

ANCAMIDE® 2050 Curing Agent**DESCRIPTION**

Ancamide 2050 curing agent is a special polyamide adduct designed for use with liquid epoxy resins in two-part, ambient-cure coatings.

BENEFITS

- Good cure at 50°F
- Good corrosion resistance
- High aqueous acid and Skydrol[®] resistance
- Zero induction time at ambient temperature
- Moderate viscosity
- Good flexibility
- High-gloss finish
- Noncritical loading (70–100 phr)

APPLICATIONS

- High-solids marine and maintenance coatings
- High-solids lining coatings
- High-solids primers and coatings for concrete
- Sealants and putties

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 2050 curing agent.

TYPICAL CURE SCHEDULE

7 days at ambient temperature.

TABLE 1: TYPICAL PROPERTIES

Appearance:	Clear, Amber Liquid
Color⁽¹⁾(Gardner):	7
Viscosity⁽²⁾ @ 77°F (cP)	4,000
Specific Gravity⁽³⁾ @ 77°F	1.02
Amine Value⁽⁴⁾ (mg KOH/g)	225
Flash Point⁽⁵⁾ (closed cup) (°F)	>200
Equivalent Wt/{H}	150
Recommended Use Level (phr, EEW=190)	70

TABLE 2: TYPICAL HANDLING PROPERTIES*

	70 phr	100 phr
Mixed Viscosity⁽²⁾ @ 77°F (cP)	6,400	5,000
Gel Time⁽⁶⁾ (150g mix @ 77°F) (min)	100	80
Thin Film Set Time⁽⁷⁾ @ 77°F (hr)	7.0	6.0
Peak Exotherm⁽⁸⁾ (100g mix @ 77°F) (min)	95	104
Peak Exotherm Time⁽⁸⁾ (min)	136	133

TABLE 3: TYPICAL PERFORMANCE*

(7 days @ 77°F)		
Glass Transition Temperature⁽⁹⁾ (°F)	108	—
Heat Deflection Temperature⁽¹⁰⁾ (°F)	108	90

*Ancamide 2050 curing agent formulated with standard Bisphenol-A based (DGEBA, EEW=190) epoxy resin.

Footnotes:

- (1) ASTM D1544-80
- (2) ASTM D-445-83, Brookfield, RVTD, Spindle 4
- (3) ASTM D 1475-85
- (4) Perchloric Acid Titration
- (5) Seta Flash Closed Cup
- (6) Techne GT-4 Gelation Timer
- (7) BK Drying Recorder
- (8) ASTM D 2471-71
- (9) ASTM D 3418-82
- (10) ASTM D 648 @ 264 psi

(A) Monsanto Company

SUPPLEMENTARY DATA

FORMULATIONS: Exhibits 1 and 2 show formulations for an aluminized epoxy mastic and an anticorrosive primer based on Ancamide 2050 curing agent.

HANDLING PROPERTIES: Table 1 compares the handling properties of Ancamide 2050 curing agent and a conventional polyamide such as Ancamide 350A curing agent. The low viscosity of the Ancamide 2050 curing agent allows formulators to develop high-solids coatings with lower VOC. Ancamide 2050 curing agent has excellent resistance to blush and exudation, so an induction time is not necessary at ambient temperature. Pot life for Ancamide 2050 curing agent is less than that of Ancamide 350A curing agent, but is still sufficient. The aluminized mastic and anticorrosive primer formulations in Exhibits 1 and 2 have pot lives of 5 hours and 8 hours, respectively.

The comparative dry times at ambient and low temperature for Ancamide 2050 and Ancamide 350A curing agents are also shown in Table 1. At ambient temperature, Ancamide 2050 curing agent has a tack-free time of 6-7 hours, depending on use level (100 vs 70 phr) compared with 11 hours for Ancamide 350A curing agent. At 50°F, the tack-free time of Ancamide 2050 is 19-24 hours vs 36 hours for Ancamide 350A curing agent.

TABLE 1: HANDLING PROPERTIES

	Ancamide 2050	Ancamide 350A
Viscosity (cP)	4,000	11,000
Mixed Viscosity (cP)	5,000-6,400	18,600
Pot Life (min)	80-100	200
Tack Free (hr @ 72°F)	6-7	11
Tack Free (hr @ 50°F)	19-24	36
Use Level (phr)	70-100	60

Curing agents were mixed with liquid epoxy (EEW=190) at use levels indicated. The full formulations in Exhibits 1 and 2 have dry to touch times of 3.5-4 hours and dry through times of 9-10 hours at ambient temperature.

FILM PROPERTIES: Table 2 shows comparisons of flexibility, gloss, VOC and film appearance for Ancamide 2050 and Ancamide 350A curing agents. Formulators can use Ancamide 2050 curing agent to achieve superior flexibility by taking advantage of its noncritical loading, and by increasing its use level to 100 phr.

TABLE 2: FILM PROPERTIES

	Ancamide 2050	Ancamide 350A
Direct impact (in/lb)		
500 EEW resin^(a)	44	52
400 EEW resin^(a)	38	33
300 EEW resin^(a)	20	20
200 EEW resin^(a)	20	12
Reverse impact (in/lb)^(b)	12/110	<20
1/8 in mandrel bend^(b)	Pass	Pass
Gloss (60°)^(c)	100	90
Voc (lb/gal)^(d)	1.7	1.8
Film appearance^(e)		
1 Day, 77°F, 50% RH	Clear, tack-free	
1 Day, 50°F, 90% RH	Haze, tacky	
1 Day, 40°F, 80% RH	Clear, very tacky	
7 days, 50°F, 90% RH	Haze, tack-free	
7 days, 40°F, 80% RH	Clear, tacky	

- (a) Pigmented formulations with usage of 70 phr for Ancamide 2050 and 60 phr for Ancamide 350A.
- (b) With liquid epoxy (EEW=190), with Ancamide 2050 being used at 70 phr and 100 phr, respectively. Ancamide 350A is used at stoichiometry. Film thickness 10 mils DFT. Measured per ASTM 2794.
- (c) Pigmented formulations based on solid epoxy resin (EEW=325) were mixed with each curing agent, applied to cold rolled steel panels (5 mil DFT) and cured 7 days at 72°F before testing.
- (d) In pigmented liquid epoxy resin (EEW=190) at stoichiometry.
- (e) Unpigmented formulations with liquid epoxy resin (EEW=190).

Ancamide 2050 at 70 phr has comparable flexibility to Ancamide 350A. When Ancamide 2050 curing agent's use rate increases to 100 phr, reverse impact in a liquid epoxy formulation increases from 12 in-lbs to 110 in-lbs. Gloss is superior to Ancamide 350A, and Ancamide 2050 can achieve lower VOC in similar formulations compared with Ancamide 350A curing agent. Films utilizing Ancamide 2050 curing agent also have very good appearance over a range of temperature and humidity conditions.

CORROSION RESISTANCE: The aluminized epoxy mastic and anticorrosive primer formulations shown in Exhibits 1 and 2 were evaluated for salt spray resistance and humidity resistance after 1000 hours of exposure. Both formulations performed very well as detailed in Tables 3 and 4.

TABLE 3: SALT SPRAY RESISTANCE - ANCAMIDE 2050

	General Corrosion	Scribe Corrosion	Field Blistering	Blister Size
Aluminum Mastic	10	5.5-6.0	9	6
Red Primer	10	8.0-8.5	9-10	8.5

5% salt spray, cabinet temperature 95°F — ASTM B-117, film thickness 2.5 mils. Rating: 10 = Best; 0 = Worst.

TABLE 4: HUMIDITY EXPOSURE - ANCAMIDE 205

	General Corrosion	Scribe Corrosion	Field Blistering	Blister Size
Aluminum Mastic	10	10	10	None
Red Primer	10	10	10	None

Continuous 100% Humidity Exposure — ASTM D-2247, cabinet temperature 122°F, film thickness 2.5 mils. Rating: 10=Best, 0=Worst

ADHESION: The Ancamide 2050-based primer and aluminum mastic formulations were evaluated for adhesion to heavy, hot rolled steel per ASTM D-4541, Pull-Off adhesion. Panels were blasted to an SSPC-SP5 white metal quality with a mil profile of 3.0 mils. Greater than 400 psi was required to cause failure, and all failures occurred in the adhesive. No cohesive failure in the coating nor adhesive failure at any interface was observed. Both formulations showed good results.

CHEMICAL RESISTANCE: Table 5 contains chemical resistance data for Ancamide 2050 curing agent. Evaluations of Ancamide 2050 at 70 phr and 100 phr with standard liquid bisphenol A epoxy resin (EEW=190) in immersion conditions were made. Improved results are seen at the 70 phr use level compared with the higher loading.

Overall, Ancamide 2050 curing agent shows good resistance after 28 days to 10% acetic acid, Skydrol, 70% sulfuric acid and deionized water. Performance is not as good for solvents and alcohols. In a comparison with several representative reagents, Ancamide 2050 out-performed Ancamide 350A curing agent.

TABLE 5: CHEMICAL RESISTANCE

Reagent	Immersion Time (Days)	Ancamide 2050 (70 phr)	Ancamide 2050 (100 phr)	Ancamide 350A (60 phr)
Deionized Water	1	0.32	0.39	
	3	0.51	0.74	
	7	0.69	0.98	
	28	1.49	2.09	
70% Sulfuric Acid	1	0.20	0.47	0.29
	3	0.29	0.62	0.71
	7	0.30	0.64	1.63
	28	0.47	0.51	10.30
10% Acetic Acid	1	0.93	2.50	7.57
	3	1.55	4.21	13.88
	7	2.20	6.43	20.72
	28	4.47	14.23	36.78
Skydrol LD-4	1	0.05	0.02	
	3	0.13	0.05	
	7	0.14	0.01	
	28	0.57	0.43	
Ethanol	1	2.06	2.81	3.26
	3	3.58	4.81	4.73
	7	5.10	7.23	6.09
	28	11.80	10.67	10.40
Xylene	1	3.53	5.09	
	3	6.40	9.03	
	7	9.50	D	
	28	D	-	
Butyl Cellosolve	1	1.90	2.77	
	3	3.50	4.87	
	7	5.27	7.40	
	28	12.13	D	
Toluene	1	7.67	11.15	13.66
	3	12.12	D	26.32
	7	D	-	D
	28	-	-	-
1,1,1 Trichloroethane	1	5.43	8.43	
	3	9.81	14.90	
	7	14.97	23.60	
	28	D	D	

* Chemical resistance data is expressed as % weight change, and testing was completed in accordance with ASTM D 543-84.

** Formulated with liquid epoxy resin (EEW=190) and cured 7 days at ambient temperature before immersion.

**EXHIBIT 1: ANCAMIDE 2050 CURING AGENT
ALUMINUM MASTIC
PRELIMINARY FORMULATION**

PART A	lb	gal
Liquid DGEBA Epoxy	300.7	31.00
Cabosil TS 720 (Cabot)	5	0.33
Mix well, then add at high speed:		
Lansford L243 (Silberline)	125.4	10.17
Mix well, then add at low speed:		
Aromatic 100 (Exxon)	48.5	6.67
Beetle 216-8 (Cyanamid)	20.0	2.30
TOTALS	499.6	50.47

PART B		
Ancamide 2050 (Evonik)	241.6	28.55
MPA-1078 (Rheox)	8.0	1.08
10 AS Wollastokup (NYCO)		9.09
Grind to 5 Hegman, reduce speed and add:		
Aromatic 100 (Exxon)	60.6	8.34
Diacetone Alcohol (Union Carbide)	23.5	3.00
Cabosil TS 720 (Cabot)	6.5	0.42
TOTALS	560.2	50.48

PROPERTIES	
Volume solids (%)	73.9
PVC (%)	18.1
CPVC (%)	42.2
PVC/CPVC	.429
Wt/gal - part A	9.90
Wt/gal - part B	11.10
Wt/gal	10.50
VOC (lb/gal)	1.9
Mixing ratio (by volume)	1:1
Pot Life (h)	5
Dry to Touch (h)	4
Dry Through (h)	10

**EXHIBIT 2: ANCAMIDE 2050 CURING AGENT
ANTICORROSIVE PRIMER
PRELIMINARY FORMULATION**

PART A	lb	gal
Liquid DGEBA Epoxy	233.7	24.093
MPA-1078 (Rheox)	4.0	0.541
Mix well, then add at high speed:		
TiPure R-900 (DuPont)	25.0	0.751
10 Wollastokup AS (NYCO)	370.0	15.289
Disperse to 5 Hegman. Reduce speed and add:		
Xylene (Ashland)	85.9	11.848
TOTALS	718.6	52.522

PART B		
Ancamide 2050 (Evonik)	195.8	23.310
MPA-1078 (Rheox)	4.0	0.541
Beetle 216-8 (Cyanamid)	15.0	1.724
Mix well at high speed, then add:		
Red Iron Oxide J-3100 (Mineral Pigments)	60.0	1.441
Beaverwhite 325 (Cyprus)	96.7	4.204
Phosplus J-0866 (Mineral Pigments)	141.4	5.065
Disperse to 5 Hegman and 125°F Reduce speed and add:		
Diacetone Alcohol (Union Carbide)	31.3	3.997
Super High Flash Naptha (Ashland)	89.0	12.242
TOTALS	633.2	52.527

PROPERTIES	
Volume solids (%)	71.8
PVC (%)	35.5
CPVC (%)	54.8
PVC/CPVC	0.647
Wt/gal - part A	13.68
Wt/gal - part B	12.06
Wt/gal	12.87
VOC (lb/gal)	2.07
Mixing ratio (by volume)	1:1
Pot Life (h)	8
Dry to Touch (h)	3.5
Dry Through (h)	9

Epoxy Curing Agents and Modifiers

ANCAMIDE® 2050 Curing Agent

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