

Product information

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.

TYPICAL PROPERTIES

Property	Value	Unit	Method
Appearance	Amber liquid		
Colour	7	Gardner	ASTM D 1544
Viscosity @ 77°F	5,200	mPa.s	ASTM D 445-83, Brookfield, RVTD, Spindle 4
Amine Value	210	mg KOH/g	Perchloric Acid Titration
Specific Gravity @ 77°F	1.03		ASTM D 1475-85
Weight per Gallon	8.60		
Flash Point	225	°F	Seta Flash Closed Cup
Equivalent Wt{H}	133		
Recommended use Level	70	PHR	(EEW=190)

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 and industrial maintenance applications.

PACKAGING AND HANDLING

Refer to the Safety Data Sheet for Ancamide 2445 curing agent.

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.

TYPICAL CURE SCHEDULE

2-7 days at ambient temperature.

TYPICAL HANDLING PROPERTIES*

Property	Value	Unit	Method
Thin Film Set Time @ 77°F	5.5	h	BK-Recorder, 6 mil wet film thickness
Gel Time (150g mix at 77°F)	89	min	ASTM D 2471-71

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

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 highvolume solids, low-VOC coatings which find use in a wide variety of industrial maintenance and military-type applications.

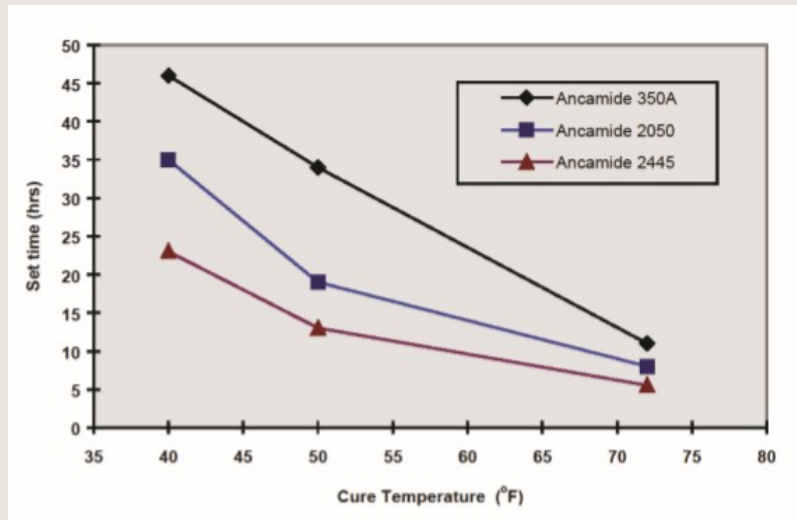
Since the loading of Ancamide 2445 curing agent is noncritical, it can be utilized at levels ranging from 70 to 100 phr when used with a liquid epoxy resin.

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.



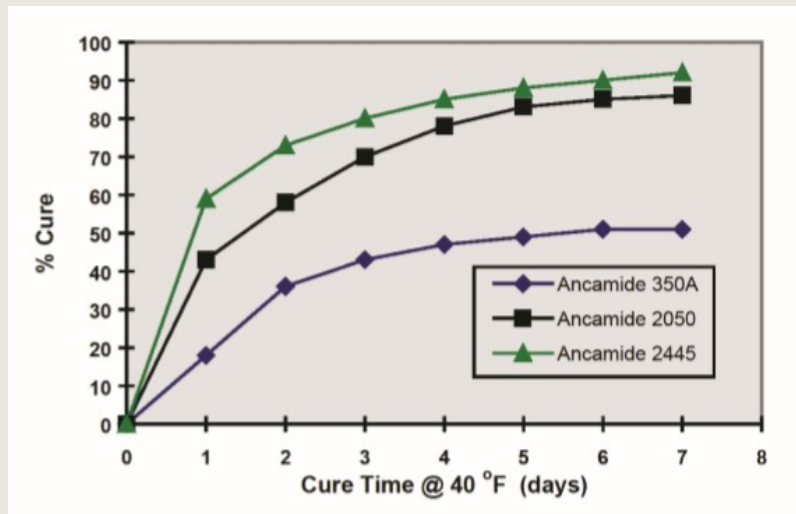
FIGURE 1: THIN FILM SET TIMES



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 FORMULATION

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 cohesion 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.



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 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

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

Nb.	A Side	Supplier	Pounds	Gallons
1.	Liquid epoxy resin*	Dow, Resolution	225.7	23.31
2.	MPA-1078	Rheox	3.9	0.53
Mix well then add at high speed				
3.	TiO ₂	DuPont	24.2	0.72
4.	Wollastokup AS	NYCO	357.3	14.76
5.	Xylene	Ashland	82.9	11.42
Total (A Side)			694.0	50.74
Nb.	B Side			
6.	Ancamide 2445	Evonik	189.6	21.03
7.	MPA 1078	Rheox	3.9	0.53
8.	Beetle 216-8	Cytec	14.4	1.64
Mix well then add at high speed				
9.	Red Iron Oxide J3100	Mineral Tech.	57.9	1.42
10.	Beaverwhite 325	Cyprus	93.4	4.07
11.	Phoplus J-0866	Mineral Tech.	136.5	4.87
12.	High Flash Naphtha		85.9	11.84
13.	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	12h
		Pencil Hardness	H

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

Nb.	A Side	Supplier	Pounds	Gallons
1.	Liquid epoxy resin*	DER 331	274.8	28.39
2.	Disparlon 650	King Industries	7.5	0.90
Mix well then add at high speed				
3.	Mistron 400 Talc	Cyprus	208.0	8.75
4.	Aromatic 150		88.6	11.93
	Total (A Side)		578.9	49.99
Nb.	B Side			
6.	Ancamide 2445	Evonik	165.0	18.31
7.	Ancamide 507	Evonik	19.4	2.34
8.	Disparlon NS-30	King Industries	5.3	0.74
9.	TiO ₂	DuPont	280.2	8.61
10.	Butanol		130.7	17.03
11.	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	12h
		Pencil Hardness	HB

Ancamide® is a registered trademark of Evonik Industries AG or one of its subsidiaries.

Disclaimer

This information and any recommendations, technical or otherwise, are presented in good faith and believed to be correct as of the date prepared. Recipients of this information and recommendations must make their own determination as to its suitability for their purposes. In no event shall Evonik assume liability for damages or losses of any kind or nature that result from the use of or reliance upon this information and recommendations. EVONIK EXPRESSLY DISCLAIMS ANY REPRESENTATIONS AND WARRANTIES OF ANY KIND, WHETHER EXPRESS OR IMPLIED, AS TO THE ACCURACY, COMPLETENESS, NON-INFRINGEMENT, MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE (EVEN IF EVONIK IS AWARE OF SUCH PURPOSE) WITH RESPECT TO ANY INFORMATION AND RECOMMENDATIONS PROVIDED. Reference to any trade names used by other companies is neither a recommendation nor an endorsement of the corresponding product, and does not imply that similar products could not be used. Evonik reserves the right to make any changes to the information and/or recommendations at any time, without prior or subsequent notice.

EVONIK OPERATIONS GMBH

Business Line Crosslinkers
Paul-Baumann-Str. 1
45764 Marl
Germany

www.evonik.com/crosslinkers

Product Information: APCSE@evonik.com

Sample Request: APCSE@evonik.com

EVONIK CORPORATION

Business Line Crosslinkers
7001 Hamilton Boulevard
Trexlerstown, PA 18087
USA

CrosslinkersProinfo@evonik.com

Crosslinkers-Samples@evonik.com

EVONIK SPECIALTY CHEMICALS (SHANGHAI) CO., LTD.

Business Line Crosslinkers
55, Chungong Road
Xinzhuang Industry Park
Shanghai, 201108
China

CL-Asiainfo@evonik.com

CL-Asiainfo@evonik.com

