Omya's opacity toolkit

Your guide to affordable opacity in sustainable paints and coatings

THINKING OF TOMORROW

The key role of opacity in paints and coatings formulations

Why is a toolkit dedicated to opacity?

Opacity is crucial in paint formulations. It's not just about achieving a uniform color on a surface; opacity also ensures that any underlying color is masked effectively. The fewer coats required, the more efficient the painter's work.

Did you know that opacity can also influence cost, sustainability, and final application performance?

Omya's opacity toolkit will help you achieve the right opacity for your formulation.

Rethinking opacity in an evolving coatings market

Today's coatings market is under pressure: raw material costs fluctuate, regulatory constraints tighten, and sustainability expectations rise. Opacity performance must now be achieved without compromising on cost, sustainability or regulatory compliance.

What if you could engineer it? What if you could always deliver it at scale? What if opacity could enhance your brand promise, keeping you at the forefront of the market?

Opacity, hiding power and the factors which influence them

Opacity is one of the main optical properties of paint. It determines the hiding power (or contrast ratio), which reflects how effectively a coating can conceal the surface beneath it.

Several factors influence opacity, including pigment volume concentration (PVC), film thickness, rheology, and the type and size of minerals used.

There are many options on the market to achieve opacity. One of the most common is the use of titanium dioxide (TiO_2), which is highly effective but also relatively expensive. Alternatives such as specialty calcium carbonates with tailored particle sizes and morphologies can help lower formulation expenses. Recent innovations enable optimized formulations that maintain, or even enhance, opacity while reducing overall material costs.

Pigment content
The more white pigment the paint contains, the better the coverage effect. Titanium dioxide (TiO_2) for example, is one of the most effective.

Refractive index
Differences in refractive index between pigments, fillers, and binders cause light to scatter. The more the light changes direction, the less visible the surface underneath becomes, increasing the coating's opacity.

Mineral and extender
The right combination of type and particle size of extender and minerals can create a higher opacity effect.

PVC concentration
A higher concentration of pigment (PVC value, or Pigment Volume Concentration) improves the dry hiding effect, enhancing the coating's opacity.

Spacers
The dispersibility of pigments, supported by special particles or additives, prevents their flocculation and keeps TiO_2 particles well separated, improving opacity.

Coverage
Coverage, measured in square meters per liter, depends on the applied layer, which also affects opacity: thicker layers deposit more pigment, improving hiding.

Rheology
The rheology of the paint influences the application and therefore the film thickness. Better leveling contributes to optimal coverage.

Binder type
The choice of binder can have an impact on all factors and components, resulting in a better or lower opacity.

Maximize opacity: enhance the performance and efficiency of TiO_2

High opacity is typically achieved by incorporating white pigments such as titanium dioxide (TiO_2) in the paint formulation. These pigments scatter light efficiently and block visibility of the substrate.

Titanium dioxide is the most effective white pigment used in coatings, thanks to its high refractive index and ability to scatter visible light without absorption. These optical properties make it essential for achieving opacity and brightness in paints and inks.

Scattering is strongest when the refractive index contrast between pigment and binder is high, and when particle size is close to half the wavelength of visible light. This ensures maximum hiding power and white color strength.

To enhance light scattering and prevent re-agglomeration or crowding of TiO_2 particles, proper spacing is essential. This is where specialty calcium carbonate acts as a performance booster.

Refractive index

The hiding power of paint depends largely on the difference in refractive index between the components of the coating.

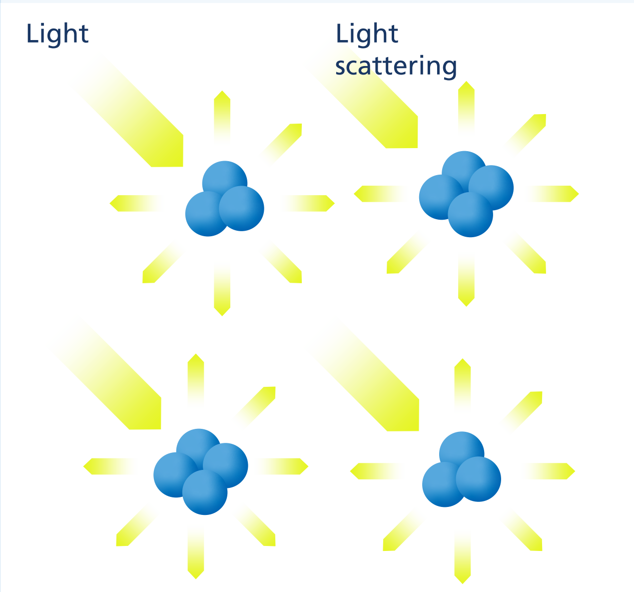
Spacing and PVC

The PVC (Pigment Volume Concentration) is critical: the closer the particles in a formulation, the more they interfere with each other. Functional minerals can enable the correct spacing.

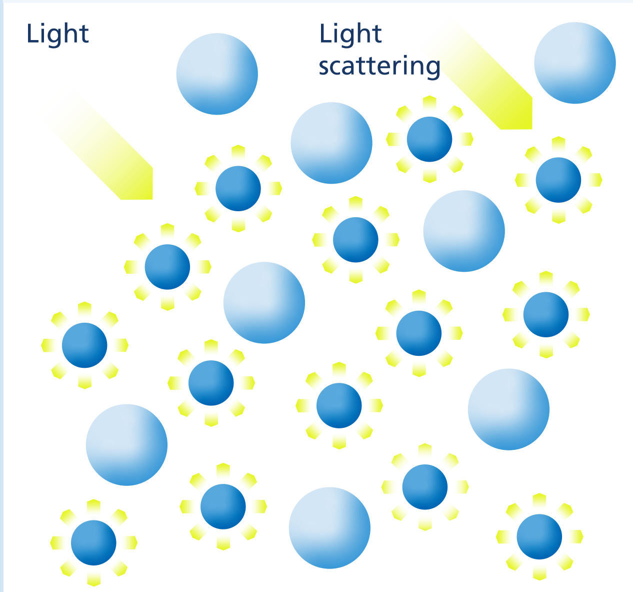
Functional minerals can provide suitable spacing between TiO_2 particles, enabling efficient light scattering and preventing their re-agglomeration or crowding.

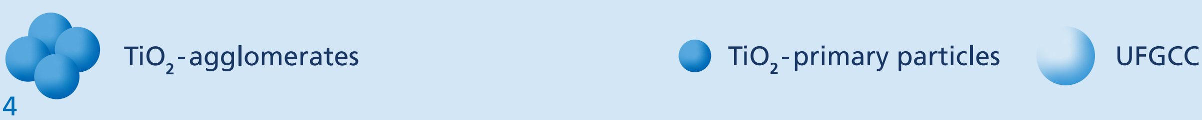
As shown on Illustration 1 on the left side, when TiO_2 primary particles form agglomerates (or poor dispersion), the system behaves as if there were only 4 pigment particles, even though there are actually many more. This reduces the pigment's effectiveness, for example in light reflection. On Illustration 2, on the contrary, the TiO_2 primary particles are well dispersed (or good dispersion), each particle contributes individually to the desired effect (such as light reflection), so the full benefit of all 14 particles is achieved.

Poor dispersion Illustration 1



Good dispersion Illustration 2





Engineering opacity with Omya and its partners

Omya's technical expertise, comprehensive portfolio, and global partnerships enable us to deliver a full mineral and pigment package for opacity engineering, from creation to enhancement of the final coating.

Creating opacity

Top-class pigments for whiteness, brightness and opacity

Chemours™ KRONOS™ 龙佰集团 LB GROUP

Please contact your local representative for more information and availability in your country.

Boosting opacity

The essential minerals to unlock next-level opacity

ChameleoBoost™ Technology

Reduce formulation cost and carbon footprint

CO_2 $

Improve paint performance

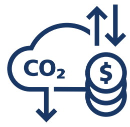
Discover the ChameleoBoost portfolio:

UFGCC	Omyacarb Extra, Omyacoat (Dry)
UFGCC	Omyaflow (Slurry)
PCC	Omyawhite
MCC	Omyabrite 1300X
Kaolin	Optiwhite, Iceberg

BURGESS PIGMENT COMPANY

Did you know?
UFGCC stands for Ultra Fine Ground Calcium Carbonate.
MCC refers to Modified Calcium Carbonate.
PCC is used for Precipitated Calcium Carbonate.

ChameleoBoost™ Technology
Cost and performance optimization



Decarbonization – cost/performance

Rising TiO_2 costs and environmental regulations create a dual challenge: maintaining paint performance while reducing formulation costs and carbon footprint.

ChameleoBoost™ Technology addresses this by optimizing opacity and TiO_2 content in your formulations, enabling you to achieve both economic and environmental goals without sacrificing quality.

The challenges for water-based decorative paints

Cost reduction
- Reduce formulation costs
- Stay competitive
- Speed up trials with digitalization

Sustainability
- Lower carbon footprint
- Minimize environmental impact
- Reduce volatile organic compounds (VOCs)

Benefits

Carbon footprint and cost reduction
- Boosting opacity at required gloss – from matte to high gloss paints
- Effective TiO_2 and partial binder substitution
- High brightness

Omya related mineral solutions

UFGCC
Ultra fine ground $CaCO_3$
- Dry (Omyacarb Extra, Calcigloss, Omyacoat)
- Slurry (Omyaflow)

UFGCC strengths
for water/solvent-based, interior/exterior paints:
- Extra high gloss
- Easy to disperse
- Simplicity in production
- Suitable for all paint types

PCC
Precipitated $CaCO_3$
- Omyawhite

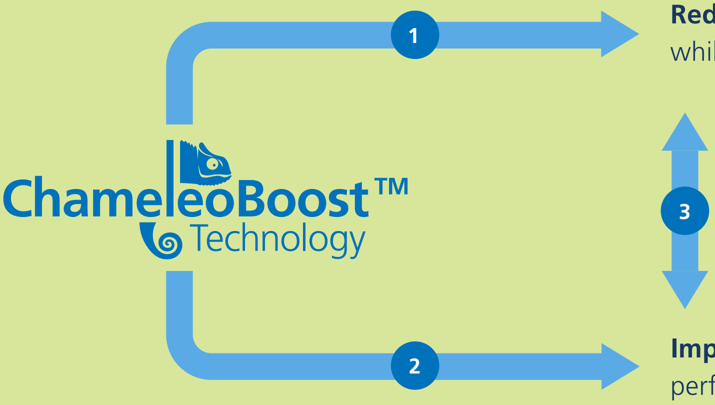
Omyawhite strengths
for water-based semi-matte and matte paints:
- Outstanding brightness/ whiteness
- Improved opacity
- Enhanced wet scrub resistance

MCC
Modified $CaCO_3$
- Omyabrite

Omyabrite strengths
for water-based matte paints:
- Enhanced TiO_2 extension
- Excellent balance between high opacity and low sheen
- Cost savings

Calcined kaolin
Water washed kaolin
- Optiwhite, Iceberg

Kaolin strengths
for water/solvent-based, interior/exterior matte paints:
- High opacity
- Maintains gloss levels
- Excellent whiteness
- Cost-effective TiO_2 replacement



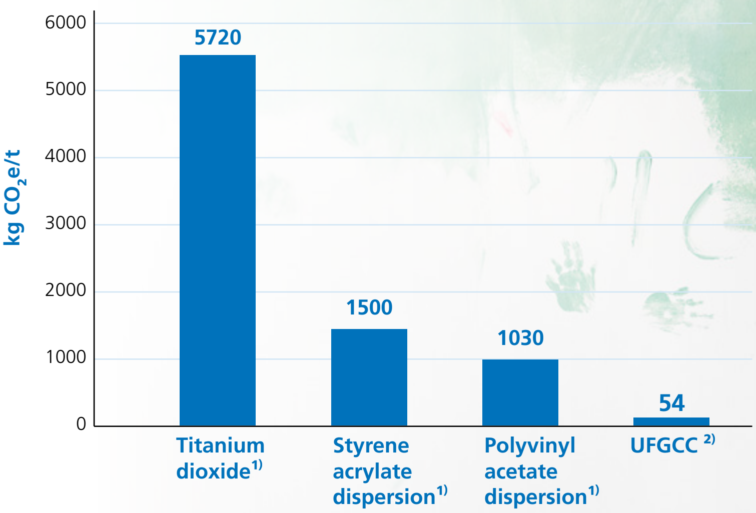
Reduce formulation cost and carbon footprint whilst maintaining paint properties

Improve opacity, wet scrub and gloss performance at equal formulation cost

Omya case studies

Less CO_2, lower costs and more opacity with ChameleoBoost™

Target high carbon footprint contributors



1) CEPE Database
2) CCA-EU (Calcium Carbonate Association) EPD value

The importance of PVC: finding the right spacing

The spacing between TiO_2 particles in a coating or film **has a direct impact on** optical performance, especially in terms of **hiding power, scattering efficiency, and film integrity.**

Optimal spacing (typically just below the critical PVC) allows maximum light scattering. If particles are too far apart, light passes through without sufficient scattering, reducing opacity. If particles are too close or touching (above critical PVC), they interfere with each other's scattering fields, reducing overall efficiency.

TiO_2 spacing with specialty minerals

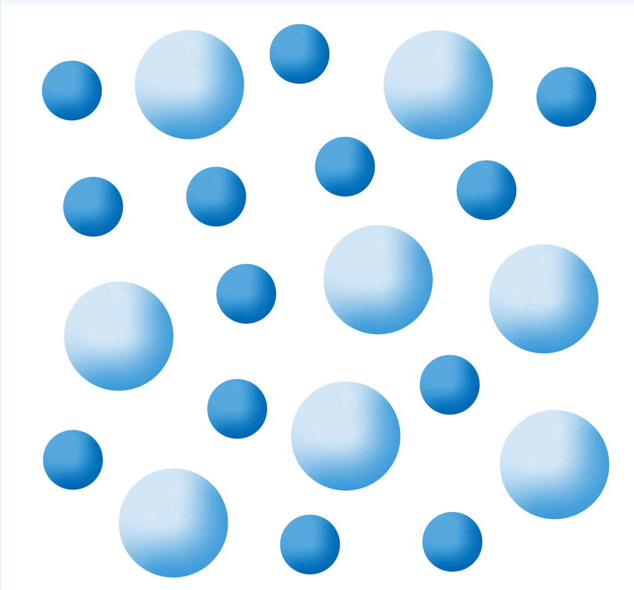
Did you know?

- Too wide spacing (low PVC) results in poor scattering and low opacity.
- Optimal spacing (near CPVC) results in maximum scattering and best hiding.
- Too close spacing (above CPVC) results in reduced scattering and poor film quality.
- A targeted application of fine calcium carbonate particles between the TiO_2 particles results in optimal spacing.
- Paints with high PVC, above CPVC, have unfilled voids which become filled with air, creating an air/pigment interface that has a high refractive index, providing superior hiding power.

Spacing of TiO_2 Prevents re-agglomeration or crowding of TiO_2 particles.

Dry Hiding = Paint formulations above CPVC show improved dry opacity due to air voids introduced in the dry paint film.

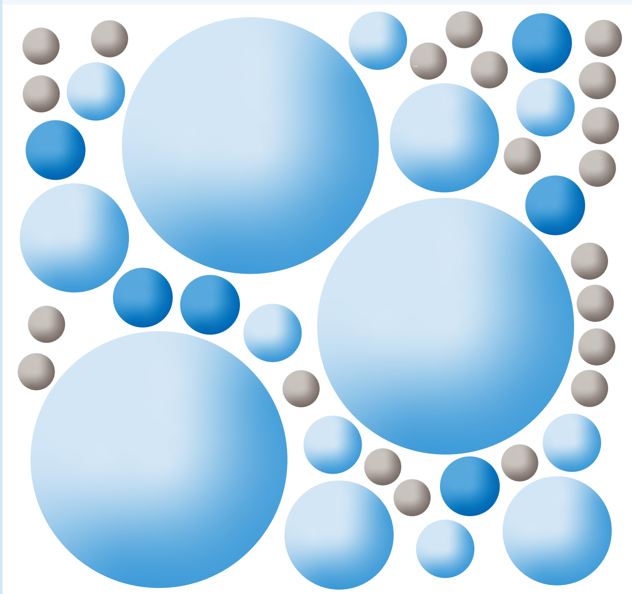
Spacing Illustration 3



PVC < CPVC

UFGCC/filler TiO_2

Dry hiding Illustration 4



PVC > CPVC

Air Binder

Water-based decorative paints optimization UFGCC PVC 60% and 80%

Optimized formulation UFGCC PVC 60%

Composition (by weight in %)	Reference	Optimized	
Water and additives	23.80	23.80	
Rutile titanium dioxide (TiO_2)	**16.00**	**13.50**	15% reduced
$CaCO_3$/Omyacycle D50 = 2.5 µm	14.00	17.50	
$CaCO_3$/Omyacycle D50 = 10 µm	20.00	10.00	
Omyacoat 420 Functional $CaCO_3$ D50 = 0.9 µm		**9.00**	ChameleoBoost™ Technology
Commercial binder, 50% styrene acrylic	26.20	26.20	
Total	**100.00**	**100.00**	
Paint properties			
PVC [%]	**60.0**	**60.0**	
Ry over black / Ry over white, 150 µm gap [%]	85.0/90.0	84.8/90.2	
Contrast ratio, 150 µm gap [%]	93.5	93.9	
Sheen 85° [GU]	2.0	4.0	
Cost & sustainability			
Carbon footprint [$kgCO_2e/t$*]	**1400**	**1240**	12% reduced
% Circular content by weight		28%	
Formulation cost		–6%	

Optimized formulation UFGCC PVC 80%

Composition (by weight in %)	Reference	Optimized	
Water and additives	35.00	35.00	
Rutile titanium dioxide (TiO_2)	**5.00**	**3.50**	30% reduced
$CaCO_3$/Omyacycle D50 = 2.5 µm	35.00	25.00	
$CaCO_3$/Omyacycle D50 = 10 µm	15.00	15.50	
Omyacoat 420, Functional $CaCO_3$ D50 = 0.9 µm		**11.00**	ChameleoBoost™ Technology
Commercial binder, 50% styrene acrylic	10.00	10.00	
Total	**100.00**	**100.00**	
Paint properties			
PVC [%]	**80.0**	**80.0**	
Ry over black / Ry over white, 150 µm gap [%]	84.8/90.3	84.7/90.1	
Contrast ratio, 150 µm gap [%]	93.9	94.0	
Sheen 85° [GU]	5.2	5.9	
Cost & sustainability			
Carbon footprint [$kgCO_2e/t$*]	**470**	**370**	21% reduced
% Circular content by weight		41%	
Formulation cost		–7%	

* cradle to gate

The broad influence of Omya functional minerals

Omya's range functional minerals have an impact on a range of paint properties, not just opacity. Using our star chart, you can see how different properties are influenced by each of our functional minerals, both positively and negatively. You can then choose the right product to suit your priorities.

Water-based decorative paints optimization PCC PVC 80% and MCC PCV 60%

Optimized formulation PCC PVC 80%

Composition (by weight in %)	Reference	Optimized	
Water and additives	35.00	35.00	
Rutile titanium dioxide (TiO_2)	**5.00**	**3.50**	30% reduced
$CaCO_3$/Omyacycle D50 = 2.5 µm	35.00	27.50	
$CaCO_3$/Omyacycle D50 = 10 µm	15.00	19.00	
Omyawhite 13-GO Precipitated Calcium Carbonate D50 = 1.1 µm		**5.00**	ChameleoBoost™ Technology
Commercial binder, 50% styrene acrylic	10.00	10.00	
Total	**100.00**	**100.00**	
Paint properties			
PVC [%]	**80.0**	**80.0**	
Ry over black / Ry over white, 150 µm gap [%]	84.8/90.3	84.7/90.4	
Contrast ratio, 150 µm gap [%]	93.9	93.7	
Sheen 85° [GU]	5.2	5.2	
Cost & sustainability			
Carbon footprint [$kgCO_2e/t$*]	**470**	**380**	18% reduced
% Circular content by weight		47%	
Formulation cost		–8%	

Optimized formulation MCC PVC 60%

Composition (by weight in %)	Reference	Optimized	
Water and additives	25.40	25.40	
Rutile titanium dioxide (TiO_2)	**16.00**	**13.50**	15% reduced
$CaCO_3$/Omyacycle D50 = 2.5 µm	14.00	12.00	
$CaCO_3$/Omyacycle D50 = 10 µm	20.00	19.00	
Omyabrite 1300 X-OM Modified Calcium Carbonate D50 = 2.4 µm		**5.50**	ChameleoBoost™ Technology
Commercial binder, 50% styrene acrylic	24.60	24.60	
Total	**100.00**	**100.00**	
Paint properties			
PVC [%]	**60.0**	**60.0**	
Ry over black / Ry over white, 150 µm gap [%]	85.0/90.0	84.4/90.2	
Contrast ratio, 150 µm gap [%]	93.5	93.6	
Sheen 85° [GU]	2.0	2.4	
Cost & sustainability			
Carbon footprint [$kgCO_2e/t$*]	**1400**	**1250**	11% reduced
% Circular content by weight		31%	
Formulation cost		neutral	

* cradle to gate

Influence of Omya's functional minerals on paint properties

Omya has developed a rating system to assist formulators and paint manufacturers in understanding the impact of our solutions on product properties, making the selection process easier.

ChameleoBoost™ Technology

Chameleoboost™ Technology

Influence of Omya's functional minerals on paint properties

Omya developed a star chart system to help formulators and paint manufacturers understand how our solutions may influence the properties of their products, supporting them in the selection process.

	UFGCC Omyacarb Extra, Calcigloss, Omyacoat	**PCC** Omyawhite	**MCC** Omyabrite 1300 X	**Kaolin** Optiwhite, Iceberg
Carbon footprint reduction	++++	++	++	++
Dry opacity	+++	+++	++++	++++
Wet opacity	+	++	+++	++++
Gloss	++++	–	–	+
Matting effect	–	++	+++	++
Wet scrub resistance	+++	++++	++	+++
Tinting behaviour	+	++	+++	+++

– not favorable   + minor influence   ++ average influence   +++ positive influence   ++++ very positive influence
Experience-based assessment; actual results may vary depending on formulation and filler type.

The impact of dispersion and rheology on opacity

Opacity can be engineered using dispersing agents and rheological modifiers. These additives, globally available, are an important part of your opacity toolkit.

Dispersing agents

How to ensure particle distribution with dispersing agents
When ‘crowding’ of TiO_2 particles occurs in the paint formulation, hiding power and therefore opacity are reduced. Dispersing agents help break down the pigment agglomerates, distribute the particles more evenly, and stabilize the paint matrix.

Finer dispersing and stable particle distribution in the formulation allows pigments to scatter light more efficiently and prevents sedimentation or flocculation in the paint over time. Dispersing agents also reduce viscosity, allowing higher pigment loading.

Rheology modifiers

More consistent film building thanks to rheology modification
Paint rheology is a key aspect of the formulation and has an impact on opacity. The use of paint thickeners helps maintain consistent film build during application, as well as preventing sag resistance and poor leveling. A thicker, uniform film scatters more light, enhancing opacity.

Rheology modifiers also improve the formulation by ensuring even pigment concentration and preventing settling during storage. Associative thickeners like HEUR or HASE respond to shear when applied by either roller or brush, helping maintain optimal viscosity and pigment distribution. Finally, rheology affects gloss and surface smoothness which can also alter perceived opacity.

A full mineral package to take you the extra mile

For formulations requiring functionalities beyond opacity, such as durability, aesthetics, chemical resistance, mechanical strength, or barrier properties, a range of mineral solutions is available to elevate your formulation to the next level.

Complete your mineral package with:

- **Mica,** chemical inert platy, lamellar structured mineral with excellent barrier properties.
- **Baryte,** chemically inert white mineral with a high specific gravity (~4.5), contributing not only to density increase in formulations but also enhancing the durability of the final product.

Please contact your local representatives to check all options and discover the best fit for your application.

Global support and technical expertise

Omya has technical laboratories at our Swiss headquarters, as well as dedicated regional technical service hubs in Europe, the Americas, Middle East and Asia. We offer laboratory analysis, reformulation support, and implementation assistance to customers worldwide, delivering comprehensive, sustainable solutions with improved performance.

Technical

Application

Analytical

Regulatory

From your needs to fully designed sustainable solutions

Best in class laboratories and R&D centers

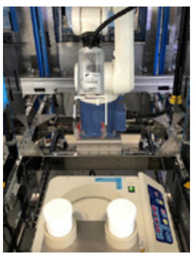
Flexshuttle
Speed to market

The first fully automated formulation laboratory in the mineral industry, based on HTE (High Throughput Experimentation) and supported by AI.

The challenge of keeping up with rapidly changing regulations

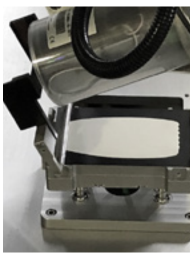
Paint producers are subject to regulations which change regularly and quickly.

Reformulating paints to remain compliant is an ongoing challenge, especially for customers with less access to laboratory resources for innovations.
The Flexshuttle offers them faster evaluation, creative solutions, and efficient processes.



Planetary mixer

Vessel storage



Drawdown

Benefits

- Reduces time to market significantly
- Accelerates innovation
- Promotes digitalization
- Offers faster and broader service for our customers

With Omya fully automatized High Throughput Experimentation (HTE or Flexshuttle) you can anticipate regulations and reformulate more efficiently with faster go to market access.

Up to 50 samples per day/17 modules.

5 performance tests:
- pH/rheology
- Hiding power/CIE L*a*b*
- Gloss 20°, 60° and 85°
- Haze on paint films at 20°
- Wet scrub resistance.

We are here for you

With experience in formulations across various applications and markets for paints and coatings, Omya's experts can help you achieve the opacity level your formulation requires.

Your preferred partner for opacity

Opacity enabler
Omya is your preferred partner, from creating to boosting opacity

One partner for all formulations
Not one product, but a world of solutions for any kind of applications and formulation needs

Reliable supply
Stable delivery despite market fluctuations or logistic demands

Versatility
Solutions from matte to gloss, for different markets and uses

Freedom to formulate
Build on your formulations' potential with well-matched raw materials

Technological support
More opportunity for tailored formulations, thanks to Omya's laboratories and high-end digital tools such as Flexshuttle

Cost cutter
Enhance your TiO_2 performance by optimizing its use and cost

Environmentally friendly
Maintain performance while reducing carbon footprint

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