Epoxy Curing Agents and Modifiers

ANCAMIDE® 2386 Curing Agent

DESCRIPTION

Ancamide 2386 curing agent is a low viscosity modified amidoamine intended for use at ambient and low temperatures with liquid epoxy resins. In comparison with standard amidoamines it imparts better chemical resistance, reduced blush and enhanced low temperature cure. Ancamide 2386 has been specifically formulated for use in combination with modified liquid and solid epoxy resins to deliver high performance coatings. The curing agent is highly compatible with a variety of mineral solvents making it ideal for formulating paints suitable for application to poorly prepared surfaces.

Ancamide 2386 can also be employed in the civil engineering sector for flooring, concrete repair systems and tile/machinery grouts.

ADVANTAGES

- Low viscosity
- Good chemical resistance
- Good balance of pot life and reactivity in thin films
- Excellent adhesion to cold, damp concrete
- Excellent film formation and blush resistance coatings coupled with high gloss

APPLICATIONS

- High solids and 100% solids anti-corrosive primers for industrial maintenance and marine
- VOC reducer for higher viscosity polyamides
- Concrete primers
- Interior floor sealer coats
- Cost performance self-leveling and mortar flooring
- Crack injection, patch repair and grout systems

SHELF LIFE

At least 24 months from the date of manufacture in the original sealed container at ambient temperature.

PACKAGING AND HANDLING

Refer to the Safety Data Sheet for Ancamide 2386 curing agent.

TYPICAL PROPERTIES

Appearance	Amber liquid
Colour[1] (Gardner)	max 10
Viscosity[2] @ 25°C, [mPa.s]	170-520
Amine Value[3] (mg KOH/g)	345-385
Specific Gravity @ 21°C	1.00
Equivalent Wt/{H}	93
Recommended use Level[4] [PHR]	49

TYPICAL HANDLING PROPERTIES

Mixed Viscosity[2] at 25°C, [mPa.s]	3,000
Gel Time[5] (150g mix at 25°C), [mins]	135
Thin Film Set Time[6] 25°C, [h]	8.5
Thin Film Set Time[6] 5°C, [h]	39
Shore D[7] 20°C (24 h)	82
Typical cure schedule	2- 7 days

TYPICAL PERFORMANCE PROPERTIES

Compressive Strength[8], [MPa]	94
Compressive Modulus[8], [GPa]	2.5
Tensile Strength[9], [MPa]	63
Tensile Modulus[9], [GPa]	2.6
Tensile Elongation at Break [%]	5.2
Flexural Strength[10], [MPa]	94
Flexural Modulus[10], [GPa]	3.0
Heat Distortion Temperature[11], [°C]	51

Footnotes:
(1) ASTM D 1544-80
(2) Brookfield RVTD, Spindle 4
(3) Perchloric Acid Titration
(4) With Bisphenol A diglycidyl ether (EEW=190)
(5) Techne GT-3 Gelation Timer
(6) BK Drying Recorder Phase III
(7) DIN 53505
(8) ISO 604
(9) ISO 527
(10) ISO 178
(11) ASTM D648

SUPPLEMENTARY INFORMATION

ANCAMIDE 2386 CURING AGENT IN ANTI-CORROSIVE PRIMERS

Ancamide 2386 curing agent can be readily formulated into high performance, low VOC anti-corrosive primers. For example, a primer based on Ancamide 2386 curing agent and liquid epoxy requires only 250g/L VOC to achieve airless spray viscosity. (Appendix 1). A mixed paint (based on this formulation) was spray applied to shot blasted steel (50µ, 2 mil profile) at 75-100µ (3-4 mil) DFT. The coatings were cured at ambient temperature for 7 days prior to testing. Test methods included Salt Fog, Prohesion, and Electrochemical Impedance Spectroscopy (EIS).

ACCELERATED CORROSION TESTING

Salt fog was conducted in accordance with ASTM B 117. Prohesion testing involved a one hour wet cycle at 25˚C followed by a one hour dry cycle at 35˚C using an electrolyte solution of 0.35% ammonium sulphate and 0.05% sodium chloride. Salt fog and Prohesion samples were rated in accordance with ASTM D 1654. Electrochemical Impedance Spectroscopy (EIS) was evaluated by immersing coated panels in 1M NaCl for 24 hours and measuring the pore resistance. Pore resistance was measured before and after 1,000 hours of Prohesion exposure.

Accelerated Corrosion Testing: Results		
	Field Rating	Scribe Rating
Salt Fog 3,000 h	10	8
Prohesion 3,000 h	9	7

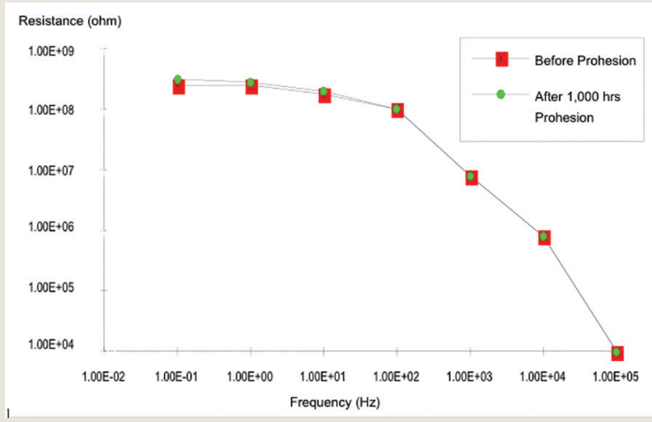
Ancamide 2386 primer (Appendix 1) delivers excellent corrosion protection in NaCl salt fog and Prohesion testing.

ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY: RESULTS

Electrochemical impedance spectroscopy (EIS) measures the resistance of a coating to ion penetration (pore resistance). The corrosion process is initiated by ions diffusing through the coating to form an electrical circuit with the steel substrate. EIS, by measuring the coatings resistance to ion diffusion, is an excellent indicator of the anti-corrosive properties of the coating. A good barrier coating should have a resistance of at least 108 ohms at a frequency of 10-1 Hz.

Coatings were tested prior to exposure by immersing them in a 1 molar NaCl salt solution for 24 hours and measuring the pore resistance. The coatings were then re-tested after 1,000 hours exposure in a Prohesion cabinet. Initial pore resistance indicated excellent resistance to ion penetration. Virtually no change was observed in the pore resistance after Prohesion exposure as indicated in Figure 1. These results indicate that Ancamide 2386 based primers will provide excellent long term corrosion protection of steel.

FIGURE 1: EIS ANALYSIS OF ANCAMIDE 2386 PRIMER (APPENDIX 1)



PIGMENTATION

Good results have been obtained using a combination of talc, wollastonite, and zinc phosphate. Conventional talcs may be used or low oil absorption talcs may be substituted to further reduce application viscosity. Surface treated Wollastonite such as Wollastokup 10AS (ex. Nyco) offers superior corrosion resistance when compared to untreated Wollastonite. A modest improvement in barrier properties can also be achieved by grinding amine treated Wollastonite (10AS) into the epoxy and by grinding epoxy treated Wollastonite (10ES) into the curing agent. Fine particle size zinc phosphate has been an effective anti-corrosive pigment. Excellent results may also be obtained using strontium zinc phosphosilicate (SZP 391 ex. Heubach). Red iron oxide and titanium dioxide are included as hiding pigments. PVC levels of 35-40% are recommended to provide maximum barrier properties while remaining safely below the critical pigment volume concentration (CPVC).

SOLVENTS

Solvents were chosen to provide good solvating power while having minimum hazard rating. The principal solvents are xylene and high flash naphtha. A ketone solvent such as methyl propyl ketone (MPK) may be added as 10% of the solvent mixture to speed solvent evaporation.

ANCAMIDE 2386 CURING AGENT AS A LOW VOC MODIFIER

Ancamide 2386 curing agent is very effective at modifying high VOC formulations to reach compliance while maintaining handling and performance. Illustrated in Table 1 overleaf is a typical high VOC primer based on high viscosity polyamide (Ancamide 220X70) and solid epoxy resin. Features of this primer include long pot life, fast dry time, and good flexibility. However, at airless spray viscosity, the VOC level is greater than 370 g/L. as shown in Appendix 2.

By replacing a portion of the high viscosity binder with Ancamide 2386 and liquid epoxy resin, the VOC can be reduced from > 370g/L. to < 320 g/L as highlighted in Appendix 3. Fast dry times are maintained with this modification but with the advantage of increased pot life due to the low mixed viscosity of the Ancamide 2386 curing agent. The volume solids are slightly higher while PVC is held constant whilst the impact resistance indicates that much of the intrinsic flexibility has been retained.

TABLE 1: PROPERTIES OF HIGH VOC AND ANCAMIDE 2386 MODIFIED ANTI-CORROSIVE PRIMERS

Property	High VOC	2386 Modified
VOC, g/L	376	320
Volume Solids, %	57.6	64
PVC, %	36.5	36.3
Mixed Viscosity mPa.s	1,300	990
Pot Life, h	5	7
Set to Touch, mins	20	55
Dust Free, mins	75	90
Hard Dry	Overnight	Overnight
Direct Impact, cmKg	69	37
Reverse Impact, cmKg	6.9	<2

ANCAMIDE 2386 IN HIGH SOLIDS AND SOLVENT-FREE GLOSS ENAMEL COATINGS

Ancamide 2386, due to its low viscosity and high blush resistance, is particularly well suited for use in high solids (Appendices 4 & 5) and solvent free gloss enamel coatings (Appendices 6 & 7). High gloss enamels with no induction time# are readily formulated for application at airless spray viscosity. Furthermore, coatings can be designed with a broad spectrum of handling and performance properties such as long pot life, low viscosity, fast dry and high impact resistance. Coating properties can be adjusted by selecting the appropriate epoxy diluents and acrylate functional modifiers.

REACTIVE DILUENTS

Ancamide 2386 reacts readily with epoxy functional diluents such as Epodil 748 (C_{12-14} alkyl glycidyl ether) and with acrylate modifiers such as trimethylolpropane triacrylate. Formulation in Appendix 7. The acrylate groups react with primary amines (Michael addition reaction). Ancamide 2386 contains high levels of primary amine compared to conventional amidoamines which allows higher levels of acrylate to be used and ensures more complete reaction of the acrylate into the epoxy backbone.

NON-REACTIVE DILUENTS

Non-reactive diluents or plasticizers are useful additives for reducing viscosity and adjusting package ratios. For example, benzyl alcohol reduces viscosity and accelerates cure. Although benzyl alcohol remains in the cured film at ambient temperature, it will partially volatilise as VOC when tested by ASTM D 2369. Epodil LV5V5, a zero VOC hydrocarbon resin, improves gloss and enhances substrate wetting. When used as the sole plasticiser, Epodil LV5 will retard cure speed (Appendix 6). When used in conjunction with benzyl alcohol the effect of Epodil LV5V5 on cure speed is minimized.

STARTING POINT FORMULATIONS

A series of solvent free formulations has been developed to demonstrate the versatility of Ancamide 2386 in solvent free coatings. For example, formulations incorporating Epodil 748 exhibit low viscosity, relatively long pot life, moderate flexibility, and slow dry time. Formulations incorporating trimethylolpropane triacrylate (TMPTA) feature very fast dry time with a correspondingly short pot life. Features are summarized in Table 2.

#Ancamide 2386 curing agent gives improved film appearance over standard amidoamines and polyamides. In some coating applications however, a 25 minute induction time is recommended for optimal film formation without amine exudate.

TABLE 2: COMPARATIVE PROPERTIES OF EPOXY MODIFIERS

	Mixed Viscosity	Pot Life	Tack Free	Hard Dry	Direct Impact	60˚Gloss
Unmodified[1]	2800 mPas	60 min	12 h	24 h	16 cm kg	90
Epodil 748 Modified[2]	820 mPas	90 min	18 h	36 h	32 cm kg	88
TMPTA Modified[3]	1900 mPas	3 h	3 h	7 h	23 cm kg	96

1. Enamel formulation based on liquid epoxy resin (EEW 190)
2. Enamel formulation based on 80% liquid epoxy, 20% Epodil 748
3. Enamel formulation based on 80% liquid epoxy, 20% trimethylolpropane triacrylate

The use of TMPTA decreases the dry time of the film, reducing the touch dry times from 12 to 3 hours and the hard dry from 24 to 7 hours compared to the unmodified formulation whilst pot life is reduced to only 45 minutes (standard 60 minutes). The TMPTA modification also results in a slightly softer film as measured by Koenig pendulum hardness with a slight improvement in abrasion resistance of 90 mg loss with the unmodified liquid epoxy system showing a 100 mg loss (determined using CS17, 1Kg weight wheel, 1000 cycles). These properties are at the expense of reduced corrosion resistance with the modification showing a few blisters following 500 hour Cleveland humidity at 40°C and inferior chemical resistance. A maximum of 20 % (based on total weight of resin and acrylate) TMPTA is advised to accelerate cure. Higher loadings of TMPTA are not recommended.

CHEMICAL RESISTANCE

Coatings were applied to steel panels and cured 7 days at 25°C and 2 days @ 35°C. Saturated cotton balls were placed on the cured coatings and covered with a watch glass. Pencil hardness and appearance were noted at 0 time, 1 hr, 6 hr, and 24 hr exposure.
The coatings were then allowed to recover for 24 hours, and the pencil hardness was retested. Tables 3 and 4 indicate that TMPTA modification still provides sufficient resistance to general chemical spillage (full continuous immersion chemical resistance results of Ancamide 2386 are presented in Table 5, overleaf).

TABLES 3 AND 4: CHEMICAL RESISTANCE OF LIQUID EPOXY AND TMPTA MODIFIED COATINGS

	0 Time	1 h	6 h	24 h	Comment @ 24 h
Toluene	2H	2H	2H	2H	No Effect
Methanol	2H	6B	6M Blisters	4D Blisters	Destroyed
MIBK	2H	2H	6M Blisters	Severe Cracking	Destroyed
10% Acetic	2H	2H	H	HB	Sl. Softening
10% Lactic	2H	2H	2H	H	V. Sl. Softening
70% Sulphuric	2H	2H	2H	2H	Discoloration
50% NaOH	2H	2H	2H	2H	No Effect

	0 Time	1 h	6 h	24 h	Comment @ 24 h
Toluene	HB	2B	4D Blisters	Severe Cracking	Destroyed
Methanol	HB	6B	6M Blisters	4D Blisters	Destroyed
MIBK	HB	6B	4D Blisters	Severe Cracking	Destroyed
10% Acetic	HB	2B	8F Blisters	6M Blisters	Destroyed
10% Lactic	HB	B	2B	3B	Sl. Discoloration
70% Sulphuric	HB	HB	HB	HB	Discoloration
50% NaOH	HB	HB	HB	HB	No Effect

Immersion studies following ASTM D543 were performed on cast discs using standard liquid bisphenol-A based (DGEBA, EEW=190) epoxy resin cured with Ancamide 2386, Ancamide 500 and Ancamine 1618 for 7 days at 25°C. Three samples were tested for each reagent. Table 1 shows the average percentage weight change after immersion at 25°C for 3 days and 28 days in various chemicals.

TABLE 5: CHEMICAL RESISTANCE FOR ANCAMINE 2386 FORMULATION VS. ANCAMIDE 500 AND ANCAMINE 1618 WITH BISPHENOL-A BASED (EEW=190) RESIN

% Weight Change as a Function of Time - Continuous Immersion						
Reagent	3 day % weight gain			28 day % weight gain		
	2386	500	1618	2386	500	1618
Deionized Water	0.35	0.53	0.49	1.13	1.53	1.50
Ethanol	2.67	8.91	3.98	6.77	20.16	10.28
Toluene	5.30	Destroyed < 24 h	0.4	Destroyed between 7-14 days		2.86
Butyl Cellosolve	0.45	6.05	1.65	2.81	18.42	5.31
MEK	Destroyed between 1-3 days	Destroyed < 24 h	Destroyed between 1-3 days			
10% Lactic Acid	0.98	4.49	1.81	2.88	10.35	5.42
10% Acetic Acid	2.49	8.15	2.92	6.83	19.03	8.23
10% Sulphuric Acid	0.60	1.19	0.3	1.78	3.08	1.5
70% Sulphuric Acid	0.32	1.09	0.08	0.84	3.86	0.14
50% Sodium Hydroxide	Not Tested	Not Tested	-0.01	Not Tested	Not Tested	-0.04
1,1,1 Trichloroethane	0.82	Destroyed between 1-3 days	0.02	3.74		-0.02
10% Hydrochloric Acid	0.37	0.72	0.4	1.21	2.04	0.7
40% Nitric Acid	4.50	3.79	Not Tested	Destroyed between 14 and 28 days	Destroyed between 14 and 28 days	Not Tested

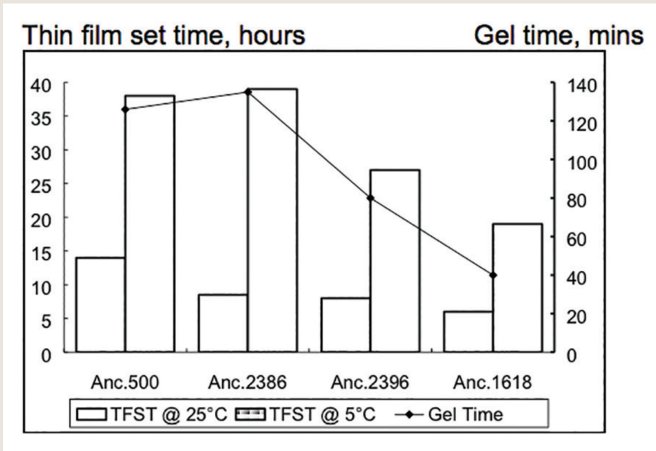
These studies show that Ancamide 2386 curing agent imparts superior chemical resistance to standard amidoamines, and comparable resistance to the cycloaliphatic amines except for hydrocarbon solvents. This resistance makes Ancamide 2386 a cost-effective cycloaliphatic alternative in less stringent flooring applications where moderate chemical resistance is required.

ANCAMIDE 2386 IN CIVIL ENGINEERING APPLICATIONS

CURE SPEED AND POT LIFE

Figure 2 shows comparative cure performance of Ancamide 2386 with a standard amidoamine, Ancamide 500, a high performance amidoamine Ancamide 2396* and a cycloaliphatic based amine, Ancamine 1618. Thin film set times (TFST) of Ancamide 2386 curing agent with standard Bisphenol A resin in a 75µ (3 mil) film is 8.5 hours at 25°C, and 39 hours at 5°C with a gel time at ambient (150g mass) of 135 minutes. In comparison with Ancamine 1618 which has TFST of 5 and 20 hours at 25°C and 5°C respectively the Ancamide 2386 curing agent imparts similar cure performance at ambient temperature facilitating it's use as a cost-effective, cycloaliphatic amine replacement where only moderate low temperature cure speed is acceptable.

FIGURE 2: CURE PERFORMANCE FOR ANCAMIDE 2386 VS. ANCAMIDE 2396*, STANDARD AMIDOAMINE ANCAMIDE 500, AND THE CYCLOALIPHATIC AMINE ANCAMINE 1618



Note: Data recorded with standard bisphenol-A (DGEBA, EEW=190) resin.

In addition to a comparable thin film set time, TFST, at ambient as Ancamine 1618, Ancamide 2386 offers a gel time related to pot life that is over three times that of the Ancamine 1618. Ancamine 2386 curing agent thus allows a similar return to service at ambient while giving the applicator more time to apply the formulated product after mixing.

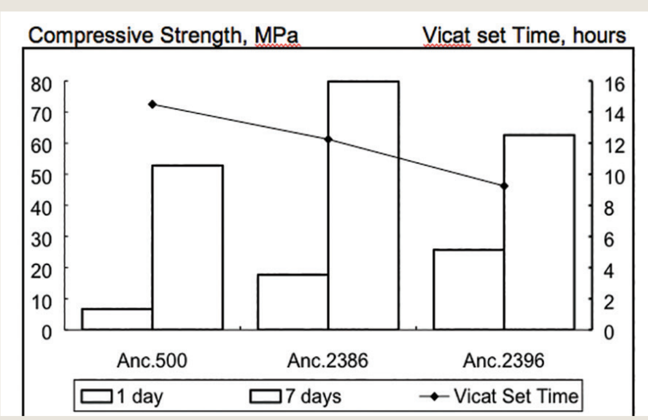
To speed thin film set times and hardness development at low temperatures, the faster cure high performance amidoamine, Ancamide 2396, curing agent can be used or the Ancamide 2386 may be accelerated with 3-5% Ancamine K.54 or with 10% of an aliphatic amine curing agent such as Ancamine 1638 or Ancamine 1768. Ancamine 2432 curing agent is recommended for low temperature (5°C) acceleration.

MECHANICAL PROPERTIES

As highlighted earlier Ancamide 2386 may be used in flooring applications as a cost effective alternative to cycloaliphatic amines coupled with enhanced performance properties to standard amidoamines. Further, the lower viscosity of the Ancamide 2386 curing agent enables easier formulation of high filler:binder ratios for mortar floors and machinery grouts.

The results in figure 3 show that Ancamide 2386 curing agent provides a comparable initial and far superior final compressive strength of 18 and 80 MPa vs. standard amidoamines. The Vicat set time, based on a modified version of ASTM C191, provides a measure of the real cure time for a filled system (SL or mortar formulation). The test involves determining the time for a weighted needle (1mm diameter) to no longer visibly penetrate the surface of the test sample. The Vicat set time for Ancamide 2386 is 11.75 hours compared to 14.5 hours for Ancamide 500.

FIGURE 3: MECHANICAL PROPERTIES OF ANCAMIDE 2386 AND ANCAMIDE 2396* VS. STANDARD AMIDOAMINE, ANCAMIDE 500, IN HEAVILY FILLED MACHINERY/ BEDDING GROUTS



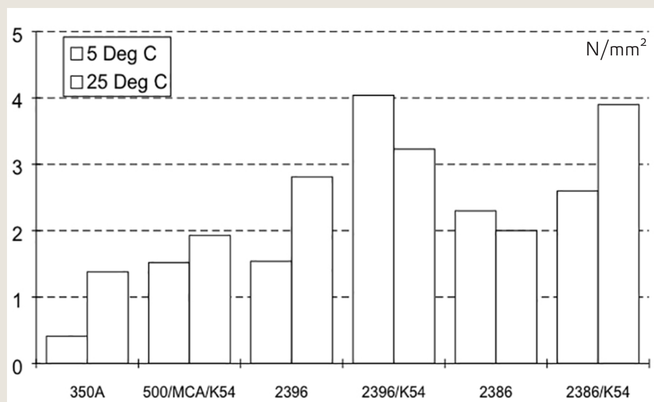
Note: Systems based on stoichiometric loading with 11% Epodil 748 diluted liquid, bis-A epoxy resin (EEW 190) with a filler:binder ratio of 6.6:1

BOND STRENGTH

In comparison with standard amidoamines or polyamides, Ancamide 2386 and Ancamide 2396* curing agents imparts superior adhesion to damp concrete at ambient and low temperature conditions. Ancamide 2386 was tested against Ancamide 350A (standard polyamide) and the Ancamide 500 amidoamine.

Figure 4, overleaf, shows the results of pull off tests conducted in accordance with ASTM 4541. Samples were prepared by immersing blocks of ASTM C109 cement mortar in water for 24 hours, removed, the excess of water wiped from the surface and the test system applied immediately. The data indicates that excellent bond strength can be obtained from Ancamide 2386 cured formulations at ambient and low temperatures. The bond strength with Ancamide 2386 alone exceeds that of Ancamide 500/Ancamine MCA/K.54 blend, which had previously been the standard recommendation for adhesion to cold, damp concrete. The adhesion of Ancamide 2386 curing agent can be further improved at both temperatures by the inclusion of Ancamine K.54 at 3-5 wt.% based on binder.

FIGURE 4: BOND STRENGTH OF ANCAMIDE 2386 AND ANCAMIDE 2396* VS. STANDARD POLYAMIDE, ANCAMIDE 350A AND A MANNICH BASE ACCELERATED AMIDOAMINE IN CONCRETE PRIMERS.



Note: Data recorded with standard bisphenol-A (DGEBA, EEW=190) resin.
* For further information on Ancamide 2396 curing agent refer to the technical bulletin.

APPENDIX 1: ANTI-CORROSIVE PRIMER

A-Component		2386 Kg	2386 Litres
Standard Bis A Resin (BADGE)		121.52	104.74
MPA-1078	Rheox	2.09	2.35
Mix well then add at high speed			
Titanium Dioxide	DuPont	12.16	3.10
Wollastokup 10AS	NYCO	127.64	43.91
Disperse to Hegman 5, reduce speed, then add:			
Xylene		16.65	19.23
Diacetone Alcohol		15.06	16.05
		295.12	**189.38**
B-Component			
Ancamide 2386	Evonik	60.19	60.15
MPA 1078	Rheox	2.09	2.35
Beetle 216-8	Cytec Industries UK	7.80	7.72
Mix well then add			
Red Irone Oxide	Mineral Pig-ments	29.03	5.79
325 Mesh Talc	Cyprus	46.95	17.00
Zinc Phosphate	Mineral Pig-ments	68.63	20.48
Wollastokup 10AS	Nyco	51.98	17.90
High Flash Naphtha		26.31	30.13
Disperse to Hegman 5, reduce speed, then add:			
High Flash Naphtha		24.13	27.63
Total		**317.11**	**189.45**

TECHNICAL DATA

VOC	250 g/l
Volume Solids	72%
PVC	39.7%
A Viscosity	1500 mPa.s
B Viscosity	3000 mPa.s
Potlife	2 h
Tack Free	2 h
Dust Free	3 h
Hard Dry	Overnight
Mix Viscosity	1800 mPa.s

APPENDIX 2: HIGH VOC ANTI-CORROSIVE PRIMER

A-Component		2386 Kg	2386 Litres
Type 1 solid resin (75% in xylene)		132.18	121.13
TiPure R 900	Rheox	8.89	2.27
Wollastokup 10AS	DuPont	84.87	29.15
PM Solvent		33.38	36.72
Disperse to Hegman 4			
		259.32	**189.27**
B-Component			
Ancamide® 220 X 70	Evonik	76.52	81.39
Wollastokup	Nyco	47.54	16.28
Red Iron Oxide	Bayer	21.27	4.16
Beaverwhite 325	Cyprus	34.29	12.49
Zinc Phosphate	Heubach	50.17	15.14
PM Solvent		18.78	20.44
Super High Flash Naphtha		34.34	39.37
Disperse to Hegman 4			
Total		**289.91**	**189.27**

TECHNICAL DATA

VOC	376 g/l
Volume Solids	57.6%
PVC	36.5%
A Viscosity	1570 mPa.s
B Viscosity	970 mPa.s
Mixed Viscosity	1300 mPa.s
Potlife	5 h
Set to Touch	20 min
Dust Free	75 min
Hard Dry	Overnight
Direct Impact	69 cmkg
Reverse Impact	6.9 cmkg

APPENDIX 3: MODIFIED ANTI-CORROSIVE PRIMER

A-Component		2386 Kg	2386 Litres
Type 1 solid resin (75% in xylene)		81.47	74.57
Standard Bis A resin (BADGE)		48.90	42.02
TiPure R 900	DuPont	9.89	2.65
Wollastokup 10AS	Nyco	88.95	30.66
PM Solvent		35.88	39.37
Disperse to Hegman 4			
		265.09	**189.27**
B-Component			
Ancamide® 2386	Evonik	29.17	29.15
Ancamide® 220 X 70	Evonik	29.17	31.04
Wollastokup 10AS	Nyco	57.11	19.68
Red Iron Oxide	Bayer	23.68	4.92
Beaverwhite 325	Cyprus	38.19	14.01
Zinc Phosphate	Heubach	55.84	16.66
PM Solvent		19.50	21.58
Super High Flash Naphtha		33.07	37.85
Disperse to Hegman 4			
Total		**285.73**	**174.89**

TECHNICAL DATA

VOC	320 g/l
Volume Solids	64.0%
PVC	36.3%
A Viscosity	990 mPa.s
B Viscosity	1570 mPa.s
Mixed Viscosity	950 mPa.s
Potlife	7 h
Set to Touch	55 min
Dust Free	90 min
Hard Dry	Overnight
Direct Impact	37 cmkg
Reverse Impact	<2 cmkg

APPENDIX 4: FAST DRY GLOSS ENAMEL — 1:1 MIX RATIO

A-Component		2386 Kg	2386 Litres
Standard Bis A resin (BADGE)		90.00	77.56
Type 1 solid resin (75% in xylene)		90.00	82.56
Propylene Glycol Methyl Ether		20.28	23.47
Methyl Propyl Ketone		4.63	5.68
		204.91	**189.27**
B-Component			
Ancamide® 220 X 70	Evonik	59.15	59.13
Beetle 216-8	Cytec Industries UK	0.59	0.57
Propylene Glycol Methyl Ether		16.01	17.34
TiPure R 960	DuPont	186.11	47.70
Disperse to Hegman 6, Reduce Speed, then add:			
n-Butanol		23.18	28.62
High Flash Naphtha		31.62	35.92
Total		**316.66**	**189.28**

TECHNICAL DATA

VOC	336 g/l
Weight Solids	75.9%
Volume Solids	62.4%
Potlife	3 h
Set to Touch	2.4 h
Dust Free	3 h
Hard Dry	Overnight
A Viscosity	720 mPa.s
B Viscosity	460 mPa.s
Mixed Viscosity	500 mPa.s
60° Gloss	>90

Appendix 4 is a medium solids compliant coating having a 1:1 (part A:B) mix ratio based utilizing a combination of standard Bis A liquid resin (EEW=190) and a Type 1 solid resin supplied at 75% solids in xylene (EEW = 450-550).

APPENDIX 5: FAST DRY GLOSS ENAMEL — 4:1 MIX RATIO

A-Component		2386 Kg	2386 Litres
DER 660PA80	Dow	217.91	198.05
Nuosperse 657	Hüls	1.63	1.63
Beetle 216-8	Cytec Industries UK	1.32	1.29
TiPure R 960	DuPont	152.54	39.07
Disperse to Hegman 6, Reduce Speed, then add:			
High Flash Naphtha		29.44	33.39
Methyl Propyl Ketone		6.53	8.03
		407.37	**281.46**
B-Component			
Ancamide® 2386	Evonik	49.94	49.97
n-Butanol		20.68	25.74
Total		**70.62**	**75.71**

TECHNICAL DATA

VOC	336 g/l
Weight Solids	75.7%
Volume Solids	62.3%
Potlife	3 h
Set to Touch	2.4 h
Dust Free	3 h
Hard Dry	Overnight
A Viscosity	1420 mPa.s
B Viscosity	70 mPa.s
Mixed Viscosity	700 mPa.s
60° Gloss	>90

Appendix 5 is a medium solids compliant coating having a 4:1 (part A:B) mix ratio utilising a solid resin alone.

APPENDIX 6: SOLVENT FREE GLOSS ENAMEL

A-Component		2386 Kg	2386 Litres
Std BADGE, EEW=190		210.6	181.5
Epodil LV5V5	Evonik	7.8	7.8
		218.4	**189.3**
B-Component			
Ancamide® 2386	Evonik	106.4	106.4
Benzyl Alcohol		21.3	20.4
Epodil LV5	Evonik	17.7	17.0
TiPure R 960	DuPont	181.6	45.4
Total		**327.0**	**189.2**

TECHNICAL DATA

VOC(measured by ASTM D 2369)	108 g/l
Weight Solids	94%
Volume Solids	92%
Potlife	60 min
Set to Touch	13 h
Hard Dry	26 h
A Viscosity	9000 mPa.s
B Viscosity	2000 mPa.s
Mixed Viscosity	2800 mPa.s

APPENDIX 7: SOLVENT-FREE GLOSS ENAMEL — TMPTA MODIFIED

A-Component		2386 Kg	2386 Litres
BADGE, EEW=190		152.8	131.7
Trimethylolpropane Triacrylate	Sartomer	38.2	34.4
Epodil LV5	Evonik	23.1	23.1
		214.1	**189.2**
B-Component			
Ancamide® 2386	Evonik	113.5	113.6
Benzyl Alcohol		24.6	23.5
Epodil LV5	Evonik	7.2	6.8
TiPure R 960	DuPont	181.6	45.4
Total		**508.5**	**189.3**

TECHNICAL DATA

VOC(measured by ASTM D 2369)	156 g/l
Weight Solids	93%
Volume Solids	90%
Potlife	45 min
Set to Touch	3 h
Hard Dry	7 h
A Viscosity	2700 mPa.s
B Viscosity	2500 mPa.s
Mixed Viscosity	1900 mPa.s

EVONIK RESOURCE EFFICIENCY GMBH
Business Line Crosslinkers
Paul-Baumann-Straße 1
45764 Marl
Germany

apcsepx@evonik.com
www.evonik.com/crosslinkers

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