Epoxy Curing Agents and Modifiers

ANCAMIDE 502 and 506® Curing Agents

DESCRIPTION

Ancamide 502 and Ancamide 506 curing agents are amidoamines designed for curing liquid epoxy resins at ambient or elevated temperatures. Both amines have different reactivity based on the imidazoline content. Fabricators can select either amine based on their processing requirements without significantly altering mechanical performance.

Ancamide 506 curative has a long pot life with a gel time of 400 minutes vs. 115 minutes for Ancamide 502 curative.

APPLICATIONS

- Structural Composites
  - Low Pressure Tanks
  - Wind Blades
  - Laminates
- Adhesives

RECOMMENDED PROCESSING

- Filament Winding
- Resin Infusion
- Wet lay-up Laminates
- Resin Transfer Molding

ADVANTAGES

- Low viscosity and long pot life
- Low temperature reactivity
- Very low exotherm

TYPICAL CURE SCHEDULE

- 2 hours at 212°F
- 2 hours at 100°C

TABLE 1: TYPICAL PROPERTIES

	Ancamide 502		Ancamide 506	
	SI	English	SI	English
Appearance	Amber Liquid		Amber Liquid	
Color (Gardner)	7		7	
Viscosity @ 77°F / 25°C	300 cPs		250 cPs	
Specific Gravity @ 77°F / 25°C	0.95		0.94	
Amine Value (mg KOH/g)	450		420	
Flash Point (closed cup)	180 °C	356 °F	160 °C	320 °F
Equivalent Wt/{H}	90		105	
Use Level (1) (PHR)	50.0		58.0	

TABLE 2: TYPICAL HANDLING PROPERTIES(1)

	Ancamide 502	Ancamide 506
Mixed Viscosity @ 104°F / 40°C	590 cPs	370 cPs
Gel Time (150g mix @ 77°F / 25°C)	115 min	400 min
Time to 10,000 cPs @ 77°F / 25°C	77 min	168 min

TABLE 3: THERMAL PERFORMANCE (1)

	Ancamide 502		Ancamide 506	
	SI	English	SI	English
Heat Deflection Temperature (ASTM D648-264)	58°C	136°F	56°C	133°F
Glass Transition Temperature (DSC second scan)	66°C	151°F	61°C	142°F

TABLE 4: MECHANICAL PERFORMANCE - CAST PANEL (1)

	Ancamide 502		Ancamide 506	
	SI	English	SI	English
Flexural Strength	88 MPa	12.7 ksi	74 MPa	10.7 ksi
Flexural Modulus	2.7 GPa	0.39 Msi	1.5 GPa	0.22 Msi
Tensile Strength	44 MPa	6.4 ksi	47 MPa	6.8 ksi
Tensile Modulus	2.4 GPa	0.35 Msi	1.9 GPa	0.28 Msi
Tensile Elongation @ Break	5.9%		4.9%	
Compressive Strength	75 MPa	10.9 ksi	68 MPa	9.9 ksi
Compressive Modulus	2.0 GPa	0.29 Msi	1.9 GPa	0.28 Msi
Izod Impact Strength	22.0 J/m	0.1 ft-lb/in	22.0 J/m	0.1 ft-lb/in

TABLE 5: MECHANICAL PERFORMANCE - COMPOSITE PANEL (1)

	Ancamide 502		Ancamide 506	
	SI	English	SI	English
ILSS 0° Longitude	53.0 MPa	7.7 ksi	53.0 MPa	7.7 ksi
ILSS 90° Transverse	23.0 MPa	3.3 ksi	23.5 MPa	3.4 ksi
Flexural Strength - Composite 0° Longitude	805 MPa	116.8 ksi	775 MPa	112.4 ksi
Flexural Modulus - Composite 0° Longitude	34.7 GPa	5.03 Msi	34.3 GPa	4.98 Msi

(1) Curing agents formulated with standard Bisphenol-A based (DGEBA, EEW=180) epoxy resin

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.

Material may crystallize or solidify upon exposure to low temperatures. Crystallized or solidified material can be utilized after melting at elevated temperatures without impacting handling or physical properties. It is recommended that the material be heated to 50-70°C while mixing continuously for 1 hour. Once the solidified material has fully homogenized, it can be cooled to room temperature and utilized under normal conditions.

STORAGE AND HANDLING

Refer to the Safety Data Sheets for Ancamide 502 and 506 Curing Agents.

VISCOSITY PROFILE

The reactivity of Amidoamines like Ancamide 502 and Ancamide 506 curatives depends on the curing agent's imidazoline content. The higher imidazoline content of Ancamide 506 results in slower reactivity and a longer pot life. Figure 1 shows the viscosity build of both Ancamide 502 curatives and Ancamide 506 curatives with EEW=180 DGEBA resin at 40°C (104°F).

MECHANICAL PROPERTIES

In addition to the cure cycle and processing conditions used, the selection of an epoxy curing agent is a critical factor in determining the structural integrity of a composite part. Evonik offers a wide selection of amine based curing agents which can be used to maximize load-bearing capabilities, fatigue resistance, and fracture toughness in a fully formulated system. In general, flexural properties determine the bending stiffness of the composite. Interlaminar shear strength (ILSS) or short beam shear (SBS) determines the shear strength between composite layers and provides insight into the interphase adhesion between the epoxy matrix and the fiber reinforcement. Mechanical properties of epoxy cured with Ancamide 502 and Ancamide 506 curatives in the presence of E-glass fiber are shown in Table 6.

FIGURE 1: CURING AGENT / DGEBA (EEW=180) MIX VISCOSITY @ 104°F (40°C)

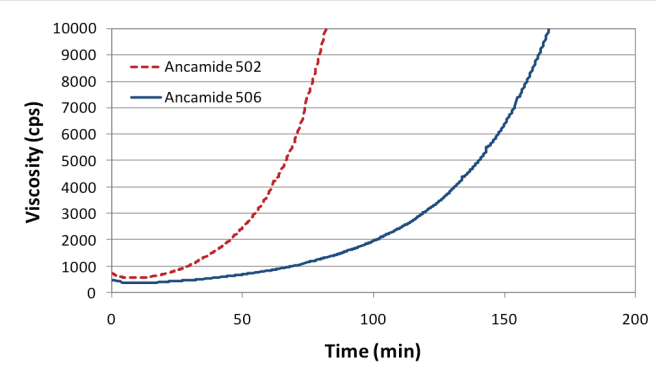

TABLE 6: MECHANICAL PERFORMANCE - COMPOSITE PANEL

Composite Panel Fabrication				
Method: Vacuum Assisted Resin Transfer Molding (VARTM)				
Fiber Type: E-glass (275g/m^2) unidirectional				
Fiber Volume: 60 ± 3%				
Cure Schedule: 2 h @ 60°C, then 3 h @ 100°C				
Mechanical Performance - Composite Panel	**Ancamide 502**		**Ancamide 506**	
	SI	English	SI	English
Flexural Strength 0° Longitude (ASTM D790)	805 MPa	116.8 ksi	775 MPa	112.4 ksi
Flexural Modulus 0° Longitude (ASTM D790)	34.7 GPa	5.0 Msi	34.3 GPa	5.0 Msi
Flexural Ultimate Strain (ASTM D790)	2.5%		2.5%	
ILSS 0° Longitude (ASTM D2344)	53 MPa	7.7 ksi	53 MPa	7.7 ksi
ILSS 90° Transverse (ASTM D2344)	23 MPa	3.3 ksi	24 MPa	3.4 ksi

CHEMICAL RESISTANCE

DGEBA epoxy resin cured with both Ancamide 502 and Ancamide 506 curatives exhibits good chemical resistance in various concentrations of acid and alkaline environments. Chemical resistance can be further improved by using Bis-F resins.

TABLE 7: CHEMICAL RESISTANCE TEST

Chemical Resistance Test		
Formulation: DGEBA Epoxy Resin Mix (EEW-190)		
Cure Schedule: 7 days at 73°F / 24°C		
1.75" Diameter with 0.2" thick Disc		
Test: % Weight gain after 120 days immersion @ 73°F / 24°C		
Reagent	**Ancamide 502**	**Ancamide 506**
Water (Distilled)	0.8%	1.0%
5% Detergent Solution	0.9%	1.0%
10% Sodium Hydroxide	0.6%	0.7%
50% Sodium Hydroxide	0.0%	0.0%
10% Sulfuric Acid	1.7%	2.9%
70% Sulfuric Acid	0.7%	2.2%
20% Nitric Acid	1.4%	2.2%
10% Acetic Acid	12.2%	25.3%

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