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LEECURE B CURATIVES AND ANHYDRIDE ACCELERATORS FOR ADVANCED COMPOSITES

Latency coupled with exceptional physical properties distinguishes Leepoxy's LEECURE B curing agents and anhydride accelerators from other epoxy curatives for use in advanced composites. Since 1965, these distinctive epoxy catalysts have served the aerospace, recreational goods, adhesive film, electronics, high-pressure tank, and industrial component industries.

The LEECURE B catalyst series consists of seven boron trifluoride (BF₃)-amine epoxy hardeners and one boron trichloride (BCl₃)-amine anhydride accelerator. Compared to other types of curing agents, LEECURE B curatives provide the longest possible work life for a particular cure schedule. The range of the reactivity of these catalysts, including LEECURE blends allows, fine tuning the product to a specific composite fabrication method. The most latent LEECURE B members appeal to both in-house prepreggers and independent fabricators. The reactive members are useful more useful to in-house prepreggers.

In addition to their unique handling and processing characteristics, the LEECURE B curatives all impart superior chemical resistance, electrical properties, and high temperature performance.

The LEECURE B catalysts and anhydride accelerators are liquid at or near room temperature and are compatible with Bisphenol A, Bisphenol F, flexible, novolac, and other multifunctional epoxy resins. They

can be formulated with dry, non-alkaline fillers: carbon, aramid, boron, quartz, basalt fibers, E-glass and S-glass. LEECURE B catalysts can be used to produce preimpregnated reinforced plastics (prepregs), and towpregs. They also can be used in Compression and Resin Transfer Molding (RTM), Vacuum Assisted Resin Transfer Molding (VARTM), Resin Fiber Infusion (RFI), pultrusion, and filament winding.

With the choice of a sufficiently latent catalyst, fabricators may be able to apply heat to lower the viscosity of the matrix for enhanced wet-out, without sacrificing batch size or work life. Therefore, the addition of solvents or other property reducing diluents may not be required. LEECURE B catalysts do not contain solvents and therefore do not add volatiles to a system.

LEECURE B product selection allows the formulator to choose a catalyst and design a product for a particular work life (out time) and cure cycle. Using a low initiation temperature precludes out-gassing and, at the same time, imparts fast "green strength" build-up during the processing cycle. It also allows ramping, which minimizes thermal stress during initial cure. Additional performance enhancements can be achieved by post curing. Table I lists usage levels, reactivity, and performance properties for LEECURE B catalysts with Bisphenol A resin.

LONGER SHELF LIFE

LEECURE 38-239 B

Most latent BCl₃ anhydride catalyst 250° F and 350° F curing systems

This low viscosity BCl₃-amine accelerator is exceptionally latent and efficient in anhydride-cured systems. Work life is 8 weeks at **104° F** with epoxy resin. When used as a 0.1 to 1.0-phr catalyst for one-part anhydride-epoxy systems for pultrusion, molding, and filament winding, it provides long working life and short cure at modest temperature. Also attractive for “Wet lay-up” and “wet” sheet molding compounds.

LEECURE B-1550

Most latent BF₃ epoxy catalyst 350° F curing systems

Four-month shelf life at room temperature. This catalyst used neat is ideally suited for one-part systems. Two week pot life in 100-gallon mass for winding and molding applications. Elevated temperature (300° F/150° C) cure schedule.

LEECURE B-550

Highly latent BF₃ epoxy catalyst 250° F and 350° F curing systems

Two and a half month shelf life at room temperature. This catalyst used neat is ideally suited for one-part systems. One week pot life in 100-gallon mass at room temperature for in-house applications. Elevated temperature (275° F) cure schedule. Excellent as a 1-phr catalyst for anhydride prepreggers not using LEECURE 38-239 B. Also used as a catalyst for Diamino Diphenyl Sulfone (DDS/DADPS). Sentence to compare 550 with 1550.

LEECURE B-1060

Highly latent B-stage epoxy catalyst 250° F and 350° F C-stage curing systems

Two and a half hour pot life in 5-gallon mass at room temperature. Used for two-part systems by independent fabricators of tapes and adhesive films as well as sheet or gunk molding compounds where a B-staged drape is preferred to “wet”. Brief heat advancement followed by immediate quenching yields B-staged composites with greater than two month shelf life at 55° F. Final cure at elevated temperatures.

FASTER CURE

LEECURE 31-43 B

High temperature performance epoxy curative 350° F curing systems

For high temperature, chemically resistant composites. This curative's low viscosity (350 cps) helps improve matrix flow and wet-out. Two hour work life in 5gallon batch at room temperature. When used to cured Bisphenol A resin, a Tg of 369° F can be achieved. The addition of a novolac resin will further increase the matrix Tg. Elevated temperature (275° F) cure schedule plus post cure.

LEECURE B-950

Latent BF₃ epoxy catalyst 250° F and 350° F curing systems

Two and a half hour work life in 5 gallon mass at room temperature. Used for two-part systems. For in-house fabrication--high-speed automated or low-volume manual--of medium-to-large reinforced molded parts and thick laminates. Elevated temperature (200°-350° F) cure schedule.

LEECURE B-110

Fast cure BF₃ epoxy catalyst 250° F curing systems

For in-house fabricators using high throughput automatic meter-mix-dispense equipment. Used in small-reinforced-part casting and in continuous on-line thin-sheet lay-up. Less than one hour work life in one-gallon mass at room temperature. Fast de-mold times when cured between 150° and 250° F. Potential out-gassing in casting large masses. Maximum physical properties achieved with post cure.

LEECURE B-1310

Fast cure BF₃ epoxy catalyst 200° F curing systems

High reactivity necessitates automatic meter-mix-dispense equipment for processing. Rapid cure at temperatures higher than 150° F. Appropriate for on-line, high throughput, mass production of laminates less than 1/4 inch thick and for castings less than 1/2 inch in diameter. Potential out-gassing in larger masses or if initial cure temperature exceeds 200° F. Maximum physical properties achieved with post cure.

TABLE I
TYPICAL PROPERTIES OF LEECURE B HARDENERS

	38-239 B	B-1310	B-110	B-950	B-1050	B-550	B-1550	31-43 B
Appearance	Amber	Brown	Brown	Brown	Brown	Brown	Amber	Brown
Viscosity @ 25°C, cps	250	15,000	14,000	22,000	24,000	28,000	14,000	14,000
Density, lbs/gal	9.2	9.4	9.3	10.0	10.0	10.6	9.9	8.6
The following typical properties are obtained in conjunction with Bisphenol A Epoxy Resin (EEW=189)								
Mix Ratio, phr	0.1 – 2.0	8 – 12	8 – 12	4 – 6	8 – 12	4 – 6	4 – 6	26
Suggested Cure Time 3/16 inch bead, time/bondline temp	2 hours/ 135°C	5 min/ 65°C	10 min/ 100°C	1 hour/ 100°C	1 hour/ 135°C	1 hour/ 135°C	1 hour/ 150°C	1.5 hours/ 175°C
Pot Life @ 25°C, 11g	----	20 min	5 hours	----	----	----	----	----
Pot Life @ 25°C, 100g	4 mo	----	----	8 hours	1 mo	2.5 mo	4 mo	6 hours
Typical performance properties according to suggested cure cycle								
Tensile Strength, psi	----	4,000	10,600	9,000	9,000	11,900	9,250	9,400
Tensile Modulus, psi	----	480,000	480,000	480,000	480,000	450,000	350,000	369,000
Tensile Elongation, %	----	4.0	4.0	4.1	4.1	4.3	3.4	4.4
Heat Deflection Temperature, °C	108	78	86	91	90	123	130	130
Dielectric Constant, 1 mHz @ 25°C	----	3.9	3.9	3.8	3.8	3.9	3.9	4.3
Dissipation Factor, 1 mHz @ 25°C	----	0.018	0.018	0.014	0.014	0.018	0.024	0.012
Volume Resistivity @ 25°C, ohm-cm	----	10 ¹⁵	10 ¹⁵	10 ¹⁴	10 ¹⁵	10 ¹⁵	10 ¹⁵	3.1x10 ¹⁶
Volume Resistivity @ 130°C, ohm-cm	----	10 ¹⁰	10 ¹⁰	10 ⁹	10 ¹⁰	10 ¹⁴	10 ¹¹	----
HDT's increase with an elevated temperature post-cure. Post cure can be realized by temperatures generated in use or operation								