



DYNAMIX

**PURE
CONVENIENCE**

**PURE
CONSISTENCY**

**PURE
PROFITABILITY**

Brown product label indicates that the pigment is not Arctic.

Yellow 30C119

Green 30C612

Yellow 30C152

Green 30C654

Yellow 30C236

Green 30C678



DYNAMIX

Orange 30C342

Black 30C933

Brown 30C888

Black 30C941

Blue 30C588

Black 30C940

Blue 30C591

Start with
ARCTIC
IR Pigments for
Cool Coatings

Blue 30C527

Black 30C965

SKIP STEPS

ACHIEVE 100% PURE COLOR
DISPERSIONS WITH DYNAMIX

CREATE PROFIT

dynamixpigments.com

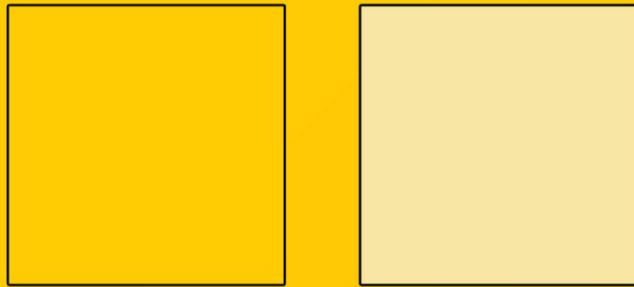


The Shepherd Color Company
We Brighten Lives

www.shepherdcolor.com

Breakthrough Highly Engineered Pigments

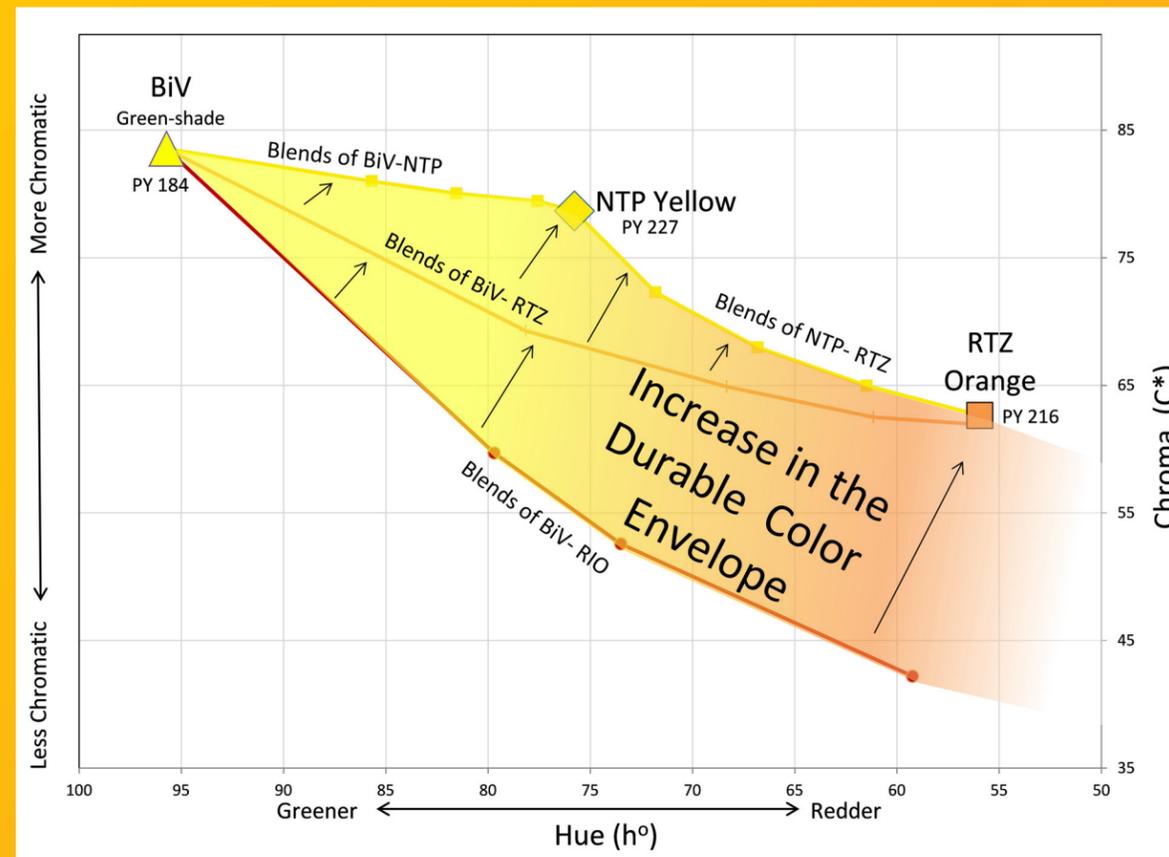
Niobium Tin Pyrochlore



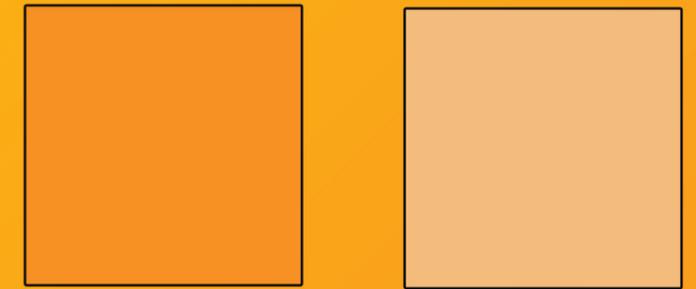
Niobium Tin Pyrochlore (NTP) is a brand-new patented pigment technology that offers outstanding bright and opaque masstones and clean tints. It is the first high-performance alternative to have the coloristic and weathering performance to provide a viable replacement for lead chromate in wide selection of demanding applications.

Before the invention of NTP pigments there was a trade-off between the bright color and lower durability and opacity of organic pigments and the high durability and opacity but limited colors of inorganic pigments. Shepherd Color has developed the inorganic NTP to have the expected high durability and opacity but with higher chroma usually reserved for organic pigments.

With the NTP pigment chemistry the edge of the color envelope has been moved. When used with Rutile Tin Zinc (RTZ) Orange and Bismuth Vanadate (BiV) Yellow pigments, NTP Yellow increases the durable color envelope.



Rutile Tin Zinc Orange



Our Rutile Tin Zinc (RTZ) pigments provide a true chromatic orange color and are the reddest shade available in the market. Because of its high red value it makes an excellent complement to organic and Bismuth Vanadate pigments to match a wide range of colors.

Before RTZ pigments the limit of highly durable color was based on blends of BiV & Red Iron Oxide (RIO). RTZ Oranges with their clean, chromatic red tones allowed modification of BiV to increase the color space available for high durability color.

A number of popular RAL colors that could only be obtained with blends of inorganic and organic pigments can now be made with blends of just inorganic pigments with increases in opacity, weatherability and inertness.

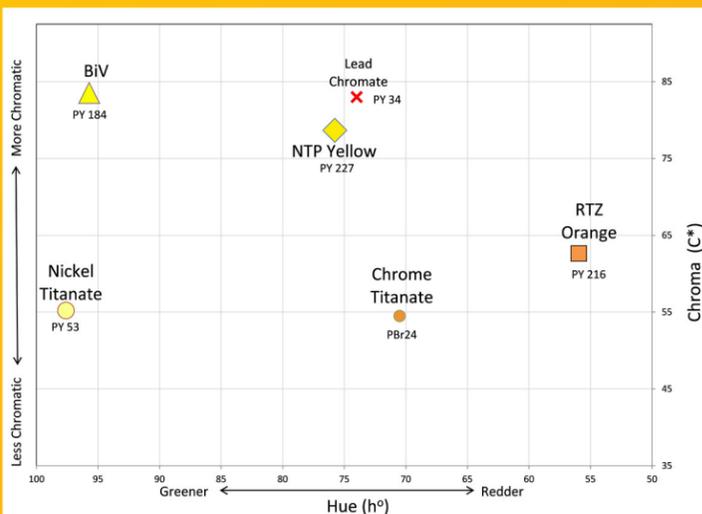
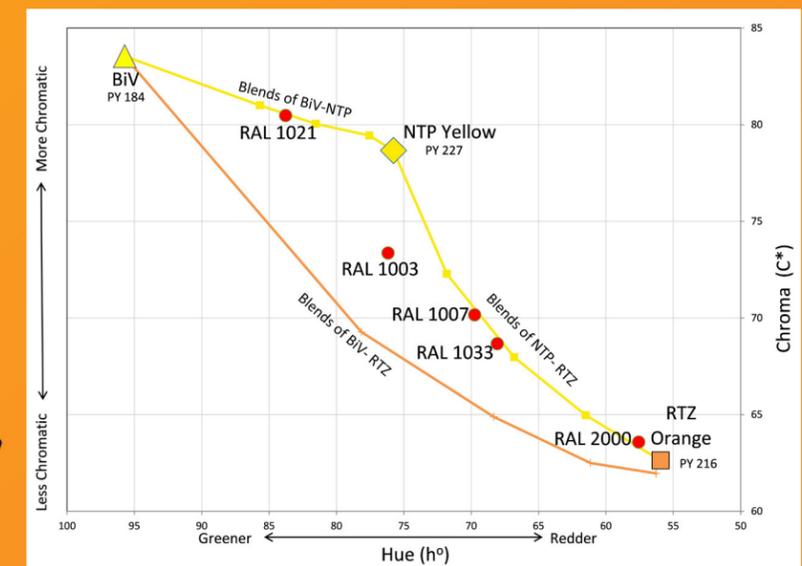
The Shepherd Color Company has developed two pigment chemistries that have high opacity, bright colors and are inherently stable. Together the NTP and RTZ pigments provide a high-performance solution in the red-shade yellow color space with excellent opacity, weatherability, stability and processing.

Ideal for:

- High-Heat Coatings
- Coil Coatings
- Silicate Coatings
- Automotive Coatings
- Powder Coatings

- Engineering Plastics
- High Solar Reflectivity Systems
- High Durability Applications
- Signage Applications
- Corporate Colors

High-Performance High-Durability Lead Chromate Replacements





The Shepherd Color Company
We Brighten Lives

Yellow 10C151

CI Pigment Yellow 227

Key Features

- **Chromium and Lead Free Formula**
- **Excellent Opacity**
- **Aesthetically Pleasing Color**
- **Compatible with Most Coatings Systems**
- **High Total Solar Reflectance (TSR)**
- **Excellent Chemical Resistance**
- **Excellent Weathering**
- **High Heat Stability**

Example Uses

- **Water, solvent and powder coatings and dispersions**
- **Automotive, Industrial, Building Products, OEM, Agricultural, Traffic and others**
- **Replacement of regulated materials based pigments**
- **Blended with organic colored pigments to improve their durability and opacity**
- **Component in RAL2000 and RAL1000 shades**
- **Blended with other pigments for high solar reflective coatings**

Regulatory Compliance

- **Toy Safety EN71.3**
- **Council of Europe AP(89)1**
- **AS 2070-1999**
- **TCLP**
- **BfR**
- **CONEG**
- **ELV 2000/53/EC**
- **RoHS 2000/95/EC**
- **WEEE 2002/96/EC**
- **Packaging 94/62/EC**

USA

Phone: 513-874-0714
Fax: 513-874-5061
Salesusa@shepherdcolor.com

AUSTRALIA / ASIA

Phone: + 613-9532-5620
Fax: + 613-9553-5844
Melbourne@shepherdcolor.com

EUROPE

Phone: + 32-9-366-11-11
Fax: + 32-9-366-11-21
Europe@shepherdcolor.com

JAPAN

Phone: + 813-3344-3010
Fax: + 813-3344-3027
Sales@shepherdjapan.com



Masstone



Tint



www.shepherdcolor.com

Technical Information

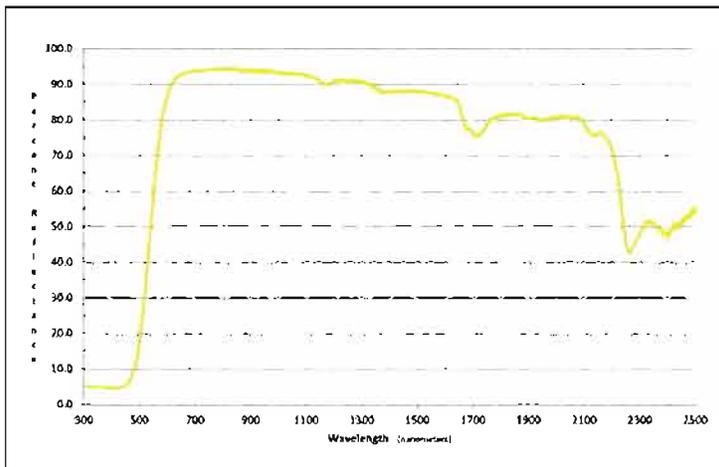
Yellow 10C151

CI Pigment Yellow 227

Niobium Tin Pyrochlore

IR Properties: TSR: 75%

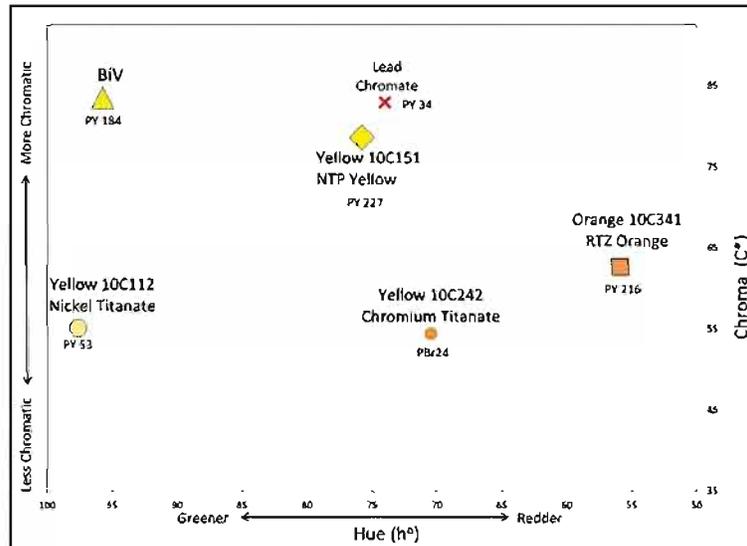
Yellow 10C151 is part of the ARCTIC® range for coatings and can be used widely in color matches to minimize HBU (Heat Build-Up)



The Shepherd Color Company

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Color Space



Masstone	L*	a*	b*	C*	h°
NTP Yellow 10C151	78.3	20.9	81.7	84.3	75.7
RTZ Orange 10C341	58.5	38.4	57.4	69.1	56.2
4:1 Tint	L*	a*	b*	C*	h°
NTP Yellow 10C151	89	3.3	40.2	40.4	85.3
RTZ Orange 10C341	83.7	13.5	22.3	26.1	58.8

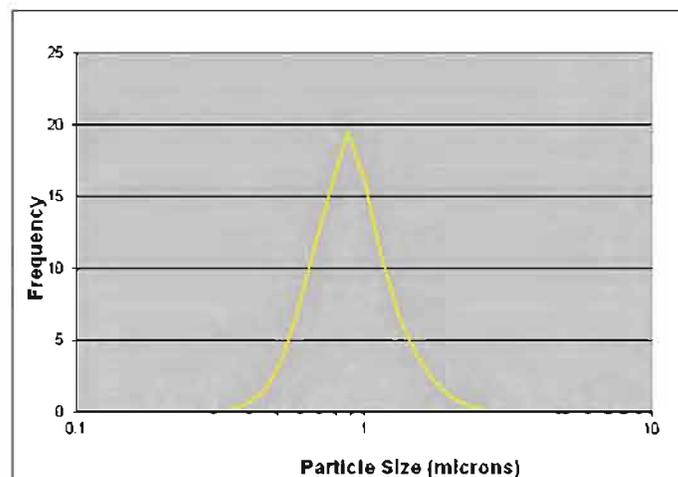
Typical Physical Properties

Yellow 10C151

	Typical Value
% Retain at 325 Mesh	0.01
% Moisture	0.1
Loose Packing Density (lbs/gal)	6.7
(kg/L)	0.80
pH in Water	5.4
Conductivity (µS/cm)	14
BET Surface Area (m ² /g)	3.5
Oil Absorption (g/100g pigment)	11
Heat Stability	320°C
	600°F
Particle Size (microns)	0.9

Particle Size

Average particle size: 0.9 Microns



Please check with your sales rep for availability in your area.



The Shepherd Color Company
We Brighten Lives

Orange 10C341 CI Pigment Yellow 216

Key Features

- Chromium and Lead Free Formula
- Excellent Opacity
- Aesthetically Pleasing Color
- Excellent way to shift colors redder without losing chroma
- Compatible with Most Resin Systems
- High Total Solar Reflectance
- Excellent Chemical Resistance
- Excellent Weathering
- High Heat Stability

Example Uses

- Water, solvent and powder coatings and dispersions
- Automotive, Industrial, Building Products, OEM, Agricultural, Traffic and others
- Replacement of regulated materials based pigments
- Blended with organic colored pigments to improve their durability and opacity
- Component in RAL2000 and RAL1000 shades
- Blended with other pigments for high solar reflective coatings

Regulatory Compliance

- Toy Safety EN71.3
- Council of Europe AP(89)1
- AS 2070-1999
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USA

Phone: 513-874-0714
Fax: 513-874-5061
Salesusa@shepherdcolor.com

AUSTRALIA / ASIA

Phone: + 613-9532-5620
Fax: + 613-9553-5844
Melbourne@shepherdcolor.com

EUROPE

Phone: + 32-9-366-11-11
Fax: + 32-9-366-11-21
Europe@shepherdcolor.com

JAPAN

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Sales@shepherdjapan.com



Masstone



Tint



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Technical Information

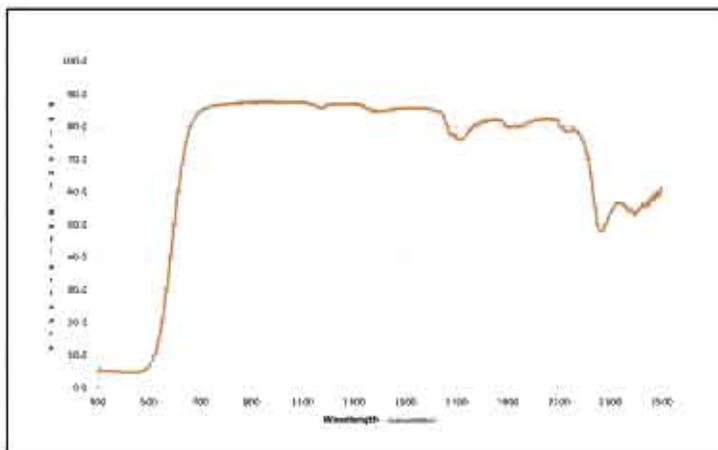
Orange 10C341

CI Pigment Yellow 216

Rutile Tin Zinc

IR Properties: TSR: 65%

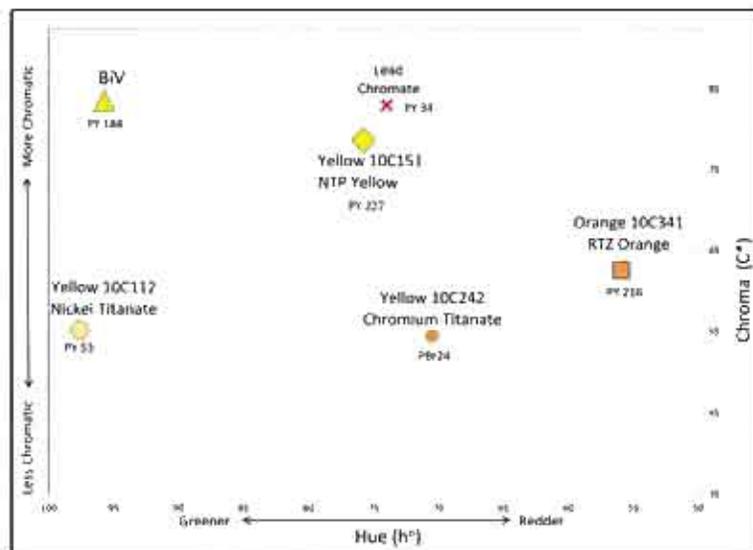
Orange 10C341 is part of the ARCTIC® range for coatings and can be used widely in color matches to minimize HBU (Heat Build-Up)



The Shepherd Color Company

We Brighten Lives

Color Space



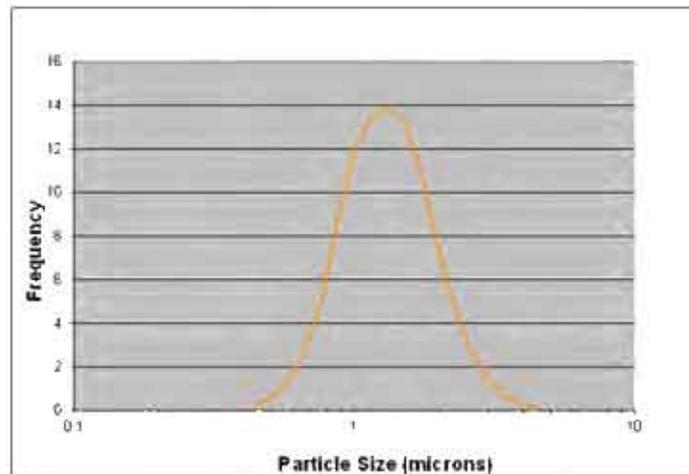
Masstone	L*	a*	b*	C*	h°
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4:1 Tint	L*	a*	b*	C*	h°
NTP Yellow 10C151	89	3.3	40.2	40.4	85.3
RTZ Orange 10C341	83.7	13.5	22.3	26.1	58.8

Typical Physical Properties Orange 10C341

Property	Typical Value
% Retain at 325 Mesh	0.02
% Moisture	0.6
Loose Packing Density (lbs/gal) (kg/L)	6.4 0.80
pH in Water	8.5
Conductivity (µS/cm)	110
BET Surface Area (m ² /g)	7.3
Oil Absorption (g/100g pigment)	19
Heat Stability	320°C 600°F
Particle Size (microns)	1.3

Particle Size

Average particle size: 1.3 Microns



These values are typical values and are not construed to be specifications. All properties are dependent on formulation of complete product.

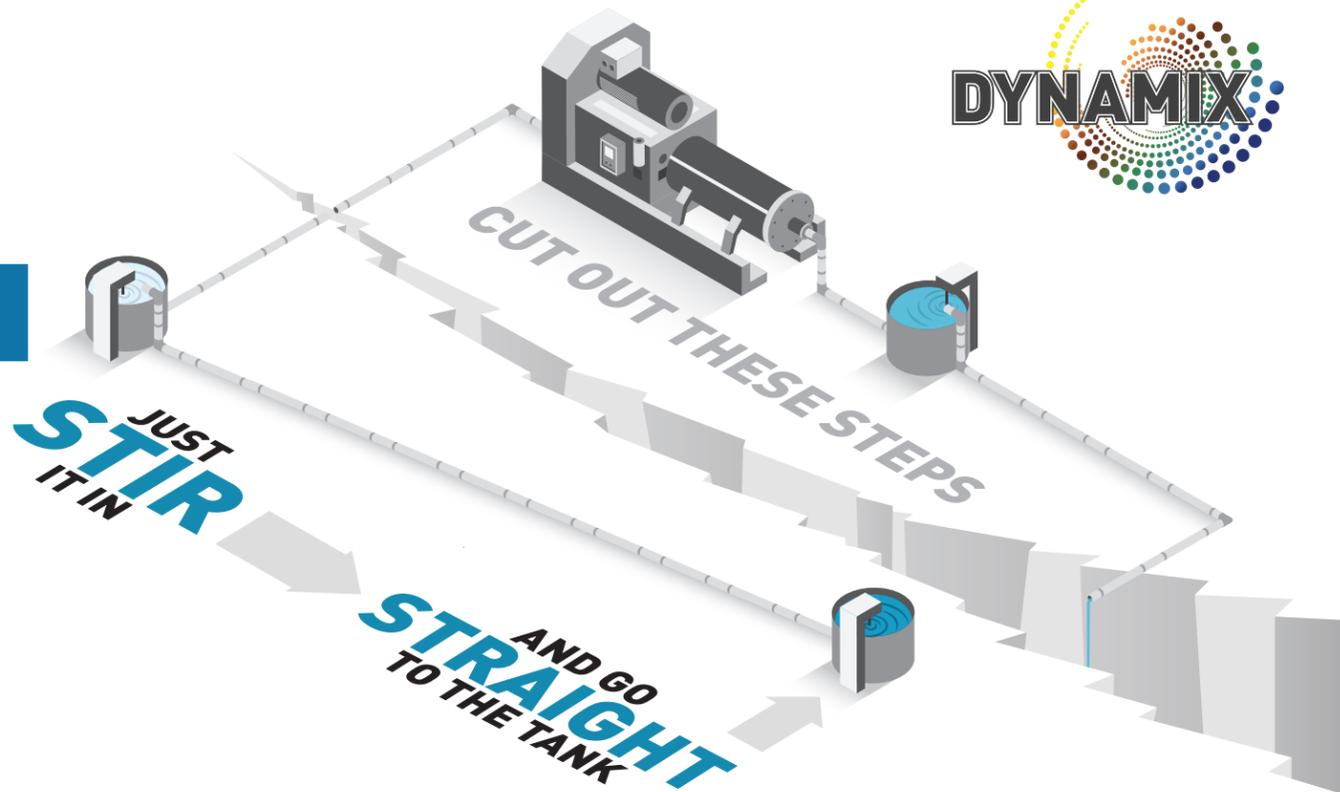
Please check with your sales rep for availability in your area.

SKIP STEPS



ACHIEVE 100% PURE COLOR DISPERSIONS WITH DYNAMIX

CREATE PROFIT



100%
PURE
COLOR

EXTRAS

PURE CONVENIENCE

- Just Stir It In
- Large or Small Batch Size
- Skip Steps for 100% Pure Color

PURE CONSISTENCY

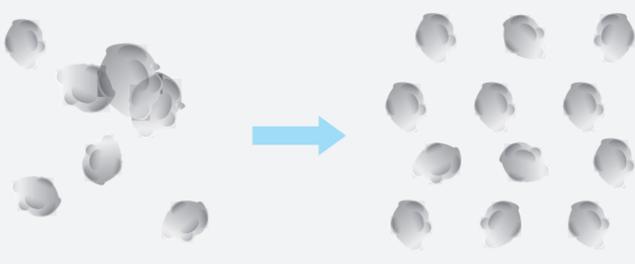
- Superior Technology
- Always Behaves the Same
- Locked-in Color

PURE PROFITABILITY

- Increase Yields
- Spend Less
- It's All in the Box

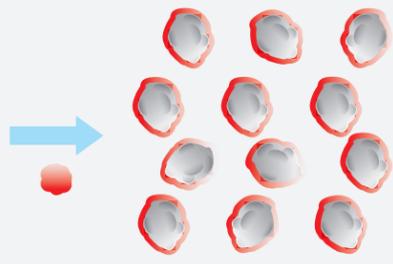
THE SCIENCE BEHIND DYNAMIX

STEP 1



Shepherd's micronizing technology reduces pigment particles to a uniform small size.

STEP 2



A modification is applied to the small particles.

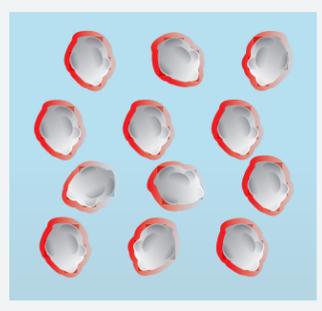
STEP 3



Dynamix Stir-in Pigment

Stabilized particles are formed into a dry Stir-in pigment powder.

STEP 4



Dynamix pigments form complete dispersions using High-Speed Dispenser only - no milling is required.

WHAT IT MEANS FOR YOU...

REDUCE WORK IN-PROCESS, STOCKS & INVENTORIES

IMPROVE QUALITY & CONSISTENCY

REDUCE SCRAP RATES BY OVER 50%

SPEED UP MANUFACTURING BY OVER 75%

REDUCE WASTE IN CLEANUP & DISPOSAL COSTS

IMPROVE MATERIALS YIELD BY OVER 20%

GET PURE... IT'S ALL IN THE BOX

shepherdcolor.com





Dispersion process

Dynamix® pigments can be dispersed under a variety of shear conditions.

Using a typical high speed dispersion (HSD) impeller or disc process where tip speeds in excess of 2000 ft/min (10 m/s) are common, full dispersion can be achieved within 5-10 minutes. Full dispersion is typically measured using grind gauges. A dispersion level of <5 microns (7.5 Hegman) is generally achieved under these conditions.

Where lower shear mixing is being used, more time may be required to achieve complete dispersion.

Typical times are:

HSD	5 – 15 minutes
Shaker	5 – 20 minutes
Paddle mixer	45 – 90 minutes

Dispersion of Dynamix® under high shear conditions is usually faster than that of titanium dioxide (TiO₂).

Dispersing Dynamix® for longer periods of time will reduce the number of “specks” or “oversized” particles. In many cases, an additional 5-15 minutes may be sufficient to ensure that the number of “specks” is reduced to a minimum.

When dispersing high concentrations of Dynamix®, there is a possibility of a reduction in viscosity relative to normal pigments. This could be beneficial to the complete system or higher pigment loadings may be achieved for the same final viscosity.

Compatibility

Dynamix® has been found to be compatible with a wide range of resins and coatings systems.

- Solventborne
- Waterborne
- High solids
- Low solids
- 100% solids (UV cure)

USA

Phone: 513-874-0714
 Fax: 513-874-5061
 Salesusa@shepherdcolor.com

AUSTRALIA / ASIA

Phone: + 613-9532-5620
 Fax: + 613-9553-5844
 Melbourne@shepherdcolor.com

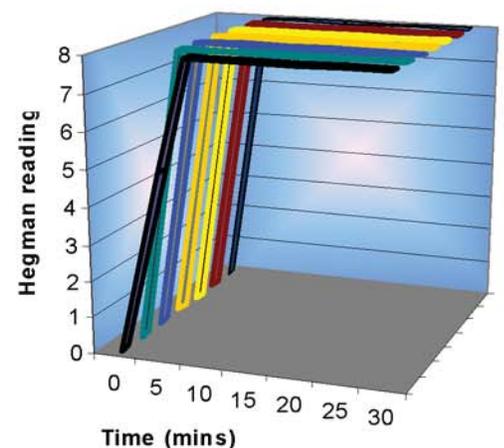
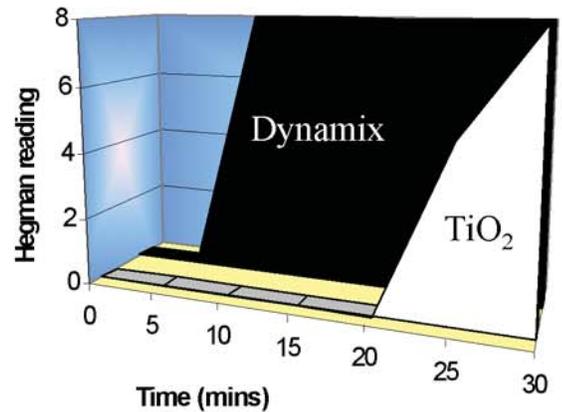
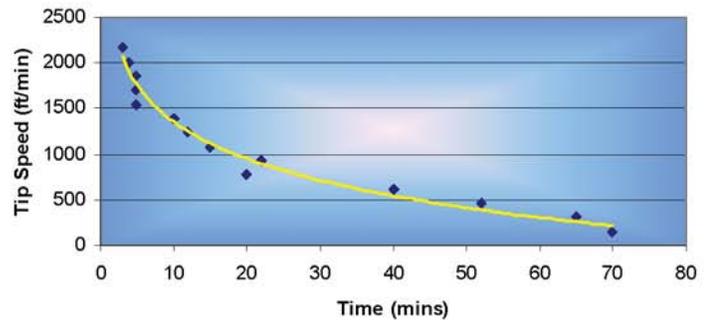
EUROPE

Phone: + 32-9-366-11-11
 Fax: + 32-9-366-11-21
 Europe@shepherdcolor.com

JAPAN

Phone: + 813-3344-3010
 Fax: + 813-3344-3027
 Sales@shepherdjapan.com

Time to achieve dispersion



The Shepherd Color Company

We Brighten Lives



Formulating Guide

General Description

This innovative new Dynamix® “stir-in” pigment technology developed by Shepherd Color is specifically designed to be used in almost all types of coatings applications. They are as equally applicable to the various different segments of the Building & Construction market, such as Metal Roofing and Siding, Window and Door extrusion, Architectural wall cladding and facades, to diverse Industrial segments such as Appliances, Traffic and Protective coatings to high performance Automotive and even Architectural Decorative systems.

Dynamix® is also referred as a dry dispersion technology because it is the closest one that can arrive to the ease of incorporation of a liquid colorant, whilst still being a dry powder and 100% pure color.

Formulating Approach

The principles of pigment dispersion are to separate the pigment particles that have agglomerated and aggregated during the various stages of finishing, packing, storage and transport using one or more high energy dispersion processes. Once dispersed, the particles are then required to be stabilized using binders and/or additives to prevent re-agglomeration or re-aggregation.

Components

Dispersion in solventborne systems generally requires a resin and solvent. A typical starting point formulation might look like:-

Dynamix®	60
Resin	25
Solvent	<u>15</u>
	100

This assumes typical resin solids of 60%, achieving a pigment to resin solids ratio of 4:1.

A dispersing agent is not necessary to achieve complete dispersion. It might be required to enhance or reinforce the compatibility between a dispersion of Dynamix® and other pigments. Many additives typically used in the coatings industry that are designed for use with inorganic pigments, including those designed for titanium dioxide (TiO₂) can be used.



The minimum level recommended by the supplier should be chosen. Dynamix® pigments typically have a low surface area and are lower than their corresponding dry pigment type homologues.

Other additives such as anti-settling agents may be required to prevent hard-settling of the high density inorganic pigments.

Dispersion in waterborne systems may or may not contain a resin. Where the system does not contain a resin, the use of a surfactant or dispersing agent must be used.

A typical formulation might look like: -

Dynamix®	60
Dispersing Agent	12
Water	<u>28</u>
	100

The choice of dispersing agent will depend upon the nature of the pigment and the interaction with the resin and final coating properties. The levels will also depend upon the type of dispersant. Manufacturer’s recommendations should be followed. As with solventborne dispersions, dispersing agents that are typically used for titanium dioxide (TiO₂) can be used for Dynamix®. The recommended levels can be similar but should be adjusted for optimum performance, both in dispersion and in the final coating.

Other additives such as defoamers and anti-settling agents may be required to obtain the optimum properties from the dispersion.

Order of Addition

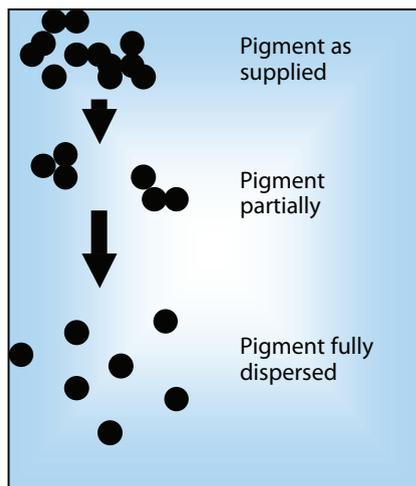
In most cases, the liquid portion of the dispersion should be prepared first. The pigment should then be added to the liquid portion during stirring or mixing.

Novel, Easy-Dispersing Pigment Technology Breaks Conventional Barriers

With the exception of clearcoats, in the manufacture of many liquid coatings there is a colored pigment dispersion step. This step is necessary to bring the appropriate colored pigments to their full functional properties and to impart the desired color. Depending on the chemistry of the pigment and a few other factors, the dispersion step is one of the most critical steps in the whole paint-making process. It is a step that, if done well, provides the coating with its ideal properties. If not done well, the color will be different and other characteristics of the coating may also be impaired and less than desirable.



Figure 1 | Pigment supply and dispersion illustration.



Pigment Dispersion

Most pigments in their delivered form are composed of aggregates and agglomerates that form from the primary pigment particles during the process of drying, packing, storage and transportation (Figure 1). The extent to which these aggregates and agglomerates exist is variable from pigment to pigment. The pigment dispersion process only serves to de-aggregate and de-agglomerate the

pigment particles and enable them to be stabilized in some way to prevent recombination.

In most cases, the pigments should be dispersed to as close to their primary particle size as possible to gain the maximum effect of color, gloss and flow properties. In the event that aggregates or agglomerates still remain, there is still the potential for color development to occur upon paint application. Dispersing agents and other polymeric species are often added to facilitate the dispersion process and also serve to enrobe the pigments and prevent pigment particles from recombining.

The energy required to achieve this dispersed state is considerable and requires the use of high-energy equipment such as ball mills, bead mills, triple roll mills etc. This process is also subject to a great deal of variability due to many factors such

as residence time, temperature, flow rate, media charge, media size, millbase viscosity, batch size, equipment type, etc. This process can also take a considerable amount of time, ranging from many hours to days, depending on the dispersion equipment and the pigment in question.

New Technology Advances

In the quest for a pigment technology that will not only bring out the maximum properties of the pigment, but also make the process of dispersion simple, quick and repeatable, many routes have been investigated, and various manufacturers have launched several to the market. Indeed, The Shepherd Color Company launched its first generation of surface-modified, easy-dispersing pigments back in 2002. These first-generation pigments worked extremely well. However, a couple of critical factors such as shelf life and multi-system compatibility led to the development of a new second-generation product, that today is known as Dynamix™.

By combining the effects of nanotechnology and creating a very thin surface modification of the pigment surface and a unique, well-controlled manufacturing process, the consequent products have outstanding characteristics that not only exceed initial expectations of dispersion capabilities but also provide compatibility across many paint systems, including both solventborne and waterborne.

By looking at the Zeta potentials of the untreated pigments (Figure 2) and comparing them to the surface-modified ones (Figure 3) in aqueous environments, a dramatic change is noted. Comparing two titanium dioxide grades as reference pigments with typically good and excellent dispersion characteristics, it can be seen that the Dynamix pigments show similar characteristics and behavior.

Dispersion Characteristics

As can be seen in Figure 4, the dispersion characteristics of the Dynamix Yellow 30C236, a chrome titanate C.I. Pigment Brown 24 composition, are compared to those of Kronos 2310 TiO₂ (Kronos Inc.). This particular titanium dioxide pigment has been found to have wide compatibility with many coatings systems and be relatively easily dispersible.

Using a Cowles-type high-speed dispersing setup, a high-molecular-weight solventborne acrylic resin and a pigment concentration of over 50%, the dispersion time (as measured with a Hegman gauge) can be as low as 10 minutes for complete dispersion. Under the same conditions, the titanium dioxide just about achieves the same level of dispersion around 30 minutes. Using a lower energy input, the DynamixYellow

Figure 2 | Zeta potential of untreated pigments in an aqueous environment.

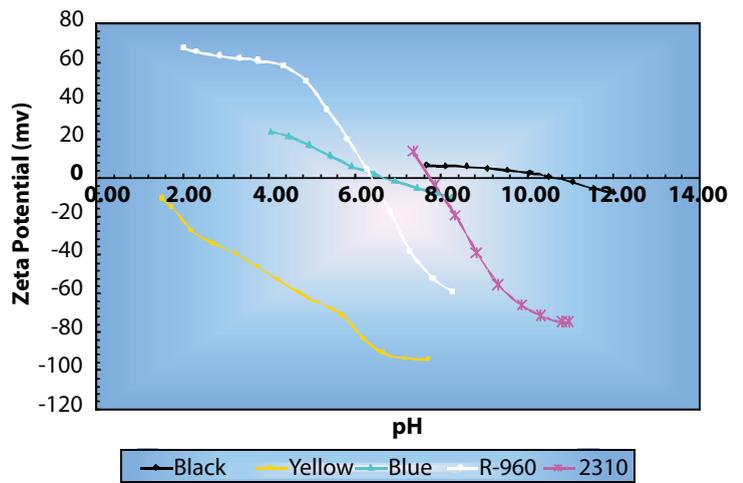


Figure 3 | Zeta potential of surface-modified treated pigments in an aqueous environment.

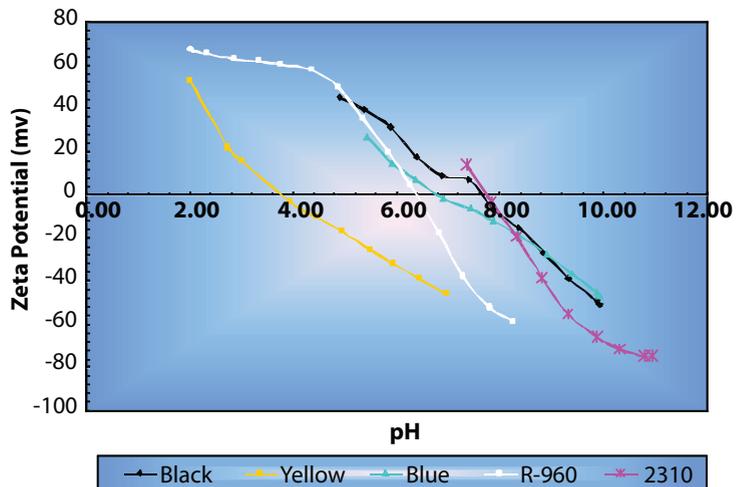


Figure 4 | Pigment dispersion characteristics.

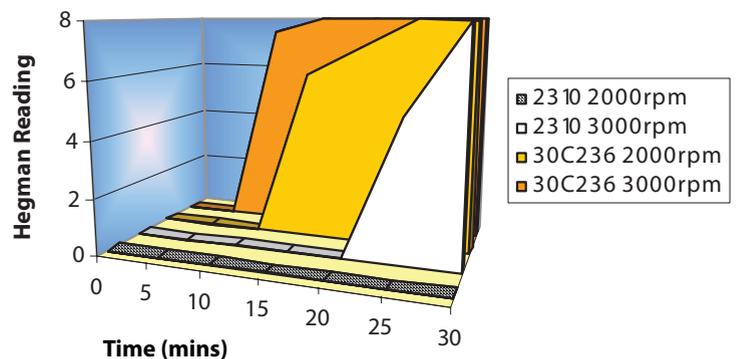
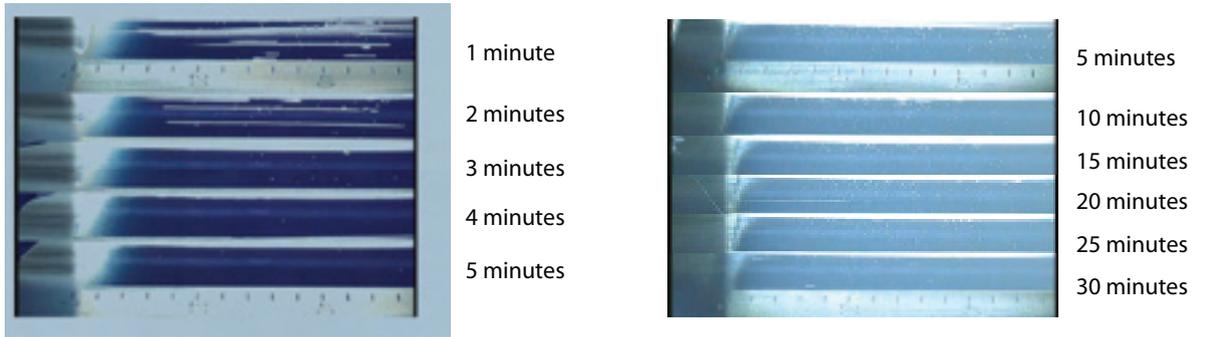


Figure 5 | Ease of dispersion of Dynamix pigments.



can still achieve dispersion in less than 30 minutes, whereas the titanium dioxide has not even begun to show any tendency to disperse at all.

Visually, the impact of the ease of dispersion for the Dynamix pigments is even more striking. The images in Figure 5 were generated using Dynamix Blue 30C588, a cobalt aluminate C.I. Pigment Blue 28 composition and titanium dioxide, also using a high-molecular-weight solventborne acrylic resin with a pigment concentration of over 50%; all measurements were made with the same Hegman gauge.

This new advanced technology surface treatment is remarkably efficient and provides complete

dispersion characteristics, even under relatively low shear conditions.

In Figure 6, the relative amount of time required for complete dispersion as a function of the tip speed of the stirring blade is shown. Using a high-speed dispersion system, the time can be reduced to as little as 5 minutes. Using lower speed paddle mixers, this time is extended to a little over one hour.

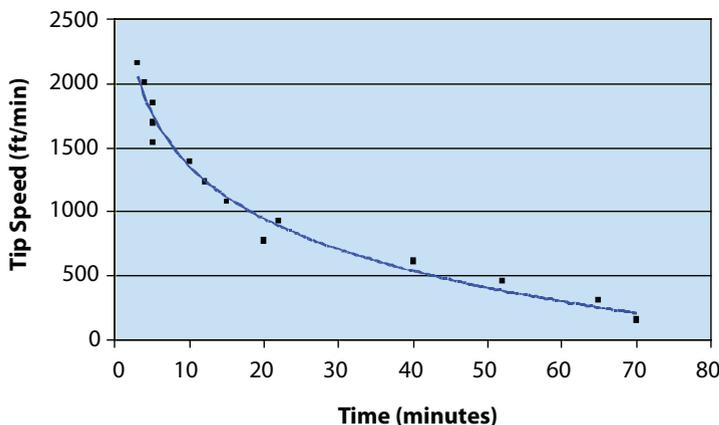
The Dynamix pigments show excellent dispersion behavior in solvents and in aqueous systems. In fact, using very simple formulas, dispersion in solventborne systems can be achieved without the additional use of dispersing agents. However, depending on the particular coating system being used, the appropriate choice of a dispersing agent will improve the compatibility of the dispersed pigment with other colored pigments in the final paint composition. In a similar fashion, in aqueous systems, the use of an appropriate surfactant will achieve similar compatibility. The choice of dispersing agent or surfactant will be wide and varied, but the coatings chemist can begin with one that is typically used for inorganic pigments and titanium dioxide.

One other feature of Dynamix pigments that is particularly interesting is that the surface area (and hence oil absorption characteristics) is lower than the corresponding pigment without the treatment. This fact, coupled with the easy dispersing nature of the surface, has a consequence on lowering the demand for the dispersing agent or surfactant significantly, sometimes by more than 50%.

Table 1 | Dynamix compatibility.

Curing Type	Medium	Coating Type
Air -dried	Solventborne	Acrylic
Oven or heat cured	Waterborne	Polyester
Radiation cured	100% solids	Urethane
		Fluorocarbon
		Phthalate
		Acrylate
		Silicone
		Silicate
		Epoxy

Figure 6 | Time to achieve dispersion.



Paint Properties

During the development of each Dynamix pigment, the appropriate color characteristic is chosen. For example, the brilliant masstone of the cobalt blue pigments (C.I. Pigment Blue 28) can be maintained by choice or the tint strength can be maximized, e.g., chrome titanate pigments (C.I. Pigment Brown 24).

These features are controlled during the processing and then the surface modification fixes it in place.

By choosing to maximize tint strength, for example, considerable increases can be seen when compared to unmodified pigments dispersed using conventional means. Increases of between 25 and 50% are not uncommon, providing significant economies in pigment usage and enabling the coatings chemist to reduce his pigment demand in a formulation.

Table 2 | Dynamix products in the marketplace.

Product	Chemistry	C.I. Classification
Dynamix Black 30C965	CuCr	CI Black 28
Dynamix Yellow 30C236	CrSbTi	CI Brown 24
Dynamix Blue 30C527	CoCrAl	CI Blue 36
Dynamix Blue 30C588	CoAl	CI Blue 28
Dynamix Blue 30C591	CoAl	CI Blue 28
Dynamix Yellow 30C119	NiSbTi	CI Yellow 53
Dynamix Black 30C940	FeCr	CI Green 17

Figure 7 | Range of dispersion times.

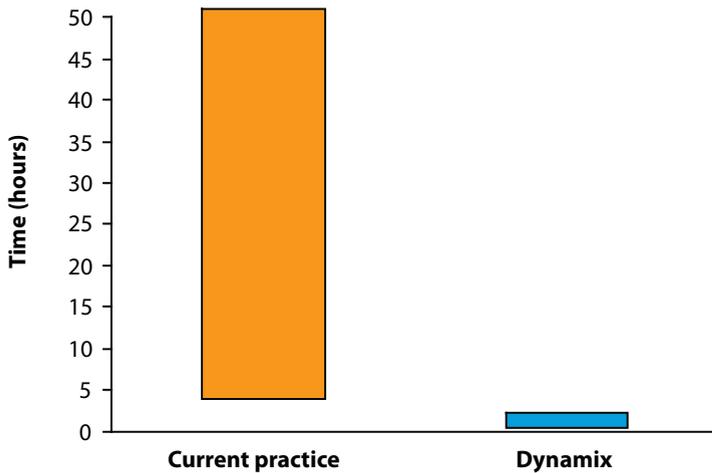
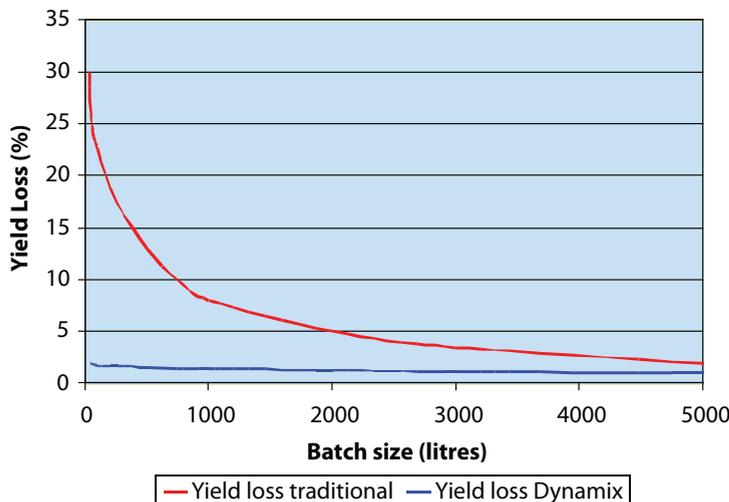


Figure 8 | Yield loss comparisons.



By achieving complete dispersion of the pigment, the color development is maximized in the sense of making the most of the coloristic properties of the pigment. No further energy will provide more. This means that the color stays constant and is repeatable time after time, leading to very consistent colored pigment dispersions.

Since the surface of the pigment has similar characteristics to titanium dioxide, similar dispersing agents can be used to stabilize both pigments. Under these conditions, no color development can be seen under typical application and shear testing conditions.

Having complete pigment dispersion through the use of Dynamix gives rise to paint films that show higher levels of gloss, display improved image clarity and can even show better paint flow properties. In some cases, pigment opacity is improved. In the case of cobalt blue pigments, an increase of over 25% in UV opacity has been achieved, a feature not insignificant in the world of thin film applications.

In certain paint systems, a lower viscosity has been achieved, leading to either better application characteristics or an increased pigment loading level. This is particularly advantageous for highly concentrated pigment bases and colorants.

Dynamix pigments have a wide range of compatibilities across many typical paint systems. Examples of such systems can be seen in Table 1.

Operational Improvements

By eliminating the need for energy-intensive pigment dispersion steps, Dynamix pigment technology provides for significant cycle time savings. Reducing typical cycle times of 40 to 50 hours to as little as 2 to 3 hours can easily be achieved using Dynamix pigment technology (Figure 7). This is simply achieved by removing the lengthy bead mill or triple roll dispersion step of the process.

In addition to significantly reducing cycle times through the elimination of the traditional pigment dispersion techniques, yield losses of expensive pigments can also be reduced. Yield losses come from the clean down of dispersion equipment. Typically, the smaller the batch size, the greater the yield loss that can be expected. By exploiting the simple mixing dispersion capability of Dynamix pigment technology, these losses can be cut considerably (Figure 8).

In addition to these easily quantifiable operational advantages and savings, there will be other savings that could be seen throughout the production process, such as minimized clean-down operations, reduced quality control operations, improved first-run capabilities, etc.

Potential Applications

Dynamix pigments have been successfully trialed in a wide range and number of different applications. Typical examples are noted here.

Building and construction	Architectural
General industrial	Coil coating
Automotive	Liquid spray
ACE	Roller/curtain coating
High heat	Powder coating
Traffic paint	Inks
Maintenance coatings	UV curing

Whatever the application, pigment dispersion has never been easier than that provided by this novel technology.

Pigment Range

The surface modification works well in a number of different pigment chemistries. Seven products have been launched to the market initially (Table 2). More launches are planned in subsequent phases.

The Dynamix Black 30C940 is an Arctic® infrared reflective pigment. By controlling the masstone color, along



with the Total Solar Reflection, higher reflectances can be achieved than with typical pigment dispersion techniques. This is a significant advantage for the infrared reflecting pigments where the choice of pigment and the quality of the subsequent dispersion play a very large role in the final performance. Over- or under-dispersion leads to diminished reflectance properties. Using this new Dynamix technology, these worries and concerns can be eliminated.

Conclusions

By simply stirring in the new Dynamix pigments under relatively low to high shear conditions, complete pigment dispersion can be achieved in a matter of minutes. Significantly increased tint strengths, resistance to color, improved gloss and image clarity are some of the benefits to be achieved using this new technology.

In these days of careful cost control, consistent product quality and reduced manufacturing lead times, Dynamix represents a breakthrough in pigment technology, similar to that achieved by the use of predispersed colorants in the paint manufacturing process.

Manufacturing processes can be significantly simplified by the reduction of a process step and dispersion times are reduced from days to hours. No longer are the yield losses incurred with conventional dispersion techniques such as bead mills, and batch sizes are no longer controlled by the size of mills available.

Pigment dispersion can be made more frequently, in smaller batch sizes, to just-in-time requirements, and the color and strength will still remain the same. A small laboratory batch will yield the same color as the one out in production.

Finally, product development becomes a faster and more efficient process because the pigment dispersion, compatibility, stabilization becomes as easy as that needed to make a white. The time to make the colored versions and tint bases will just be a matter of simple mixing! ■

This paper was presented at the Nürnberg Congress held during the European Coatings Show, Nürnberg, Germany, May, 2007 and organized by the Vincentz Network. See events@coatings.de.

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INORGANIC PIGMENTS FOR COATINGS

Masstone	4:1 Tint	Shepherd Product	Pigment Color Index	ARCTIC	Total Solar Reflectance	Oil Absorption	FDA Approved	CONEG	RoHS/ WEEE	EN 71.3 (Cat. 1)	EN 71.3 (Cat. 111)	AP (89)1	French Positive List	Heat Stability	Light Fastness (1-8)	Mean Particle Size (microns)	Specific Gravity
		Black 1G	CI Black 28		5%	11	✓		✓			✓		800°C	8	1.5	5.5
		Black 430	CI Black 28		6%	11	✓		✓			✓		800°C	8	0.9	5.4
		Black 20C920	CI Black 28		5%	17			✓			✓		800°C	8	1.0	5.1
		Black 444	CI Black 26		5%	24	0	✓	✓			✓		600°C	6	*4.1	5.3
		Black 10C912	CI Brown 29	✓	25%	9			✓			✓		800°C	8	1.6	5.2
		Black 10G996	CI Brown 29	✓	27%	9			✓			✓		800°C	8	1.2	5.4
		Black 10P950	CI Brown 29	✓	29%	11		✓	✓			✓		800°C	8	0.9	5.1
		Blue 385	CI Blue 28	✓	30%	30	✓	✓	✓		5%	✓	✓	800°C	8	1.0	4.2
		Blue 10C595	CI Blue 28	✓	30%	18	✓	✓	✓	1%	10%	✓	✓	800°C	8	1.1	4.3
		Blue 211	CI Blue 36	✓	29%	18	0	✓	✓			✓	✓	800°C	8	1.0	4.7
		Blue 424	CI Green 50	✓	42%	17	✓	✓	✓	1%	10%	✓	✓	800°C	8	2.0	3.7
		Green 187B	CI Blue 36	✓	29%	11		✓	✓		1%	✓	✓	800°C	8	1.6	4.8
		Green 179	CI Green 26	✓	24%	9			✓			✓		800°C	8	2.5	5.2
		Green 10C650	CI Green 17	✓	40%	9		✓	✓		5%	✓		800°C	8	1.8	5.1
		Green 10G655	CI Green 50	✓	25%	11	✓	✓	✓	1%	10%	✓	✓	800°C	8	1.3	5.4
		Yellow 10C112	CI Yellow 53	✓	71%	9	✓	✓	✓					800°C	8	1.4	4.6
		Yellow 10C242	CI Brown 24	✓	66%	15	✓	✓	✓		2%	✓	✓	800°C	8	0.7	4.5
		Yellow 10C229	CI Brown 24	✓	58%	17	✓	✓	✓		2%	✓	✓	800°C	8	1.0	4.7
		Yellow 10C151	CI Yellow 227	✓	75%	11		✓	✓	1%	10%	✓		320°C	8	0.9	5.5
		Orange 10C341	CI Yellow 216	✓	65%	19		✓	✓	1%	10%	✓		320°C	8	1.3	4.5
		Brown 19FDA	CI Black 12	✓	45%	13	✓	✓	✓		5%	✓		800°C	8	2.0	4.1
		Violet 92	CI Violet 14		17%	15		✓	✓			✓		600°C	6	2.9	3.8

All values represent typical values and are not to be construed as specifications.
*Particle size is highly influenced by dispersion energy and is often lower than this value when fully processed into a coating.

ASTM C1549
SCTM 134

For EN 71.3 (Cat. 1) and EN 71.3 (Cat. 111) the percent listed is at max loading.
0-With FDA Certification Testing

Observed

ASTM D1366
ASTM D153

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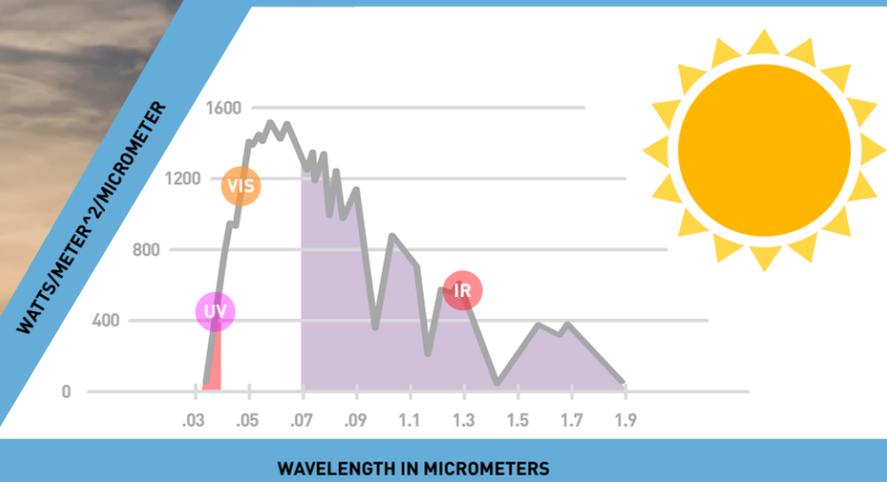


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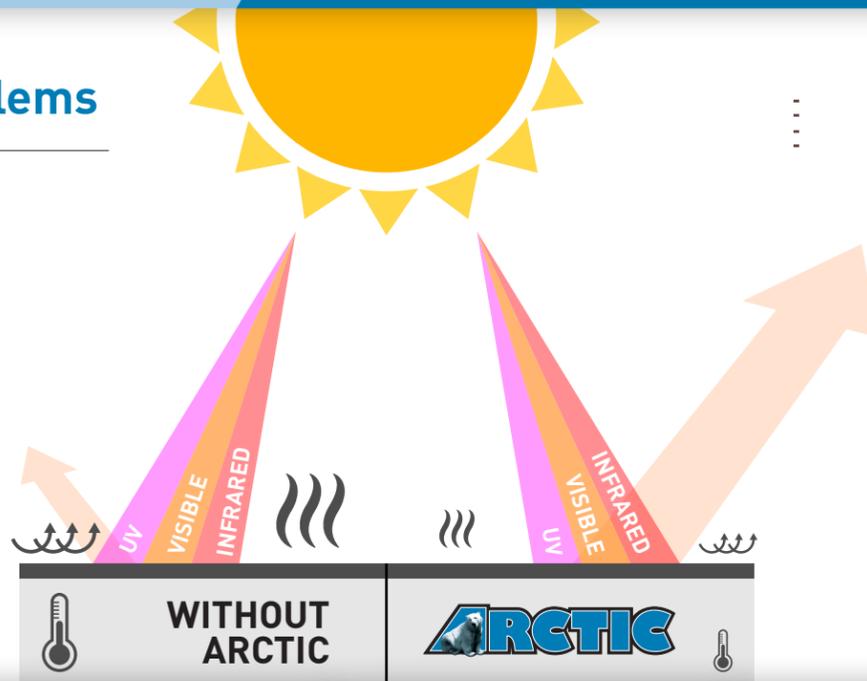
BETTER PERFORMANCE



BEST VALUE

These Are The Problems

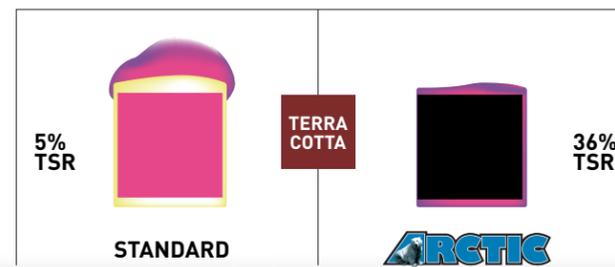
	Convection A hot object heats up the air around it
	Conduction Heat is transferred from the exterior surface to the interior
	Emission Hot materials radiate heat back into the environment



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IR Heat Signature Same Color Comparison



Product Innovation

GEN 1 15% 1980 Black 123: 15%TSR Black 242: 15%TSR Red shade blacks (Not jet black), improvement over 5% from carbon black	GEN 2 20% 1990 Black 411A: 25%TSR Black 376A: 15%TSR Higher tint strength and jet black but TSR=15%	GEN 3 25% 2001 Black 10C909A: 25%TSR Optimized Blue-shade masstone black with High TSR	GEN 4 28% 2010 Black 30C940: 25%TSR Black 10P950: 28%TSR IR Black easily incorporated into systems without degradation of TSR, increase in tint strength and TSR	GEN 5 29% 2014 Black 30C941: 29%TSR Higher TSR with locked in performance
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More Color Options



- To Match Specifications
- To Satisfy Code Requirements
- To Exceed Standards
- To Enhance Performance

What's In It For You?



Introduction to IR-

While the human eye is sensitive to only a small part of the electromagnetic spectrum, pigment interactions with wavelengths outside the visible can have interesting effects on coating properties. One key area of the spectrum is the infrared (IR), specifically the near infrared. While not visible to the human eye, a pigment's, and thus a coating's IR properties can affect usability and durability.

The primary purpose of IR-reflective coatings is to keep objects cooler than they would be using standard pigments. This IR-reflective feature is the basis for

their use in markets like Cool Roofing for the EPA's Energy Star Program¹ and the California Energy Commission² Title 24 2008 version. This technology is also finding use in transportation and other areas where the ability to stay cool is a valuable benefit.

The easiest way to increase IR reflectivity is to use white pigments like titanium dioxide. TiO₂ reflects in the visible and in the infrared. The key to fight this "White Blight" and produce innovative, colored IR-reflective coatings is to use pigments that absorb in the visible to produce color and reflect in the IR for coolness. From these demands, Shepherd Color has developed a line of highly engineered products called Arctic[®] IR-reflective pigments. The Arctic line of pigments provides a palette of colors that allows the formulation of coatings and the design of materials to meet infrared reflectivity and long-term durability requirements, and provide deep and rich colors.

Articles have been written about the pigments used to make infrared reflecting coatings. This article is meant to inform chemists and formulators about some specific issues and phenomena pertinent to formulating and optimizing IR-reflective coatings. Some variables and factors that can affect a coating's IR reflectivity are individual pigment selection, milling and dispersing, mixing IR-reflective pigments, opacity, and contamination.

Solar Spectrum

Any discussion of IR coatings requires a short review of basic physics. The sun's energy that reaches the Earth's surface is divided into three parts.

Figure 1/Solar spectrum.

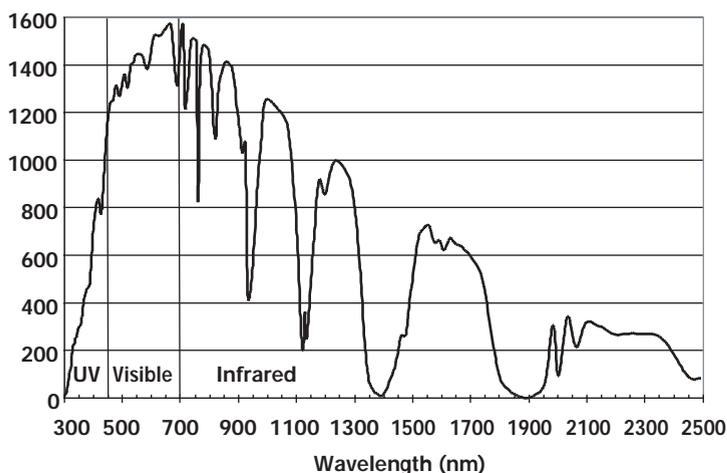
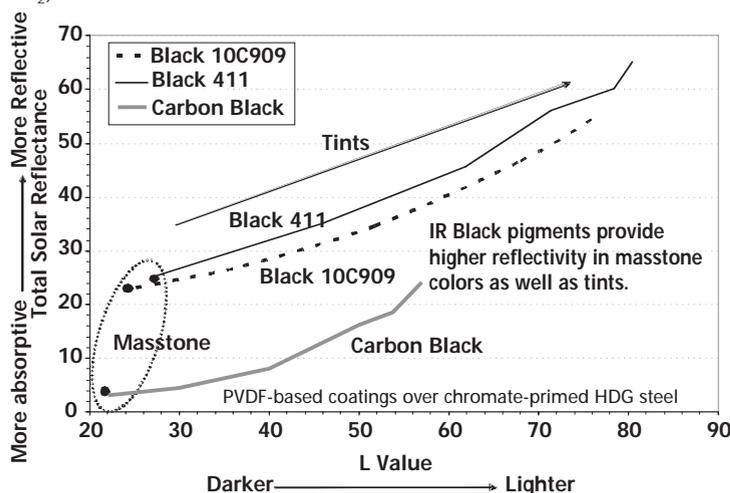


Figure 2/Total Solar Reflectance versus L value (black pigments mixed with TiO₂).



By Mark Ryan, Technical Sales Representative/Shepherd Color, Cincinnati, OH

Reflective Pigments

- **Ultraviolet (295-400 nm):** The UV region starts at 295 nm where the atmospheric cut-off occurs. While UV only accounts for roughly 5% of the sun's energy that reaches the Earth's surface, it is a major contributor to the degradation of coatings.
- **Visible (400-700 nm):** Roughly 50% of the sun's energy makes up the wavelengths that give us the perception of color.
- **Infrared (700-2,500 nm):** Forty-five percent of the total solar energy is in the infrared region. As can be seen in Figure 1, the majority of the energy in the infrared range is found in the 700-1,200 nm range. Beyond 2,500 nm there is little solar energy. The solar infrared region is different from the infrared energy given off by objects as heat. For most everyday objects, the heat emitted is found at much longer wavelengths and is dependant on an object's black body properties.

For an object in an outdoor environment, the four main mechanisms of reflectivity, emissivity, convection and conduction determine its temperature. Convection is largely dependant on air flow, and conduction depends on how well an object is insulated to prevent heat flows. Reflectivity and emissivity are the factors that can be manipulated.

Cool Mechanisms

Objects reflect or absorb solar energy from these three regions: UV, visible and infrared. Total Solar Reflectance (TSR) describes how much of the sun's energy an object reflects. The common instrument for determining TSR is the Devices and Services³ Solar Spectrum Reflectometer Model SSR, more commonly known as the "D&S". The D&S returns a single number for the TSR, while a spectrophotometer reads individual wavelengths that can be used to make the spectral reflectance curves seen in this article. Reflectivity can be manipulated by the careful selection of high-IR-reflective Arctic pigments. The key is to reflect infrared and absorb and reflect in the visible region to produce the needed color.

Cool Coatings System

Shepherd Color Company supplies pigment to the high-performance coatings market. These products, including the Arctic line, are highly engineered ceramic pigments. These pigments, also called mixed metal oxides (MMO) or complex inorganic colored pigments (CICP), provide lasting color for demanding applications. The inorganic ceramic nature of the pigments provides resistance to high tempera-

tures, chemicals, acids, bases, weathering and environmental pollutants.

Colormatching Blindfolded

Pigment Selection

The highest reflective pigments should be chosen for cool coatings. Carbon black, iron oxide black or copper chromite black are standard black pigments for most formulations, but they have very low infrared reflectivity and a TSR of about 6%. One key to formulating cool coatings is the use of an infrared-reflecting black pigment. In general, IR-reflective formulations incorporate Arctic Black 10C909 to lower the L value in colors made with the other Arctic colors. Black 411 provides a higher TSR, but with a redder undertone. A complete listing of Arctic pigments (Table 1) provides a nearly full color gamut to use to help formulate high-IR-reflective coatings.

IR-Reflective Coatings Benefits

General Benefits

- Longer potential life-cycle due to less polymer degradation and thermal expansion due to lower temperature.
- Aesthetically pleasing colors.
- Cooler to the touch for better ergonomics.
- Improved system durability and less thermal degradation

Roofing Benefits

- Less heat to transfer into buildings.
- Reduced heat island effect.
- Lower peak energy demand.
- Reductions in air pollution due to lower energy usage, power plant emissions, and a reduction in urban air temperatures.
- Installation crews can work longer into the day before roof gets too hot to work on.

Table 1/Arctic pigments.

Pigment	Color Index	Color Shade	Total Solar Reflectance (TSR%)
Black 10C909	Pigment Green 17	Blue Shade Black	24
Black 411	Pigment Brown 29	Red Shade Black	30
Blue 385	Pigment Blue 28	Red Shade Blue	28
Blue 211	Pigment Blue 36	Green Shade Blue	30
Blue 424	Pigment Blue 28	Turquoise	39
Green 187B	Pigment Blue 36	Teal	29
Green 179	Pigment Green 26	Camouflage Green	24
Green 223	Pigment Green 50	Yellow Shade Green	25
Brown 12	Pigment Brown 33	Red Shade Brown	30
Brown 157	Pigment Brown 33	Medium Shade Brown	38
Brown 8	Pigment Black 12	Blue Shade Brown	38
Brown 156	Pigment Black 12	Yellow Shade Brown	51
Yellow 10C112	Pigment Yellow 53	Green Shade Yellow	66
Yellow 10C272	Pigment Brown 24	Red Shade Yellow	71

This advantage in TSR for the masstones also continues when the pigments are added with TiO₂ to make tints. Figure 2 portrays TSR on the vertical axis and the lightness L value on the horizontal axis. Each line represents a different pigment with the dot on the left-hand side (low-L-value) as the masstone. Adding white increases the L value and increases the TSR. What you can see from the graph is that low-L-value masstone colors with around 25% TSR can be achieved with IR-reflective blacks, while standard blacks need to be mixed to a light to medium gray before they can achieve 25% TSR.

Figure 3/Grind study of Black 10C909 (Masstone L value and Total Solar Reflectance).

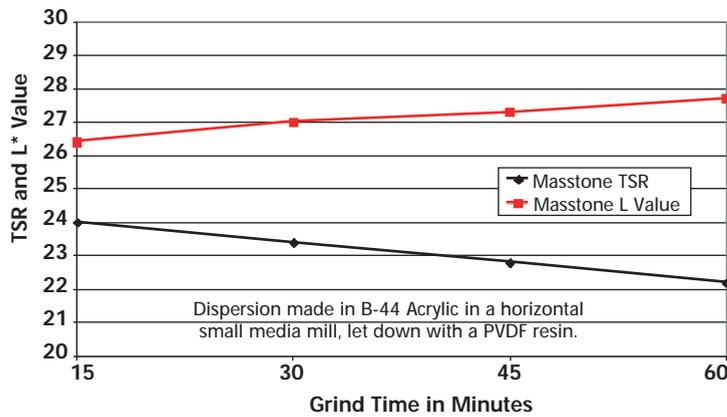
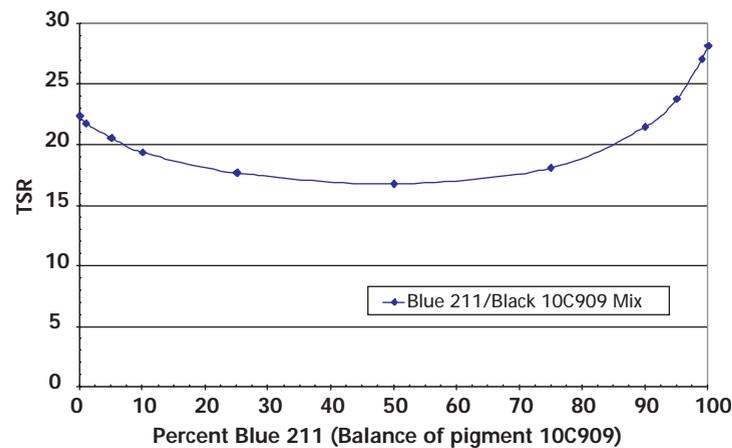


Figure 4/Effect of blending pigments on TSR (mixes of Black 10C909 and Blue 211).



Dispersion

Arctic pigments are compatible in almost all solvent and aqueous coatings systems, including polyesters, acrylics and fluoropolymer systems. To achieve full dispersion and optimum properties, the pigments should be dispersed in a small media mill to at least a 7 Hegman. Care must be taken not to over grind the pigment. Additional grinding will break the pigment into smaller particles, causing color shifts, which usually increase tint strength but lightens masstones. Consistent grinding past the dispersion step needs to be carefully controlled to maximize color and IR properties. Figure 3 shows that with increased grinding, Arctic IR Black 10C909 moves lighter in the masstone and lower in TSR, both of which are undesirable.

Many additives can be used to produce stable dispersions. In some systems no additives are needed due to the inherent dispersion properties of the pigments. Due to their high specific gravity, careful screening of finished paints for pigment settling should be conducted.

Blending Pigments

Very few colors are single-pigment dispersions. In order to match a color, care must be taken when more than one pigment is mixed together to make a color. As seen above, any Arctic pigment mixed with white will provide a higher total solar reflectance than the Arctic pigment by itself. Two Arctic pigments with different absorption areas, when mixed together, will have a lower reflectance than the pigments have individually. A good example of this is a mixture of Arctic Blue 211 and Black 10C909. While both have about 25-30% TSR, when combined they will have a lower TSR than a weighted average of the individual pigments, as seen in Figure 4.

An examination of the spectral curves in the infrared (Figures 5 and 6) shows that the black's reflectance comes just as the cobalt absorption band of the blue starts. This is to be expected since pigmented films don't really reflect; they either absorb, scatter or transmit. The absorbance of the pigment over-powers the scattering. This battle between absorbance and scattering is predominate over transmittance in thick objects. But in the relatively thin world of paint films, transmittance can also play a factor.

Opacity

CICPs, such as Arctic pigments, are known for their high visible opacity. What is harder to see is that since they don't absorb in the IR region, the only two mechanisms left are scattering and transmission. Thin films

Figure 5/Effect of mixing pigments on reflectance curves (ratios of Black 10C909/Blue 211).

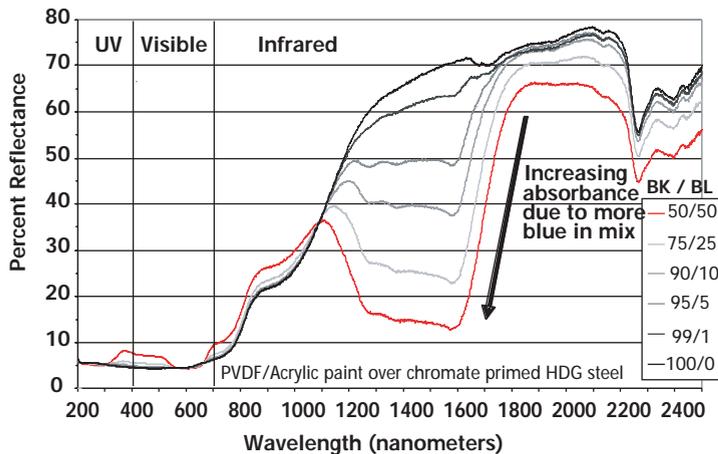


Figure 6/Effect of mixing pigments on reflectance curves (ratios of Black 10C909/Blue 211).

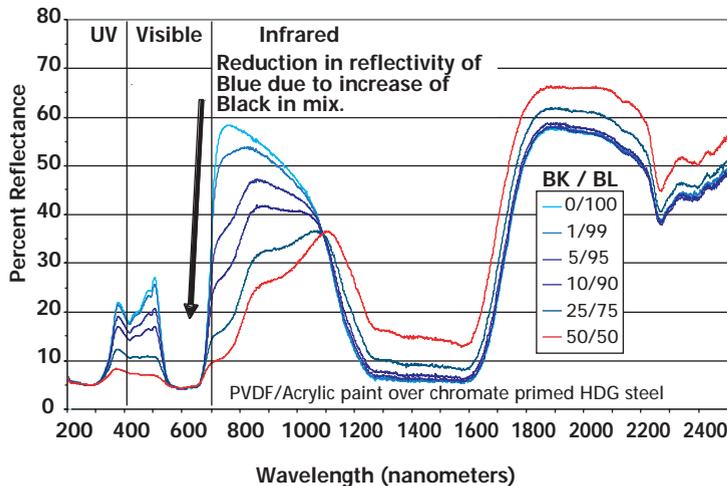
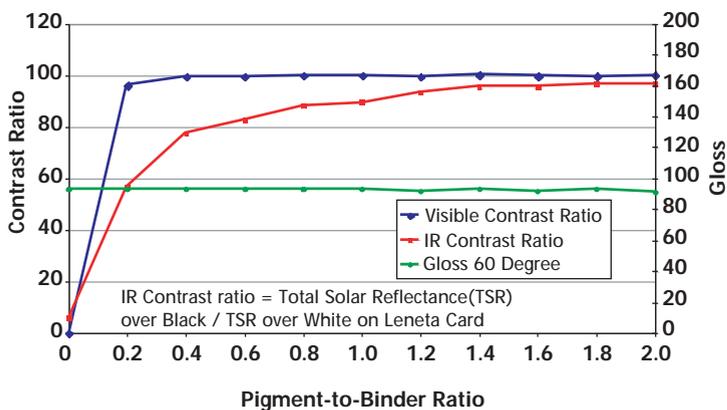


Figure 7/Visual versus IR opacity [Black 10C909 in 1.1 to 1.3 mil DFT (acrylic system)].



may not completely scatter and reflect the sun's energy back out of the coating, so the IR energy may continue through to the substrate.

Figure 7 shows how a paint film can be visually opaque, while still semi-transparent in the IR. A solventborne air-dry acrylic was used to make coatings with varied pigment-to-binder ratios. The paints were then drawn down over the black and white portion of Leneta cards. The visible contrast ratio was read, and a "TSR contrast ratio" was determined by dividing the TSR reading over the black part of the card by the TSR over the white portion of the card. For each pigment-to-binder ratio, P/B, the respective contrast ratio was plotted, along with the 60 degree gloss of the coating. As can be seen, the films obtained visual opacity much sooner than IR opacity. Along with P/B ratios, a similar behavior can be seen if the P/B were held constant and the film thickness increased.

This difference in visual and IR opacity leads to many issues. A pigment's and a coating's TSR can depend on the substrate and film thickness. This makes it difficult to predict TSR for a pigment or coating without knowing particulars about its application and use. A gray primer with carbon black in it will cause a greater loss in TSR than if a similar color primer is made with IR black, other non IR absorbing pigments, or left white.

Along with these negatives, the positive is that an IR-reflective substrate can help to keep a coating's TSR higher. A different take on the graph in Figure 7 is the graph that is shown in Figure 8, which illustrates the visible contrast ratio along with the TSR readings of the coating containing the Black 10C909. The red and blue lines represent the TSR over white and over black respectively. Not surprisingly, the TSRs differ while the film is not visually opaque, but the TSR is also higher over the white when visual opacity is reached. As the P/B increases and hides the black and white portions of the Leneta card, the TSR numbers start to converge. In the range of about 0.4 to 0.8, the Black 10C909 film shows good visual opacity and the ability to maximize the coating's TSR over reflective substrates.

Contamination

One last area of concern is contamination. Figure 9 shows the curve previously shown that demonstrates the decline in TSR when Black 10C909 and Blue 211 are mixed together. Even more damaging to TSR is the inclusion by design or contamination of a non-IR-reflecting black, like carbon black. The carbon black

Figure 8/Total Solar Reflectance and contrast ratio vs pigment-to-binder ratio. [Arctic Black 10C909 (1.1 to 1.3 mil DFT- Acrylic System)]

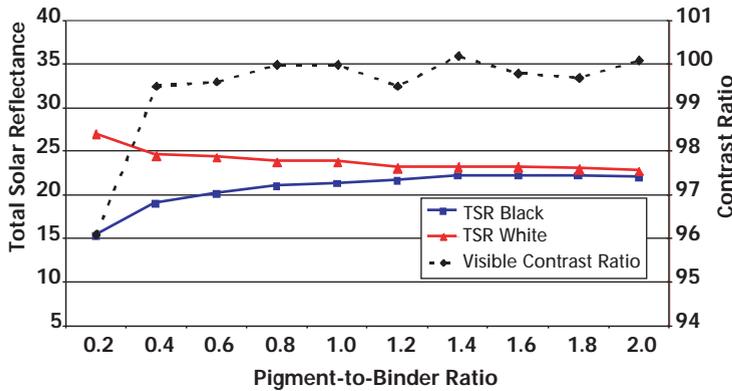
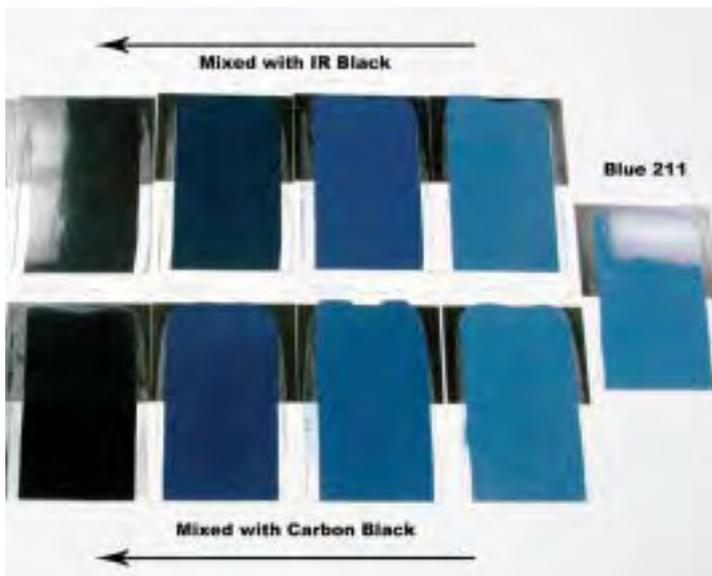
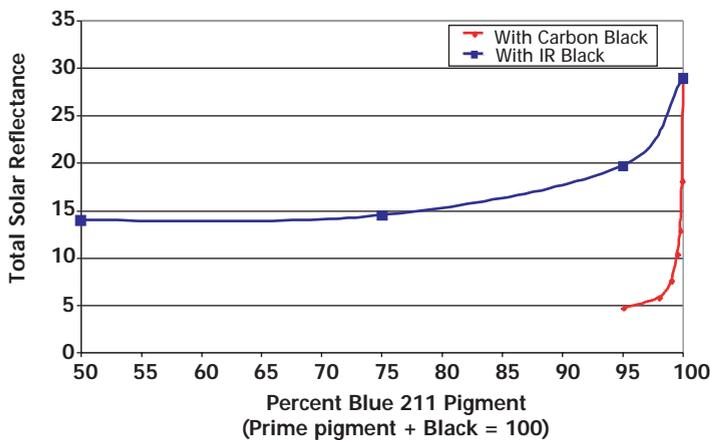


Figure 9/Cobalt Blue with Carbon and IR Black.



greatly affects the TSR of the mix when as little as 0.10% is included, and before the color starts to change dramatically, as seen in the picture. The two lessons that this shows is that mills and handling equipment must be clean to make sure that cross-contamination doesn't occur and that using even small amounts of non-IR colors to shade a batch can have drastic effects on TSR.

Conclusion

The formulation of IR-reflective coatings for various applications depends on many factors, some of which cannot be seen with the naked eye. There are two main keys to formulating these coatings. The first has to do with the physical characteristics laid out in this article.

- **Individual pigment selection:** Select IR-reflective pigments.
- **Milling and dispersing:** Do not over grind and degrade IR properties.
- **Mixing IR-reflective pigments:** Be aware of the invisible interactions of different pigment types in the IR region.
- **Opacity:** Use an IR-reflective substrate/primer if possible, or manage the pigment-to-binder and film thickness to minimize effect of absorptive substrates.
- **Contamination:** Inclusion of even small amounts of IR-absorbing pigments can greatly reduce TSR.

The second key is to work with a partner with the products, research, and most importantly, technical support to allow you to formulate, test and validate your IR-reflective coatings. The IR range is invisible to the human eye, not covered by standard spectrophotometers, and measurable only by expensive and specialized equipment. A partner who can shepherd you in pigment selection, color matching and testing, along with guidance in the different regulations and programs can be an invaluable aid in formulating, marketing and supporting differentiated IR-reflective coatings. ☺

References

- 1 EPA Energy Star Roofing: www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products.
- 2 California Energy Commission: www.energy.ca.gov/.
- 3 Devices and Services: 10290 Monroe Dr., Ste. 202, Dallas, TX 75229; 214/902.8337; www.devicesand-services.com.

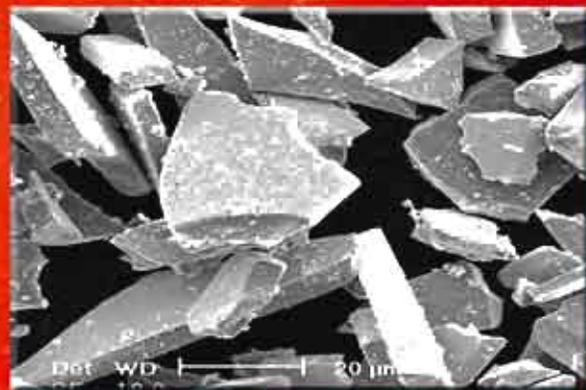
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www.shepherdcolor.com

USA
1-513-874-0714
Salesusa@shepherdcolor.com

EUROPE/MIDDLE EAST/AFRICA
+32-9-366-11-11
Europe@shepherdcolor.com

AUSTRALIA / ASIA
+613-9532-5620
Melbourne@shepherdcolor.com

JAPAN
+813-3344-3010
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AND YOUR CUSTOMERS



MORE EXPERTISE

World class scientists in Shepherd Color's laboratories develop new and innovative pigments, maintain the highest level of quality control and ensure environmental and regulatory compliance.



BETTER PERFORMANCE

Shepherd Color's pigments maintain their color in long lasting outdoor coatings and polymer systems, high temperature engineering plastics and highly corrosive environments.



BEST VALUE

From Classic to Arctic Infrared Reflective to Dynamix Stir-In, Shepherd Color pigments will help to cut time and waste.

Our roots originate in the 1920s ceramics industry, where we supplied colors for porcelain enamels. By the early 1960s, our product line had expanded to a full range of complex inorganic color pigments for the premium coatings and plastics markets.

Today, our products are used in many diverse applications, particularly where performance is critical under the most extreme conditions.

Our success has been built upon the fundamental belief that exemplary character, quality work, and customized products brighten the lives of everyone involved.

Headquartered in Cincinnati, Ohio with sales offices in Belgium, Australia, and Japan, we supply millions of pounds annually of high-quality pigments to customers around the world.



DO YOU HAVE THE RIGHT COMPANY BEHIND YOU?

OTHERS

•VS•

Shepherd



MORE EXPERTISE

WORK WITH THE RIGHT TEAM

The Expertise at Shepherd Color will help you to reduce time and help you to develop a superior product. With continuing advances in color and technology, rely on Shepherd Color to Brighten Your Life with quality products and the latest innovation.

MORE KNOWLEDGE

We are known as a leader in the color industry with continuous improvement of technical applications and a history of innovation. The Shepherd Color Company is a recognized regulatory resource.

BETTER ANSWERS

Helping you to get the answers without a lot of work on your side. Shepherd is your trusted advisor every step of the way.

BETTER RESULTS

Get to the end result more efficiently and effectively. This will lead to increased market opportunities for you!

Making color since the

1930s



“Shepherd Color has distinguished and differentiated themselves in their ability to come in and talk about the basic chemistry of the products.”

Shepherd Color Customer

DOES YOUR SUPPLIER UNDERSTAND YOUR EXPECTATIONS?



WHAT DRIVES YOUR SUCCESS?



BETTER PERFORMANCE

FIND THE RIGHT PRODUCTS

Shepherd Color pigments are highly-engineered ceramic colorants — and that means tough! They are impervious to sunlight, chemicals, and thermal attack. They are compatible with not only widely used polymers, but also the most exotic, difficult-to-formulate systems. Their extreme inertness defends against migration from plastics or coatings, and helps to ensure environmentally sound, non-toxic recipes. Have confidence that your colors will outlast your product.

MORE DURABLE

Our robust and reliable products are built for long term applications. They are lightfast, chemical, and temperature resistant.

MORE CONSISTENT

With our precision color matching you have less guess work and waste. The Shepherd Color Company will give you confidence in meeting regulatory requirements with our reliable and dependable people and products.

MORE RESPONSIVE

Ask questions to our technical support staff as well as have access to top scientists and engineers. We have a dedicated Customer Experience staff to help you every step of the order process to ensure that our products and sample orders are delivered fast worldwide.



“ Everyone in Shepherd Color customer service has always been very responsive to emails and phone calls. A fantastic team that no doubt puts the customer first. I do appreciate them getting everything out the fastest way possible.”

Shepherd Color Customer



“ Long standing relationships matter, almost as much as pricing. Selling value is key and getting that value in what is bought is critically important.”

Shepherd Color Customer



MORE VALUE

PARTNER WITH SHEPHERD COLOR FOR SUCCESS

The right partner will help your product development so that you stop missing growth opportunities. Shepherd Color will support you across all levels to help you cut time and waste and increase your speed to market. A solid long-term partnership with Shepherd Color will lead to more satisfied downstream users.

MORE BENEFITS

We strive to make business easier for you, whether in the lab or the office, with support across all levels. Our products speak for themselves with the benefits they offer.

LOWER COST

Using our specialized products and support systems will help you cut time and waste. You will get more with less with higher strength.

YOUR SUCCESS

Get the right answers faster. We will help you develop products with More Expertise, Better Performance and Best Value to impress your customers.

ALL OF OUR PRODUCTS HAVE
ONE THING IN COMMON...

QUALITY

Outstanding performance, customer service and reliability are fundamental to our business philosophy. We work hard to deliver our products on time and with the confidence that they will perform consistently.

We support our worldwide customer base with a staff of technically trained sales representatives and a global distribution network. From special effect, IR reflective to easily dispersed, Shepherd Color can meet your pigment requirements.

Shepherd Color has been ISO certified since 1994. We maintain ISO certification through frequent internal audits, continuous training and periodic reviews, all of which help guarantee that we deliver the best products possible, both now and in the future. With ongoing advances in color and technology, rely on Shepherd Color to Brighten Your Life with quality products and the latest innovation.



ARCTIC INFRARED REFLECTIVE COLOR PIGMENTS

Arctic Infrared-Reflective pigments allow for the design of products that remain cooler under the sun – without sacrificing color! Durable. Color. Cooler.

APPLICATIONS

- Coatings
- Vinyl, Windows, and Siding
- Cement Concrete and Pavers
- Roof Tiles
- Automotive
- Military
- Decking / Fencing



DYNAMIX STIR-IN PIGMENTS

Dynamix stir-in pigments are designed with the ease of a liquid colorant, while still being a dry powder and 100% pure color.

Get Pure Profitability, Pure Consistency and Pure Convenience with Dynamix.

APPLICATIONS

- Building & Construction
- General Industrial
- Automotive
- ACE
- High Heat
- Traffic Paint
- Maintenance Coatings
- Architectural



STARLIGHT SPECIAL EFFECT PIGMENTS

With MicroMirror® technology silver-coated glass flake special effect pigment used for unsurpassed sparkle and brilliance to create dramatic effects.

APPLICATIONS

- Transportation
- Fashion
- Building and Construction
- Consumer Goods
- Electronics
- Sports and Leisure



CLASSIC COMPLEX INORGANIC COLOR PIGMENTS

Complex Inorganic Color Pigments with unbeatable weatherability, heat and chemical resistance, are non-warping and easy to disperse.

APPLICATIONS

- Coatings
- Plastics
- Concrete
- Glass

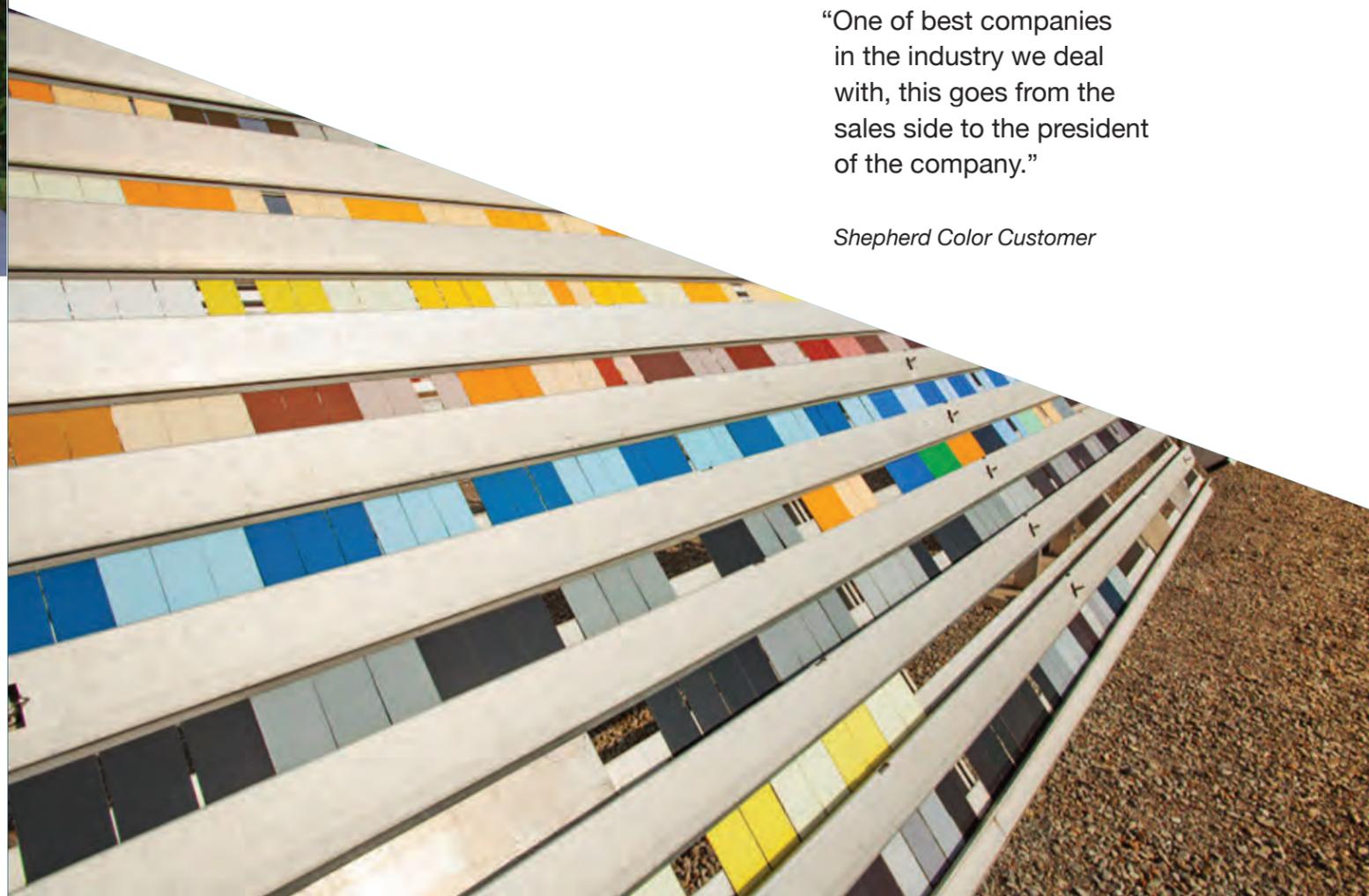


CALYPSO PIGMENTS

Useful for cementitious applications, such as concrete, grout, stucco and putz, the CALYPSO line of Shepherd pigments provides permanent colors. They are weather resistant, heat resistant, alkali resistant, and acid resistant. Our CALYPSO colors are also very easy to disperse.

APPLICATIONS

- Coatings
- Vinyl, Windows, and Siding
- Cement Concrete and Pavers
- Roof Tiles
- Automotive
- Military
- Decking / Fencing



“One of best companies in the industry we deal with, this goes from the sales side to the president of the company.”

Shepherd Color Customer



OUR PURPOSE

At Shepherd Color we don't just brighten the world with our pigments. As a company we strive to enhance the lives of everyone with whom we have contact. That means working to satisfy the needs and advance the goals of our employees, families, customers, suppliers, shareholders and community. We know striving for excellence in every facet of our operations is good business. More importantly, the impact it has on people is what makes business worth doing.

OUR CORE VALUES

Our core values don't just direct us; they define us. We are people of exemplary character. We strive for excellence in all we do. We work for long-term impact.

OUR QUALITY PURPOSE

We understand that excellence and self-improvement must go hand in hand. While providing superior products and service, we continually work to improve our operations for the mutual benefit of both our internal and external customers.

OVER 70 YEARS OF EXPERIENCE



Shepherd Color is a fourth-generation family-owned and operated business dedicated to being a world-class producer of complex inorganic color pigments. Started in the late 1920s as the color department of the The Shepherd Chemical Company, we originally made ceramic colors, primarily for the porcelain enamel industry. By the early 1960s, the color department's product line had expanded to a full range of complex inorganic color pigments used in the premium coatings and plastics markets. Thanks to increasing sales in those markets, the color operation outgrew its space at Shepherd Chemical. In 1980, The Shepherd Color Company was organized as a separate entity and relocated to a new facility north of Cincinnati.

Since our spin-off, we've broadened our global reach. Each year Shepherd Color supplies thousands of tones of high-quality pigments to customers through sales offices in the United States, Belgium, Australia and Japan along with local distribution and warehouses worldwide.





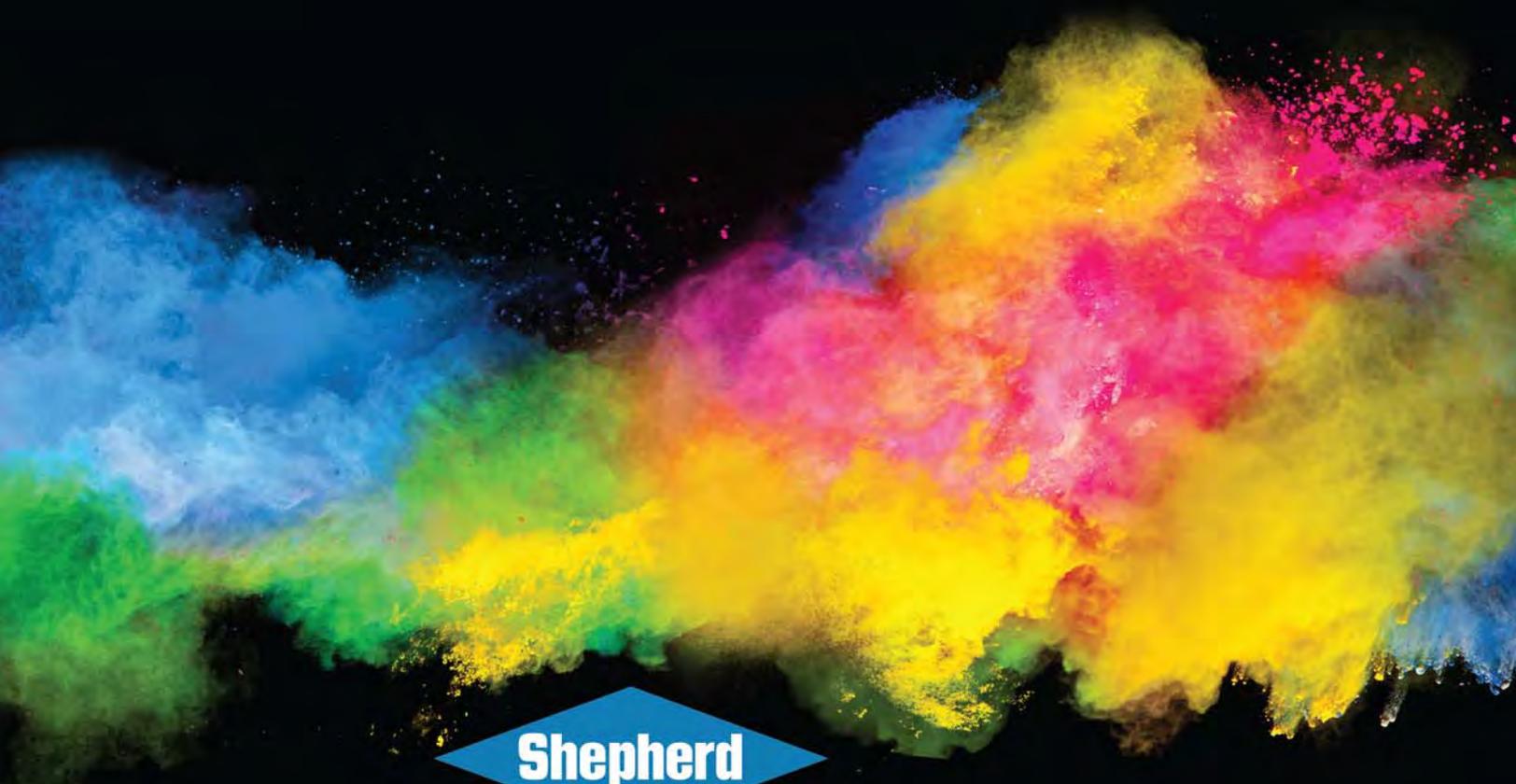
**MORE
EXPERTISE**



**BETTER
PERFORMANCE**



**BEST
VALUE**



The Shepherd Color Company

We Brighten Lives

4539 DUES DRIVE CINCINNATI, OH USA 45246 • PHONE: +1 513-874-0714
www.SHEPHERDCOLOR.com