

ANCAMIDE 2634® Curing Agent

DESCRIPTION

Ancamide 2634 is a modified polyamide curing agent designed for use in two component solvent borne epoxy coatings where high performance and cost effectiveness are key requirements. Ancamide 2634 offers high corrosion and chemical resistance along with good heat resistance, cathodic disbondment resistance, high blush resistance, good flexibility and good adhesion.

Ancamide 2634 can be used over a broad temperature range. Its ability to cure at low temperatures and develop a high T_g when heat cured, makes Ancamide 2634 an excellent candidate for both low temperature and high temperature applications.

BENEFITS

- High corrosion and chemical resistance
- Broad application and service temperature range
- Very cost effective
- High blush resistance
- Good cathodic disbondment resistance
- Good flexibility and adhesion
- DOT non-corrosive

APPLICATIONS

- Metal primers
- Build coats and barrier coats
- Gloss enamels

SHELF LIFE

At least 24 months from date of manufacture in original sealed container at ambient temperature. Store away from excessive heat and humidity in tightly closed containers.

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Ancamide 2634 curing agent.

TYPICAL CURE SCHEDULE

Ambient: 2–7 days

Heat Cure: 2-4 hrs at 200-240°F

TABLE 1: TYPICAL PROPERTIES

Appearance	Amber Resinous Liquid, Slight Haze
Color ¹ (Gardner)	7
Viscosity ² @ 77°F (cPs)	1700
Amine Value ³ (mg KOH/g)	335
Specific Gravity ⁴ @ 77°F	0.96
Weight per Gallon	7.99
Flash Point ⁵ (°F)	111
Non-volatile (wt %)	80
Solvent (n-butanol wt %)	20
Equivalent Wt/{H}	90
Recommended Use Level, phr (with EEW 190 epoxy resin)	48

TABLE 2: TYPICAL HANDLING PROPERTIES*

Mixed Viscosity ² @ 77°F (cPs)	4,000
Gel Time ⁶ @ 77°F (150 g mix) (min)	> 180
Thin Film Set Time (h)	7
Hard Dry Time (h)	12
Glass Transition Temperature ⁷ (°F)	240

* Cured with liquid Bisphenol-A based epoxy resin (EEW=190)

SUPPLEMENTARY DATA

CORROSION PROTECTION

Ancamide 2634 provides significantly higher corrosion protection than conventional polyamides. Formulators may be able to reduce the amount of expensive anticorrosive pigments and therefore save money.

Ancamide 2634 and a conventional polyamide, Ancamide 260A were compared in anticorrosive formulations as shown below. In the Ancamide 2634 formulation the anticorrosive pigment was reduced by 50%. As the salt fog and prohesion results demonstrate, performance can be improved and costs reduced by utilizing Ancamide 2634.

TABLE 3: ANCAMIDE 2634 PRIMER (FORMULATION V)

A Side	Pounds	Gallons
Liquid Epoxy	282.4	29.17
Anti-terra U80	2.6	0.31
Modaflow	7.7	0.92
Xylene	55.1	7.68
MPK	28.2	4.22
Talc	179.4	7.70
Total	555.3	50.0
B Side		
Ancamide 2634	128.8	15.58
Nevchem LR	25.6	3.01
Benzyl Alcohol	19.2	2.20
n-Butanol	85.2	12.66
Red Iron Oxide	50.0	1.16
Halox SZP 391	50.0	1.99
Imsil A8 Silica	294.9	13.38
Total	653.7	50.0
	1209.0	100.00
PVC	34%	
VOC (lb/gal)	1.96	
Wt Solids	84%	
Vol Solids	72%	

ANCAMIDE 260A PRIMER

A Side	Pounds	Gallons
Liquid Epoxy	250.5	25.87
Anti-terra U80	2.3	0.28
Modaflow	6.8	0.82
Xylene	48.9	6.82
MPK	25.0	3.74
Talc	159.1	6.83
Total	492.6	44.36
B Side		
Ancamide 260A	133.3	16.46
Nevchem LR	22.7	2.67
benzyl alcohol	17.0	1.95
n-Butanol	115.4	17.15
Red Iron Oxide	50.0	1.16
Halox SZP 391	100.0	3.98
Imsil A8 Silica	270.5	12.27
Total	708.9	55.64
	1201.5	100.00
PVC	34%	
VOC (lb/gal)	1.9	
Wt Solids	84%	
Vol Solids	72%	

Corrosion Resistance

Salt Fog – 500 h exposure
2 mil DFT on shot blasted steel

Overall Rating = 8
Blisters #6 Few
0-1 mm scribe creep

Prohesion – 500 h exposure
2 mil DFT on shot blasted steel

Overall Rating = 9
Blisters – None
0-1 mm scribe creep

Corrosion Resistance

Salt Fog – 500 h exposure
2 mil DFT on shot blasted steel

Overall Rating = 5
Blisters #4 and #6 Medium
0-1 mm scribe creep

Prohesion – 500 h exposure
2 mil DFT on shot blasted steel

Overall Rating = 9
Blisters – None
0-1 mm scribe creep

CHEMICAL RESISTANCE

Ancamide 2634 based coatings exhibit good resistance to organic solvents. A gloss enamel based on Ancamide 2634 (see appendix: Formulation II) was exposed to representative solvents and acids for 7 days then evaluated for hardness retention, gloss retention, and blistering. When exposed to ketones, alcohols, and aromatic solvents, Ancamide 2634 based coatings maintain high gloss with no signs of blistering or delamination. Softening of the coatings is largely reversible when the coatings are allowed to recover. For optimum resistance to organic and mineral acids, Ancamide 2634 based coatings should incorporate Bis F and Novolac epoxy resins with a stoichiometric excess of epoxy.

Reagent	Initial Hardness	Hardness 7 Day Exposure	Hardness 1 hr Recovery	Hardness 4 hr Recovery	Appearance
MEK	HB	B	B	B	No blistering, no gloss loss
Toluene	HB	HB	HB	HB	No blistering, no gloss loss
PM Solvent	HB	< 6B	5B	4B	No blistering, v. slight gloss loss
Methanol	HB	HB	HB	HB	No blistering, no gloss loss
10% Acetic Acid	HB	Destroyed	—	—	Dense Blistering
20% Sulfuric Acid	HB	Destroyed	—	—	Dense Blistering

CATHODIC DISBONDMENT RESISTANCE

Ancamide 2634 based formulations exhibit good cathodic disbondment resistance at both ambient and elevated temperatures. The Ancamide 2634 based formulation (see appendix: Formulation IV) was spray applied at 9-10 mil DFT onto shot blasted steel (2 mil profile) and cured 7 days at ambient temperature prior to testing. A ¼" radius holiday was exposed on each coating followed by immersion in 3% NaCl electrolyte at 70°F and 125°F with an impressed current of 1.5 volts. The coatings were rinsed, scribed and tested for adhesion loss and blistering with the following results:

Immersion Temperature	Immersion Time	Disbondment Radius	Blistering	Visual Appearance
70°F	28 Days	0 mm	None	No Effect
70°F	90 Days	0 mm	None	No Effect
125°F	28 Days	0 mm	None	No Effect
125°F	90 Days	0 mm	Yes	8-10 #2 anodic blisters 15-20 mm distance from holiday

HOT WATER RESISTANCE

Ancamide 2634 based coatings (see appendix: Formulation IV) were applied at 6 mil DFT to shot blasted steel (2 mil profile), cured 24 hours at 240°F, then scribed and immersed in deionized (DI) water at 195°F. After 3 days and 7 days immersion, the panels were tested for hardness, cross-hatch adhesion, and appearance.

Test Method	0 Immersion	3 Day Immersion	7 Day Immersion
Pencil Hardness	F	HB	HB
Cross-Hatch Adhesion	5B	5B	5B
Gloss / Appearance	—	No Change	No Change
Scribe Creep	—	0 mm	0 mm

FORMULATING GUIDELINES

Stoichiometry - Ancamide 2634 develops optimum properties when used at or near 1:1 stoichiometry. A slight (5-10%) excess of epoxy improves corrosion resistance whereas a slight (5-10%) excess of curing agent improves solvent resistance.

Low Temperature Cure - Plasticizers such as Epodil® LV5 diluent, Nevchem LR, or Benzyl Alcohol should be added to the formulation to improve ambient and sub-ambient through cure. The typical plasticizer level is 15-25% based on the Ancamide 2634 weight.

High Temperature Resistance - When formulating Ancamide 2634 for high temperature service, avoid using plasticizers and epoxy diluents. Ancamide 2634 can develop a Tg of 240°F when cured at 1:1 stoichiometry with Bis A liquid epoxy. For optimum properties, a heat cure of 2 hrs or longer at 200°F or higher is recommended.

Accelerating Cure - Dry times can be accelerated by adding Ancamine® K54 accelerator (5% based on Ancamine 2634 weight) or by adding a fast co-curing agent such as Ancamine 1767, 1768, 2089M, or 2432 (10-20% based on Ancamine 2634 weight). Lacquer dry characteristics can be achieved by using a blend of liquid and solid epoxy resin as shown in Formulation III in the appendix.

Additives - Flow and leveling additives such as Modaflow resin, Beetle 216-8, or Byk 307 can be used to eliminate any cratering and improve substrate wetting. Typical use levels are 0.1-0.5% based on total formulation weight.

Solvent Selection - Ester solvents should be packaged with epoxy and not packaged with amine curing agents to avoid side reactions. Alcohols such as butanol are strong solvents for Ancamide 2634 but should not be packaged with epoxy resins. Ketones, strong solvents for solid epoxy resins, should be packaged with the epoxy to avoid side reaction with amines.

APPENDIX – STARTING POINT FORMULATIONS

FORMULATION I: HIGH SOLIDS BUILD COAT STARTING POINT FORMULATION

A Side	Pounds	Gallons	Supplier
Liquid Epoxy (EEW 190)	393.4	40.6	Dow, Shell, etc.
Nevchem LR	21.7	2.6	Neville Chemical
MIBK	26.5	4.0	
TiPure R 960	91.8	2.8	DuPont
Total A Side	533.4	50.0	
B Side			
Ancamide 2634	186.4	21.9	Evonik
Benzyl alcohol	14.4	1.7	Noveon
Butanol	57.7	8.5	
Nevchem LR	12.9	1.5	Neville Chemical
MPA 2000X	2.6	0.4	Rheox
Beetle 216-8	10.5	1.2	Cytec
LVT 325 Talc	170.5	7.2	Mineral Technologies
Imsil A10	170.5	7.7	Unimin
Total B Side	625.4	50.0	
Total A + B	1158.8	100.0	
PVC 22%	Pencil Hardness 3H		
VOC 1.37 lb/gal	Mandrel Bend 1" Pass		
Wt Solids 88%	Set to Touch 6 hrs		
Vol Solids 80%	Visc. A side = 2112 cPs		
Stoichiometry 1:1	Visc. B side = 4750 cPs		

**FORMULATION II:
GLOSS ENAMEL STARTING POINT FORMULATION BASED ON LIQUID EPOXY**

A Side	Pounds	Gallons	Supplier
Liquid Epoxy	378.9	39.13	Dow, Shell, Vantico
MIBK	19.1	2.87	
Xylene	57.4	8.01	
Total	455.4	50.0	
B Side			
Ancamide 2634	163.6	19.80	Evonik
Ancamine 1767	18.2	2.25	Evonik
Ancamine K54	8.3	1.01	Evonik
Xylene	18.1	2.53	
Nevchem LR	31.9	3.75	Neville
Aromatic 100	25.5	3.47	
n-Butanol	26.0	3.85	
Byk 307	2.6	0.30	Byk Chemie
Modaflow	2.6	0.31	Solutia
TiPure R960	190.0	5.84	DuPont
MP 40-27	80.0	3.36	Mineral Technologies
Barytes	130.0	3.54	Cimbar
Total	696.8	50.0	
Total A + B	1152.2	100.0	
PVC	18%	A Side Viscosity	240 cP
VOC (lb/gal)	1.8	B Side Viscosity	1650 cP
Wt Solids	84%	Mixed Viscosity	1300 cP
Vol Solids	75%	Pot Life	3 h
Stoichiometry	1.05	Thin Film Set Time	6.5 h
		Hard Dry Time	9.5 h

**FORMULATION III:
FAST DRY GLOSS ENAMEL STARTING POINT FORMULATION BASED ON LIQUID AND SOLID EPOXY**

A Side	Pounds	Gallons	Supplier
Liquid Epoxy (EEW 190)	170.0	17.6	Dow, Resolution, Huntsman
1001X75	255.0	28.0	Dow, Resolution, Huntsman
Anti-terra U80	4.2	0.5	Byk Chemie
Byk 307	4.2	0.5	Byk Chemie
Xylene	51.0	7.1	
MIBK	89.8	13.4	
TiPure R 960 TiO ₂	180.0	5.5	DuPont
Talc MP 40-27	90.0	3.8	Mineral Technologies
Imsil A 10 Crystalline Silica	80.0	3.6	Unimin
	924.2	80.00	
B Side			
Ancamide 2634	111.0	13.0	Evonik
Ancamine K54	5.8	0.7	Evonik
Benzyl alcohol	25.5	2.9	
Butanol	22.4	3.3	
Total B Side	164.8	20.00	
Total A + B	1089.0	100.0	
PVC	21%		
VOC (lb/gal)	2.76		
Wt Solids	75%		
Vol Solids	61%		
Stoichiometry	105%		

**FORMULATION IV:
CATHODIC DISBONDMENT AND HOT WATER RESISTANCE FORMULATION**

A Side	Pounds	Gallons	Supplier
Epon 828	327.39	33.81	Dow, Resolution, Huntsman
Nuosperse 657	5.24	0.63	Huls
Xylene	72.03	10.05	
MIBK	32.74	4.90	
Aromatic 100	72.03	9.81	
TiPure R 960 TiO ₂	130.96	4.02	DuPont
Nytral 300 talc	399.41	16.79	NYCO
	1039.79	80.0	
B Side			
Ancamide 2634	160.21	20.0	Evonik
Total A + B	1200.00	100.00	
PVC	29%		
VOC (lb/gal)	2.09		
Wt Solids	83%		
Vol Solids	71%		
Stoichiometry	1		

**FORMULATION V:
ANTICORROSIVE METAL PRIMER FORMULATION**

A Side	Pounds	Gallons	Supplier
Liquid Epoxy (EEW 190)	282.4	29.17	Dow, Resolution, Huntsman
Anti-terra U80	2.6	0.31	Byk Chemie
Modaflow	7.7	0.92	Solutia
Xylene	55.1	7.68	
MPK	28.2	4.22	
MP 40-27 Talc	179.4	7.70	Mineral Technologies
Total	555.3	50.0	
B Side			
Ancamine 2634	128.8	15.58	Evonik
Nevchem LR	25.6	3.01	Neville
Benzyl Alcohol	19.2	2.20	Noveon
n-Butanol	85.2	12.66	
Red Iron Oxide	50.0	1.16	Bayer
SZP 391	50.0	1.99	Halox
Imsil A8 Silica	294.9	13.38	Unimin
Total	653.7	50.0	
Total A + B	1209.0	100.00	
PVC	34%		
VOC (lb/gal)	1.96		
Wt Solids	84%		
Vol Solids	72%		

Footnotes

- (1) ASTM D 1544-80
- (2) ASTM D 445-83, Brookfield, RVTD, Spindle 4
- (3) Perchloric Acid Titration
- (4) ASTM D 1475-85
- (5) Seta Flash Closed Cup
- (6) Techne GT-4 Gelation Timer
- (7) ASTM D 3418-82 7 Maximum $T_g = 240^\circ\text{F}$ when sample is fully heat cured

EVONIK CORPORATION

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

For Technical Information and Support:

Americas: picus@evonik.com
EMEA: apcse@evonik.com

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