Epoxy Curing Agents and Modifiers

ANCAMINE® 2014AS AND 2014FG Curing Agents

DESCRIPTION

Ancamine 2014AS and 2014FG curing agents are modified polyamines that have been designed as latent curing agents. They can also be used as accelerators for dicyandiamide (DICY). Their ability to provide extremely long pot life in undiluted resins, coupled with their ability to cure rapidly above their temperature of activation and to give good adhesion, make them ideal for use in one-component adhesives applications.

In all cases, it is essential to disperse these curing agents uniformly to achieve optimum performance. The addition of a small amount of fumed silica will aid in their dispersion. Ancamine 2014FG curing agent is a fine-grind version of Ancamine 2014AS curing agent. It offers improved reactivity at lower temperatures.

ADVANTAGES

- Long pot life
- Rapid cure above their temperature of activation
- Good adhesion

APPLICATIONS

- One-component adhesives
- Composites
- Small potting 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.

STORAGE AND HANDLING

Refer to the Safety Data Sheet for Ancamine 2014AS and 2014FG curing agents.

TYPICAL CURE SCHEDULE

- 40 minutes at 212°F.
- 30 minutes at 248°F.

TABLE 1: TYPICAL PROPERTIES

Appearance	White Micronized Powder
Melting Point (°F)	208-223
Particle Size (micron):	
2014AS	8 ≤ D50 ≤ 10
2014AS	20 ≤ D90 ≤ 36
2014FG	90% ≤ 6
Amine Value (mg KOH/g)	184
Equivalent Wt/{H}	52
Recommended Use Level (phr, EEW=190)	25

TABLE 2: TYPICAL FORMULATIONS

	I	II
Epon 828	100.0	100.0
Ancamine 2014AS	28.0	—
Ancamine 2014FG	—	28.0
Fumed Silica	2.0	2.0

TABLE 3: TYPICAL HANDLING PROPERTIES*

	I	II
DSC Activation Temperature (°F)	167	167
Pot Life (150g mix @ 108°F) (mo)	>3	1

TABLE 4: TYPICAL PERFORMANCE*

	I	II
(Cure Schedule 2)		
Glass Transition Temperature (30 min @ 300°F) (°F)	230	230
Lap Shear Strength (electrogalvanized steel) (psi)	1,050	1,120

* Ancamine 2014AS and 2014FG curing agents formulated with standard Bisphenol-A based (DGEBA, EEW=190) epoxy resin.

SUPPLEMENTARY DATA

Four one-package adhesives formulations containing Ancamine 2014AS and 2014FG curing agents, with and without DICY, were studied for reactivity, glass transition temperature, shear strength development and shelf stability.

Reactivity: At lower temperatures, the formulations containing higher levels of modified polyamines were more reactive. At both 176°F and 212°F, the formulation containing Ancamine 2014FG curing agent gelled significantly faster than the formulation containing Ancamine 2014AS. At 248°F and 284°F, the temperature affected reactivity much more than the effects of particle size or the inclusion of DICY.

Viscosity increase as a function of time was studied using a Rheometrics Dynamic Analyzer. Each sample was loaded into an environmental chamber and preheated to 176°F. The rate of viscosity increase was found to be greater for formulations containing Ancamine 2014FG curing agent than for the similar formulations containing Ancamine 2014AS curing agent. The viscosity results suggest faster development of green strength and ultimate cure for formulations containing Ancamine 2014FG curing agent.

TABLE 5

PARTICLE SIZE IMPACT ON REACTIVITY, GLASS TRANSITION TEMPERATURE, SHEAR STRENGTH DEVELOPMENT AND FORMULATION SHELF STABILITY

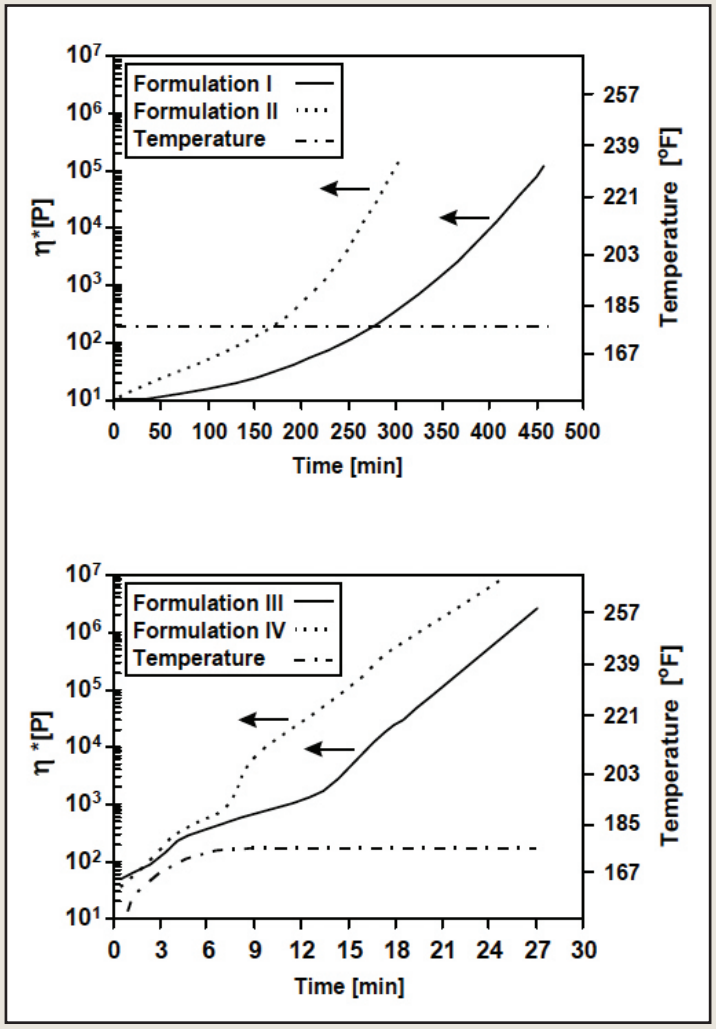
Ingredient	Composition, % by weight			
	I	II	III	IV
Epon 828	100	100	100	100
Dicyandiamide	6	6	—	—
Ancamine 2014AS	5	—	28	—
Ancamine 2014FG	—	5	—	28
Fumed Silica	2.0	2.0	2.0	2.0

TABLE 6

Stroke Gel Time	Composition, % by weight			
	I	II	III	IV
min @ 176°F	No gel/ 30 min	No gel/ 30 min	22.0	15.0
min @ 212°F	No gel/ 30 min	No gel/ 30 min	15.0	7.0
min @ 248°F	18.0	16.0	2.0	1.5
min @ 284°F	5.5	5.2	1.0	1.0

FIGURE 1

VISCOSITY VS. TIME @ 176°F



Glass Transition Temperature: Samples of cured formulations were placed in a small pan and analyzed for glass transition temperature (Tg), using DSC. The scan rate was 18°F/minute starting at 68°F.

The results of the testing are shown in Table 7. As can be seen, the glass transition temperatures increase as a function of the increasing temperature of cure but are not influenced by particle size. The presence of DICY in the formulation gave a high glass transition temperature, but only at the highest bake temperature.

Shear Strength Development: Electrogalvanized steel lap coupons were bonded together with a ½" overlap and a 10-mil bondline thickness. All bonded coupons were cured in an air-circulated oven at 176°F, 212°F, 248°F and 284°F. Lap shears were tested at room temperature according to ASTM D1002.

Figure 2 shows that lap shear strength was highest for the Ancamine 2014FG curing agent formulations, regardless of whether they contained DICY. Lap shear strength was also more pronounced at lower temperatures.

Formulation Shelf Stability: Table 8 indicates that Formulations I and II have more than 3 months of shelf stability at 108°F. In formulations that contained higher polyamine loading and no DICY, a rapid viscosity increase was observed. The Ancamine 2014FG-containing formulation doubled in viscosity after 4 weeks, and the Ancamine 2014AS-containing formulation doubled in viscosity after 11 weeks.

TABLE 7

GLASS TRANSITION TEMPERATURE (°F)

Cure Conditions	I	II	III	IV
30 min @ 176°F	—	—	100	104
30 min @ 212°F	—	—	167	167
60 min @ 212°F	104	104	—	—
30 min @ 248°F	174	180	185	189
30 min @ 284°F	250	246	185	189

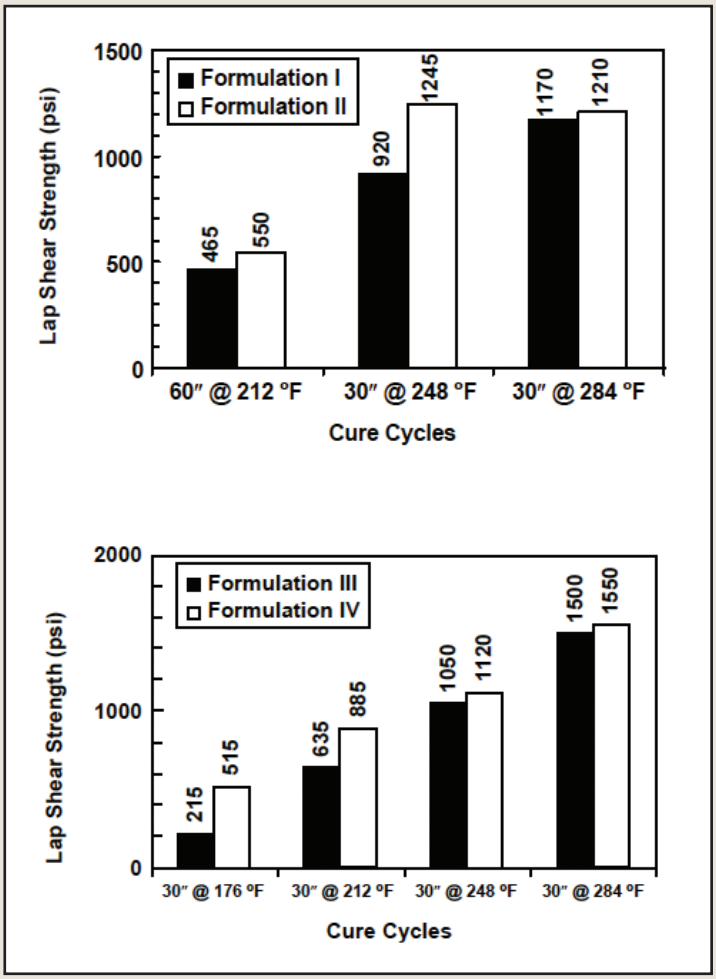
TABLE 8

FORMULATION SHELF STABILITY

	I	II	III	IV
Time needed to double the viscosity @ 108°F	>3 mo	>3 mo	11 wk	4 wk

FIGURE 2

LAP SHEAR STRENGTH



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