

ANCAMIDE 2445[®] Curing Agent**DESCRIPTION**

Ancamide 2445 curing agent is a modified polyamide designed to be used with liquid epoxy resin. It is a medium-viscosity curing agent which exhibits fast cure at low temperatures. Ancamide 2445 curing agent has a low residual amine content and it gives coatings with reduced blush. The product can be used to formulate low-VOC, anti-corrosive coatings for marine, military and industrial maintenance applications.

ADVANTAGES

- Fast cure at low temperatures (40°F)
- Medium viscosity
- Low residual amine
- Non-critical loading
- Good film appearance and no amine blush
- Good humidity and corrosion resistance

APPLICATIONS

High-solids, corrosion-resistant coatings for marine, industrial maintenance and military applications.

SHELF LIFE

At least 24 months from the date of manufacture in the 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 2445 curing agent.

TYPICAL CURE SCHEDULE

2-7 days at ambient temperature.

TABLE 1: TYPICAL PROPERTIES

Appearance	Amber liquid
Color¹ (Gardner)	7
Viscosity² @ 77°F (cP)	5,200
Amine Value³ (mg KOH/g)	210
Specific Gravity⁴ @ 77°F	1.03
Weight per Gallon	8.60
Flash Point⁵ (°F)	225
Equivalent Wt/{H}	133
Recommended Use Level (phr, EEW=190)	70

TABLE 2: TYPICAL HANDLING PROPERTIES*

Thin Film Set Time⁶ @ 77°F (h)	5.5
Gel Time⁷ (150g mix @ 77°F) (min)	89

* Ancamide 2445 curing agent formulated with standard Bisphenol-A based (DGEBA, EEW=190) epoxy resin.

Footnotes:

- (1) ASTM D 1544
- (2) ASTM D 445-83, Brookfield, RVTD, Spindle 4
- (3) Perchloric Acid Titration
- (4) ASTM D 1475-85
- (5) Seta Flash Closed Cup
- (6) BK-Recorder, 6 mil wet film thickness
- (7) ASTM D 2471-71

SUPPLEMENTARY DATA

Ancamide 2445 curing agent is a medium-viscosity, modified polyamide. When used with liquid epoxy resins, Ancamide 2445 curing agent offers fast drying speed, improved coating flexibility and excellent long-term humidity and corrosion resistance. The product also has a low level of free, unreacted amine which reduces the curing agent corrosivity and improves the coating surface appearance by reducing the tendency of the coating to blush.

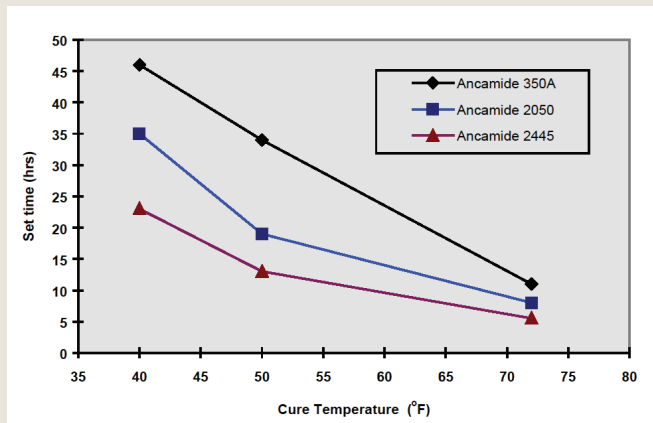
Ancamide 2445 curing agent can be used to formulate high-volume solids, low-VOC coatings which find use in a wide variety of industrial maintenance and military-type applications.

Since the loading of Ancamide 2445 curing agent is non-critical, it can be utilized at levels ranging from 70 to 100 phr when used with a liquid epoxy resin.

FAST DRY TIMES

When used with liquid epoxy resin, Ancamide 2445 curing agent exhibits fast cure speed. As shown in Figure 1, the thin film set times obtained with Ancamide 2445 curing agent offer a significant improvement over conventional polyamide curing agents, including Ancamide 2050 and Ancamide 350A curing agents. At room temperature, the thin film set time was reduced to 5 hours from 8 hours and 11 hours, respectively. At lower application temperatures (40°F), set times of less than 24 hours were achieved for Ancamide 2445 curing agent, compared with 36 hours for Ancamide 2050 and 46 hours for Ancamide 350A curing agents.

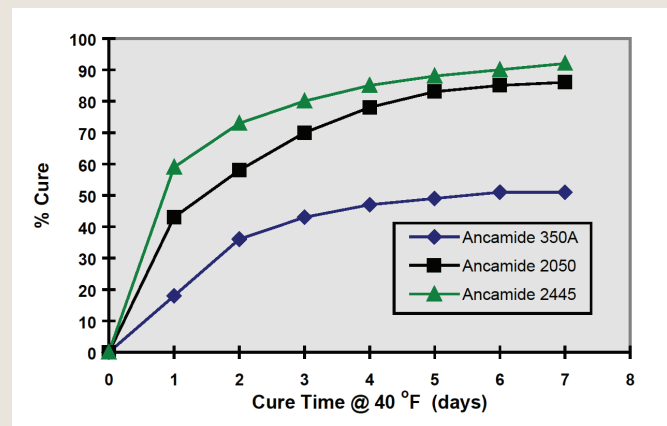
FIGURE 1: THIN FILM SET TIMES



The above results were based on loadings of 70 phr for Ancamide 2445 and Ancamide 2050 curing agents, and 80 phr for Ancamide 350A curing agent. All results were measured using a B-K recorder and 6 mil wet film applied to glass plates.

Further evidence supporting the excellent low temperature cure characteristics of Ancamide 2445 curing agent is shown in Figure 2. This plot compares the cure development of Ancamide 2445, Ancamide 2050 and Ancamide 350A curing agents by measurement of the residual exotherm during low temperature cure. The test method utilized measures residual exotherm using differential scanning calorimetry (DSC).

FIGURE 2: LOW TEMPERATURE (40°F) CURE PROFILES



The results show that Ancamide 2445 curing agent reached approximately 60% of full cure within the first 24 hours, significantly faster than both Ancamide 2050 (43%) and Ancamide 350A curing agents (16%). After 7 days cure at 40°F, Ancamide 2445 curing agent reached 90% cure compared with only 85% and 48% cure for Ancamide 2050 and 350A curing agents, respectively.

FILM PROPERTIES

In a clear coat formulation, Ancamide 2445 curing agent also exhibited a high degree of flexibility. As shown in Table 3, the direct impact resistance of Ancamide 2445 curing agent is comparable to that of Ancamide 2050 curing agent and superior to that of Ancamide 350A curing agent. Ancamide 2445 curing agent also exhibited greater reverse impact resistance compared with conventional polyamides.

TABLE 3: PERFORMANCE PROPERTIES

Property	Ancamide 2445	Ancamide 2050	Ancamide 350A
Direct Impact	96	84	40
Reverse Impact	44	20	10
Specular Gloss 60°	128	125	92
Pendulum Hardness	117	100	120
Mandrel Bend	Pass	Pass	Pass

STARTING POINT FORMULATIONS

Appendix 1 contains preliminary starting point formulations based on Ancamide 2445 curing agent for an anticorrosive primer and a general-purpose white gloss enamel. When pigmented, the dry-to touch state of the coatings was generally reached in less than 4 hours, with hard dry achieved within approximately 12 hours for systems applied and cured at 75°F. Pot lives on the order of 5 to 6 hours were obtained with proper formulation, while maintaining VOCs of less than 2.8 lb/gal.

Formulation A2445P1 is a high-volume solids (74%), low-VOC (2.4 lb/gal) red iron oxide primer with a low-mix viscosity of approximately 1,000 cps and a pot life of 6 hours. It can be spray-applied with conventional spray equipment or brush-applied to a steel substrate without the addition of extra solvents. Set-to-touch was reached after 4 hours, and the coating system was hard dry in less than 15 hours.

Formulation A2445P1 was evaluated for salt spray, humidity and prohesion resistance. After 3,000 hours, the coatings exhibited excellent corrosion resistance, and no signs of field blisters or scribe creep were detected using the above accelerated weather tests.

Formulation A2445E1 is a white enamel based on Ancamide 2445 curing agent in combination with the amidoamine, Ancamide 507 curing agent. This formulation is Navy Formulation 15 Type IV for use in Mil Spec P24441 applications. Evaluation of Formulation A2445E1 shows that the paint formulation had an initial mix viscosity of 1,300 cps, with a pot life of 4.5 hours. The paint reached a set-to-touch after 4 hours, with hard dry achieved in less than 15 hours.

TABLE 4: SALT SPRAY RESISTANCE—ANCAMIDE 2445

Formulation	Scribe Creep	Field Blistering	Blister Size
2445P1	9	10	10
2445E1	9	10	10

5% salt spray, cabinet temperature 95°F — ASTM B-117, film thickness 3.5-4.5 mils
Rating: 10 = Best (no blisters), 0 = Worst

PERFORMANCE EVALUATION

All coatings were evaluated in 5% salt spray and in continuous humidity at 122°F. They were also evaluated using a prohesion weathering tester following a 10 day ambient cure. The coatings were applied to grit blasted, hot rolled steel (2.5=4.0 mil profile) in double coats to give 3.5-4.5 DFT using conventional spray equipment. In salt spray, (ASTM B-117) the panels were scribed and evaluated for field blisters using the Federal Standard Test Method #141a, Method 6461, and the scribe creepage was rated in accordance with ASTM D-1654. Similar evaluations were made for panels placed in the prohesion cabinet (ASTM G85-94). The panels exposed to humidity were not scribed, and the coatings were assessed for blistering only. These tests also included evaluations for changes in visual appearance.

CORROSION RESISTANCE

Both of the attached formulations were evaluated for salt spray and constant humidity resistance. The results obtained are presented in Tables 4-6. Following 3,000 hours of salt fog exposure, Formulations 2445P1 and 2445E1 both exhibited excellent resistance, with only a faint trace of damage along the scribe for the primer formulation. Following 3,000 hours of continuous humidity resistance testing, both formulations gave excellent humidity resistance with no signs of field blistering being observed.

TABLE 5: PROHESION EXPOSURE—ANCAMIDE 2445

Formulation	Scribe Creep	Field Blistering	Blister Size
2445P1	7	10	10
2445E1	8	10	10

Prohesion ASTM G85-94
 Film thickness 4.0 mils. Rating: 10 = Best, 0 = Worst
 For blister size, rating 10 = no blisters observed

TABLE 6: CLEVELAND HUMIDITY EXPOSURE—ANCAMIDE 2445

Formulation	Field Blistering	Blister Size
2445P1	10	10
2445E1	10	10

Continuous 100% humidity exposure - ASTM D-2247, cabinet temperature 122°F
 Film thickness 4.0 mils. Rating: 10 = Best, 0 = Worst
 For blister size, rating 10 = no blisters observed

APPENDIX I: ANCAMIDE 2445 CURING AGENT STARTING POINT FORMULATIONS**TABLE 7: FORMULATION 2445P1
HIGH-SOLIDS COATING—RED IRON OXIDE PRIMER**

A Side	Pounds	Gallons	Supplier
Liquid Epoxy Resin*	225.7	23.31	Dow, Resolution
MPA-1078	3.9	0.53	Rheox
<i>Mix well then add at high speed:</i>			
TiO ₂	24.2	0.72	DuPont
Wollastokup AS	357.3	14.76	NYCO
Xylene	82.9	11.42	Ashland
Total (A Side)	694.0	50.74	
B Side			
Ancamide 2445	189.6	21.03	Evonik
MPA 1078	3.9	0.53	Rheox
Beetle 216-8	14.4	1.64	Cytec
<i>Mix well then add at high speed:</i>			
Red Iron Oxide J3100	57.9	1.42	Mineral Tech.
Beaverwhite 325	93.4	4.07	Cyprus
Phoplus J-0866	136.5	4.87	Mineral Tech.
High Flash Naphtha	85.9	11.84	
Diacetone Alcohol	30.2	3.85	
Total (B Side)	611.8	49.25	
TOTAL	305.8	99.99	

*bis A diglycidyl ether EEW = 190

TABLE 8: TYPICAL PROPERTIES

Non Volatile (Wt)	72.2%	Weight/Gallon Comp A	13.67
Non Volatile (Vol)	73.8%	Weight/Gallon Comp B	12.42
PVC	35.0%	Weight per Gallon	13.06
Initial Viscosity	1090 cps	Mix Ratio	1:1
Pot Life	6 h	VOC (lb/gal)	2.40
Dry to Touch	4 h	Dry Hard	12 h
		Pencil Hardness	H

**TABLE 9: FORMULATION 2445E1
HIGH-SOLIDS COATING—GENERAL PURPOSE WHITE TOP COAT**

A Side	Pounds	Gallons	Supplier
Liquid Epoxy Resin*	274.8	28.39	Dow, Resolution
Disparlon 650	7.5	0.90	King Industries
<i>Mix well then add at high speed</i>			
Mistron 400 Talc	208.0	8.75	Cyprus
Super High Flash Naphtha	88.6	11.93	
Total (A Side)	578.9	49.99	
B Side			
Ancamide 2445	165.0	18.31	Evonik
Ancamide 507	19.4	2.34	Evonik
Disparlon NS-30	5.3	0.74	King Industries
TiO ₂	280.2	8.61	DuPont
Butanol	130.7	17.03	
Super High Flash Naphtha	22.4	3.00	
Total (B Side)	623.0	50.03	
TOTAL	1201.9	100.02	

*bis A diglycidyl ether EEW = 190

TABLE 10: TYPICAL PROPERTIES

Non Volatile (Wt)	78.9%	Weight/Gallon Comp A	11.58
Non Volatile (Vol)	70.0%	Weight/Gallon Comp B	12.45
PVC	24.8%	Weight per Gallon	12.02
Initial Viscosity	1370 cps	Mix Ratio	1:1
Pot Life	4.5 h	VOC (lb/gal)	2.42
Dry to Touch	4 h	Dry Hard	12 h
		Pencil Hardness	HB

Epoxy Curing Agents and Modifiers

ANCAMIDE 2445[®] Curing Agent

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

Disclaimer

The information contained herein is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed and no warranty of any kind is made with respect thereto.

