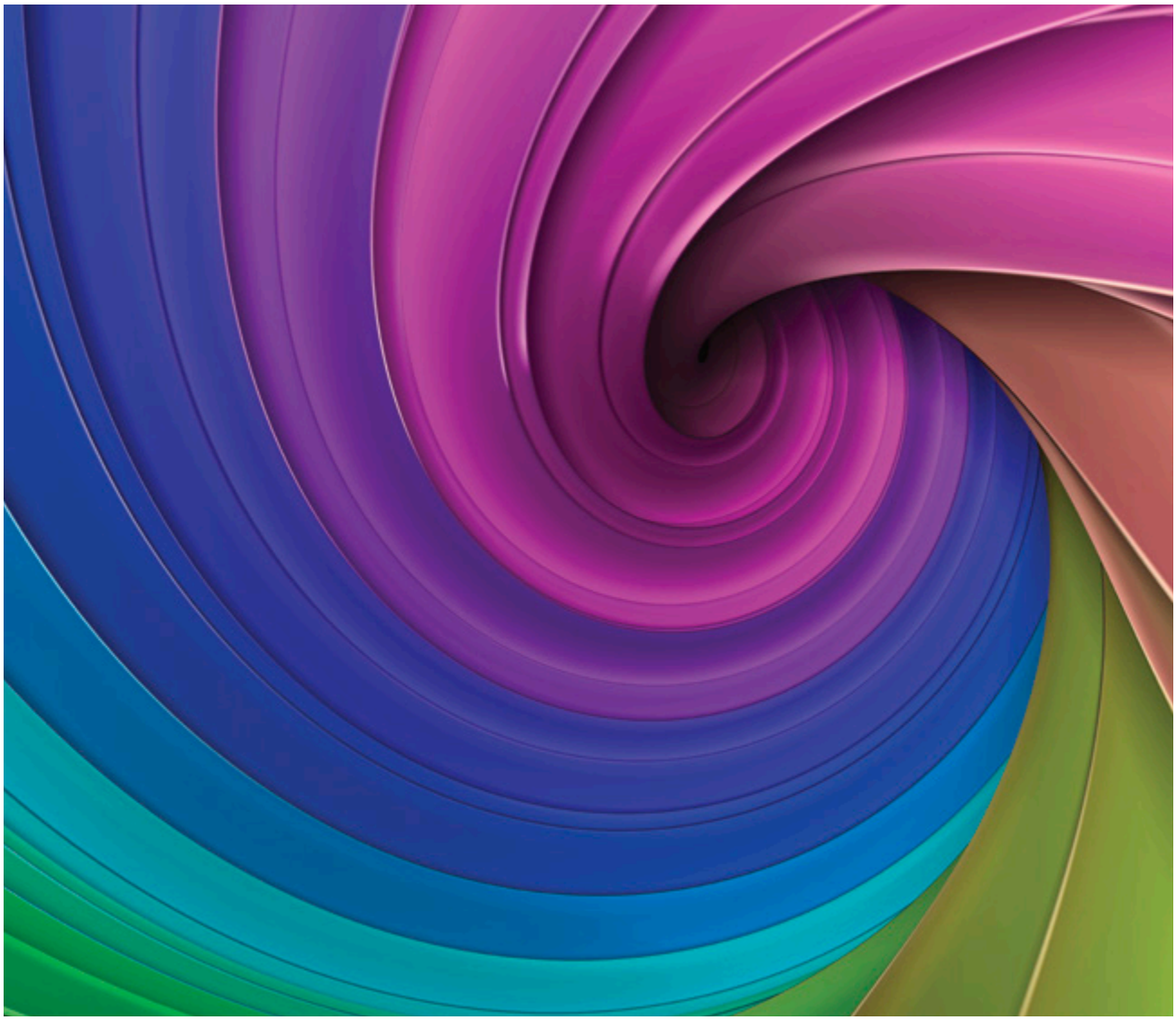
Additives for improved color acceptance in paints and coatings



EVONIK
POWER TO CREATE

COLOR COMPATIBILITY AND COLOR DEVELOPMENT:
A major formulation challenge for architectural paints

Among the various challenges of paint formulation, issues related to colorant compatibility and color development are certainly some of the most common and difficult to solve.

TINTING SYSTEMS

The basic concept of a tinting system is that the selected color shade can be formulated by dispensing colorants into a can containing a prefilled base paint under set conditions and at a ratio according to the specific formulation. Excellent compatibility between the main components is necessary to create the desired color and reproduce that color during each formulation.

A key goal in implementing a tinting system is making sure that the compatibility requirements will be met under all relevant tinting processing conditions.

COLOR DEVELOPMENT AND CONSEQUENCES OF INCOMPATIBILITY

The term "color development" describes the degree of color quality and color uniformity of a tinted paint. Good color development implies that the color appears in a uniform manner and at the expected strength.

The main causes of poor color development are improper compatibility between colorants and paints, resulting in pigment separation, as well as pigment flocculation during mixing and film formation. Additives used in the colorant to stabilize the pigment may displace the additives used to stabilize the pigments and fillers used in the base paints. This migration of additives to and from pigments and fillers can result in under-stabilized pigment/filler surfaces and, potentially, to flocculation of one of the pigments.

Poor colorants compatibility may become visible over time if flocculation occurs slowly and leads to the production of tinted paints with different shades or a finished paint that changes shades over time so that later touch ups result in a color-mismatch. A rub out test can clearly identify if flocculation has occured; either a lighter or darker colored rub-out will be visible. The color difference between the touched and untouched film can be measured.

SPECIALTY ADDITIVES for improved color compatibility and color acceptance

Evonik offers a series of additives that can improve pigment wetting and stabilization and consequently help create compatible colorants in water-based and solvent-based systems. This brochure highlights the performance of these additives with colorants identified by the market survey as being particularly problematic in terms of color acceptance in paint tinting. Based on customer feedback, colorants with indices PV23, PBk7, PB15:3, and PR112 are among the most challenging.

Several products from Evonik's SURFYNOL® surfactant, CARBOWET® surfactant, and ZETASPERSE® dispersant lines were post-added to base paints of various chemistries at a 1.0% (w/w) dosage and tested with colorants to measure the influence of the additives on color compatibility and color strength.

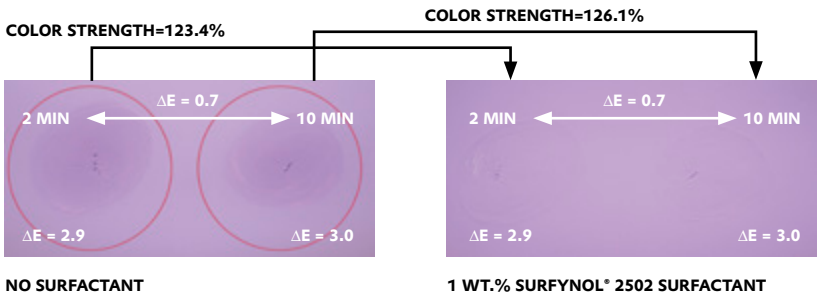
A selector guide with Evonik additives recommendations for various colorants combined with various types of base paints can be found on page 6.

PV23 COLORANT

SURFYNOL® 2502 surfactant significantly improved color development in a water-based acrylic paint tinted with PV23 colorant. It also provided high foam control and dynamic wetting with no drop in viscosity.

Figure 1 shows the test method used for determining the color compatibility. The color strength was measured using an X-Rite 939 spectrodensitometer D65/10. Drawdowns were made after 2 and 10 minutes of shaking. A rub-out test was then performed on each of the drawdowns, and the color difference between the rubbed and unrubbed parts also was recorded.

FIGURE 1
Test methods for color compatibility show enhanced color acceptance in PV23 colorant-tinted, water-based acrylic base-paint.



NO SURFACTANT

1 WT.% SURFYNOL® 2502 SURFACTANT

FIGURE 2
Comparison of color strength and ΔE values using different compatibilizers.

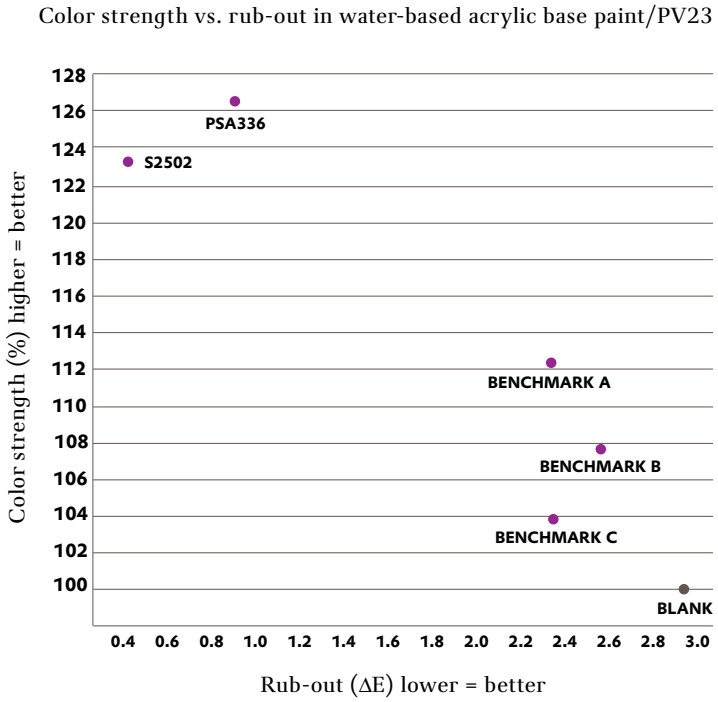


Figure 2 shows how, when used with the PV23 colorant to tint water-based acrylic base paint, SURFYNOL® PSA336 and SURFYNOL® 2502 surfactants helped increase color strength and reduce color difference between the rubbed and unrubbed parts of the drawdown compared to blank paint and paint containing a benchmark compatibilizer.

PBK7 COLORANT

In addition to PV23 colorant, one of the most widely used colorants is PBk7, which is based on a very different chemistry than the organic PV23. With the PBk7 colorant, ZETASPERSE® 179 and 182 dispersants enabled improved color strength in both a water-based acrylic and a solvent-based alkyd paint. The additives were post-added to the base paint at 1 wt.% before adding 1 wt.% of the tinting paste. The paint samples were shaken with a Scandex shaker for 2 minutes and a sample was taken for a drawdown and rub-out. The samples were shaken again for 8 minutes and another drawdown was made. Color strength was again measured using an X-Rite 939 spectrodensitometer D65/10. The formulation without additives, or blank, was used as the reference and its color strength was set to 100%. The results in the solvent-based alkyd paint are shown in **Table 1**.

TABLE 1
Comparison of color strength and ΔE values using different compatibilizers.

ADDITIVES 1 WT.% AS SUPPLIED	COLOR STRENGTH (%) 2 MIN	COLOR STRENGTH (%) 10 MIN	DELTA E 2 MIN VS. 10 MIN	DELTA E RUB-OUT 2 MIN	DELTA E RUB-OUT 10 MIN
Blank	100.0	100.0	0.42	1.01	0.61
ZETASPERSE® 179 dispersant	110.4	106.6	0.03	0.22	0.26
ZETASPERSE® 182 dispersant	110.7	106.8	0.04	0.27	0.26
Benchmark 1	101.2	98.6	0.16	1.26	1.23
Benchmark 2	100.2	96.7	0.02	0.90	0.78

PB15:3 AND PR112 COLORANTS

Similar results were also achieved with other problematic colorants such as PB15:3 and PR112. The addition of nonionic surfactants such as ZETASPERSE® 182 dispersant and CARBOWET® GA-210 surfactant showed improved color development and acceptance of different colorants when they were let down into base paints of different chemistries **(Figure 3)**.

FIGURE 3
PB15:3 colorants let down into a Vinnapas[1] EZ3010 (VAE) white base paint 45% PVC (left) and PR112 colorants let down into a satin interior paint based on Acronal[2] 296D (styrene-acrylic emulsion 30% PVC) (right).

[1]WackerChemie [2]BASF Chemicals

Evonik additives can be used as colorant compatibilizers.

These same experiments were repeated using different colorants combined with various types of base paints. Results showed that Evonik additives can be used to improve the acceptance of colorants into different chemistries and types of base paints. Evonik additives help the stabilization of the pigments by slowing down or compensating for the migration of dispersants and other stabilizing surfactants from the pigment in the colorant to pigments in the base paint, or vice versa. **Table 2** can be used as a selector guide to help identify a suitable additive for a specific system (colorant/base paint). Additives are recommended at an initial concentration of 0.5 wt.%. The use level of the additive should then be optimized by running a ladder study.

TABLE 2

Additives selector guide for improved color compatibility and color acceptance.

+++ First Recommendation + Second Recommendation	WB ACRYLIC FLAT PAINT			WB ALKYD/PU TRIM PAINT	WB STYRENE-ACRYLIC FLAT PAINT			SB ALKYD HIGH-GLOSS PAINT	
	PV23	PBK7	PR112	PBK7	PBK7	PR112	PB15:3	PBK7	PB15:3
SURFYNOL® 2502 surfactant	+++	+++	+			+			
SURFYNOL® 485 surfactant						+++			
SURFYNOL® PSA336 surfactant	+		+++			+			
ZETASPERSE® 179 dispersant							+	+++	+
ZETASPERSE® 182 dispersant				+++	+		+++	+++	+
ZETASPERSE® 2500 dispersant									+++
CARBOWET® 106 surfactant*			+++	+					
CARBOWET® 138 surfactant*		+++							
CARBOWET® GA-210 surfactant						+++	+		
CARBOWET® GA-221 surfactant				+++					

* Note: Products may not be available in all regions.

Product offering for color compatibility improvement

SURFYNOL® 2502 surfactant	A 100% active, alkoxylated nonionic surfactant that provides low-foam, dynamic wetting properties to coatings and paints.
SURFYNOL® 485 surfactant	A 100% active, ethoxylated wetting agent that provides low-foam surface tension reduction with slight emulsification properties, improved solubility and compatibility in water-based paints and coatings.
SURFYNOL® PSA336 surfactant	A formulated wetting agent that provides very low dynamic surface tension and substrate wetting with minimal foam in water-based paints and coatings.
ZETASPERSE® 179 dispersant	A high HLB branched surfactant and wetting agent that offers excellent nonionic stabilization properties for dispersion, emulsification, and color acceptance benefits in a variety of coatings and paints.
ZETASPERSE® 182 dispersant	A high HLB linear surfactant and wetting agent that offers excellent nonionic stabilization properties for dispersion emulsification and color acceptance properties in a variety of coatings and paints.
ZETASPERSE® 2500 dispersant	A high-performance dispersant (40% active solution in water) that provides excellent viscosity stability and stabilization of demanding organic pigment chemistries in coatings and paints.
CARBOWET® 106 surfactant*	An ethoxylated nonionic surfactant designed to provide performance comparable to NP-6 type and similar alkyl-phenol-based surfactants in water-based coatings and paints. Allows for the surface tension reduction necessary to wet both pigment and substrate, and can enhance/stabilize color acceptance.
CARBOWET® 138 surfactant*	An ethoxylated nonionic mid-HLB (HLB: 13.8) traditional surfactant with balanced properties for use in typical water-based formulations. Low-viscosity, easy-to-handle liquid provides an excellent alternative to APE chemistries of similar HLB.
CARBOWET® GA-210 surfactant	A nonionic wetting and stabilizing surfactant that offers efficient wetting and stabilization benefits for a wide range of paints and coatings. Compared to its sibling products in the GA series, CARBOWET® GA-210 surfactant offers the most universal and balanced properties and is suitable for all applications.
CARBOWET® GA-221 surfactant	A nonionic wetting and stabilizing surface active chemistry that offers low-foam wetting of substrates and pigments and provides compatibility and stability benefits in coatings and paints. Compared to its sibling products in the GA series, CARBOWET® GA-221 offers the greatest stabilization benefits and is the first choice for organic and carbon black pigment dispersions.

* Note: Products may not be available in all regions.

EVONIK CORPORATION
7201 Hamilton Blvd.
Allentown, PA 18195
1 800 345-3148
Outside U.S. and Canada 1 610 481-6799

EVONIK MATERIALS NETHERLAND BV
Kanaalweg IS, 3502 GD Utrecht

For Technical Information and Support:
Americas: picus@evonik.com
EMEA: apcse@evonik.com

For Samples:
Americas: prodinfo@evonik.com
Asia: picasia@evonik.com
EMEA: apcse@evonik.com

For Customer Service:
US / Canada
cspolyur@evonik.com

LASA
lachem@evonik.com

Japan
pmdcsojp@evonik.com

Asia
PMD-Asia Customer Service:
pmdcso@evonik.com
APCS PMGP (Korea):
apcskr@evonik.com

EMEA:
apcsepx@evonik.com

EVONIK
POWER TO CREATE

120-16-015-US-MAR17-E