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

Introduction to Architectural Coatings and Review of Sustainability Trends

Webinar 1

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Introduction to Architectural Paints

Agenda

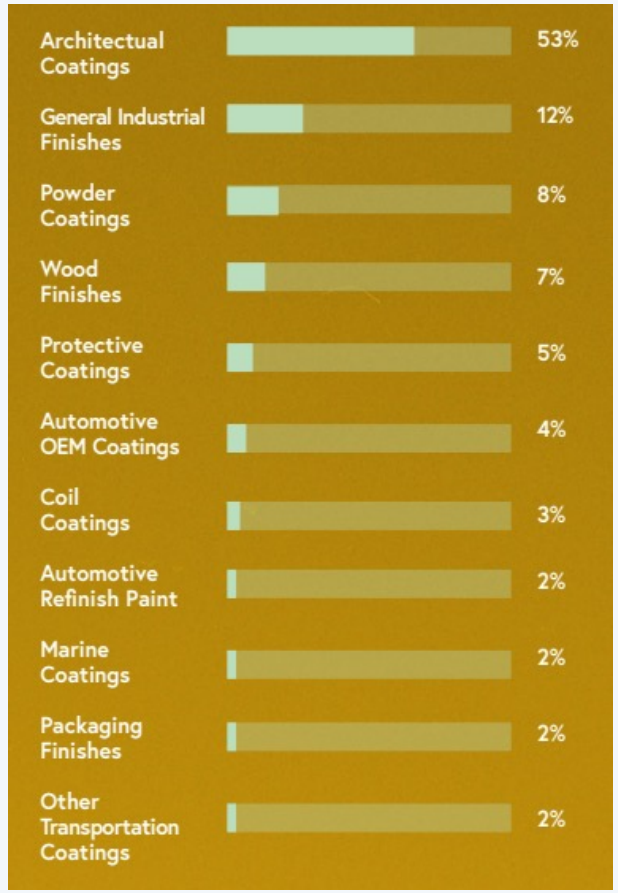
- Definition of architectural paints and segments
- Short introduction of waterbased architectural paint components
- Understanding pigment / binder ratio (PVC) and qualities of paint
- Wall paints & Trim paints properties
- Current sustainability trends in paints
- Definition of biobased binders

Introduction to Architectural Paints

Architectural (Decorative) Paints

‘Decorative paints and varnishes’ means paints and varnishes that are applied to buildings, their trim and fittings, for decorative and protective purposes. While their main function is decorative in nature, they also have a protective role.

(*) Global End Use Market Share (2019)



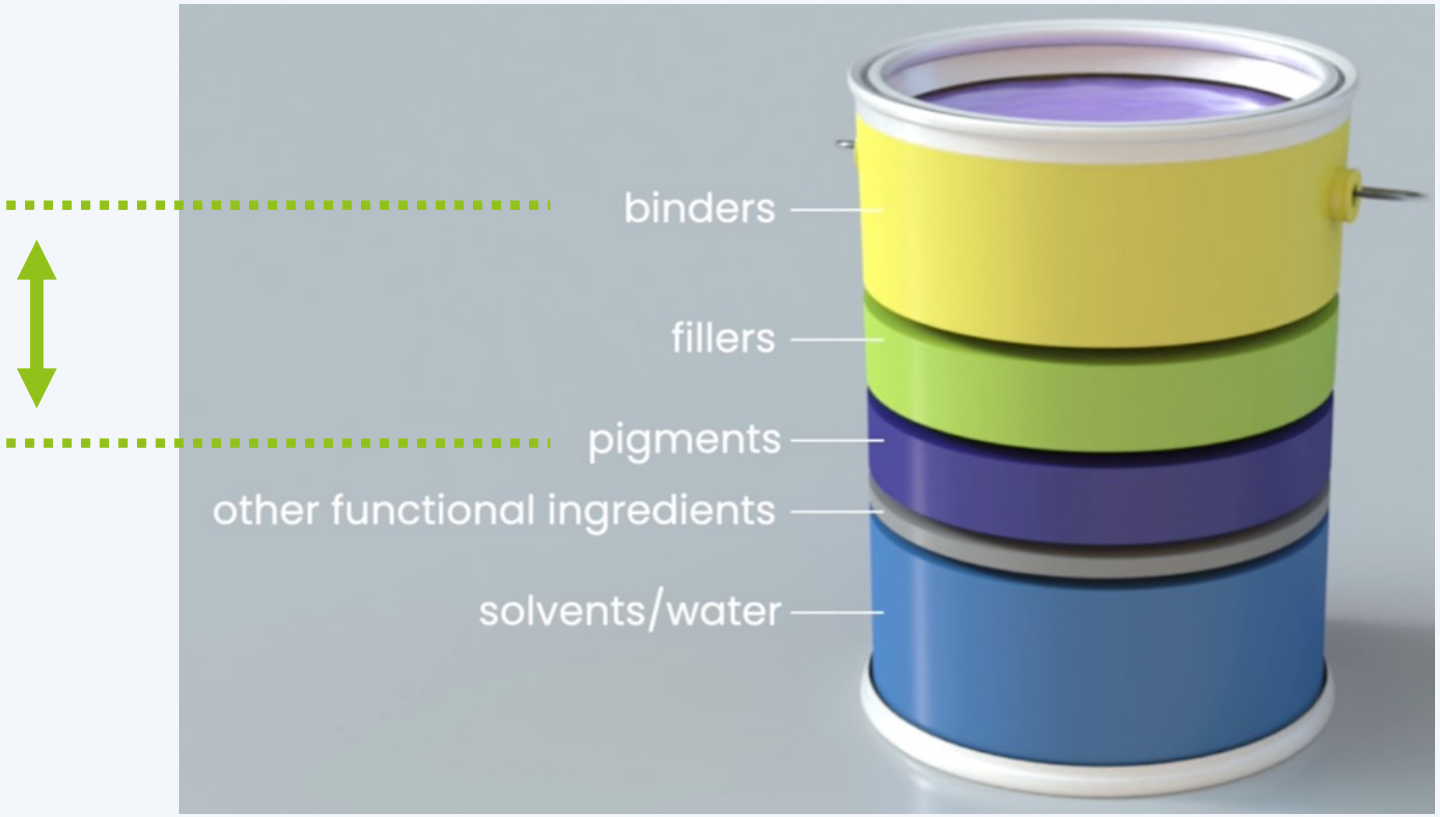
(*): Source: World Coatings Council / Sustainability in the Global paints & Coatings Industry Report
(**): https://www.cepe.org/decorative-coating/what-paint-gives-you/

Introduction to Architectural Paints

Types of Paints and Varnishes in EU Ecolabel
a. Interior matt walls and ceilings (Gloss < 25@60°)
b. Interior glossy walls and ceilings (Gloss > 25@60°)
c. Exterior walls of mineral substrate
d. Interior/Exterior trim and cladding paints for wood and metal
e. Interior/Exterior trim varnishes and wood stains, including opaque wood stains
f. Interior and Exterior minimal build wood stains
g. Primers
h. Binding primers
i. On pack performance coatings
j. Two-pack reactive performance coatings for specific end use such as floors
l. Decorative effect coatings

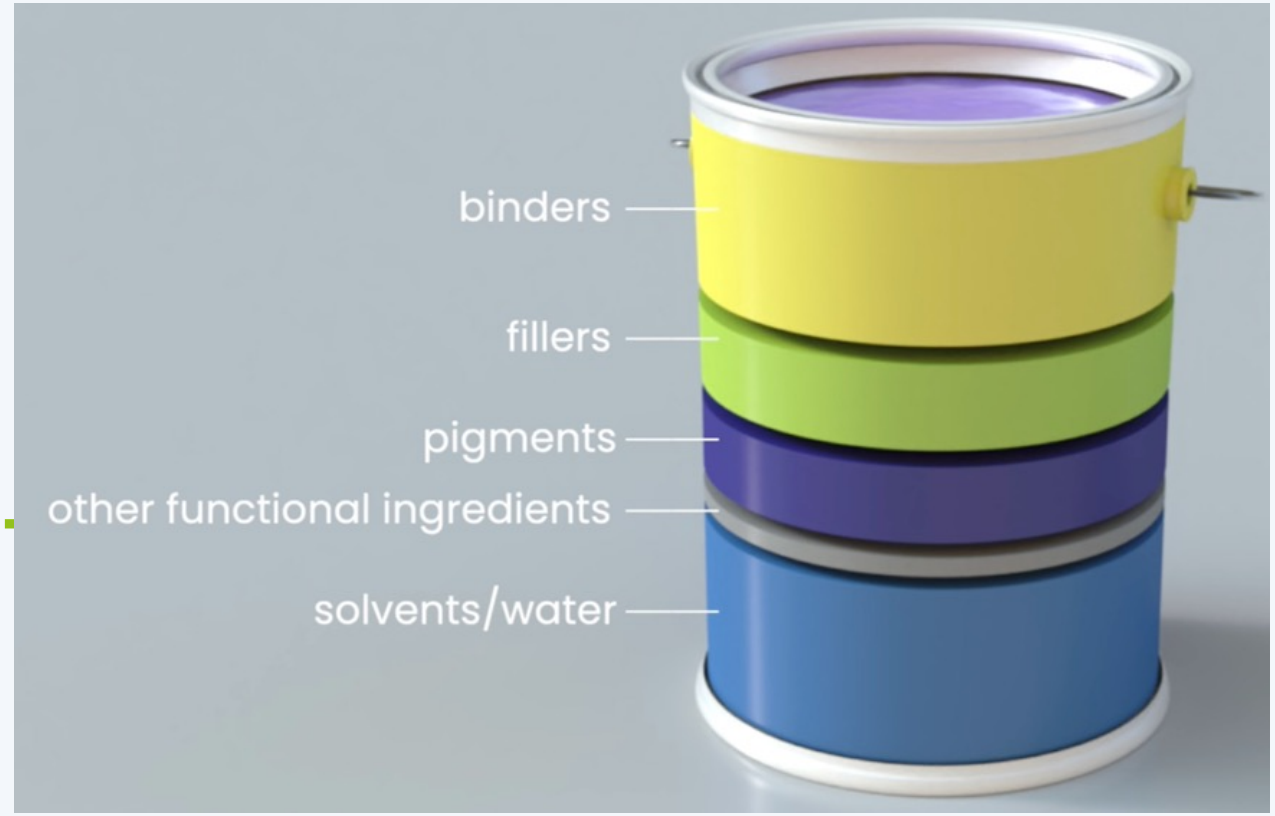
Introduction to Architectural Paints

Varying ratios determines the type of paint



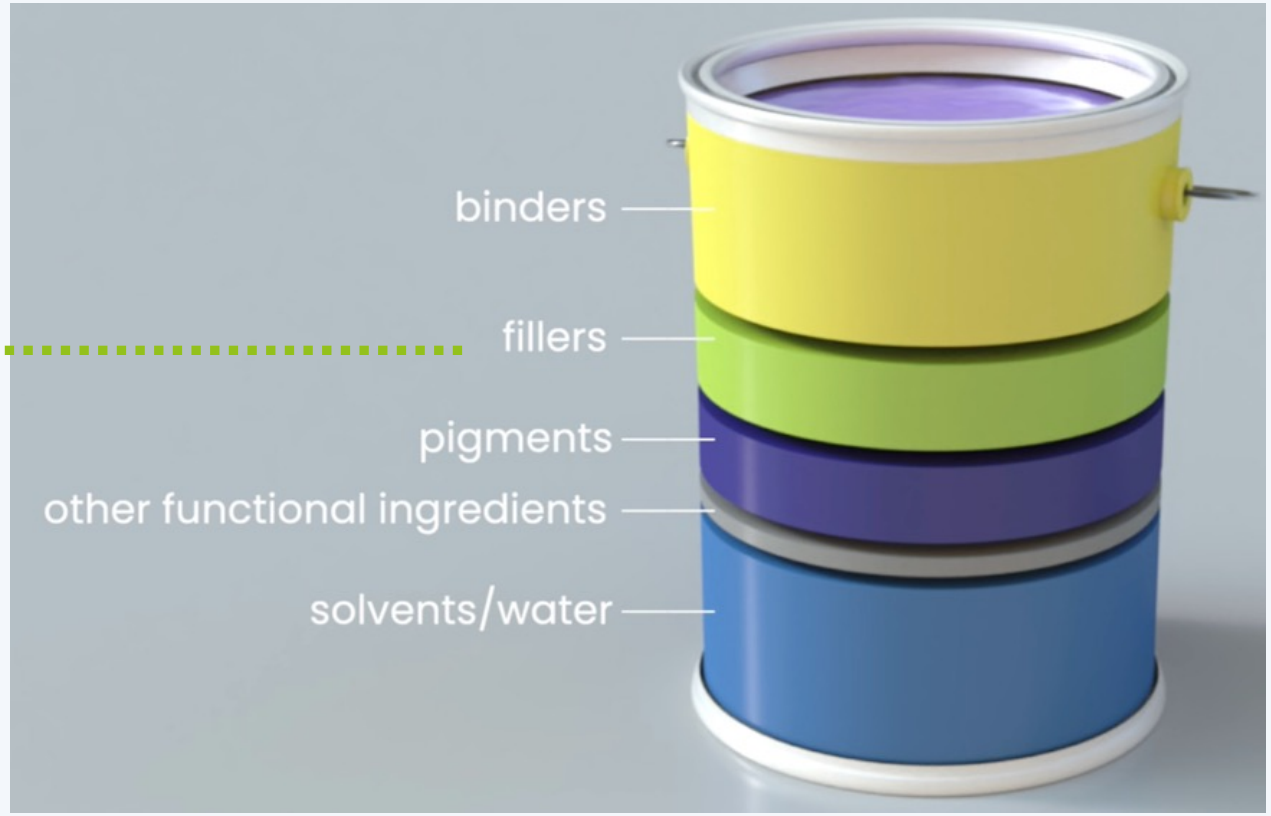
Introduction to Architectural Paints

- Wetting & dispersing additives
- Rheological additives
- Defoamers
- Biocides
- Coalescing agents
- Surface additives
- Substrate wetting additives
- …..



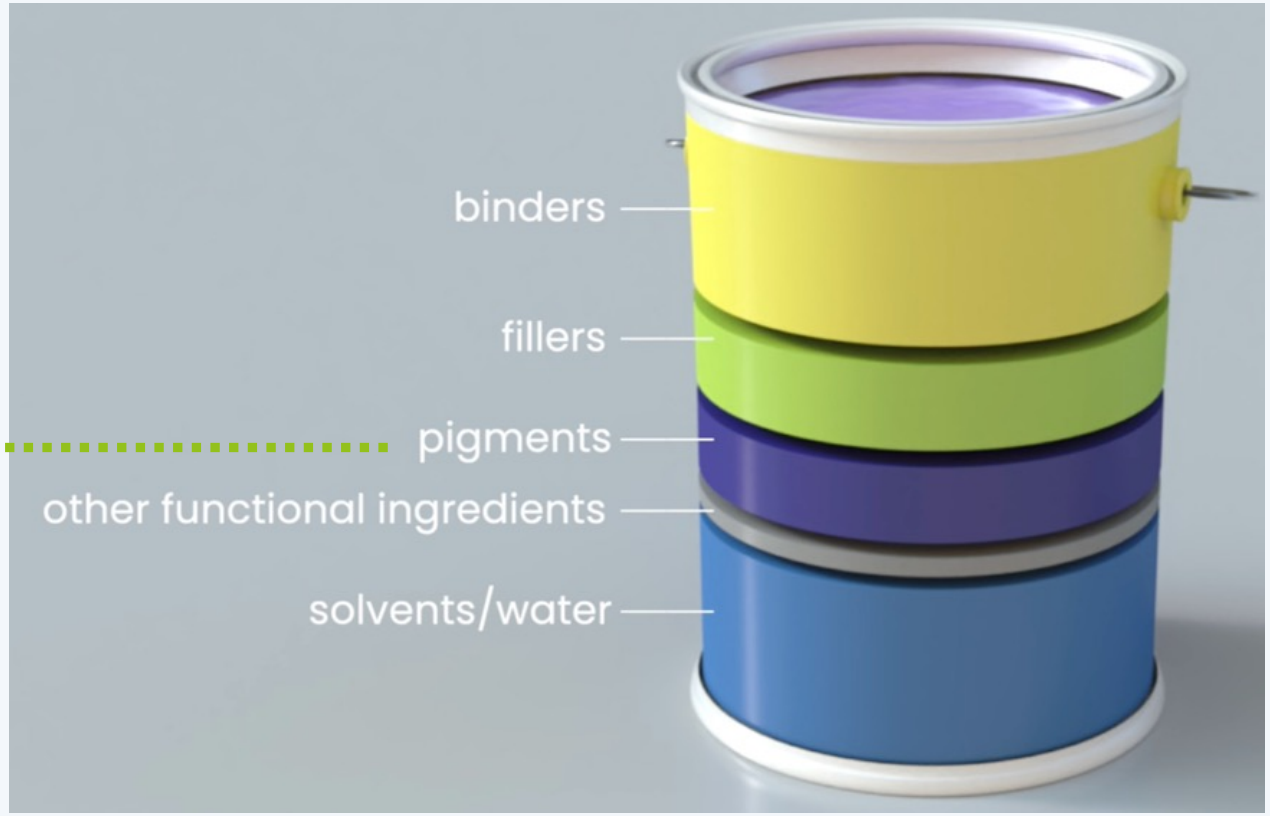
Introduction to Architectural Paints

- Calcium carbonate
- Talc
- Kaolen
- Aluminium silicate
- Mica
- Barium sulphate
- Other silicate fillers
- ….



Introduction to Architectural Paints

- Titanium Dioxide
- Iron Oxides
- Carbon Black
- Phthalocyanine Blue
- Quinacridone Red
- ….



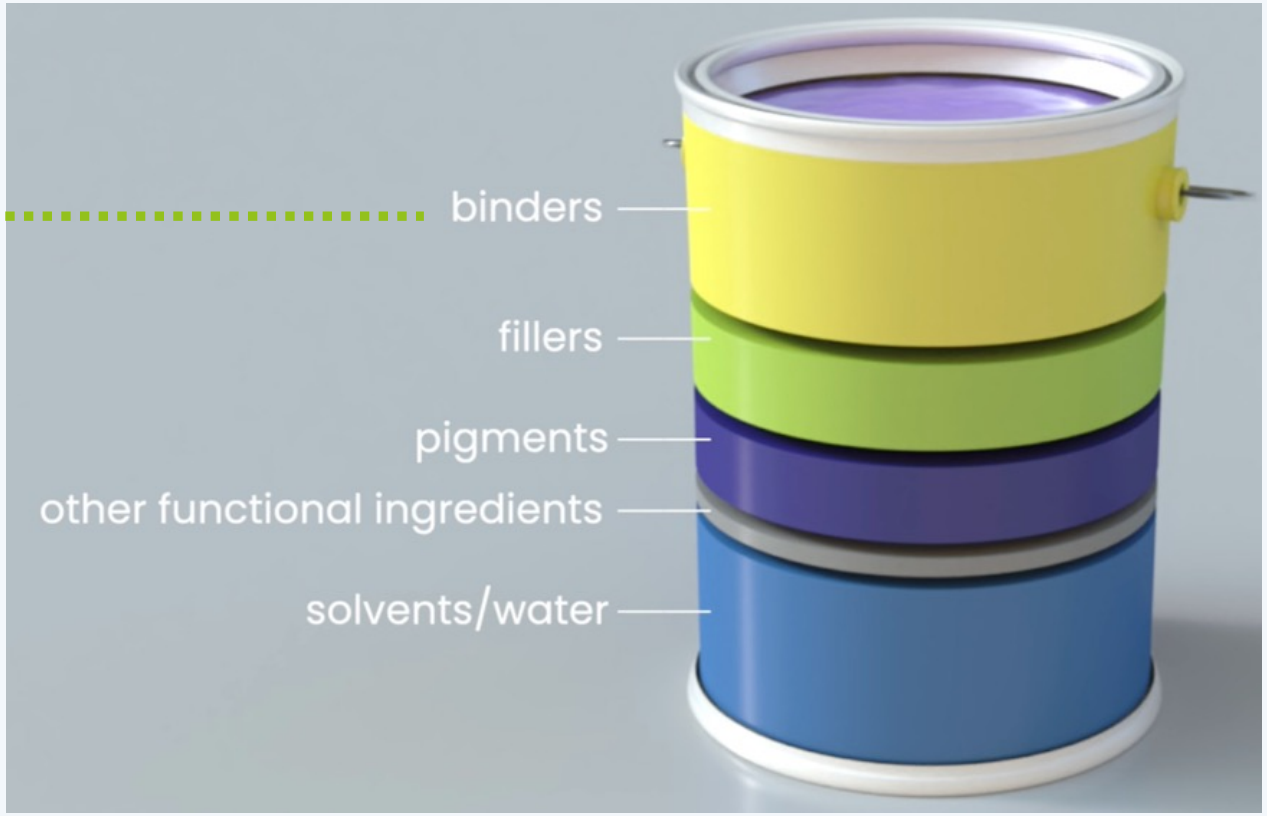
Introduction to Architectural Paints

Emulsion Polymers
- Styrene acrylics
- Acrylics
- Vinyl acrylics
- Vinyl acetate / vinyl ester copolymers
- VAE

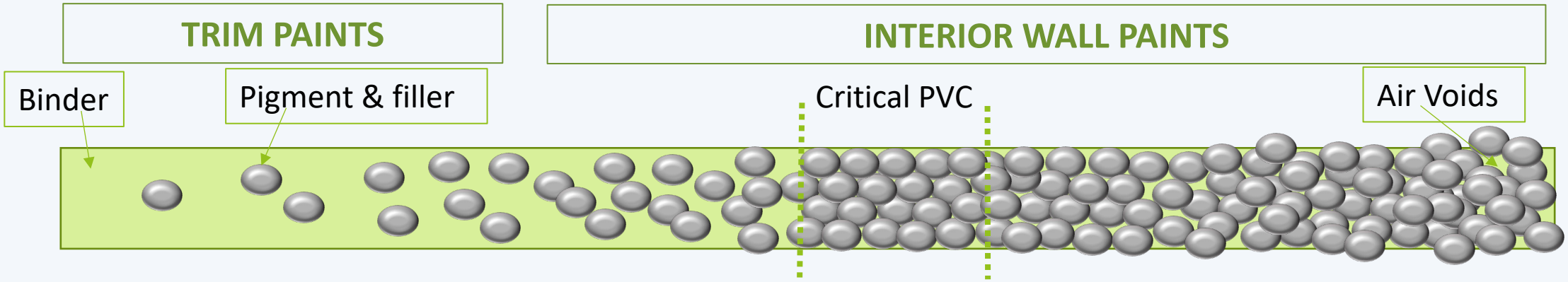
WB alkyds

SBR

Polyurethane dispersions



Relationship of Pigment Volume Concentration & Paint Properties



High Gloss
High wet scrub resistance
High water resistance
High mechanical resistance & barrier properties
Low water vapor permeability (less breathable)
Higher elasticity

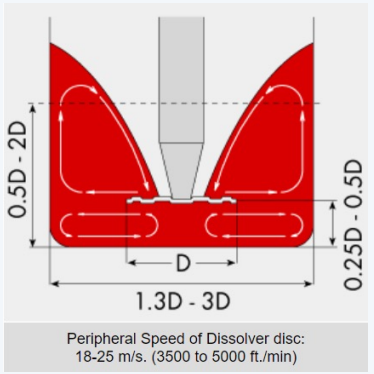
Low Gloss (Matt)
Low wet scrub resistance
Low water resistance
Low mechanical resistance & barrier properties
High water vapor permeability (more breathable)
Lower elasticity

Production of Waterbased Wall Paints

	Component	Function	Weight (g)
1	Water	Carrier	275,0
2	PDMS or MO Defoamer	Defoamer	1,0
3	Hydroxy Ethyl Cellulose	Rheology Modifier	4,0
4	NaOH (25%)	pH Stabilizer	2,0
5	Polyacrylic acid salt	Dispersing Agent	6,0
6	Sodium hexametaphosphate (%10)	Ca^{2+} Stabilizer	5,0
7	Titanium Dioxide	Pigment	145,0
8	Calcium Carbonate 2µ	Filler	123,0
9	Calcium Carbonate 5µ	Filler	153,0
10	Talc	Extender	40,0
	Mixing high speed for 20 mins		
11	Orgal P 036V	Binder	220,0
12	CIT/MIT (1,5%)	Biocide	1,0
13	ASE or HEUR	Rheology Modifier	3,0
14	PDMS or MO Defoamer	Defoamer	1,0

GRIND

LETDOWN



Source: http://www.vma-getzmann.com/english/dispersing_&_grinding_know-how/dispersing_with_dissolvers/dispersing_with_dissolvers_0_935_987_1809.html

Film Formation of Waterbased Dispersions

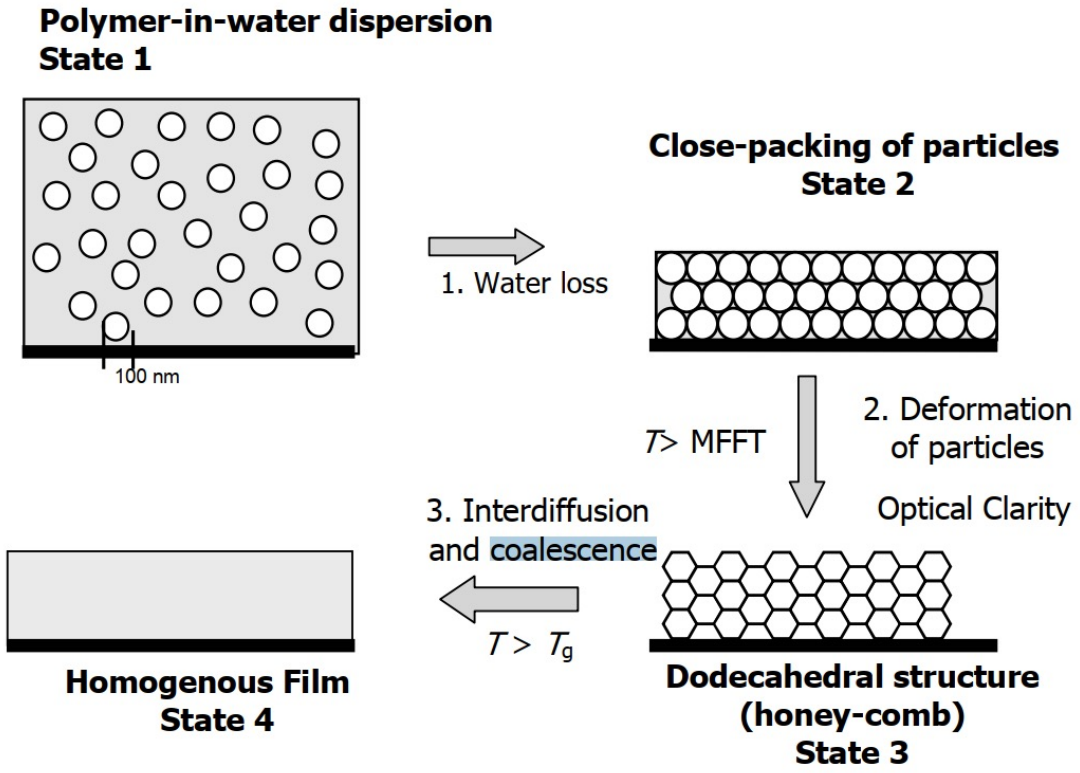
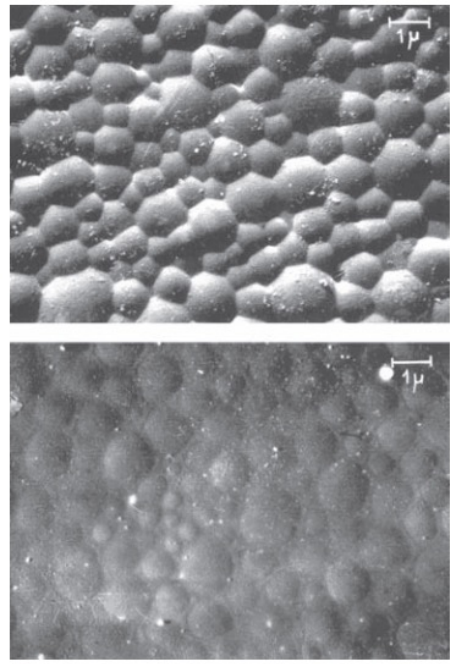


Fig. 1.8 Schematic of the process of film formation: a colloidal dispersion's transition into a continuous polymer film. (Drawing courtesy of Jacky Mallégol, University of Surrey)



- **MFFT (Minimum Film Formation Temperature):** Lowest temperature at which the polymer can coalesce into a continuous film upon drying.
- The MFFT of an emulsion polymer is usually a few centigrade lower than its glass transition temperature (**Tg**)

Source: *Fundamentals of Latex Film Formation, Processes and Properties, Joseph L. Keddie & Alexander F Routh
** Basics of Coating Technology, Goldschmidt / Streitberger

EN 13300 Classification of Interior Wall Paints

WET SCRUB CLASS	CRITERIA (ISO 11998)
Class 1	<5 µm at 200 scrubs
Class 2	≥5 µm and <20 µm at 200 scrubs
Class 3	≥20 µm and <70 µm at 200 scrubs
Class 4	<70 µm at 40 scrubs
Class 5	≥70 µm at 40 scrubs

GLOSS CLASS	ANGLE	REFLECTANCE
Gloss	60°	≥60
Mid sheen	60° 85°	<60 ≥10
Matt	85°	<10
Dead matt	85°	<5

CONTRAST RATIO CLASS	CRITERIA (ISO 6504-3)
Class 1	≥99,5
Class 2	≥98 and <99,5
Class 3	≥95 and <98
Class 4	<95

LARGEST GRAIN SIZE	CRITERIA (EN 13300)
Fine	Upto 100 µm
Medium	Upto 300 µm
Coarse	Upto 1500 µm
Very coarse	Above 1500 µm

Introduction to Trim Paints

- Trim Paints are low PVC paints for trims, moldings, windows, doors, cabinets, furnitures with a gloss of satin, semi gloss to high gloss (can also be matt). Trim paints can be opaque or semi-transparent finishes.

Key requirements

- Excellent levelling for avoidance of brush marks
- Non-yellowing
- Adhesion on wood, mineral, plastics and metal
- Chemical resistance (household chemicals & hand fat)
- Block resistance & hardness
- Open time

Performance Testing of Trim Paints

Typical test methods

EN 927-6 Exposure of wood coatings to artificial weathering using fluorescent UV lamps and water

EN 927-5 Assessment of the liquid water permeability

ISO 2409 Cross cut adhesion test on wood, metal, plastic etc.

ISO 1522 Pendulum hardness

ISO 2812 Paints and varnishes. Determination of resistance to liquids - Method using an absorbent medium

Chemical Resistance test

DIN 68861 Furniture Surfaces - Part 1. Resistance to chemical attack

Sustainability in Architectural Paints

Arhitectural paints segment important milestones:

- Switch from solventborne to waterborne
- Limitations for VOC & SVOC (Indoor air quality)
- Regulatory limitations & bans
  - Heavy metals (Lead, mercury, cadmium, chromium VI...)
  - Biocidal actives (formaldehyde, carbendazim, isothiazolinones)
  - Substances classified SVHC, PBT
  - APEO
  - Phthalates
- Sustainable & Circular (EU Greendeal)

The Chemicals Strategy will:

- **Ensure better protection** of human health and the environment from hazardous chemicals
- **Boost innovation** for safe and sustainable chemicals
- Enable the transition to chemicals that are **safe and sustainable by design**

It is a first step towards the **Zero pollution ambition** for a toxic-free environment announced in the **European Green Deal**.

Source: https://environment.ec.europa.eu/strategy/chemicals-strategy_en#documents

Sustainability in Architectural Paints

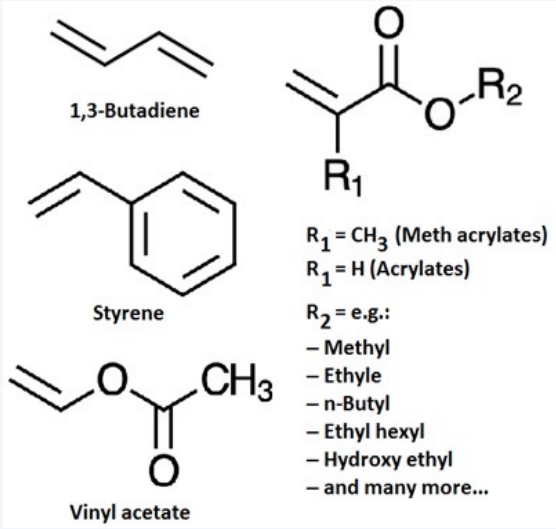
Paint Industry is currently looking

- To improve PCF value of products by less energy intensive & environmetal friendly & circular solutions
  - Biobased binders, recycled materials, biomass balance chemicals
- To reduce biocides and develop biocide free paints (CLP regulation, Blue Angel, Allergy and Asthma Certification...)
- To replace PFAS materials
- Reducing & replacing microplastics
- To Improve durability & efficiency
- To add functionalities like antibacterial, easy to clean, fire resistance..
- To complete Life Cycle Assesment (LCA) data and Environmental Product Declarations (EPD)

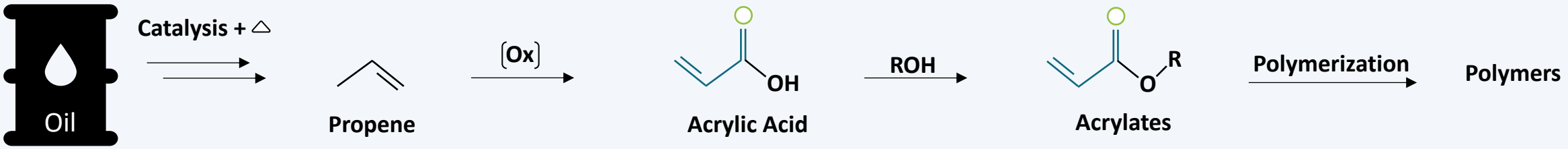
Binders in Architectural Paints

Emulsion Polymers
- Styrene acrylics
- Pure acrylics & acrylic copolymers
- Vinyl acrylics
- Vinyl acetate / vinyl ester copolymers
- VAE

WB alkyds
SBR
Polyurethane dispersions



Binder Technology	(*) PCF kg CO2 eq.
AC	2.0 - 2.7
ST/AC	1.5- 2.0
VA/AC	1.0 – 1.6



Source: https://coatings.specialchem.com/selection-guide/emulsion-polymers-selection-for-paints-and-coatings
(*): Average product carbon footprint values calculated on the basis of Ecoinvent database in Sima Pro software

Biobased Acrylics in Architectural Paints

Biobased Binder Alternatives in Paints and Coatings Market

1. Acrylic Emulsions
    a) **2-Octyl acrylate** from castor oil (73% biobased C14 carbon), **Stearyl (C16-C18) acrylate** (85% bio content), **n-Lauryl (C12) methacrylate** (78% bio content), **Isobornyl acrylate** (75% bio content)
    b) **Biobased Vinyl Acetate** from biobased acetic acid and ethylene
    c) **Biobased acrylic acid** (from sugar by fermentation), **biobased itaconic acid** (lignocellulose biomass by fermentation) etc.
2. Alkyds (fatty acids, glycerol and oil. Linseed oil, sunflower oil, tall oil, castor oil etc.)
3. Polyurethane Dispersions (Biobased polyols based on natural oils)
4. Other biobased binders: Modified starch, lignocellulose, sugars...

THANK YOU !