

ANCAMIDE[®] 221

Curing Agent

DESCRIPTION

Ancamide 221 curing agent is a member of a series of reactive polyamides developed for use in the curing of epoxy resins in solvent-based surface coatings applications. Special features include good color, color stability, chemical resistance and excellent corrosion resistance properties. It is freely compatible with a wide range of solvents, including those generally used in epoxy resin based coatings.

TYPICAL PROPERTIES

Property	Value	Unit	Method
Appearance	Clear amber liquid		
Colour	9 max	Gardner	ASTM D 1544-80
Specific Gravity @ 21°C	0.99		
Viscosity @ 40°C	42,300	mPa.s	Brookfield RVTD, Spindle 4
Amine Value	205-235	mg KOH/g	Perchloric Acid Titration
Recommended Use Level	35-50	phr	Theoretical value with Bisphenol A diglycidyl ether (EEW=500), calculated based on both curing agent and resin @ 100% solids

ADVANTAGES

- Good corrosion resistance
- Rapid touch dry with solid epoxy resins
- Good colour and light stability
- Compatible with wide range of solvents

APPLICATIONS

- Solvent based marine and protective coatings
- Primers, sealers and coatings for concrete

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. Do not freeze.

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Ancamide 221 curing agent.

TYPICAL HANDLING PROPERTIES*

Property	Value	Unit	Method
Pot Life	> 7	h	Clear coat formulation, time to double in viscosity
Thin Film Set Time @ 25°C	4.5	h	BK Drying Recorder Phase II
Set to touch (finger)	1.5	h	
Hard dry thumb twist	7.5	h	

* Ancamide 221 curative cut to 70% solids in xylene and solution used at 50 phr with solid epoxy resin

TYPICAL CURE SCHEDULE

2-7 Days at Room Temperature

FILM PROPERTIES AFTER 10 DAYS CURE @ 23°C

Property	Value	Unit	Method
Perzoz Hardness	315		
Direct impact	175	in.lb	
Reverse impact	175	in.lb	
Flexibility Cylindrical Mandrel	3	mm pass	Erichsen mandrel tester 266

SUPPLEMENTARY DATA

Due to the high viscosity of Ancamide 221 curing agent, all supplementary data has been generated on a 70% solvent cut version in xylene.

Ancamide[®] 221-X70 curing agent is low viscosity, solvent based polyamide, supplied at 70% solids in xylene. The product is intended for use with solvent based solid epoxy resins in the development of high performance, corrosion resistant coatings for the protection of steel and concrete. When used with type 1 solid epoxy resins (Dow DER[™] 671X75 Resin or Hexion EPON[™] 1001X75 Resin), Ancamide 221-X70 offers fast lacquer dry, rapid mechanical property development, good adhesion to the steel substrate and excellent long-term humidity and corrosion resistance.

Solvent based coatings can be formulated using this product which can then be used for a wide variety of industrial maintenance and marine applications.

Ancamide 221-X70 curing agent has a non-critical loading and can be used at levels ranging from 40 to 100 phr with the preferred range being 50-70 phr^(a) with a solid epoxy resin EEW 500.

(a) Equates to a loading of 37.5 - 52.5 parts of Ancamide 221-X70 with 100 parts DER 671-X75 as supplied.

FILM PROPERTIES

In a clear coat formulation, Ancamide 221-X70 curing agent also exhibits a high degree of flexibility. As shown in Table 5, the direct impact resistance of Ancamide 221-X70 is comparable to Ancamide 220-X70 and superior to Ancamide 350A curing agents. Ancamide 221-X70 curing agent also shows excellent reverse impact resistance (175 inch-lbs), and Ancamide 221-X70 formulations can be accelerated using Ancamine[®] K54 (phenolic, tertiary amine accelerator). Levels can be varied to achieve the desired dry speed properties, with the preferred level in the 2.5-5.0% range based on Ancamide 221-X70 curing agent use level.

TABLE 5: CLEAR COAT PERFORMANCE PROPERTIES

Property	Ancamide 221-X70	Ancamide 220-X70	Ancamide 350A ^(b)
Direct Impact	175	175	35
Reverse Impact	175	175	10
Dry Speed BK Phase II [h]	4:30	6:00	10:00
Dry Speed (+2.5% K54)	2:00	2:30	5:30
Specular Gloss 60°	142	140	95
Pendulum Hardness			
Day 1	80	70	45
Day 3	205	200	89
Day 14	300	300	120
Conical Mandrel Bend	Pass	Pass	Pass
Cylindrical Mandrel Bend (mm pass)	3	3	ND
Cross Hatch Adhesion (dry)	Gt0	Gt0	Gt0
*Ancamide 350A tested with liquid Bis A diglycidyl ether (EEW 190); Cross hatch adhesion Gt0 = no loss of adhesion			

STARTING POINT FORMULATIONS

Appendix 1 contains preliminary start point formulations based on Ancamide 221-X70 curing agent for a clear coat and an anti-corrosive primer. When pigmented, Ancamide 221-X70 coatings exhibit a fast lacquer dry, as measured using the “finger” dry to touch method, where coatings are dry to touch in less than 2 h. Using the “Beck Koller” method, dry-hard times range from 5-9 h depending upon the system tested, when applied and cured at 23°C. As with all solvent based coatings, dry times are influenced by solvent choice, so dry times may vary depending upon the ratio of polar and non-polar solvents incorporated into the coating formulation. Pot lives as measured by the time for the mix to double in viscosity are in the 6-8 hours range, which is typical for such solvent based polyamide systems.

Formulation A221X70P1 (page 6) is a low volume solids (43%), medium PVC (34%) primer, with a 3:1 mix ratio by volume, based on epoxy resin to amine hardener. The initial viscosity of the formulated resin base is 2,300 mPa.s and the mix viscosity of the system is 500 mPa.s with a total VOC of 485 g/l. The primer formulation is compatible with a variety of different let down solvents (including xylene, n-butanol, MIBK, methoxy-propanol, etc) and can be further let down if required for additional spray applications. The coating formulation can be applied with conventional spray equipment or brush applied to the steel substrate. After application the primer is dry to handle after 5 h.

Formulation A221X70P1 has been evaluated for corrosion resistance properties using salt spray, humidity and prohesion resistance accelerated weather tests. After 1000 hrs exposure, coatings exhibit excellent corrosion resistance. No signs of field blisters have been detected using the above weather tests, with panels exhibiting no scribe creep in the salt spray test and some minor damage around the scribe when subjected to the prohesion test study. For comparative purposes, Ancamide 220-X70 was also included in the test study as the “industry” standard reference. In all the corrosion resistance tests carried out, both Ancamide 221-X70 and Ancamide 220-X70 demonstrated comparable performance.

PERFORMANCE EVALUATION

All coatings were evaluated in 5% salt spray, and in continuous humidity at 35°C. They were also evaluated using a prohesion — cyclic weathering tester, and Cleveland — constant humidity exposure, following a 10 day ambient cure of applied coatings.

Coatings were applied to grit blasted, hot rolled steel (SA2.5), using conventional spray equipment, in double coats to give coatings with a 75-100 μ dry thin thickness (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 creep 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

Anti-corrosion resistant primers based on Ancamide 221-X70 and Ancamide 220-X70 curatives, were evaluated for salt spray and constant humidity resistance. The results obtained are presented in Table 6. Following 1000 h salt fog exposure, formulations A221-X70P1 and A220-X70P1 both exhibit excellent resistance. Both formulations also demonstrated excellent humidity resistance with no signs of field blistering being observed following 2000 h continuous testing.

TABLE 6: SALT SPRAY RESISTANCE - ANCAMIDE 221-X70 & ANCAMIDE 220-X70 CURATIVES (1000 H)

Formulation	Scribe Creep	Field Blistering	Blister Size
A221-X70P1	10	10	10
A220-X70P1	9	10	10
5% salt spray, cabinet temperature 35°C — ASTM B-117, film thickness 75-100μ			
Rating: 10 = Best (no blisters), 0 = Worst			

TABLE 7: PROHESION EXPOSURE - ANCAMIDE 221-X70 & ANCAMIDE 220-X70 CURATIVES (1000 H)

Formulation	Scribe Creep	Field Blistering	Blister Size
A221-X70P1	7	10	10
A220-X70P1	6	10	10
Prohesion ASTM G85-94			
Film thickness 75-100μ. Rating: 10 = Best, 0 = Worst			
For blister size, rating 10 = no blisters observed			

TABLE 8: CLEVELAND HUMIDITY EXPOSURE - ANCAMIDE 221-X70 & ANCAMIDE 220-X70 CURATIVES (2000 H)

Formulation	Field Blistering	Blister Size
A221-X70P1	10	10
A220-X70P1	10	10
Continuous 100% humidity exposure — ASTM D-2247, cabinet temperature 50°C		
Film thickness 75-100μ. Rating: 10 = Best, 0 = Worst		
For blister size, rating 10 = no blisters observed		

SALT SPRAY PANELS 1000H EXPOSURE



Ancamide 221X70



Field 10
Scribe 7

Ancamide 220X70



Field 10
Scribe 6

APPENDIX I

TABLE 9: ANCAMIDE 221-X70 CURATIVE CLEAR COAT FORMULATION

			Clear Coat
A-Component (g)			
1. Epoxy Resin	DER 671X75	Dow	410.00
2. Solvent	MIBK		80.00
3. Solvent	Dowanol PM		10.00
			500.00
A-Component Manufacture Procedure:			
Charge components 1-3 and stir homogeneous at low shear			
B-Component (g)			
1. Curing Agent	Ancamide 221-X70	Evonik	155.00
2. Solvent	Xylene		140.00
3. Solvent	Dowanol PM		140.00
			435.00
Total			935.00
After mixing Part A and B, apply a 15-30 minute induction time prior to application.			

TABLE 10: TECHNICAL DATA

Mixing Ratio	Weight	1.1 : 1
	Volume	1.0 : 1
Density (g/ml)	Part A	1.02
	Part B	0.93
	Mix	0.98
Solid Content (Weight %)	Part A	61.5
	Part B	25.0
	Mix	44.5
VOC	g/l	540
Mix Viscosity @ 25°C	mPa.s	300
Pot-life	h	7
Gloss (60°)		142
BK Dry time 23°C		
Phase I	h	1.30
Phase II	h	4.30
Phase III	h	9.30
Hard Dry Thumb Twist	h	7:30
Persoz Hardness	14 days	300
MEK Double Rubs		>200

TABLE 11: ANCAMIDE 221-X70P1 ANTI-CORROSIVE PRIMER FORMULATION

A-Component (g)			Anti-Corrosive Primer
1. Epoxy Resin	DER 671X75	Dow	280.00
2. Solvent	MIBK		80.00
3. Solvent	Xylene		110.00
4. Solvent	n Butanol		30.00
5. Filler	Blanc fix Micro		100.00
6. Filler	Talc 10MO		100.00
7. Filler	Heucophos ZPO	Heubach	140.00
8. Filler	Bayferrox 130M	Bayer	150.00
			1,000.00

A-Component Manufacture Procedure:

- Charge components 1-3 and stir homogeneous at low shear
- Slowly add components 5-8 and then mix under high shear for 15-30 mins until Hegman gauge 7 is achieved

B-Component (g)			
1. Curing Agent	Ancamide 221-X70	Evonik	106.00
2. Solvent	Xylene		59.00
3. Solvent	Dowanol PM		35.00
			200.00
Total			1,200.00

After mixing Part A and B, apply a 15-30 minute induction time prior to application.

TABLE 12: TECHNICAL DATA

Mixing Ratio	Weight	5.0 : 1
	Volume	3.0 : 1
Density (g/ml)	Part A	1.51
	Part B	0.92
	Mix	1.37
Solid Content (weight %)	Part A	70.0
	Part B	37.1
	Mix	64.5
Solid Content (Volume %)	Part A	46.0
	Part B	31.5
	Mix	42.5
Mix Viscosity @ 25°C	mPa.s	300
VOC	g/l	484
PVC	%	33.8
Pot-life	h	7
Gloss (60°)		25
BK Dry time 23°C		
Phase I	h	1.30
Phase II	h	4.00
Hard Dry Thumb Twist	h	3.00
Persoz Hardness	7 days	185
Direct impact	cm.kg	200
Reverse impact	cm.kg	180

1. An additional 20g of xylene/n-butanol (1:1) solvent added to achieve desired spray viscosity

* Reference formulation A220-X70P1 is as above but substituting the Ancamide 221-X70 curing agent with Ancamide 220-X70

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