H.B. Fuller

H.B. Fuller Company
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TECHNICAL DATA SHEET

EPOLITE FH-2330

EPOXY

DESCRIPTION

EPOLITE FH-2330B epoxy hardener is a reddish brown-black, odorless, liquid or crystallized solid which returns to liquid at 150F.

EPOLITE FH-2330B Hardener is a stable 100% aromatic curing agent for epoxy resins capable of exceptional high performance. With high functionality aromatic resins and an adequate cure cycle, the polymer physical properties are greatly improved over that of most available epoxy systems at elevated working temperatures.

FEATURES

Contains no methylene dianiline or aniline derivatives. Low toxicity. Rabbit skin test: Draize rating - 1.08 (very mild irritant).

Insoluble in water; insensitive to air or moisture exposure.

Compatible with all aromatic and most alicyclic resins.

Very low vapor pressure; no fuming or outgassing during cure, no water or volatiles involved.

The pH range of 6.5-7.0 has no effect on alkaline or acidic sensitive surfaces.

Low and predictable exotherm; viscosity buildup during cure can be programmed.

Excellent wetability for fabrics and fibers, especially glass, graphite, Kevlar and Boron.

In combination with novalacs and other high performance resins and a high temperature cure schedule, a non-functional, highly crosslinked resin is developed that is not attacked by any normal chemical reagents and demonstrates excellent strength at temperatures in excess of 400F.

EPOLITE FH-2330B does not contain any functional hydroxyl groups and the water absorption of cured resins is low.

All contact during processing is with stainless steel, no contamination with copper or other oxidation catalyst; consequently very low internal oxidation at prolonged, extreme elevated temperatures.

Final process step involves a vacuum strip at 28 inches and 300F followed by filtration through a 50 micron filter. This ensures removal of all volatiles and polymer which may clog pumps or automatic resin mixing equipment.

PROPERTIES FH-2330B HARDENR	TEST METHOD	VALUE
Viscosity at 77F, cps	ERF 1-74	25,000 - 35,000
Viscosity at 100F, cps	ERF 1-74	2,500 - 3,000
Weight per Gallon	ERF 3-7	9.5 - 9.7
Gel time with DER 331 (100 grams at 77 +/- 5F), hours	ERF 2-74	16 - 24
Vapor Pressure at 100C, m/m Hg		0.62
Flash Point, F	Open Cup	356

CONSIDERATIONS FOR USE

Active Hydrogen equivalent weight = 31.7.

For novalacs, Ciba MY-720, Dow XD-7342 and Bisphenol A resins such as Dow DER 331 or Shell EPON 828, it has been determined by tests that 82% of the stoichiometric equivalent will develop useful physicals for elevated temperature use.

The actual optimum ratio may change if a super cure time-temperature schedule is not followed.

The initial cure temperature used will determine the period that the various functional groups are readily available for reaction. A modest temperature of 150F will produce more linkages at gel than one of 400F. After the resin has hardened the cure rate at a temperature will taper off and a higher temperature is required to get molecular movement for further cure.

Controlled shrinkages and lower locked-in strain results from a well programmed cure schedule. It is obvious that the harder a resin becomes at elevated temperatures, the higher the temperature and longer time required of further crosslinking.

For critical work where an optimum ratio is required and a cure cycle has been prescribed, resin / hardener ratios can be checked by establishing the glass transition point Tg of the cured system.

Range changes in increments of 0.5% can be tried until the highest Tg is obtained. A change in the cure schedule can alter the optimum ratio. Water absorption values are changed considerably if cure cycle and / or hardener ratios are changed from a previous established optimum.

Typical starting ratios for use with different base resins obtained by acetone extraction methods are:

EPOLITE FH-2330B PER 100 PARTS OF RESIN

DER 331	DEN 438	EPOLITE FH-2447A	MY-720	XD-7342	XB-2818 (Ciba)
15.0	16.0	20.5	23.0	16.0	17.3

CURE CYCLE

For a typical novalac, a cure schedule similar to that given below should produce an excellent result:

150 - 175F for 2 - 3 hours
plus 250F for 2 hours
plus 350F for 2 hours

If the anticipated use temperature is above 350F, an additional 2 hours at 10F above the use temperature is recommended. The maximum would be 2 hours at 450F.

Other schedules are permissible, but the time / temperature relationship for super cure has to be considered. The initial lower temperature will produce a gel, followed by a 175F period to compensate for any shrinkage and strains.

In critical applications when very high performance is required, it is essential that consideration be given to the introduction of extraneous materials such as volatiles present in the resin used or on the surface of fabrics or fillers. The presence of 1% of water can lower the Tg by as much as 10C.

All fabrics and filler materials have large surface areas which absorb appreciable amounts of gases and water. Either pre-drying or storage in a low humidity area is essential for best results.

In a number of applications a super cure at elevated temperatures may not be practical due to local conditions such as inadequate ovens, the presence of other components that cannot stand the temperature or a scheduling problem.In such cases, the final cure temperature must be at least 10F above the expected operational

maximum. The duration can be checked experimentally by determining the time to maximum surface hardness with a Barcol or Shore D instrument.

GLASS TRANSITION TEMPERATURE (Tg)

Comparative data has been obtained on a number of high performance systems currently used for "prepregs" and wet lay up of glass, Graphite, Kevlar and Boron.

The optimum ratio of hardener to resin was determined and the samples were super cured.

Using identical sample dimensions, plots were made using a DuPont 942 TMA at a heating ratio of 5C per minute.

MIXED RESIN VISCOSITY, CPS

RESIN	HARDENER	TG,	C 77F	100F	200
Dow XD-7342	D.A.D.P.S	227.00	Solid	Semi-Solid	16,000
Ciba MY-720	D.A.D.P.S.	208.00	Semi-Solid	Semi-Solid	6,400
Dow XD-7342	EPOLITE FH2330	228.00	Semi-Solid	2,000,000	---
Ciba MY-820	EPOLITE FH2330	208.00	860,000	145,000	---
EPOLITE FH2447	EPOLITE FH2330	216.00	5,230	1,700	---
DEN 438	EPOLITE FH2330	191.00	Semi-Solid	275,000	---
DER 331	EPOLITE FH2330	175.00	17,000	5,000	---
Dow XD-7342	EPOLITE FH2347	243.00	Semi-Solid	384,000	---
Dow XD-7342	EPOLITE FH2320	211.00	Semi-Solid	---	---

1. The use of D.A.D.P.S. with unmodified novalacs, XD-7342 or CY-720 produces highly viscous systems that are very difficult to use except as a hot melt technique for prepreg fabrics. Filament winding is not practical.

2. Imadazole curing agents such as EPOLITE FH-2347B have excellent pot life and storage life but have a threshold temperature of about 150 - 180F at which time the action becomes rapid and very high exotherms are produced. If used in adequate heat sink situations such as filament winding, it is of no consequence. However, due to the rapid build up of viscosity at gel, large strains can be set up which can produce brittle fractures if high temperature stress relief is not undertaken. Adhesion to other surfaces and interlaminar bond strength is excellent. Due to the small ratios used, no viscosity improvement is available.

3. EPOLITE FH-2330B is typical of the best previously available aromatic amines. However, to maintain a liquid system, chemical modifications were necessary which prevent maximum performance at very high temperatures.

4. EPOLITE FH-2330B represents a definite advancement over available hardeners in that convenience of use with no sacrifice or compromise of final properties is necessary. The viscosity build up of the mixed system is gradual and not step wise as with some hardeners. The exotherm is low and controllable. Viscosity is low and with a modified novalac such as EPOLITE FH-2447A, is suitable for wet lay up or filament winding.

For unmodified resins with high viscosities, the hardener is an excellent viscosity reducer at moderate temperatures. The water absorptions of the cured systems are low compared to the much higher values obtained when a Lewis acid system such as BF3 or an anhydride system is used.

Prepregs can be made without the need for advancement of the resin system. Useful storage life of up to six months at -10F has been obtained with graphite. The drape and interlaminar adhesion after this period was excellent with no fall off in final properties.

STORAGE

Store, if possible, at normal temperatures. Cold will cause freezing which is not damaging. Excessive prolonged heat (150F and up) may produce an increase in viscosity of the hardener. Hardener may crystallize upon storage, but will return to liquid state after gentle warming to 149-203F.

Although the hardener is non-hygroscopic and insoluble in water, containers should be closed when not in use to avoid any absorption of solvents or other possible atmospheric contaminates.

EXPORT ADVICE

This product is a Defense Article as defined in the International Traffic in Arms Regulations (Volume 22 Code of Federal Regulations Parts 120-130). As such, any export of this product or items containing this product may be prohibited by or require a license issued by the U.S. Department of State, Directorate of Defense Trade Controls. Contact H.B. Fuller Company by phone at 651-236-5858 or by email at reg.request@hbfuller.com for further information.

PRECAUTIONS FOR USE

EPOLITE FH-2330B is to be regarded as an industrial chemical to be used by informed professionals.

To the best of our knowledge, no harmful materials are present and rabbit skin tests indicate a low order of irritation potential. No halogenated aromatic aniline derivatives are present.

The vapor pressure is very low and no casual harmful ingestion through respiration would be expected. Common sense, however, would contraindicate the use of inadequately ventilated ovens or the exposure of workers to large surfaces of hot, uncured, mixed resin. Good industrial hygiene must be observed.

Keep off skin and clothing. Wear safety glasses and protective gloves.

EPOLITE FH-2330B will stain the skin and contaminate clothing. The yellow color is similar to dye and is not easily removed.

In areas where spills may occur, it is recommended that floors and table tops be periodically washed down with a caustic or TSP hot water solution which will dissolve any spilled hardener and enable removal by a water wash.

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