

Titanium Dioxide Reduction by Kaolin in Decorative Paints

Milano, 03./04. October 2018

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Titanium Dioxide Reduction in Decorative Paints

How Do We Create Opacity in Paint?

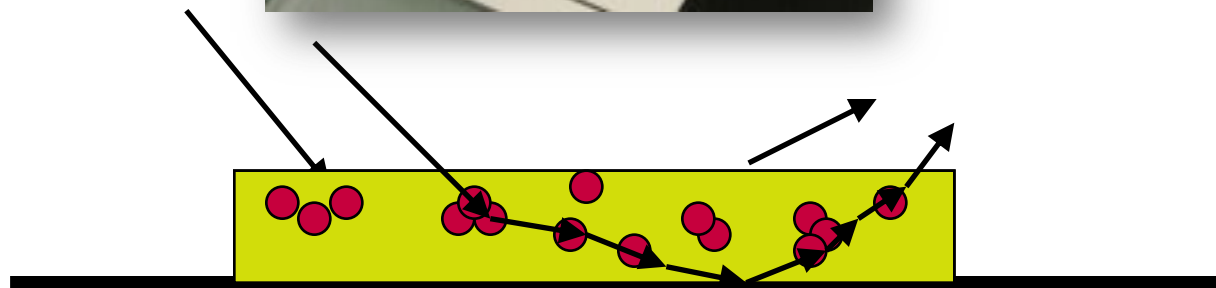
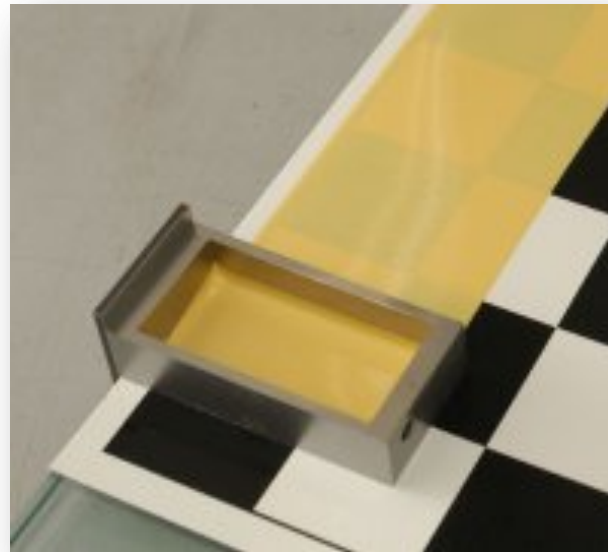
The Effect of Minerals on Opacity

How To Use Kaolin to Reduce TiO_2



Paint Opacity

The ability of the paint film to prevent light from interacting with the substrate.

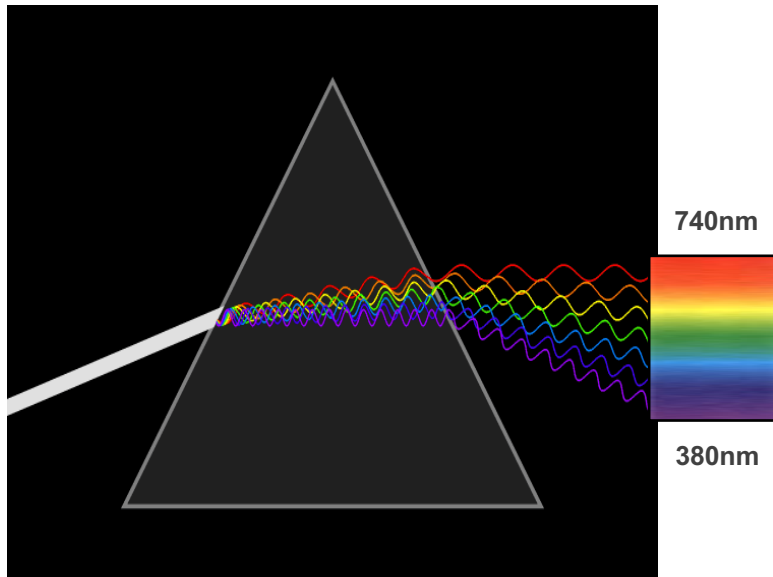


Good Opacity

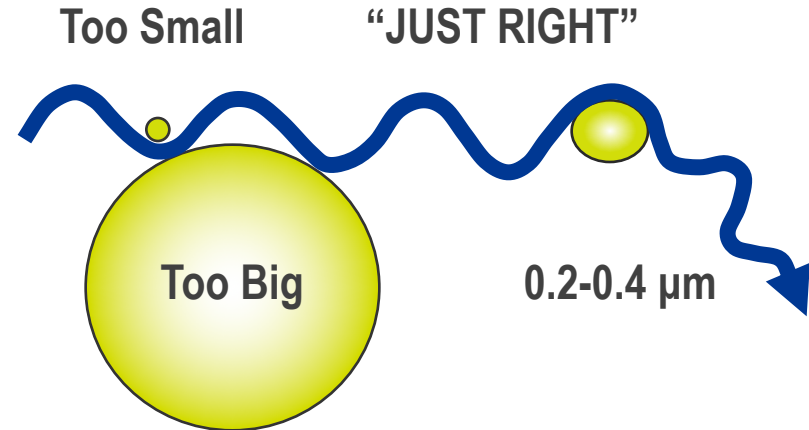
How Do We Create Opacity?

- Complete opacity is achieved when all incident light is reflected back (scattered) or absorbed.
- Light scattering occurs when light changes direction by refraction or diffraction.

Refraction



Diffraction



Opacity in Paints

We achieve opacity in white paints using two different mechanisms:

■ Titanium dioxide

- ◆ Opacity comes from high refractive index white pigment
- ◆ Dominant mechanism in low PVC paints (gloss, semi-gloss, high quality matt)
- ◆ Gives good wet and dry opacity but is expensive
- ◆ Minerals can also improve opacity and allow reduction of high cost TiO_2

■ Dry hiding

- ◆ Opacity comes from air voids in high PVC paint film
- ◆ Dominant mechanism in medium-high PVC paints (medium and low quality matt)
- ◆ Opacity in dry paint only
- ◆ Minerals are a low cost route to higher PVC paints



Titanium Dioxide Reduction in Decorative Paints

How Do We Create Opacity in Paint?

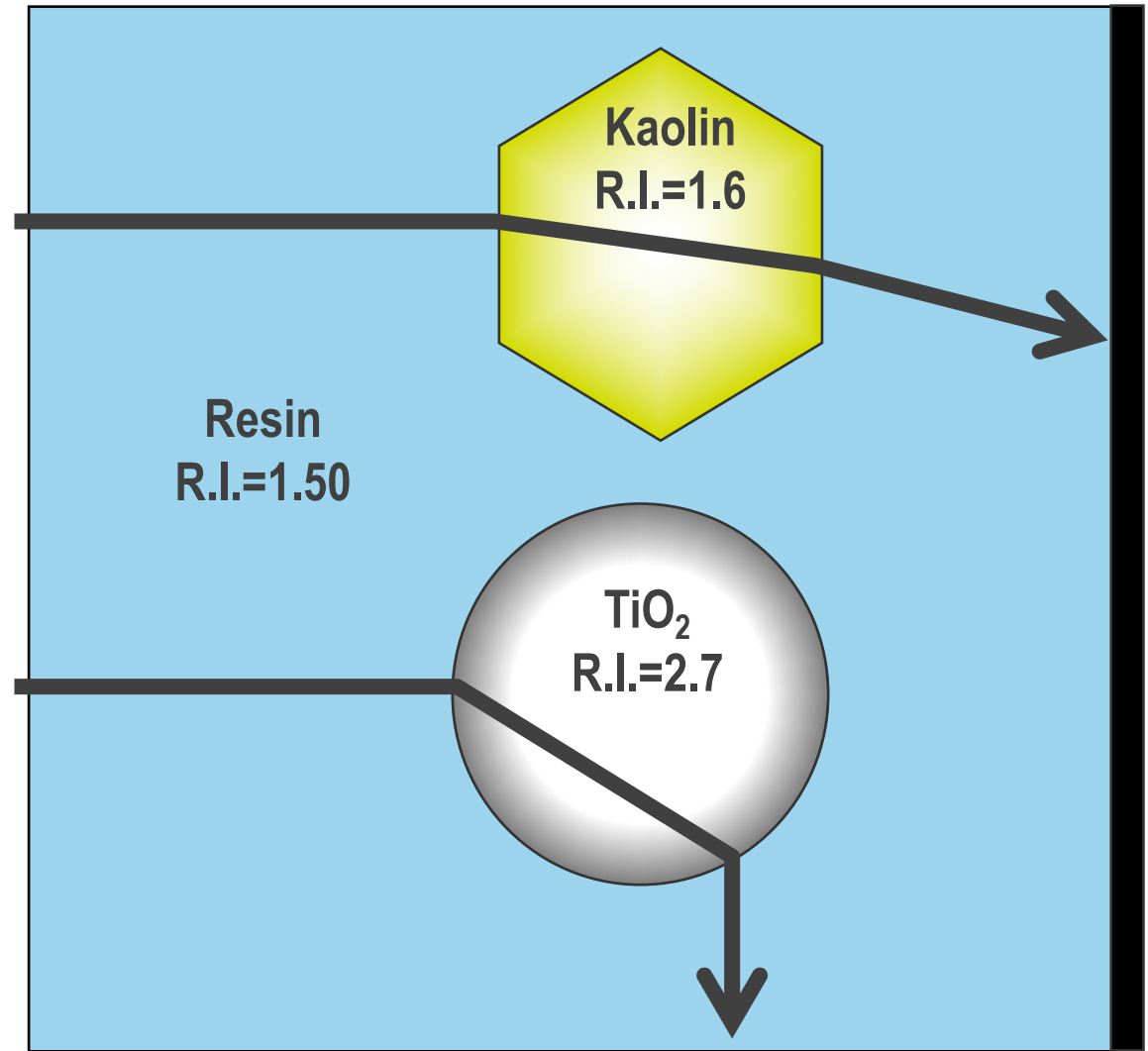
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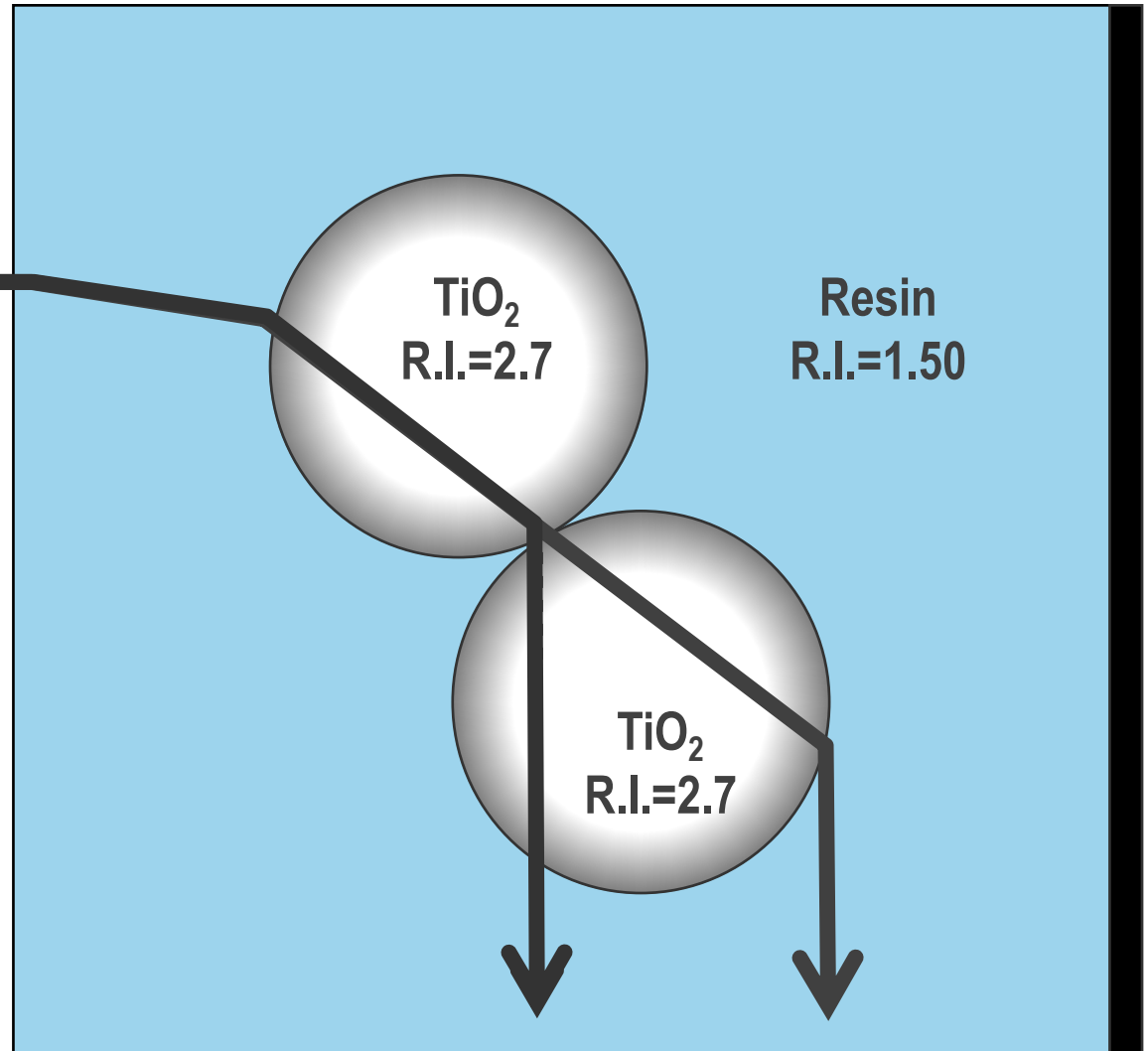
Effect of Refractive Index

Single particles refract light according to their refractive index (R.I.).



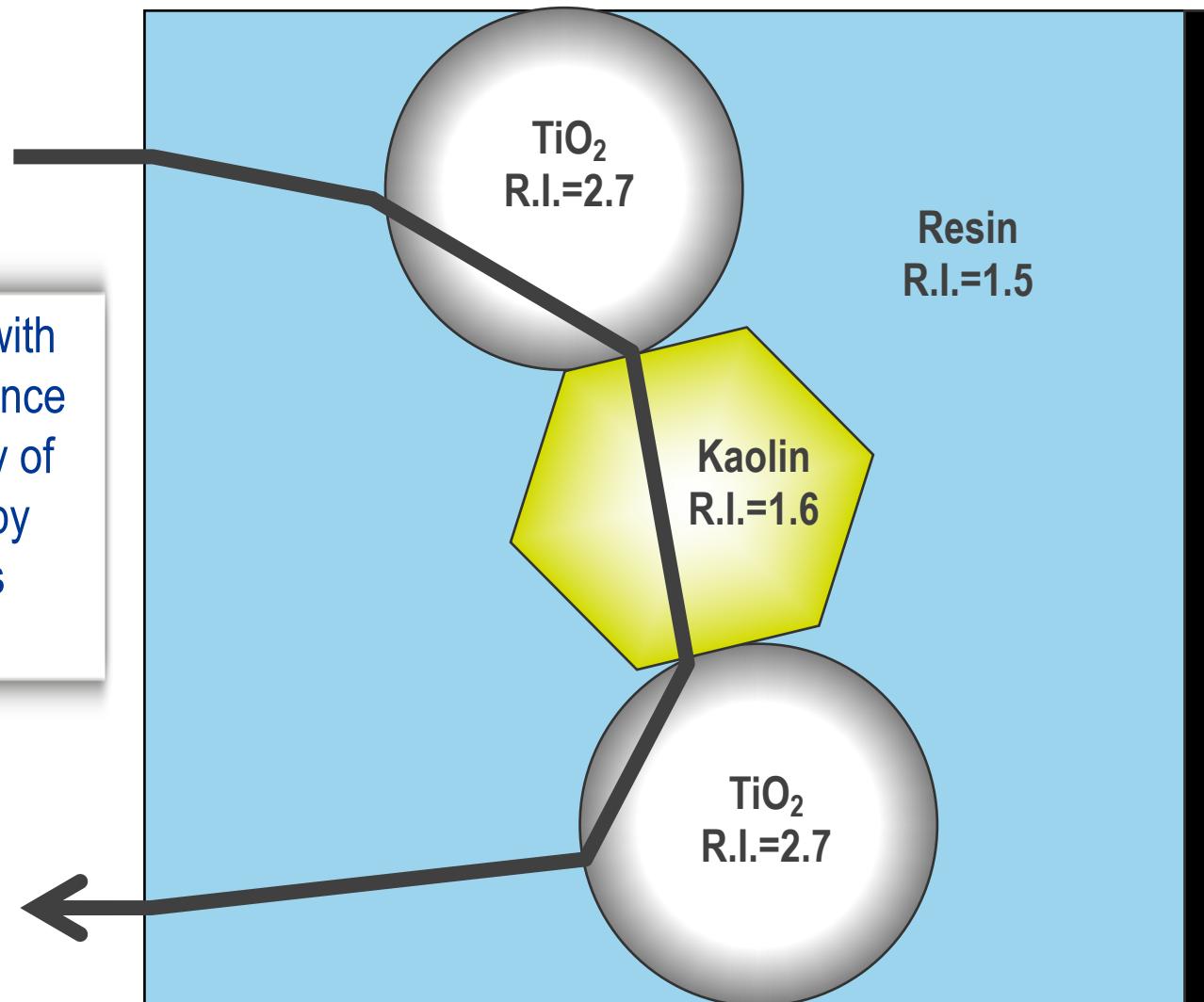
Agglomeration of TiO_2 Particles

Agglomerated particles
behave as one large
particle, reducing scattering
efficiency.

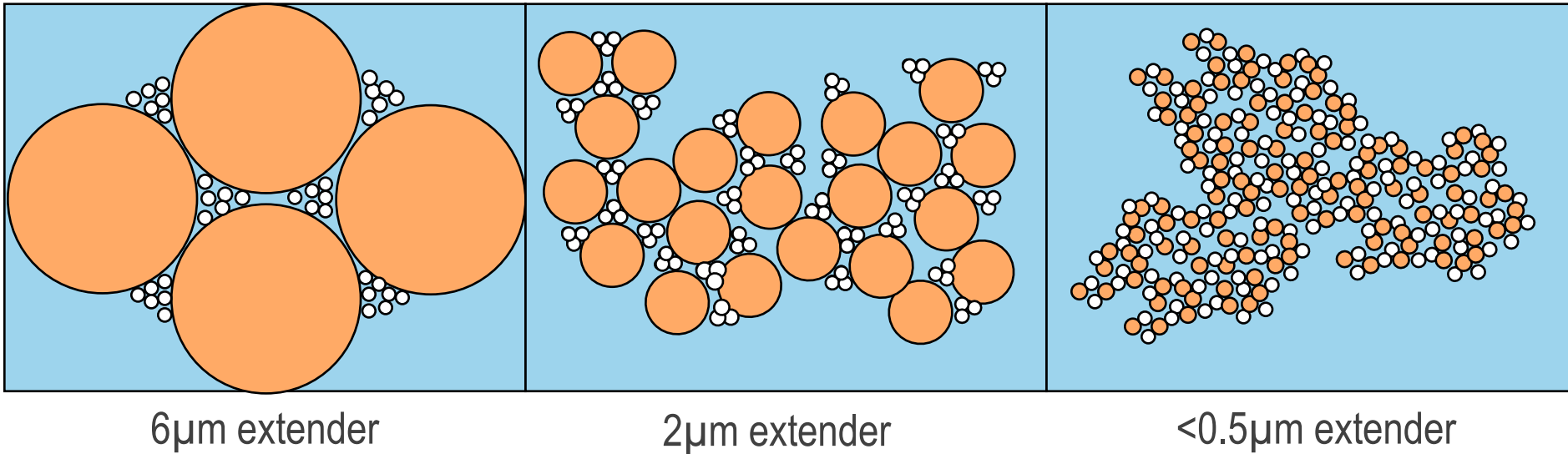


Spacing of TiO_2 by Kaolin

A mixture of pigments with different R.I.'s can enhance the scattering efficiency of the primary opacifier by keeping the particles separated.



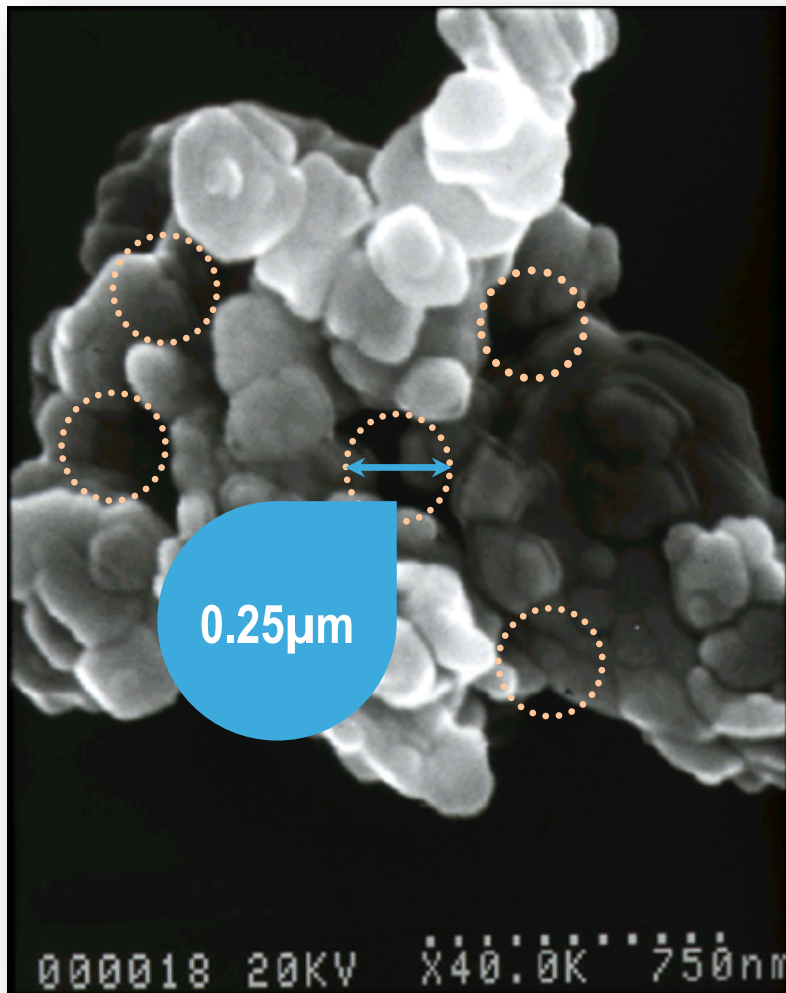
Crowding of TiO₂ Particles



Decreasing extender particle size

Improving pigment spacing / distribution
Improving opacity

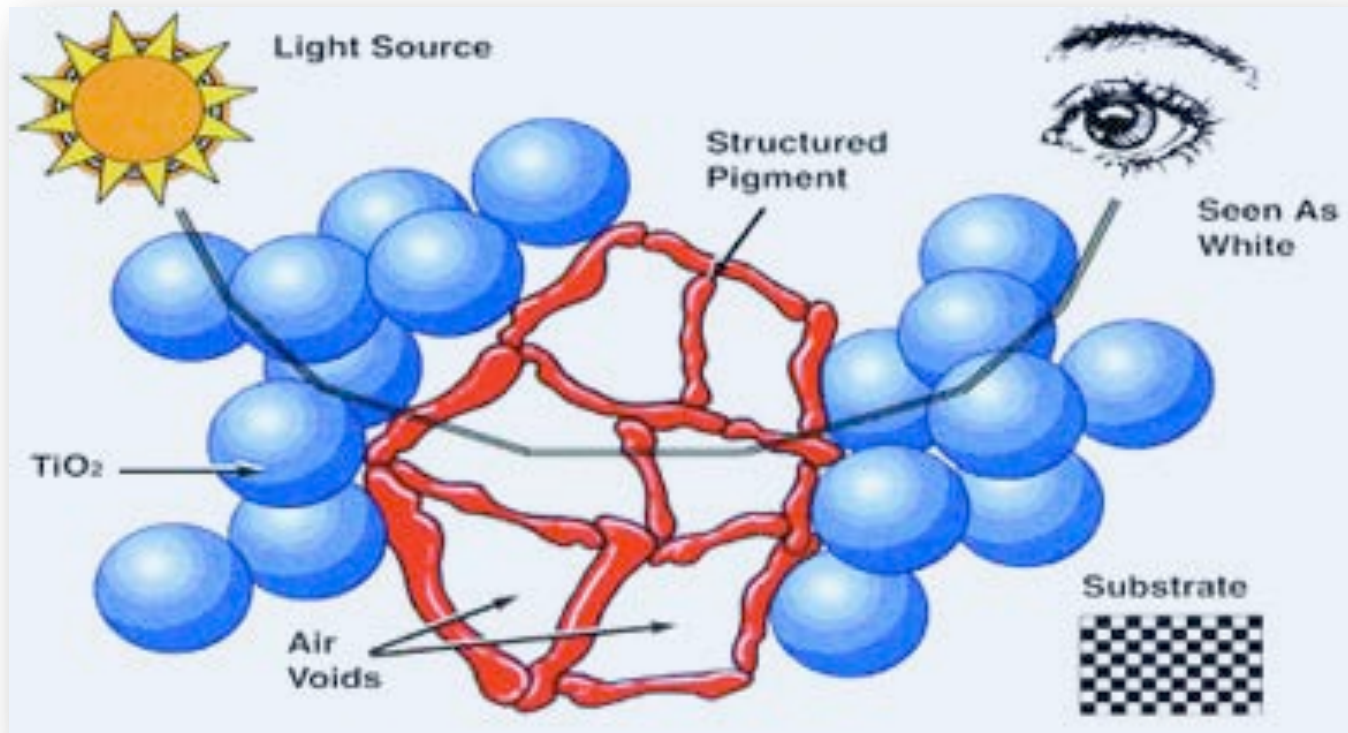
Optimisation of Dry Hiding by Calcined Kaolin



Size of voids engineered to create maximum light scattering in dry paint film

Optimal size is 0.2 - 0.4 μm

Opacity from Structured Pigment



	Air	Binder	Kaolin	TiO_2
Refractive Index	1.00	1.50	1.60	2.70



Titanium Dioxide Reduction in Decorative Paints

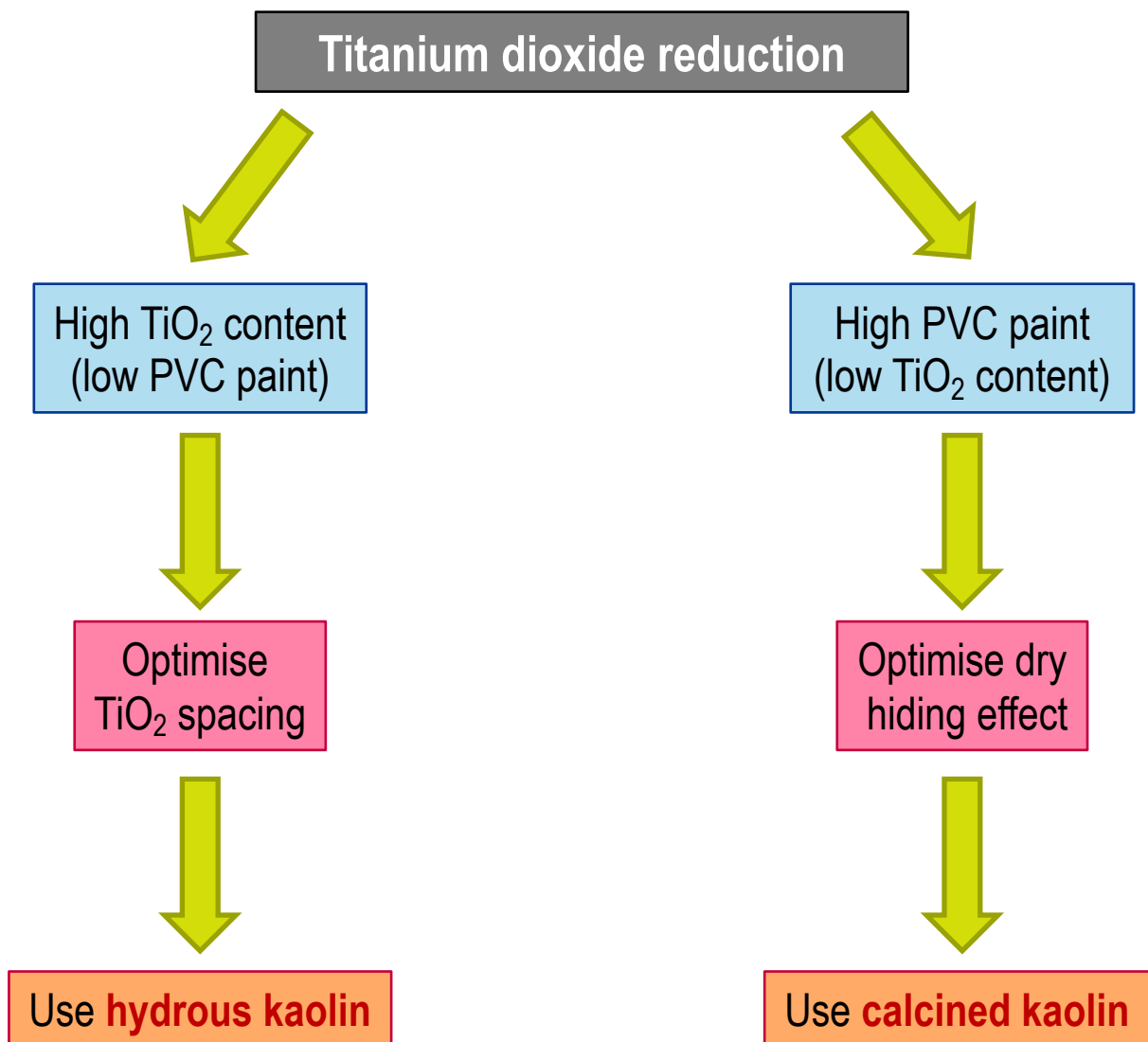
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Routes to Titanium Dioxide Reduction



TiO₂ Spacing by Hydrous Kaolin in Semi-Gloss Paint

Water-based semi-gloss / silk styrene-acrylic emulsion paint

PVC	Variable	Control	Reformulation
Volume Solids	31%	PVC – 31.6%	PVC – 35.5%
		TiO ₂ – 21.2%	TiO ₂ – 18.0%
		CaCO ₃ (2µm) – 6.6%	ImerSilk™ – 10.9%
Opacity @ 20m ² /l, %		90.8	90.8
L*		96.5	96.1
b*		1.6	2.2
Gloss % @ 60°		40	40
Cost TiO ₂ + kaolin + binder			

Resin
extension

CaCO₃ +
TiO₂

TiO₂ Spacing by Hydrous Kaolin in Semi-Gloss Paint

Water-based semi-gloss / silk styrene-acrylic emulsion paint

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Opacity @ 20m²/l, %		90.8	90.8
L*		96.5	96.1
b*		1.6	2.2
Gloss % @ 60°		40	40
Cost TiO ₂ + kaolin + binder		113,3 €c / litre	106 €c / litre



Using ImerSilk™ gives 7,3 €c / litre cost reduction

Guide Formulation – Imerys Water-based Semi-gloss / Silk Paint

Formulation	Weight %
Tioxide TR92	18.0
ImerSilk	10.9
AMP95	0.4
Dispex G40	0.5
Foamaster NDW	0.2
Acticide BX(N)	0.1
Ammonia 0.88	0.4
Texanol	1.5
Acronal 290D	33.9
Acrysol RM-55	4.5
Water	29.6
Total	100.0

Properties	
PVC, %	35
Weight solids, %	47
Volume solids, %	31
Specific gravity	1.27
Gloss, 60°	40

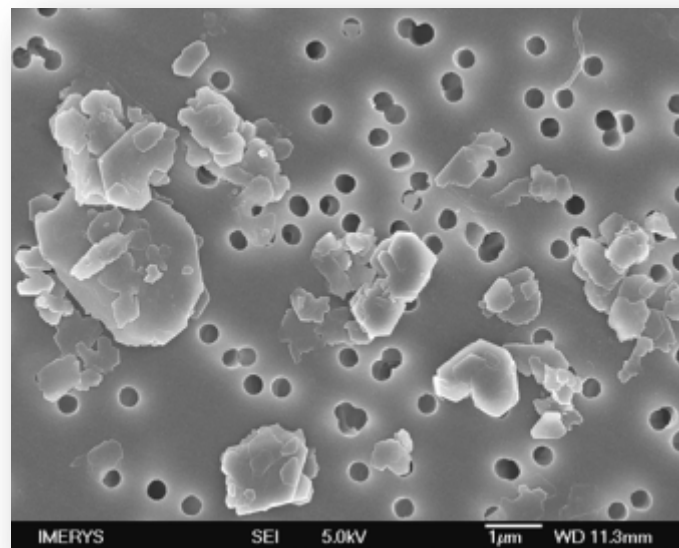
Based on Acronal 290D styrene-acrylic copolymer emulsion

Hydrous Kaolin Products for TiO₂ Spacing

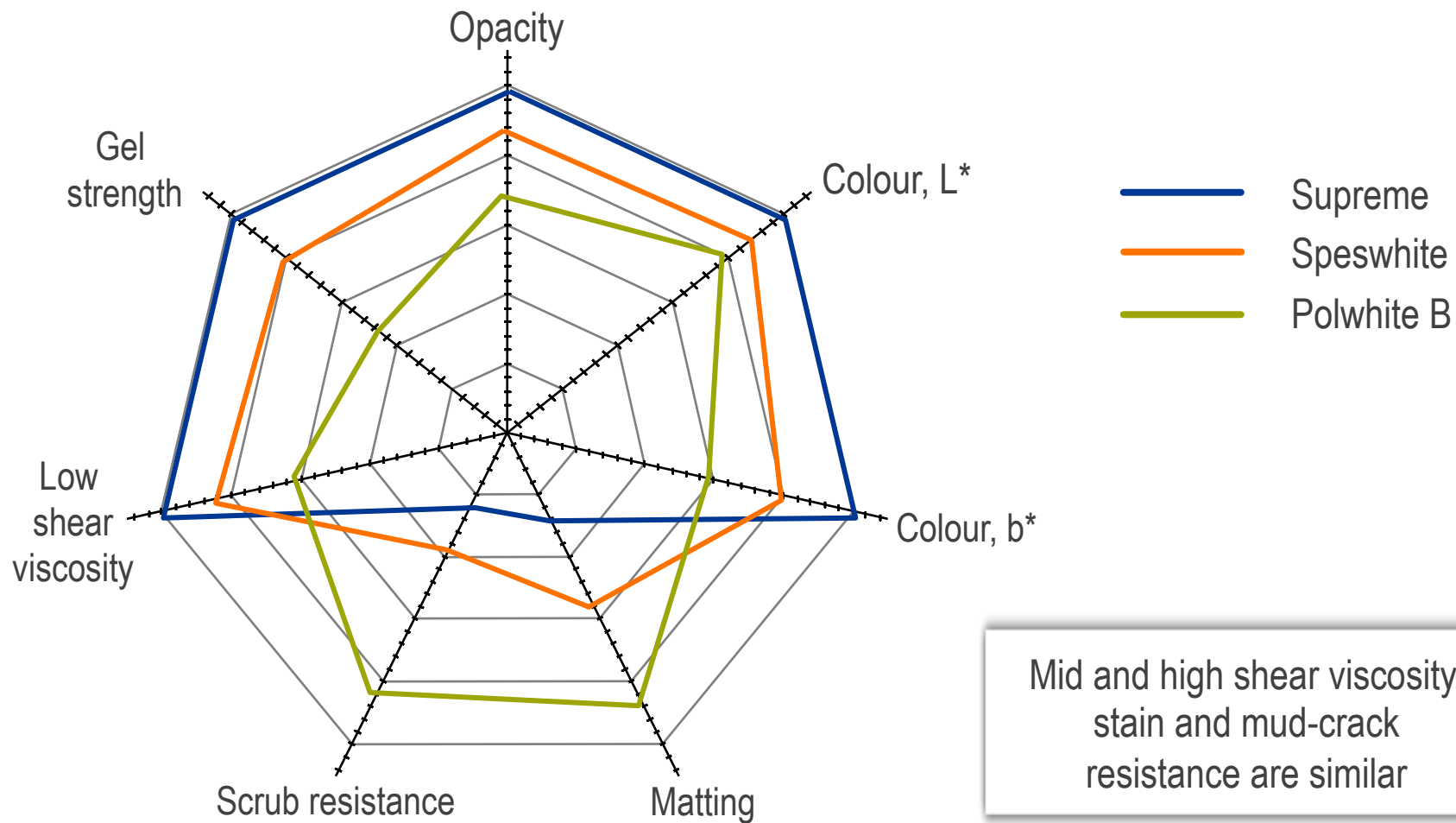
Water-based paints: **OptiGloss™**
ImerSilk™
Supreme™
Speswhite™
Polwhite™ B
Polwhite E

Solvent-based paints: **OptiGloss™ XD**
Polsperse™ 10
Polsperse™ 20
Polsperse™ 50
Polsperse™ 80

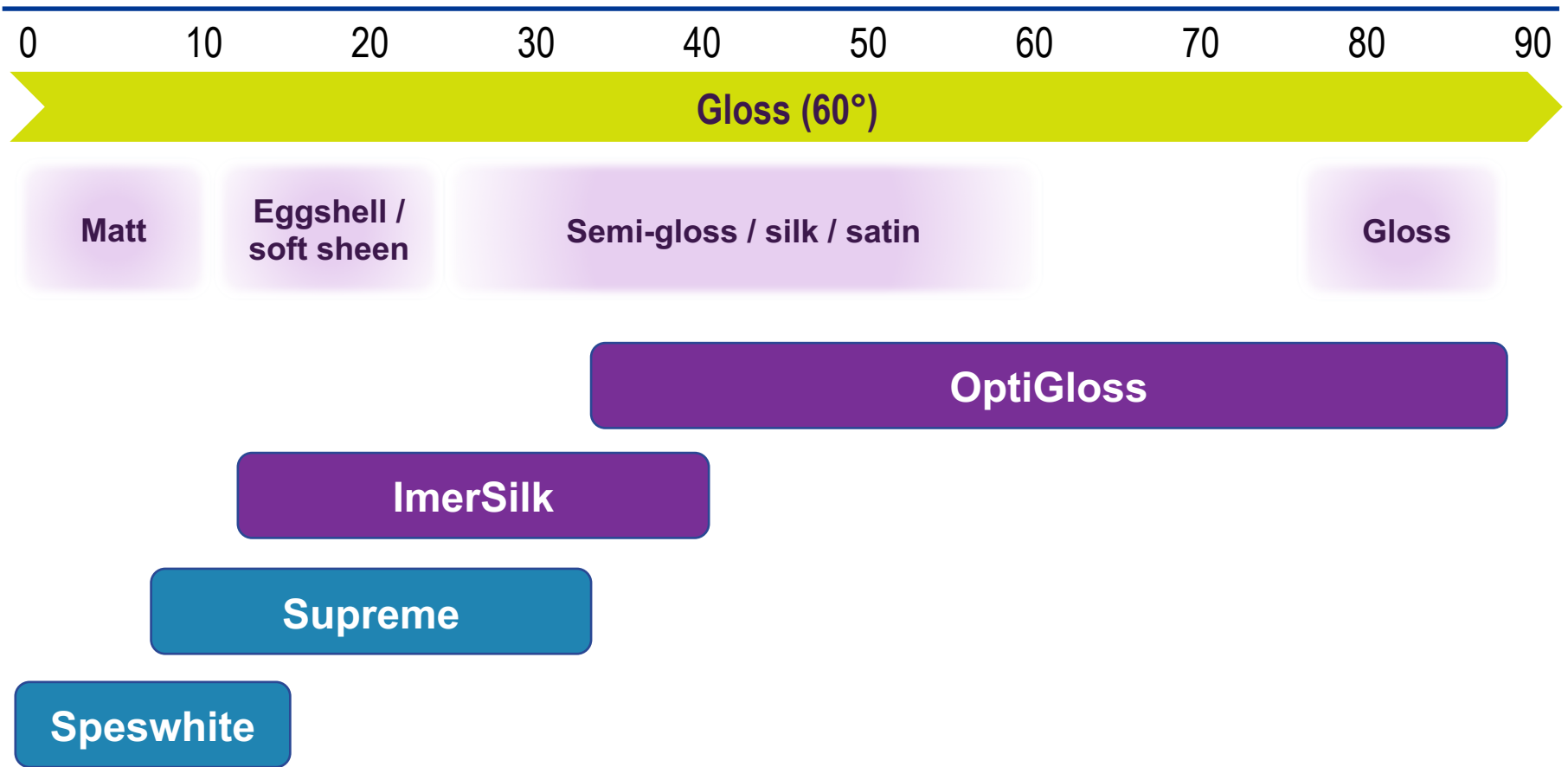
- TiO₂ spacing effect stronger with finer grades
- Replacement of up to 15% TiO₂ possible
- Excellent opacity in all coating types
- Additional rheological properties – thixotropy
 - ◆ Thickener reduction
 - ◆ Improved sag resistance
 - ◆ Improved storage stability
- Coarser grades provide more matting effect
- Easy to disperse



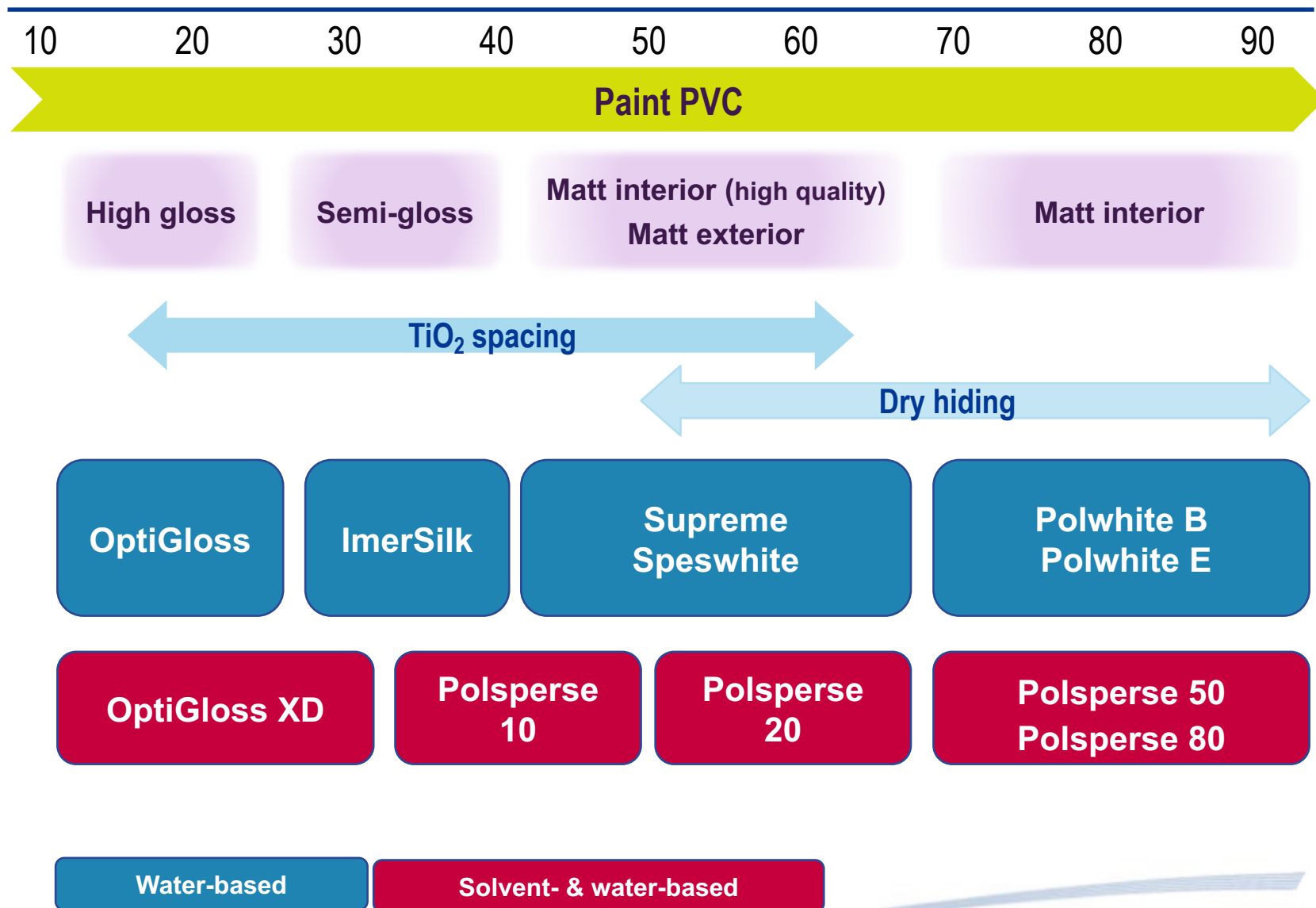
Effect on Paint Properties



TiO₂ Extension in Low PVC Paints – By Gloss Level



Extender Recommendations for Decorative Paints



TiO₂ Extension at PVC > CPVC: Opacilite™

Medium quality matt emulsion paint

PVC	67.2%	Control	Reformulation
		TiO ₂ – 10.0%	TiO ₂ – 7.0%
		Talc (5µm) – 6.0%	Talc (5µm) – 6.0%
		CaCO ₃ (5µm) – 15.0%	CaCO ₃ (5µm) – 18%
		Calcined kaolin - 6.0%	Opacilite™ – 6.0%
Contrast Ratio @10m ² /l, %		97.0	97.1
L*		96.5	96.1
b*		2.5	2,6
Sheen @ 85°		3.0	3.2
Scrub resistance, mg loss/200		39	47
Mudcrack resistance		>1000	>1000

Reduce TiO₂
to match

Maintain
PVC with
CaCO₃
and
kaolin

6.2 € cents
/ litre cost
saving



Opacilite™ gives a 30 % reduction in TiO₂ loading

Optimisation of Dry Hiding by Calcined Kaolins

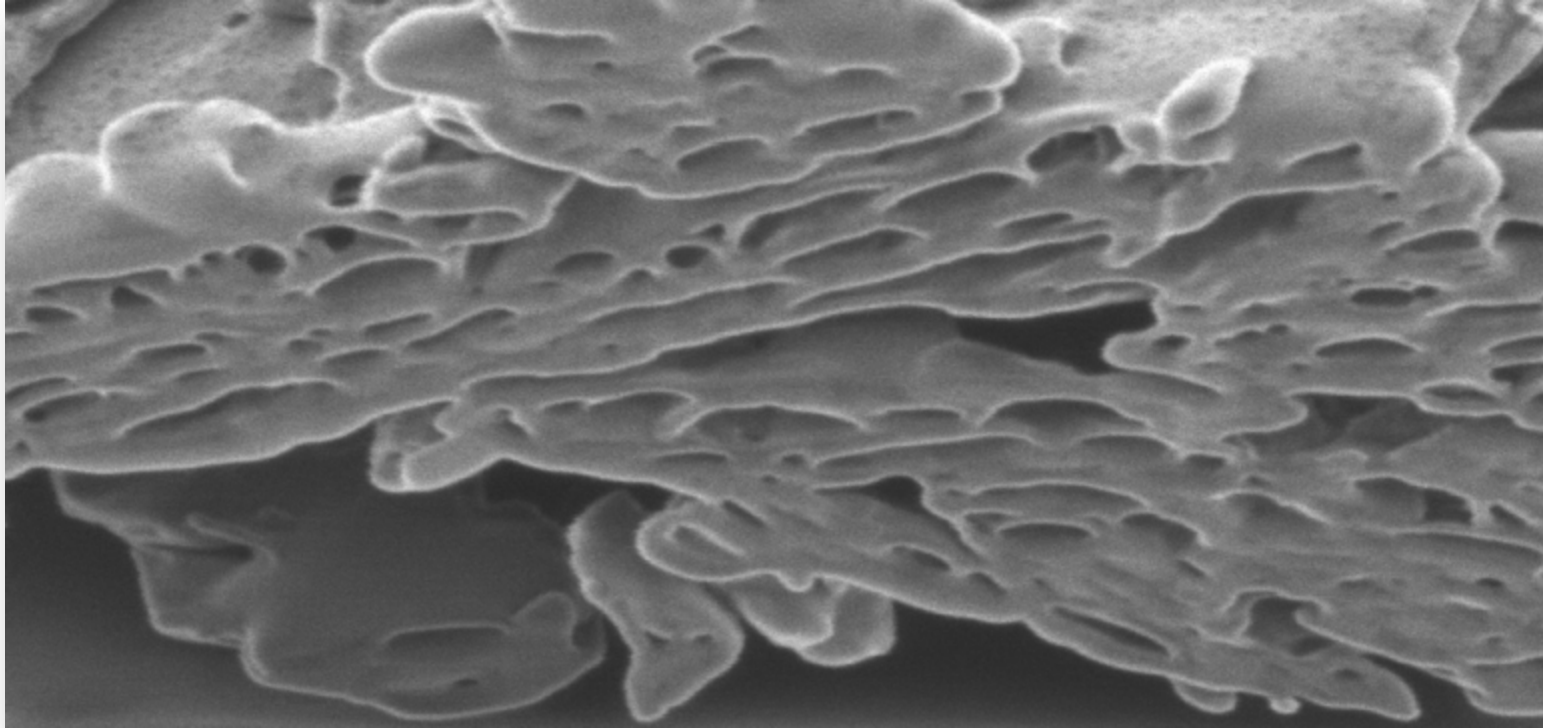
Matt emulsion paint

PVC	67,2%
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	PoleStar™ 200P calcined kaolin	Opacilite™ flash-calcined kaolin
	TiO ₂ – 10.0%	TiO ₂ – 7.0%
	Talc (5µm) – 6.0%	Talc (5µm) – 6.0%
	CaCO ₃ (5µm) – 15.0%	CaCO ₃ (5µm) – 18.0%
	PoleStar 200P- 6.0%	Opacilite™ – 6.0%
Contrast Ratio @10m ² /l, %	97.0	97.1
L*	96.5	96.1
b*	2.5	2.6
Sheen @ 85°	3.0	3.2
Scrub resistance, mg loss/200	39	47
Mud-crack resistance	>1000	>1000

Greater TiO₂
reduction

Flash-calcined kaolin: Opacilite™



Air voids account for approximately 22% of volume

Calcined Kaolins for Optimisation of Dry Hiding

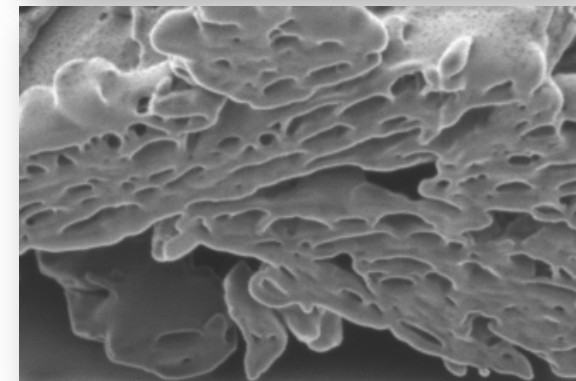
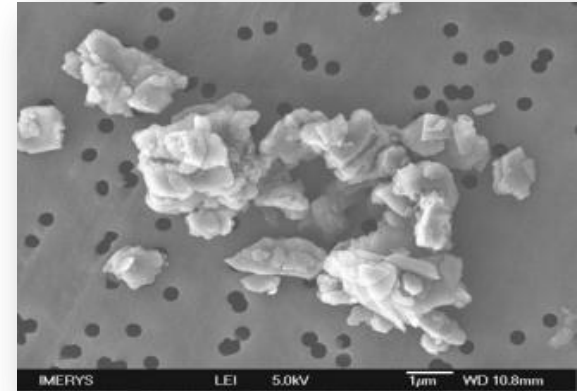
PoleStar 200P™

NeoGen MX™

PoleStar 400™

Opacilite™

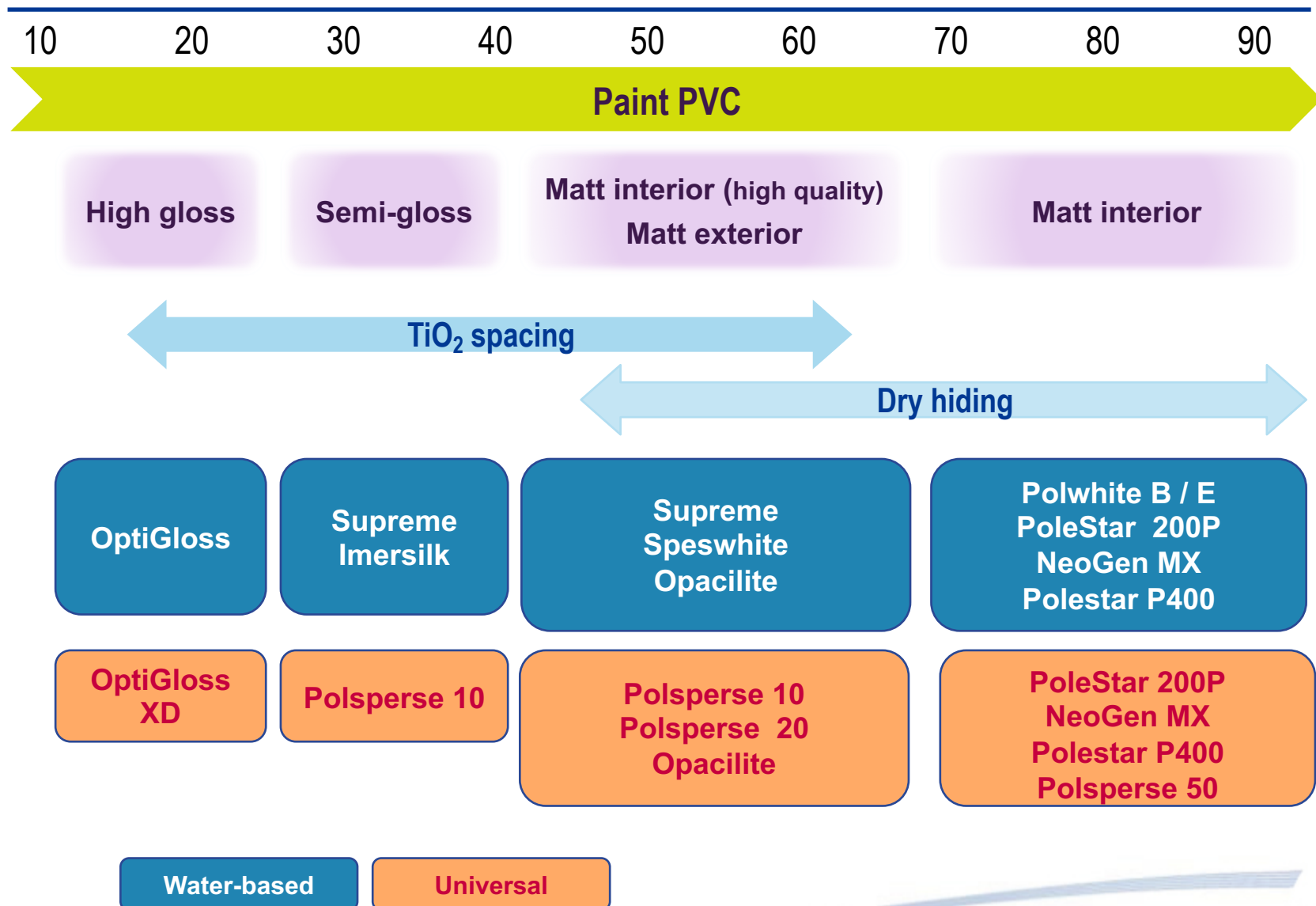
- Dry hiding effect from optimised air voids
- Replacement of up to 15% TiO_2 possible
- Excellent opacity in mid – high PVC coatings
- Opacilite gives additional opacity below CPVC
- Easy to disperse



Comparison in matt paint @70% PVC



Recommendations for TiO₂ Extension in Decorative Paints



Thank you for your attention



Questions ?

