Epoxy Curing Agents and Modifiers

ANCAMIDE 702-B75® Curing Agent

DESCRIPTION

Ancamide 702-B75 curing agent is a member of a new series of reactive polyamides developed for use in the curing of epoxy resins in solvent-based surface coatings applications. Ancamide 702-B75 curing agent is an epoxy adduct of the low viscosity Ancamide 351A polyamide curing agent, supplied as a 75% solids by weight solution in n-butanol. Special features of this pre-adducted polyamide include; good epoxy resin compatibility without induction; excellent adhesion and cure under adverse conditions.

ADVANTAGES

- Good corrosion resistance
- Fast touch dry
- Good color and light stability
- Good adhesion

APPLICATIONS

- High solid 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 702-B75 curing agent.

TABLE 1: TYPICAL PROPERTIES

Appearance	Clear amber liquid
Color[1] (Gardner)	8 max
Viscosity[2] @ 25°C (mPa.s)	4000 - 8000
Amine Value[3] (mg KOH/g)	245 ±15
Specific Gravity @ 21°C	0.96
Equivalent Wt (AHEW)	170
Recommended Use Level[4] (phr)	90
Solids Content (%)	75±1

TABLE 2: TYPICAL HANDLING PROPERTIES

Primer formulations 32.5% PVC Liquid Epoxy Resin (80phr, 90% stoichiometric loading)	
Set to touch (finger) (h)	1.5
Hard dry thumb twist (h)	3.5
Pot Life[5] (h)	3
Perzoz Hardness	240
Direct impact (in.lb)	69
Reverse impact (in.lb)	3.5

TABLE 3: TYPICAL HANDLING PROPERTIES

Primer formulations 34% PVC. Semi Solid Epoxy Resin EEW 375 (40phr, 90% stoichiometric loading)	
Set to touch (finger) (h)	1.0
Hard dry thumb twist (h)	3.0
Pot Life[5] (h)	5
Perzoz Hardness	220
Direct impact (in.lb)	174
Reverse impact (in.lb)	10

Footnotes:
(1) ASTM D 1544-80
(2) Brookfield RVTD, Spindle 4
(3) Perchloric Acid Titration
(4) Theoretical value with Bisphenol A diglycidyl ether (EEW=190)
(5) Paint formulation, time to double in viscosity

SUPPLEMENTARY DATA

Ancamide® 702-B75 curing agent is low viscosity, solvent-based polyamide adduct, supplied at 75% solids in n-butanol. The product is intended for use with a variety of epoxy resin types in the development of high performance, corrosion resistant coatings for the protection of steel and concrete. When used with a semi-solid epoxy resin (EEW 300-380), Ancamide 702- B75 curing agent offers fast lacquer dry, rapid mechanical property development, good adhesion to the steel substrate and excellent long-term humidity and corrosion resistance.

In addition, Ancamide 702-B75 curing agent exhibits excellent compatibility with liquid epoxy resins and therefore high solid, 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 702-B75 curing agent has a theoretical loading with standard bisphenol A diglycidyl ether resin of 90 phr, however, for optimum performance it is recommended that the Ancamide 702-B75 curing agent be used at or below stoichiometry. Where good corrosion and humidity resistance are required, it is recommended to use less than the stoichiometric ratio and to use the curing agent in the 70-80 phr range, with an epoxy resin EEW of 190.

Ancamide 702-B75 curing agent, like other polyamide curing agents, is highly soluble in polar solvents such as n-butanol, glycol ethers and ketones. Ancamide 702-B75 curing agent does, however, exhibit lower solubility in aromatic solvents, such as xylene, therefore it is important when developing coating formulations to maintain a suitable balance of polar and nonpolar solvents. This is particularly important because as pot life progresses and molecular weight increases, stronger solvents may be needed to maintain good solubility of the polyamide-epoxy resin polymer. The addition of benzyl alcohol or propylene glycol phenyl ether (PPh) can also be beneficial, in that these materials will improve the initial compatibility of Ancamide 702-B75 curing agent with epoxy resin, minimizing any induction time.

Formulations based on Ancamide 702-B75 curing agent can also be accelerated to enhance dry speed both at ambient at low temperature, using Ancamine® K54 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 702-B75 curing agent loading

STARTING POINT FORMULATIONS

Appendix 1 contains preliminary starting point formulations based on Ancamide 702-B75 curing agent for a series of anticorrosive primers and top coats. When pigmented, coatings cured with Ancamide 702-B75 curing agent 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 2-3 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 life as measured by the time for the mix to double in viscosity corresponds to 3 h for a formulated coating based on liquid epoxy resin and 5 h for a coating formulated with a semi-solid epoxy resin. Such results are typical for this type of polyamide system.

Formulation A702-B75P1 is a medium volume solids (62%), anti-corrosive primer, based on liquid bisphenol A diglycidyl ether (EEW 190). The formulation has a 2:1 mix ratio by volume, based on epoxy resin to amine hardener. The initial viscosity of the formulated resin base is 3,000mPa.s and the mix viscosity of the system is 1000mPa.s with a total VOC of 320g/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 and has a pot life of 3 h. After application the primer is tack free after 2 h and dry to handle (thumb twist) after 5 hrs, following cure at 23°C.

Formulation A702-B75P2 is a medium volume solids (55%), anti-corrosive primer, based on a semi-solid, bisphenol A diglycidyl ether mixture (EEW 375). The formulation has a 3:1 mix ratio by volume, and a VOC of 380g/l. The coating formulation can be applied with conventional spray equipment or brush applied to the steel substrate and has a pot life of 4 h. After application the primer is tack free after 1 hr and dry to handle after 3 h, following cure at 23°C.

Formulation A702-B75P3 is a low volume solids (48%), anti-corrosive primer, based on a modified solid bisphenol A diglycidyl ether (EEW 525). The formulation has a 4:1 mix ratio by volume and a VOC of 485g/l. The coating formulation can be applied with conventional spray equipment or brush applied to the steel substrate and has a pot life of 6 h. After application the primer is tack free after 1 hr and dry to handle after 3 hrs following cure at 23°C.

Formulation A702-B75W1 is a medium volume solids (57%), medium PVC (29%) white top coat based on a modified solid epoxy resin (EEW 525). This formulation demonstrates the

utility of the Ancamide 702-B75 curing agent for use as either a tie coat or a top coat for primer systems.

The formulations on page 2 have been evaluated for corrosion resistance properties using salt spray, humidity and prohesion resistance accelerated weather tests. After 1000 h exposure, coatings exhibit excellent corrosion resistance. The primer system based on the solid epoxy resin was also tested after overcoating with the white topcoat. The two coat system exhibited >1000 h salt spray and salt water immersion resistance. For comparative purposes, Ancamide 700-B75 curing agent was also included in the test study as the "industry standard" reference. In all the corrosion resistance tests, both Ancamide 702-B75 and Ancamide 700-B75 curing agents 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. In addition the two coat system (A702-B75P3 overcoated with A702-B75W1) was assessed for 1000 h corrosion resistance following immersion in a 3.5% NaCl salt solution.

Primer coatings were applied to grit blasted, hot rolled steel (SA2.5), using conventional spray equipment, in double coats to give coatings with a 75-100µm (3-4 mils) dry film thickness (DFT). Where multi-coat systems were tested, the primer was over coated with a white-enamel via spray application in order to achieve a total dry film thickness of approximately 200µm (8 mils). 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 and salt solution immersion, were also scribed and coatings were also assessed for scribe damage, blistering and for changes in visual appearance.

CORROSION RESISTANCE

Anti-corrosion resistant primers based on Ancamide 702-B75 and Ancamide 700-B75 curing agents, were evaluated for salt spray, salt water immersion and constant humidity resistance. The results obtained are presented in Tables 5 - 7.

TABLE 5: SALT SPRAY RESISTANCE - ANCAMIDE 702-B75 AND ANCAMIDE 700-B75

Formulation	Scribe Creep		Field Blistering	
	1000 h	1500 h	1000 h	1500 h
A702-B75P1	10	9	10	6F
A700-B75P1	10	9	10	4F
A702-B75P2	10	10	10	4F
A700-B75P2	10	9	10	6F
A702-B75P3	10	10	4F	-
A702-B75P3	10	10	4F	-
A702-B75 (P3/W1)	10	-	10	-
A700-B75 (P3/W1)	10	-	10	-

5% salt spray, cabinet temperature 35°C - ASTM B-117, film thickness 75-100µm
Rating: ASTM D714: 10 = Best (no blisters), 0 = Worst, F= few

TABLE 6: SALT WATER IMMERSION - ANCAMIDE 702-B75 AND ANCAMIDE 700-B75

Formulation	Scribe Creep	Field Blistering	Appearance
A702-B75P1	10	6F	Slight blanching
A700-B75P1	10	6F	Blanching
A702-B75P3	10	4F	Slight blanching
A700-B75P3	10	4F	Slight blanching
A702-B75 (P3/W1)	10	10	Slight rusting
A700-B75 (P3/W1)	10	10	Slight rusting

3.5% NaCl solution at 23°C
Film thickness 75-100µm. Rating: 10 = Best, 0 = Worst
For blister size, rating 10 = no blisters observed: F= Few blisters

TABLE 7: CLEVELAND HUMIDITY - ANCAMIDE 702-B75 AND ANCAMIDE 700-B75

Formulation	Scribe Creep	Field Blistering	Appearance
A702-B75P1	10	10	No defects
A700-B75P1	10	10	No defects
A702-B75P3	10	10	No defects
A700-B75P3	10	10	No defects

Continuous 100% humidity exposure - ASTM D-2247, cabinet temperature 50°C
Film thickness 75-100µm. Rating: 10 = Best, 0 = Worst
For blister size, rating 10 = no blisters observed

PERFORMANCE RESULTS

Ancamide 702-B75 curing agent can readily be formulated into a wide range of anti-corrosive primers and top coats depending upon the epoxy resin system required. General handling properties of the formulated coatings are comparable to Ancamide 700-B75 curing agent and coatings can easily be applied using a range of application methods such as brush, roller and spray application. In accelerated weather testing, corrosion resistance indicates that Ancamide 702-B75 curing agent delivers the high level of corrosion resistance typically observed for this class of polyamide adduct. Resistance up to 1000 h resistance was easily achieved for all systems tested with no noticeable damage around the scribe during this period. Primer panels after 1500 h exposure did demonstrate some minor scribe damage and panels also began to show the early development of field blistering, however, the results obtained with Ancamide 702-B75 curing agent were comparable to those obtained with the standard reference, Ancamide 700-B75 curing agent.

The test data shows that multi-coat systems based on the Ancamide 702-B75 curing agent, also deliver excellent protection. Primer panels over coated with a white titanium dioxide-based enamel showed no signs of damage following 1000 h accelerated salt spray exposure. In addition, exposure to both constant humidity and immersion in a NaCl (3.5%) salt solution indicates that the curing agent can be formulated into barrier coatings offering a high level of protection, thus making Ancamide 702-B75 curing agent an excellent choice in the area of metal protection.

CORROSION RESISTANCE FOLLOWING 1000 H ACCELERATED SALT SPRAY EXPOSURE

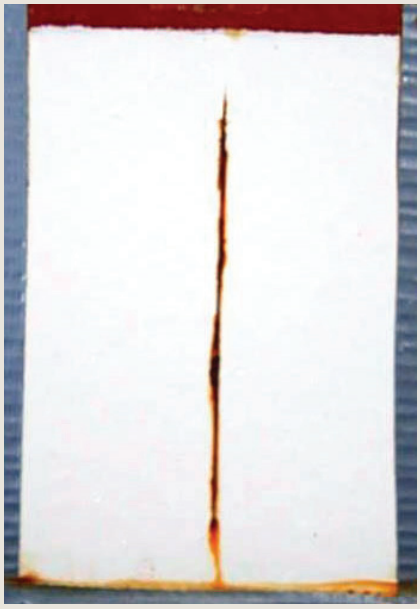
ANTI-CORROSIVE PRIMER A700-B75P1 AND A702-B75P1

Ancamide 700-B75
Scribe 10, Field 10

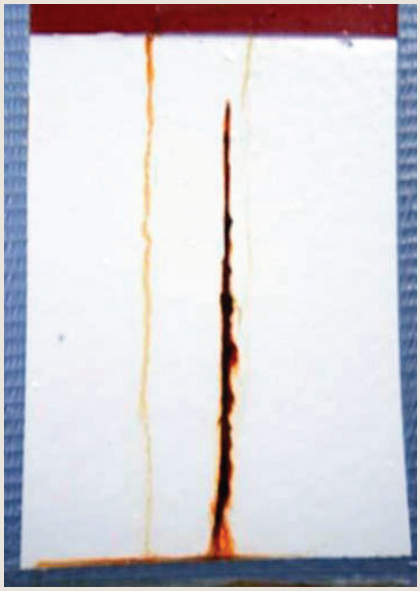
Ancamide 702-B75
Scribe 10, Field 10

Coatings applied using conventional spray equipment. 2 coatings applied to achieve total dry film thickness 75-100µm

ANTI-CORROSIVE PRIMER A700-B75P3 AND A702-B75P3 OVER COATED WITH WHITE TOP COATS A700-B75W1 AND A702-B75W



Ancamide 700-B75
Scribe 10, Field 10



Ancamide 702-B75
Scribe 10, Field 10

Coatings applied using conventional spray equipment. 2 primer coatings applied to achieve total dry film thickness 75-100µ, followed by top coat to give a total dry film thickness ~200µm

APPENDIX I PRIMER FORMULATIONS

TABLE 8: ANCAMIDE 702-B75P1 ANTI-CORROSIVE PRIMER BASED ON LIQUID EPOXY RESIN EEW 190. CURING AGENT LOADING 90% OF THEORETICAL STOICHIOMETRY

A-Component (g)			Anti-Corrosive Primer
1. Epoxy Resin	Bis A diglycidyl ether (EEW190)		250.00
2. Settling agent	Antiterra U		5.00
3. Thixotrope	Bentone SD-2		8.00
4. Solvent	Xylene		127.00
	n butanol		40.00
5. Filler	Blanc fix micro		160.00
6. Filler	Microtalc mica W1		100.00
7. Filler	Heucophos ZP10	Heubach	100.00
8. Filler	Bayferrox 130M	Bayer	90.00
9. Filler	Wollastocoat 10ES		120.00
			1000.00

A-Component Manufacture Procedure:
- Charge components 1-4 and stir homogeneous at low shear
- Slowly add components 5-9 and then mix under high shear for 30 mins until Hegman gauge 7 is achieved

B-Component (g)			
1. Curing Agent	Ancamide 702-B75	Evonik	202.00
2. Curing Agent	Ancamine K54	Evonik	6.00
3. Solvent	Xylene		57.50
4. Solvent	Dowanol PM		18.50
			284.00
Total			**1284.00**

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

TABLE 9: TECHNICAL DATA

Mixing ratio	Weight	3.5 :1	VOC	g/l	320
	Volume	2.0 :1	PVC	%	32.5
Density (g/ml)	- Part A	1.64	Pot life	h	3
	- Part B	0.95	Gloss (60°)		45
	- Mix	1.41	BK Dry time 23°C		
Solid Content (Weight %)	- Part A	83.3	Phase I	h	1.30
	- Part B	55.5	Phase II	h	4.00
	- Mix	77.1	Hard Dry	h	3.50
Solid Content (Volume %)	- Part A	67.9	Thumb twist		
	- Part B	49.2	Persoz Hardness	7 days	240
	- Mix	62.0	Direct impact	cm.kg	80
Mix Viscosity[1] @ 25°C	mPa.s	1000	Reverse impact	cm.kg	4

TABLE 10: ANCAMIDE 702-B75P2 ANTI-CORROSIVE PRIMER BASED ON SEMI-SOLID EPOXY RESIN EEW 375. CURING AGENT LOADING 90% OF THEORETICAL STOICHIOMETRY

A-Component (g)			Anti-Corrosive Primer
1. Epoxy Resin	Solvent BADGE (EEW 670)	75% wt in xylene	215.60
2. Epoxy Resin	Liquid BADGE (EEW 190)		92.40
3. Settling agent	Antiterra U		6.00
4. Solvent	Xylene		100.00
	n butanol		33.00
	MIBK		25.00
5. Filler	Blanc fix micro		112.00
6. Filler	Microtalc mica W1		81.00
7. Filler	Heucophos ZP10	Heubach	100.00
8. Filler	Bayferrox 130M	Bayer	125.00
9. Filler	Talc 10m0		110.00
			1000.00

A-Component Manufacture Procedure:
- Charge components 1-4 and stir homogeneous at low shear
- Slowly add components 5-9 and then mix under high shear for 30 mins until Hegman gauge 7 is achieved

B-Component (g)			
1. Curing Agent	Ancamide 702-B75	Evonik	126.00
2. Curing Agent	Ancamine K54	Evonik	4.00
3. Solvent	n butanol		15.00
4. Solvent	Xylene		55.00
			200.00
Total			**1200.00**

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

TABLE 11: TECHNICAL DATA

Mixing ratio	Weight	5.0 :1	VOC	g/l	380
	Volume	3.0 :1	PVC	%	33.8
Density (g/ml)	- Part A	1.59	Pot life	h	5
	- Mix	1.42	Gloss (60°)		46
			BK Dry time 23°C		
Solid Content (Weight %)	- Part A	78.2	Phase I	h	1.50
	- Part B	49.3	Phase II	h	2.25
	- Mix	73.4	Hard Dry	h	3.00
Solid Content (Volume %)	- Part A	59.4	Thumb twist		
	- Part B	43.0	Persoz Hardness	7 days	220
	- Mix	55.3	Direct impact	cm.kg	200
Mix Viscosity[1] @ 25°C	mPa.s	nd	Reverse impact	cm.kg	12

Examples of solvent based, solid BADGE: Dow DER 671-X75 or Epon 1001-X75 types
Examples of liquid based BADGE: Nanya NPEL 128, Dow DER 331 or Epon 828 types

TABLE 12: ANCAMIDE 702-B75P3 ANTI-CORROSIVE PRIMER BASED ON SOLID EPOXY RESIN EEW 525. CURING AGENT LOADING 90% OF THEORETICAL STOICHIOMETRY

A-Component (g)			White Top Coat
1. Epoxy Resin	Solid BADGE (EEW 670)	75% wt in xylene	212.20
2. Epoxy Resin	Liquid BADGE (EEW 190)		23.10
3. Epodil® diluent	Epodil® LV5 diluent		28.90
4. Thixotrope	Bentone SD-2		8.70
5. Dispersant	Disperbyk 163		3.90
6. Solvent	Xylene		183.20
	Dowanol PM		19.30
	MIBK		24.10
7. Filler	Barite		163.90
8. Filler	Quartz 400 mesh		173.60
9. Filler	Heucophos ZPA	Heubach	33.80
10. Filler	Bayferrox 130M	Bayer	48.20
11. Filler	Talc 400 mesh		77.10
			1000.00

A-Component Manufacture Procedure:
- Charge components 1-4 and stir homogeneous at low shear
- Slowly add components 5-9 and then mix under high shear for 30 mins until Hegman gauge 7 is achieved

B-Component (g)			
1. Curing Agent	Ancamide 702-B75	Evonik	70.50
2. Curing Agent	Ancamine K54	Evonik	2.00
3. Solvent	n butanol		18.30
4. Solvent	Xylene		59.30
			150.10
Total			**1150.00**

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

TABLE 13: TECHNICAL DATA

Mixing ratio	Weight	5.0 :1	VOC	g/l	445
	Volume	3.0 :1	PVC	%	37.5
			Pot life	h	5
Density (g/ml)	- Part A	1.48	Gloss (60°)		58
	- Part B	0.90	BK Dry time 23°C		
	- Mix	1.37	Phase I	h	1.00
Solid Content (Weight %)	- Part A	72.0	Phase II	h	4.50
	- Part B	36.6	Cross Hatch Ad.	5 (no loss)	
	- Mix	67.4	Persoz Hardness	7 days	nd
Solid Content (Volume %)	- Part A	52.1	Direct impact	cm.kg	200
	- Part B	32.8			
	- Mix	48.2			

TABLE 14: ANCAMIDE 702-B75W1 WHITE TOP COAT BASED ON SOLID EPOXY RESIN EEW 525. CURING AGENT LOADING 95% OF THEORETICAL STOICHIOMETRY

A-Component (g)			White Top Coat
1. Epoxy Resin	Solid BADGE (EEW 670)	75% wt in xylene	301.30
2. Epoxy Resin	Liquid BADGE (EEW 190)		34.40
3. Additive	Cymel 303		8.60
4. Rheology aid	MPA 2000X		6.90
5. Thixotrope	Bentone SD-2		8.60
6. Flow agent	Modaflow		1.30
7. Additive	Antiterra U-80		3.40
8. Pigment	Titanium Dioxide		258.80
9. Filler	Barite		155.00
10. Filler	Quartz 400 mesh		133.00
11. Solvent	Xylene		94.70
11. Solvent	n butanol		24.20
			1000.00

A-Component Manufacture Procedure:
- Charge components 1-7 and stir homogeneous at low shear
- Charge appropriates amounts of 11 & 12 to aid dispersion
- Slowly add components 8-10 and then mix under high shear for 30 mins until Hegman gauge 7 is achieved
- Add remaining 11 & 12 after grind

B-Component (g)			
1. Curing Agent	Ancamide 702-B75	Evonik	103.40
2. Curing Agent	Ancamine K54	Evonik	4.00
3. Solvent	n butanol		10.00
4. Solvent	Xylene		68.50
			185.90
Total			**1185.90**

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

TABLE 15: TECHNICAL DATA

Mixing ratio	Weight	5.4 :1	VOC	g/l	367
	Volume	3.0 :1	PVC	%	29.0
			Pot life	h	5
Density (g/ml)	- Part A	1.63	Gloss (60°)		82
	- Part B	0.93	BK Dry time 23°C		
	- Mix	1.46	Phase I	h	1.00
Solid Content (Weight %)	- Part A	80.6	Phase II	h	4.75
	- Part B	43.9	Cross Hatch Ad.	5 (no loss)	
	- Mix	74.8	Persoz Hardness	7 days	nd
Solid Content (Volume %)	- Part A	63.3	Direct impact	cm.kg	180
	- Part B	38.0			
	- Mix	57.1			
Mix Viscosity1 @ 25 °C	mPa.s	nd			

ANCAMIDE 702-B75® Curing Agent

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