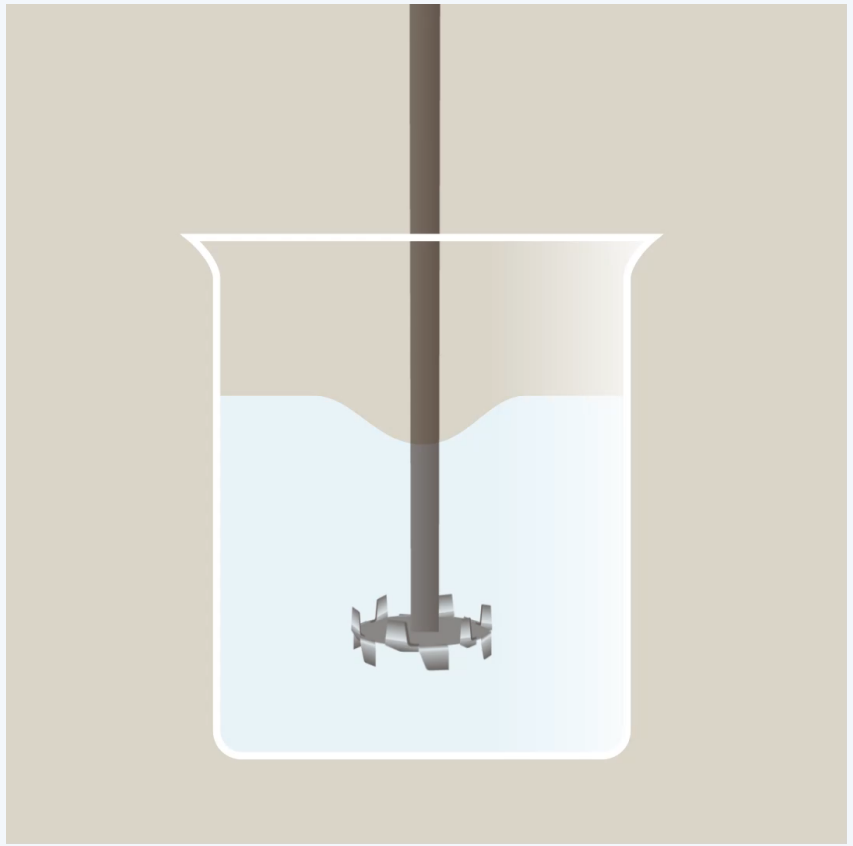
Mechanical resistance

Ingredients	Function	Dosage
Epoxyacrylate	main resin / 60 Pas / f=2	**30%**
TMPEOTA	diluting oligomer / 100 mPas / f=3	**15%**
DPGDA	diluting monomer / 20 mPas / f=2	**25%**
Inorganic extenders	e.g. talcum, calciumcarbonate	**10%**
Matting agent	e.g. silicondioxide	**10%**
Additives	e.g. defoamer, dispersing agent	**2%**
Photoinitiator	e.g. IRGACURE® 184	**5%**

1st step: grind

The dispersion mechanism

- Pigments and fillers particles are reduced to minimum particle size and stabilised
- A defoamer is used to support air removal.
- A thickener can be added to avoid sedimentation of the particles



The challenges of the dispersion mechanism

Fast wetting of powders helps to optimize production speed & avoid challenges with dust formation

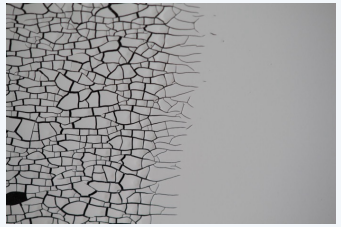
Standard dispersant

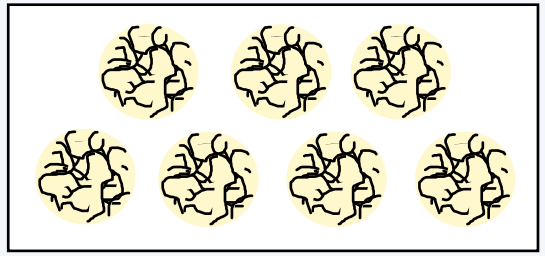
Standard dispersant + wetting additive

Second step: Letdown

Addition of the binder and solvents

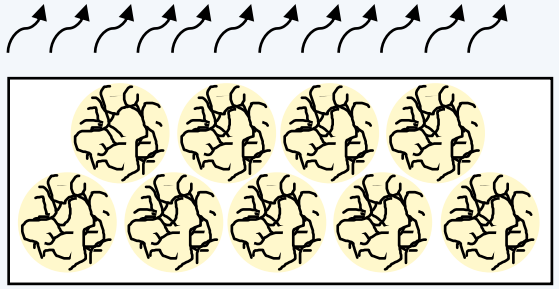
Film formation mechanism





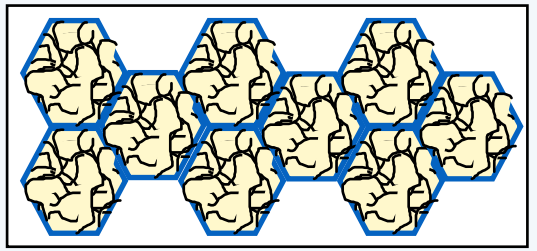
1. Coating applied; polymer spheres dispersed in water

Initial bulk water evaporation and particle packing



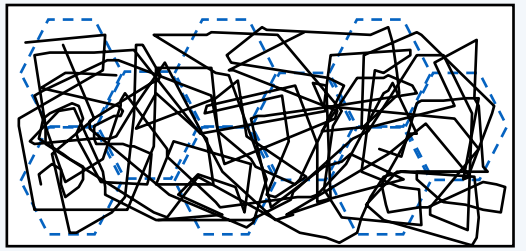
2. Close-packed particles with water-filled interstices

Continuing evaporation, initial particle compaction



3. Initial film formation with compacted particles

Inter-particle diffusion of polymer chains

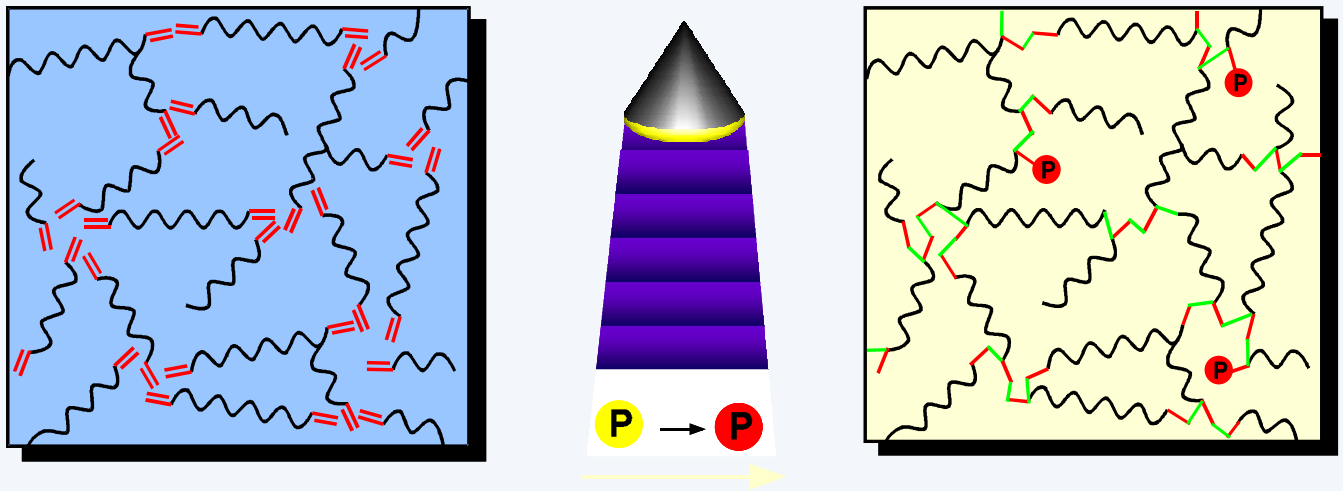


4. Isotropic polymer film (coalescence)

R.M.Rynders, C.R.Hegedus, A.G.Gilicinski, *Journal of Coatings Technology*, ***67***, *845, 59-69 (1995).*

Second step: Letdown

UV cured wood coating technology



liquid paint:

low molecular reactive components

solid coating film:

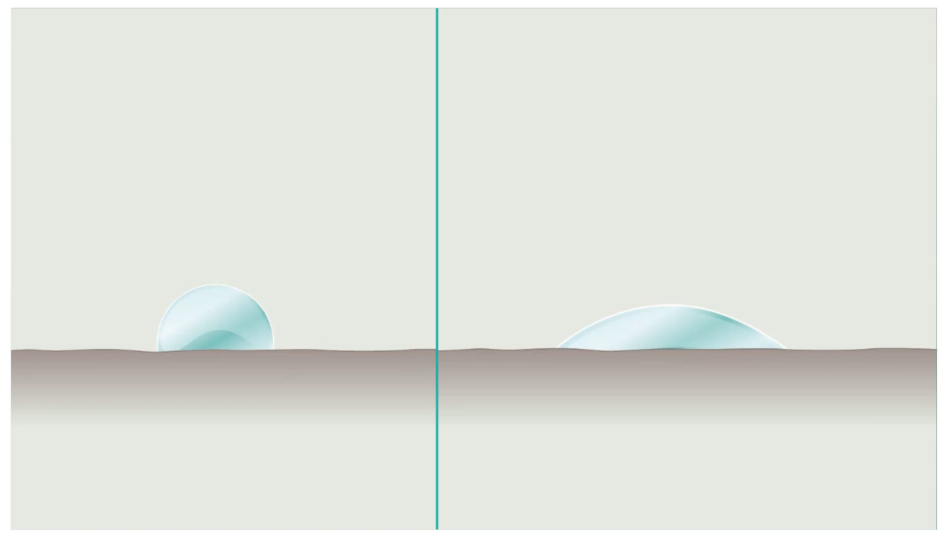
high molecular crosslinked polymer

UV radiation cracks photoinitiator, free radical fragments start the polymerisation reaction of acrylic double bonds

Second step: Letdown

Addition of the wetting agent

- For a perfect wetting, surface tension of the liquid needs to be lower than the surface energy of the substrate or surface that needs wetting.
- Wetting agents are surfactants designed to reduce surface tension, enabling a liquid to more easily cover solid surfaces.



First and Second steps

Addition of the defoamer

Act via a controlled incompatibility

Hydrophobic

surface active

Limited/no solubility in clear coating/thin films

Typical ingredients:

Polyether siloxanes, mineral oils, natural oils

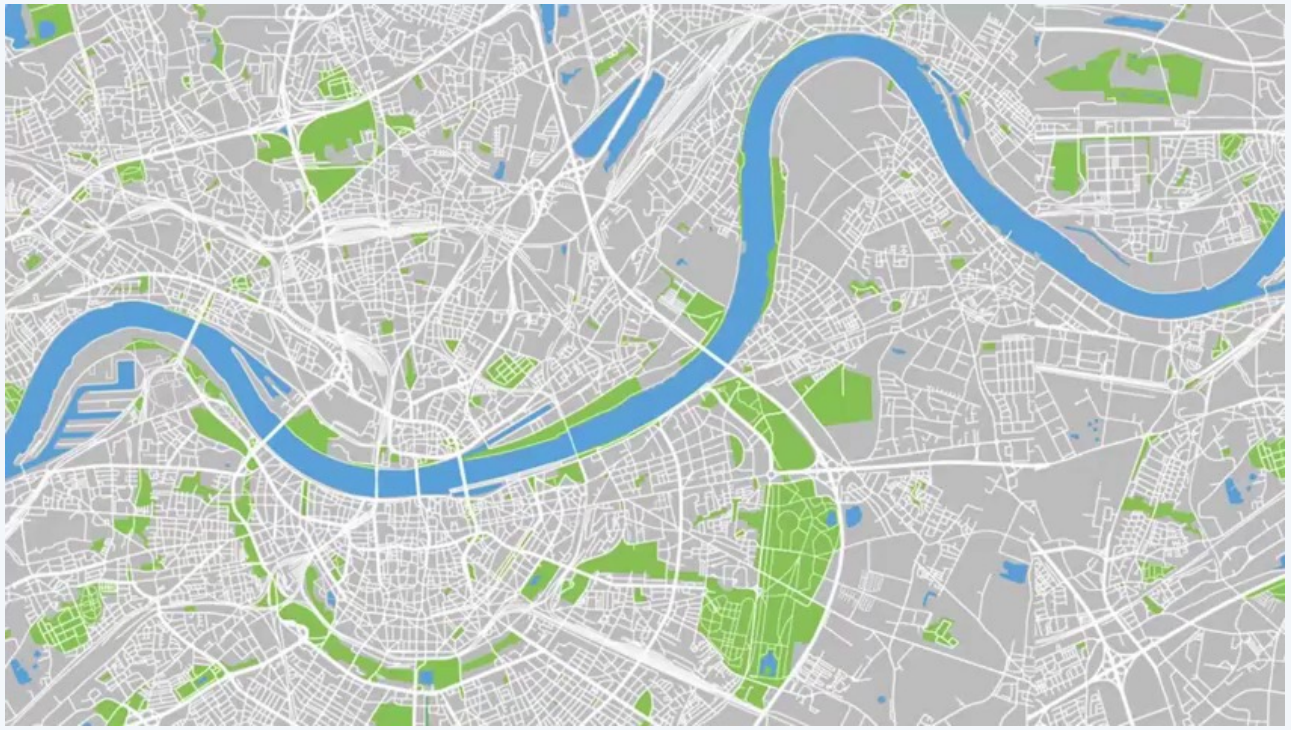
Polymers

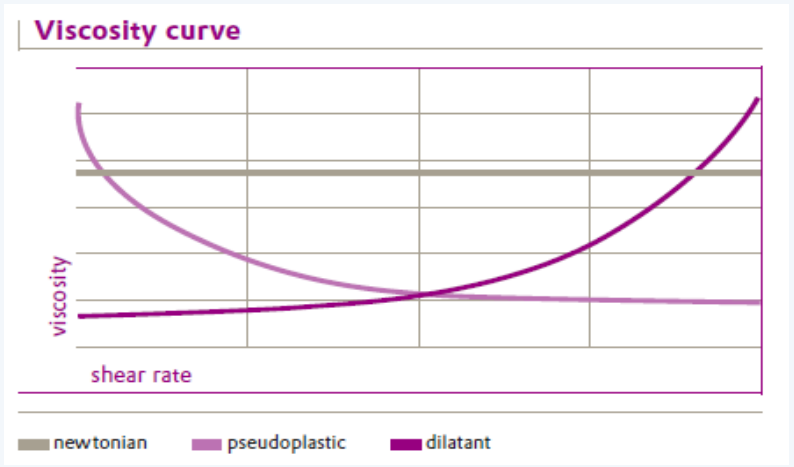
Emulsifiers

Solid particles (e.g. SiO2, urea, wax,…)

First and Second steps

Addition of the rheology modifier

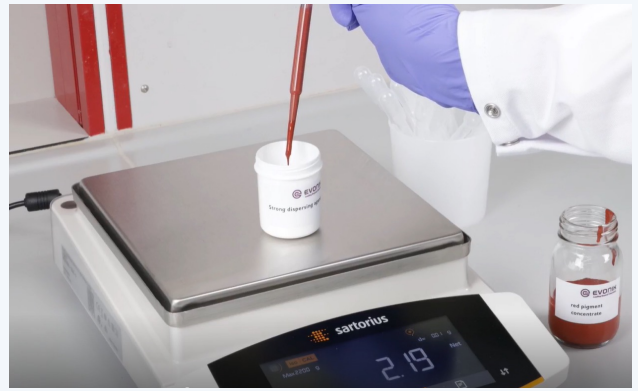


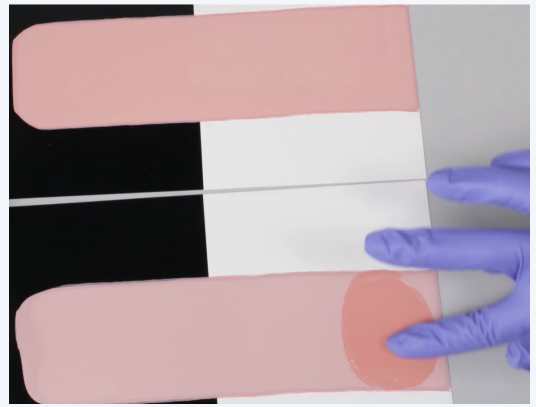


Tinting step

Tinting of a base paint

To reach the desired tint, pigment concentrates are prepared and post-added to the base paint





Challenges :

- Compatibility between base paints and pigment concentrate is key
- Development of the color strength
- Stability in time (color and viscosity)

Thank you for your attention !