Epoxy Curing Agents and Modifiers

Ancamine® 1693 Curing Agent

DESCRIPTION

Ancamine® 1693 curing agent is a very lowviscosity modified cycloaliphatic amine designed as an ambient-temperature curative for liquid epoxy resins. The product can be co-cured with Ancamide® 506 curing agent to extend the pot life or it can be accelerated with modified aliphatic amines.

ADVANTAGES

- Low viscosity
- Very good chemical resistance to acids,organic solvents and alcohols (see followingtables)
- DOT noncorrosive

APPLICATIONS

- Solvent-free and high-solids coatings
- Self-leveling and mortar flooring
- Chemically-resistant linings

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Ancamine 1693 curing agent.

SHELF LIFE

At least 12 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

7 days at ambient temperature. Gel at ambient temperature plus 2 hours at 212°F.

TABLE 1: TYPICAL PROPERTIES

Appearanc	Light Yellow Liquid
Color (Gardner)	3
Viscosity @ 77°F (cP)	100
Amine Value (mg KOH/g)	310
Specific Gravity @ 77°F	1.04
Density @ 77°F (lb/gal)	8.7
Flash Point (closed cup) (°F)	208
Equivalent Wt/{H}	96
Recommended Use Level (phr, EEW=190)	50

TABLE 2: TYPICAL HANDLING PROPERTIES

	A*	B*
Use Level (phr)	50	49
Mixed Viscosity @ 77°F (cP)	–	580
Gel Time (150g mix @ 77°F) (min)	52	97
Thin Film Set Time @ 77°F (h)	9	12

TABLE 3: TYPICAL PERFORMANCE (7 DAY CURE @ 77ºF)

	A*	B*
Glass Transition Temperature (°F)	121	111
Compressive Strength @ Yield (psi)	–	7,400
Compressive Modulus (thousand psi)	–	262
Tensile Strength (psi)	–	4,600
Tensile Modulus (thousand psi)	–	214
Tensile Elongation @ Break (%)	–	20
Flexural Strength (psi)	7,500	7,700
Flexural Modulus (thousand psi)	–	274
Bond Strength (mild steel to mild steel (psi)	2,550	–

A* Ancamine 1693 curing agent formulated with standard Bisphenol-A based (DGEBA, EEW=190) epoxy resin.

B* Ancamine 1693 curing agent with 90% DGEBA resin (EEW=190) and 10% Epodil® 748 diluent (C12 C14 alkyl glycidyl ether).

SUPPLEMENTARY DATA

CHEMICAL RESISTANCE

Chemical immersion studies following ASTM D543 were performed using Ancamine 1693 formulations cured for 7 days at 77°F. Ancamine 1693 curing agent was mixed in the recommended use levels with the following resins:

- 100% Bisphenol-A based liquid resin (EEW=190)
- 100% Bisphenol-F based liquid resin (EEW=172)
- 60 % Bisphenol-F (EEW=172) / 40% multifunctional epoxy novolac (EEW=176) resin blend
- 10% Cresyl glycidyl ether (CGE - Epodil® 742 reactive diluent) diluted Bisphenol-A resin (EEW=188)

Three samples were tested for each reagent. Table 1 shows the percent weight gain or loss after 3 days and 28 days for each of these formulations immersed in various chemicals at 77 °F.

TABLE 1: AMICURE IC-321 CURING AGENT

REAGENT	with Bis-A Based Resin (EEW=190)		with Bis-F Based Resin (EEW=172)		with 60% Bis-F / 40% Novolac		with 10% CGE Diluted Bis-A	
	3 days	28 days	3 days	28 days	3 days	28 days	3 days	28 days
Deionized Water	0.53	1.59	0.55	1.62	0.62	1.71	0.47	1.39
Methanol	8.46	8.21	7.29	7.28	8.25	9.69	9.09	6.25
Ethanol	1.97	5.57	1.42	4.25	1.62	4.59	2.25	5.81
Toluene	1.37	–	0.13	1.98	0.06	1.32	2.62	22.15
Xylene	0.11	1.67	-0.03	0.10	0.02	0.05	0.04	2.87
Butyl Cellosolve	0.98	3.61	0.28	0.98	0.35	1.11	1.37	4.48
MEK	15.62	11.88	14.30	5.33	14.63	4.54	16.12	11.45
10% Lactic Acid	0.65	2.38	0.84	2.94	1.12	3.46	0.72	2.39
10% Acetic Acid	1.68	5.62	1.92	6.58	2.50	7.51	1.69	5.25
70% Sulfuric Acid	0.06	-0.05	0.03	-4.32	0.04	0.11	-0.05	-0.17
98% Sulfuric Acid	Dest.	Dest.	Dest.	Dest.	Dest.	Dest.	Dest.	Dest.
50% Sodium Hydroxide	0.01	-0.04	-0.04	-0.12	-0.11	-0.25	-0.21	-0.33
10% Sodium Hypochloride	0.54	1.26	0.46	1.14	0.43	0.94	0.48	1.23
1,1,1 Trichloroethane	3.02	15.91	0.01	0.20	0.05	1.07	0.01	0.40

Dest. = Samples destroyed

Spillage resistance studies were conducted on Ancamine 1693 curing agent formulated with a 90% bis-A resin (EEW=190) and 10% Epodil 748 diluent (C12-C14 alkyl glycidyl ether) blend. Samples were cured for 7 days at 77°F; three samples were tested for each reagent. The immersion/recovery schedule for the testing is shown in Table 2. Percentage weight change and Shore D hardness were measured after each of the immersion periods. The samples were then allowed to recover before reimmersion for the next time period. Hardness retention is relevant in flooring applications where it indicates the ability of the floor to support traffic after exposure to chemical spills. Results of this study are presented in Table 3.

TABLE 2: SPILLAGE RESISTANCE TEST METHOD SCHEDULE

Castings of 1/8" thickness are immersed for specified time period.
Sample is then removed, weighed, and hardness tested immediately.
Sample is then allowed to recover for specified time before re-immersion.

3 hr immersion → test → 24 hr recover → 24 hr immersion → test → 24 hr recover → 3 day immersion → test → 3 day recover → 7 day immersion → test → 7 day recover →28 day immersion → test → 7 day recover → 90 day immersion → test

TABLE 3: SPILLAGE RESISTANCE FOR ANCAMINE 1693 WITH 90% DGEBA / 10% EPODIL 748 % WEIGHT CHANGE AND SHORE D HARDNESS AS A FUNCTION OF TIME

REAGENT	Initial Hard	After 3 hr		After 24 hr		After 3 days		After 7 days		After 28 days		After 90 days	
		% wt.	Hard	% wt.	Hard	% wt.	Hard	% wt.	Hard	% wt.	Hard	% wt.	Hard
10% Acetic Acid	79	0.36	77	1.15	72	2.34	65	3.70	67	6.19	64	9.8	64
10% Lactic Acid	79	0.13	79	0.45	79	0.95	78	1.52	77	2.39	76	3.22	70
Toluene	79	0.17	75	6.08	60	24.91	52	22.69	44	19.97	37	15.74	52
Xylene	79	0.01	76	0.61	72	4.35	60	10.02	42	18.22	45	15.14	48
Trichloroethane	79	0.20	75	3.22	70	12.64	55	22.8	50	41.71	43	39.71	39
Methanol	79	1.96	66	5.50	39	9.04	25	3.95	40	2.19	60	1.42	57
Ethanol	79	0.46	75	1.33	71	2.56	68	3.84	66	3.20	63	-1.17	68
Butyl Cellosolve	79	0.26	75	1.06	70	2.41	68	3.31	66	6.75	63	15.93	57
Methyl Ethyl Ketone	79	5.66	56	19.76	20	15.21	20	14.29	22	14.33	28	14.09	27
Skydrol	79	-0.01	78	-0.13	78	-0.24	78	-0.37	77	-0.67	79	-1.17	54
70% Sulfuric Acid	79	0.05	80	0.01	79	-0.02	79	-0.02	81	-0.09	81	-0.05	79
90% Sulfuric Acid	79	-21.35	74	Destroyed									
Deionized Water	79	0.11	78	0.03	79	0.58	78	0.95	79	1.27	77	1.04	77
50% Sodium Hydroxide	79	-0.02	79	-0.11	80	-0.14	80	-0.20	80	-0.35	80	-0.54	65
Bleach	79	0.10	78	0.28	78	0.54	78	0.77	78	0.74	78	-0.72	67

Dest. = Samples destroyed

These studies show that Ancamine 1693 curing agent imparts good chemical resistance to all types of reagents. Compared with most curing agents, Ancamine 1693 provides excellent resistance to alcohols and to methyl ethyl ketone (MEK). Chemical resistance of 1693-based formulations can be optimized for specific chemicals using different resin blends. The chemical resistance imparted by Ancamine 1693 curing agent makes it useful in formulating chemically resistant coatings and secondary containment linings. For information on the chemical resistance of many other Evonik curing agents, please refer to publication number 125-9326 (Rev 1996): "Chemical Resistance for Ambient Cure Epoxy Formulations."

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