

Low Gloss Hybrid Powder Coatings with Even Lower Cures



The leading technology for over three decades to produce matte hybrid powder coatings is the incorporation of cyclic amidine-polycarboxylic acid salts (the former VESTAGON® B 68 or offsets) into epoxy – polyester hybrid powder coating formulations. In this way they produce matte hybrid coatings through a complex reaction pattern with several reactions occurring simultaneously. These salts have relatively high melting temperatures over 200 °C, and their ability to produce matte hybrid coatings was previously limited to cure temperatures of 180 – 200 °C. Insufficient cure schedules cause reduced matting effects.

The business line Crosslinkers of Evonik Industries has recently discovered a class of tetraalkylammonium carboxylate (TAAC) salts that can be used to catalyze the curing of these hybrid reactions in such a way that enables cyclic amidine salts to cure at significantly lower temperatures while maintaining the gloss obtained at higher curing temperatures. The new catalyst, VESTAGON® EP-SC 5050 which is the TAAC adsorbed at 50% onto silica, thus allowing it to be added in solid form to a formulation. Another advantage of this delivery form is a reduced moisture uptake normally inherent in this class of catalysts.

The effect of using VESTAGON® EP-SC 5050 in black hybrid formulations was investigated using two different polyesters and varying polyester:epoxy ratios, cure schedules, and catalyst levels.

Flat Matte Black Hybrid Powder Coatings Using Crylcoat® 1716-0: Variation of Catalyst Concentration

Polyester : Epoxy Ratio	33 : 67					
Catalyst Level	0% wt		0.18% wt		0.36% wt	
VESTAGON® B 68	5.00		5.00		5.00	
Epikote® 1055	39.20		38.90		38.70	
Crylcoat® 1716-0	19.30		19.20		19.00	
VESTAGON® EP-SC 5050	-		0.40		0.80	
Pigments & Additives	36.50		36.50		36.50	
Cure Schedule	8' 200°C	30' 160°C	8' 200°C	30' 160°C	8' 200°C	30' 160°C
Cupping (mm)	7.5	4.0	6.8	6.3	5.3	6.0
Dir impact (in-lb)	80	60	80	40	60	40
Gloss 60°	6	10	6	7	7	9
Gloss 85°	15	26	17	20	23	27

Table 1

Table 1 lists the results using Crylcoat® 1716-0 combined with an epoxy resin (Epikote® 1055) at a 33:67 polyester:epoxy ratio. The Crylcoat® 1716-0 normally produces a dead matte effect in typical hybrid systems. The results clearly show the excellent properties of the coatings cured at 160 °C catalyzed with Vestagon EP-SC 5050 vs. the uncatalyzed control. Also, a significantly lower gloss shift of 1 – 2 units at 60° compared to a shift of 3 – 4 units for the unmodified formulation suggests a higher robustness by using the new VESTAGON® catalyst. At 85° gloss, this shift is more noticeable, with a reduction of 11 – 13 units down to 3 – 4 units.

An additional advantage is that the gloss reduction is as reproducible as normally observed with pure matting agents, but now within this much wider baking range of 160 – 200 °C.

The effect of VESTAGON® EP-SC 5050 when using the polyester resin Pulverol® 6010, which normally produces matte to half-gloss hybrid coatings with polyester:epoxy ratios of 27:73 and 40:60, was a reduction of the 60° gloss shift of 8 – 22 units without the catalyst to a shift of 1 – 4 units with each polyester ratio. As with Crylcoat® 1716-0, the 85° gloss shift is reduced even further with the use of VESTAGON® EP-SC 5050. This effect is confirmed by formulating matte respectively half-gloss hybrid systems based on Pulverol® 6010 in different ratios (Tab. 2).

Matte to Half-Gloss Black Hybrid Powder Coatings Using Pulverol® 6010: Variation of Polyester/Epoxy-Ratio

Polyester : Epoxy Ratio	27 : 73				40 : 60			
Catalyst Level	0% wt		0.18% wt		0% wt		0.18% wt	
VESTAGON® B 68	5.00		5.00		5.00		5.00	
Epikote® 1055	42.70		42.41		35.10		34.86	
Pulverol® 6010	15.80		15.69		23.40		23.24	
VESTAGON® EP-SC 5050	-		0.40		-		0.40	
Pigments and Additives	36.50		36.50		36.50		36.50	
Cure Schedule	8' 200°C	30' 160°C	8' 200°C	30' 160°C	8' 200°C	30' 160°C	8' 200°C	30' 160°C
Cupping (mm)	8.3	7.8	8.5	7.5	9.0	9.5	9.0	8.5
Dir impact (in-lb)	160	160	120	140	150	>160	90	100
Gloss 60°	21	29	18	19	52	74	50	55
Gloss 85°	57	75	49	57	83	95	81	92

Table 2

Aside from the tests shown above, studies are ongoing at Evonik's VESTAGON® laboratories to test the response of this catalyst with other polyester and epoxy resins for this application. It should be noted that not all polyester/epoxy blends show this behavior, i.e. maintaining the gloss values when curing matte hybrid coatings at lower temperatures.

VESTAGON EP-SC 5050 shows several advantages in matt hybrid systems:

- Co-application and cure of parts with different thicknesses
- Elimination of patchwork appearances due to uneven powder application
- Reduction in oven cure temperature to lower overall fuel consumption
- Pastel colors possible at curing temperatures below 180 °C (overbake stability is not improved compared to the pure B 68 system)

VESTAGON® EP-SC 5050 thus can grant powder coating applicators more flexibility in coating parts to achieve the same finishes, while providing the option of reducing their overall fuel consumption in their curing processes by using very small amounts of this new catalyst.

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 Crylcoat® = Cytec Surface Specialties Inc
 EPIKOTE® = Resolution Performance Products
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