

# Ancamide<sup>®</sup> 2445 Curing Agent

## DESCRIPTION

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

## ADVANTAGES

- Fast-cure at low temperatures (5°C)
- Moderate viscosity
- 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

## 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.

## PACKAGING AND HANDLING

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

## TYPICAL PROPERTIES

<b>Appearance</b>	Amber Liquid
<b>Colour<sup>1</sup> (Gardner)</b>	7
<b>Viscosity<sup>2</sup> @ 25°C, [mPa.s]</b>	4,500-6,500
<b>Amine Value<sup>3</sup> (mg KOH/g)</b>	180-220
<b>Specific Gravity @ 21°C</b>	1.03
<b>Equivalent Wt/{H}</b>	150
<b>Recommended use Level<sup>4</sup> [PHR]</b>	70-100

## TYPICAL HANDLING PROPERTIES<sup>4</sup>

<b>Gel Time<sup>5</sup> (150g mix at 25°C) [mins]</b>	±90
<b>Thin Film Set Time<sup>6</sup> 25°C, [h]</b>	5
<b>Typical cure schedule 2- 7 days</b>	

## TYPICAL HANDLING PROPERTIES<sup>4</sup>

<b>Heat Distortion Temperature<sup>7</sup>, [°C]</b>	45
<b>Carbamation Test<sup>8</sup></b>	3

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) ASTM D648
- (8) ISO 2812 (Wet Patch Method), scale 1-5 (5 is best)

## SUPPLEMENTARY DATA

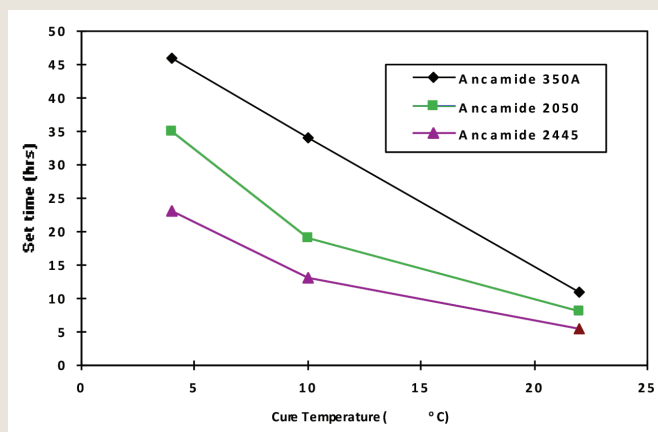
Ancamide 2445 curing agent is a moderate viscosity, modified polyamide. When used with liquid epoxy resins, Ancamide 2445 curing agent offers fast dry time, improved coating flexibility and excellent long term humidity and corrosion resistance. Ancamide 2445 curing agent also has a low level of free,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

High volume solids, low VOC coatings can be formulated using this product which can be used for a wide variety in industrial maintenance and marine applications.

Ancamide 2445 curing agent has non-critical loading and can be used 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. At room temperature, the thin film set time is reduced to 5 h from 8 h and 11 h, respectively. At lower application temperatures (5°C), thin film set times of less than 24 h are achievable for Ancamide 2445, compared to 36 h for Ancamide 2050 and 46 h for Ancamide 350A curing agents respectively.

**FIGURE 1: THIN FILM SET TIMES**

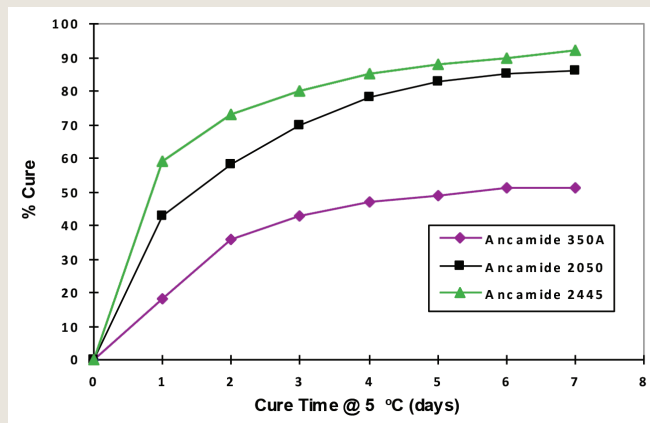


The results above are based on loadings of 70 phr for Ancamide 2445 and Ancamide 2050 and 80 phr for Ancamide 350A. All results were measured using a B-K recorder, 150 micron wet film applied to glass plates.

Further evidence supporting the excellent low temperature cure characteristics of Ancamide 2445 curing agent is also 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, is to measure residual exotherm using differential scanning calorimetry (DSC).

**FIGURE 2: LOW TEMPERATURE (5 °C) CURE PROFILES**



Systems based on Ancamide 2445 curing agent reach approximately 60% of full cure within the first 24 h, significantly higher than both Ancamide 2050 (43%) and Ancamide 350A (16%) systems. After 7 days cure at 5°C, Ancamide 2445 reaches 90% cure, which is slightly above the 85% for Ancamide 2050, but significantly higher than 48% cure for Ancamide 350A.

**Film Properties:** In a clear coat formulation, Ancamide 2445 curing agent also exhibits a high degree of flexibility. As shown in Table 1, the direct impact resistance of Ancamide 2445 is comparable to Ancamide 2050 and superior to Ancamide 350A. Ancamide 2445 also exhibits greater reverse impact resistance compared to conventional polyamides.

**TABLE 1: PERFORMANCE PROPERTIES**

Property	Ancamide 2445	Ancamide 2050	Ancamide 350A
Direct Impact, cm.kg	200	200	40
Reverse Impact, cm.kg	200	200	10
Specular Gloss 60°	142	140	95
Pendulum Hardness	142	140	95
Mandrel Bend	142	140	95

**Starting Point Formulations:** Attached at the back of this technical bulletin are preliminary starting point formulations based on Ancamide 2445 curing agent for an anti-corrosive primer and a general purpose white gloss top-coat respectively. When pigmented, dry to touch time of coatings is generally less than 4 h, with hard dry achievable within approximately 12 h for systems applied and cured at 24°C. Pot lives in the order of 5 to 6 h can be obtained with proper formulation, while maintaining VOCs of less than 330 gm/l.

Formulation 2445P1 is a high volume solids (74%), low VOC (290 gm/l) red iron oxide primer. The primer formulation has a low mix viscosity ~ 1000 mPa.s, with a pot life of 6 h. The coating formulation can be spray applied with conventional spray equipment or brush applied to a steel substrate without the addition of extra solvents. Dry to touch is reached after 4 h and the coating system is hard dry in less than 15 h.

Formulation 2445P1 has been evaluated for salt spray, humidity and prohesion resistance. After 750 h, coatings exhibit excellent corrosion resistance. No signs of field blisters or scribe creep have been detected using the above accelerated weathering tests.

Formulation 2445E1 is a white gloss top-coat based on Ancamide 2445 in combination with the amidoamine, Ancamide 501. Evaluation of 2445E1 shows the paint formulation has an initial mix viscosity of 1300 mPa.s, with a pot life of 4.5 h. The paint reaches dry to touch after 4 h with a hard dry achievable in less than 15 h.

**Performance Evaluation:** All coatings were evaluated in 5% salt spray, and in constant humidity at 50°C. They were also evaluated using a prohesion weathering tester, following a 10 day ambient cure.

Coatings were applied to grit blasted, hot rolled steel (60-100 micron profile), using conventional spray equipment, in double coats to give 90-120 micron DFT. In salt spray, (ASTM B-117) panels were scribed and evaluated for field blisters using the US 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). Panels exposed to humidity were not scribed and coatings were assessed for blistering only. These tests also included evaluations for changes in visual appearance.

**Corrosion Resistance:** Both of the attached formulations 2445 PI and 2445EI were evaluated for salt spray and constant humidity resistance. The results obtained are presented in Tables 2-4. Following 3000 hours salt fog exposure, formulations 2445P1 and 2445E1 both exhibit excellent resistance with only a faint trace of damage along the scribe for the primer formulation exposed in the prohesion cabinet. Both formulations gave excellent humidity resistance with no signs of field blistering being observed following 3000 h continuous testing.

**TABLE 2: 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 35°C —  
ASTM B-117, film thickness 90-120 micron  
Rating: 10 = Best (no blisters), 0 = Worst

**TABLE 3: 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 90-120 micron  
Rating: 10 = Best (no blisters), 0 = Worst  
Prohesion data is after 2000 h exposure

**TABLE 4: 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 50°C  
Film thickness 90-120 micron  
Rating: 10 = Best (no blisters), 0 = Worst

**COATINGS HIGH SOLIDS**  
**RED IRON OXIDE PRIMER — ANCAMIDE 2445 START FORMULATION**

		2445P1 (kg)	2445P1 (litres)
<b>A-Component</b>			
Liquid epoxy resin	DER 331	27.05	23.31
MPA-1078	Rheox	0.47	0.53
Mix well then add at high speed			
Titanium Dioxide	DuPont	2.90	0.72
Wollastokup	NYCO	42.83	14.76
Xylenes	ICI	9.94	11.42
		<b>83.19</b>	<b>50.74</b>
<b>B-Component</b>			
Ancamide® 2445	Evonik	22.73	21.03
MPA 1078	Rheox	0.47	0.53
Beetle 216-8	Cytec Industries UK	1.73	1.64
Mix well then add at high speed			
RIO J3100	Mineral Pigments	6.94	1.42
Beaverwhite 325	Cyprus	11.20	4.07
Phoplus J-0866	Mineral Pigments	16.36	4.87
Aromatic 100	Exxon, Total	10.30	11.84
Diacetone alcohol	Union Carbide	3.62	3.85
		<b>73.33</b>	<b>49.25</b>
<b>TOTAL</b>		<b>156.52</b>	<b>99.99</b>

**TECHNICAL DATA**

Mixing ratio	Comp. A to B	by volume	1:1
Density	Comp. A	g/ml	1.64
	Comp. B	g/ml	1.49
	Comp. A+B	g/ml	1.57
Potlife		h	6
Non Volatile	Comp. A+B	by weight	77.2%
Non Volatile	Comp. A+B	by volume	73.8%
VOC		g/l	288
PVC			35.0%
Dry to touch		h	4
Dry hard		h	12
Pencil hardness			H

**COATINGS HIGH SOLIDS  
GENERAL PURPOSE WHITE TOP COAT — ANCAMIDE 2445 START FORMULATION**

		2445E1 (kg)	2445E1 (litres)
<b>A-Component</b>			
Liquid epoxy resin	DER 331	32.94	28.39
Disparlon 650	King Industries	0.90	0.90
Mix well then add at high speed			
Mistron 400 Talc	Cyprus	24.93	8.75
Aromatic 150	Exxon, Total	1.03	11.93
		<b>69.39</b>	<b>49.99</b>
<b>B-Component</b>			
Ancamide 2445	Evonik	19.78	18.31
Ancamide® 501	Evonik	2.33	2.34
Disparlon NS-30	King Industries	0.64	0.74
Titanium Dioxide	DuPont	33.59	8.61
Butanol		15.67	17.03
Aromatic 150	Exxon, Total	2.69	3.00
		<b>74.68</b>	<b>50.03</b>
<b>TOTAL</b>		<b>144.07</b>	<b>100.02</b>

**TECHNICAL DATA**

Mixing ratio	Comp. A to B	by volume	1:1
Density	Comp. A	g/ml	1.39
	Comp. B	g/ml	1.49
	Comp. A+B	g/ml	1.44
Potlife		h	4.5
Non Volatile	Comp. A+B	by weight	78.9%
Non Volatile	Comp. A+B	by volume	70.0%
VOC		g/l	290
PVC			24.8%
Dry to touch		h	4
Dry hard		h	12
Pencil hardness			HB

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