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ESCAT™ 50 TECHNICAL BRIEF #1
Catalyst Evaluations in Powder Coatings

BACKGROUND:

Imidazole type catalysts are known to accelerate the carboxy-epoxy reaction. This class of reactions is typical of many binder systems in current powder coatings technology including polyester-epoxy hybrids, acrylic-epoxy hybrids, polyester-TGIC, diacid - GMA acrylic, and polyester-GMA acrylic systems.

ESCAT™ 50 is a 50% masterbatch of a substituted imidazole in castor wax carrier. This blend of the catalytic material assures uniform distribution throughout a powder coating system during extrusion.

Usage of ESCAT™ 50 in a powder coating system can accelerate gel times, improve mechanical properties, produce smoother films with higher DOI, and lower cure temperatures.

PROCEDURE:

Powder coatings were prepared and sprayed on test panels. The gel time test results indicated the chemical reactivities of each system. Physical properties were tested to demonstrate the improvements possible when ESCAT™ 50 is employed for these carboxy-epoxy reaction based powder coatings.

PROCESSING CONDITIONS:

Premix:	Hamilton Beach Food Processor, High Speed for 15 - 20 seconds
Extruder settings:	Zone 1: 200°F Zone 2: 215°F 150 rpm
Milling:	Bantam Mill, 010 Herringbone screen; Liquid Nitrogen cooling
Sieve:	Stainless steel, No. 200 mesh, 75 µm
Cure:	20 minutes, 180°C
Substrate:	QD-35, Untreated cold rolled steel panels

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FORMULATIONS AND DATA:

In an acrylic-epoxy hybrid, ESCAT™ 50 is compared to other substituted imidazoles for reactivity, pill flow and impact.

FORMULATIONS, wt %	**1**	**2**	**3**	**4**
Johncryl SCX-819[1]	34	34	34	34
Araldite GT 7013[2]	34	34	34	34
Resiflow P-67	1	1	1	1
Benzoin	1	1	1	1
TiO_2 R960 DuPont	30	30	30	30
ESCAT™ 50	-	0.66 0.33% active	-	-
2-propyl imidazole[3]	-	-	0.50 0.33% active	-
2-methyl imidazole, neat	-	-	-	0.33 0.33% active
RESULTS				
Gel Time, seconds @ 200°C	>160	36	28	18
Pill Flow, mm	>128	65	53	39
Reverse Impact, in-lbs	fail<20	60	60	80

Reference PD-070

[1]Johnson acrylic resin [2]Vantico epoxy resin [3]67% on silica carrier

In a 60/40 polyester-epoxy hybrid, ESCAT™ 50 is compared to other substituted imidazoles for reactivity, pill flow and impact.

FORMULATIONS, wt %	**1**	**2**	**3**
Rucote 560[1]	52.4	52.4	52.4
Araldite GT 7013[2]	35.0	35.0	35.0
Resiflow PL-200	1.0	1.0	1.0
Oxymelt A-4	1.0	1.0	1.0
TiO_2 R960 DuPont	10.0	10.0	10.0
Phthalo Blue pigment	0.1	0.1	0.1
ESCAT™ 50	0.66 0.33% active	-	-
2-propyl imidazole[3]	-	0.50 0.33% active	-
2-methyl imidazole, neat	-	-	0.33 0.33% active
RESULTS			
Gel Time, seconds @ 200°C	45	40	35
Pill Flow, mm	68	65	54

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Reverse impact, in-lbs	160	160	160

Reference PD-068
[1]Rucote polyester resin [2]Vantico epoxy resin [3]67% on silica carrier

In a 60/40 (uncatalyzed) polyester-epoxy hybrid, ESCAT™ 50 is evaluated in increasing proportions and compared to an analogous catalyzed polyester-epoxy hybrid for mechanical properties, reactivity, pill flow and distinctness of image.

FORMULATIONS, wt %	**1**	**2**	**3**	**4**
Crylcoat 360[1], uncatalyzed	58.75	58.75	58.75	-
Crylcoat 370[1], catalyzed				58.75
Araldite GT-7013[2]	39.25	39.25	39.25	39.25
Benzoin	0.5	0.5	0.5	0.5
Carbon Black, Monarch 800	0.5	0.5	0.5	0.5
Resiflow PL-200	1	1	1	1
ESCAT™ 50	-	0.3	0.6	-
RESULTS				
Pencil Hardness	F	3H	3H	3H
Reverse Impact, in·lbs	fail <20	160	160	160
Conical Mandrel bend	fail	pass	pass	pass
Gel Time, seconds @ 200°C	>180	85	59	90
Pill Flow, mm	>250	118	107	131
DOI, distinctness of image	50	70	60	60

Reference PE-080
[1]UCB polyester resins [2]Vantico epoxy resin

In a polyester-TGIC, two formulations are compared to demonstrate how ESCAT™ 50 increases reactivity and distinctness of image.

FORMULATIONS, wt %	**1**	**2**
Crylcoat 440[1], uncatalyzed	91.25	91.25
TGIC, Araldite PT-810[2]	6.75	6.75
Benzoin	0.5	0.5
Carbon Black, Monarch 800	0.5	0.5
Resiflow PL-200	1	1
ESCAT™ 50	-	0.3
RESULTS		
Pencil Hardness	3H	3H
Reverse Impact, in·lbs	160	160
Conical Mandrel bend	pass	pass
Gel Time, seconds @ 200°C	100	60

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Pill Flow, mm	114	77
DOI, distinctness of image	20	40

Reference PE-080
[1]UCB polyester resins [2]Vantico

In a 50/50 polyester – epoxy hybrid ESCAT™ 50 is used at two concentrations to establish how the cure temperature can be lowered.

FORMULATIONS, wt %	**1**	**2**	**3**
Crylcoat 340[1]	38.75	38.75	38.75
Dow 663U epoxy[2]	38.75	38.75	38.75
Resiflow P-67	1.0	1.0	1.0
Benzoin	0.5	0.5	0.5
Barium Sulfate	20.0	20.0	20.0
Carbon Black	1.0	1.0	1.0
ESCAT™ 50	-	0.5	1.0
RESULTS			
Gel Time, seconds @ 200°C	72	46	39
Pill Flow, mm	48	55	44
Reverse impact, in-lbs Cured for 10' x 180°C	160	160	160
Reverse impact, in-lbs Cured for 10' x 160°C	fail < 20	140	160

Reference PF-057
[1]UCB polyester resins [2]Dow

CONCLUSIONS:

The relative reactivity of powder coatings catalyzed with ESCAT™ 50 by active concentration is comparable to that of 2-propyl imidazole. Increasing the concentration of ESCAT™ 50 speeds up the gel times of the powder coatings. However, the change in reactivity with a small change in catalyst concentration of ESCAT™ 50 is not nearly as sensitive as with 2-methyl imidazole. The optimum concentration for a particular binder combination will have to be determined experimentally to meet the formulator's performance requirements such as gel time or a given cure cycle.

The castor wax portion of ESCAT™ 50 facilitates uniform dispersion of the catalyst into the powder coating systems as well as promoting smoother film surfaces. Additionally, weighing

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errors are half as sensitive with ESCAT™ 50 than with pure 2-methyl imidazole or 2-propyl imidazole.

In conclusion, the benefits of using ESCAT™ 50 include accelerated reactivity, improved mechanical properties, enhanced film smoothness, higher DOI ratings and lower cure temperatures which go beyond just a standard imidazole type catalyst for carboxy-epoxy reactions.

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