Starting Formulation

SF 8000

Prepreg Laminating Compound for High Temperature and Ultra-Thin Laminating Applications EPON™ Resin SU-8

Introduction A high functionality resin, EPON Resin SU-8 is employed in conjunction with dicyandiamide, (dicy) solvents and a latent accelerator in this formulation for a prepreg laminating solution.

Suggested Uses

- Printed circuit boards; NEMA G-11 specification
- Thin laminates for multilayer circuitry; NEMA G-10-VT and MIL-P-55617A specifications
- Chopped glass molding compounds
- Advanced engineering composites; modification with low molecular weight epoxy resins as tackifiers is desirable

Features

- Dry prepreg with approximately 4 months shelf life
- Rapid gelation in press; controlled flow
- High strength retention and good thermal stability at 175 °C
- Thin laminates resist degreasing solvents and copper etching solutions, maintaining dimensional stability and low absorption values

Formula

Material	Supplier	Pounds	Gallons
Formulation			
EPON Resin SU-8	Hexion	100.0	10.100
Acetone	Shell Chemical Company	60.0	9.090
Dicyandiamide (dicy)	SKW Corporation	4.0	0.35
2-Methoxyethanol	Union Carbide Corporation	40.0	4.980
1-Methylimidazole	BASF-Wyandotte Corporation	0.2	0.023
	Total Formulation	204.2	24.543

Mixing Instructions Dissolve the EPON Resin SU-8 in acetone. This step requires a closed tank equipped with a heating jacket or coils, an agitator, and a water cooled condenser. Solutions of this resin in acetone or other solvent lineups can be supplied upon request.

Dissolve the dicyandiamide in the 2-methoxyethanol using agitation at a temperature of 50 °C or higher. When the dicy dissolves, add this warm solution to the resin solution at normal room temperature under moderate speed agitation. Continue the agitation while adding the 1-methylimidazole accelerator and blend to a homogeneous, clear solution.

It is important to completely dissolve the dicy in the glycol ether solvent prior to adding it to the resin solution. Dicy is only sparingly soluble in acetone and any undissolved particles will serve as “seeds” for crystallization of the dissolved dicy during varnish storage.

An induction period of approximately two hours at room temperature is suggested prior to using this varnish for impregnation.

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Typical Formulation Properties

Table 1 / Properties of Laminating Solution

	Units	Value
Viscosity at 25 °C	cP	94
Pounds/gallon	lbs/gal	8.32
Pot life at 25 °C	weeks	4-6
Gel time, stroke cure at 160 °C	sec.	60

Prepreg Procedures

Parameters affecting the resin pick-up and degree of “B” stage in commercial impregnation/ drying tower operations are:

(1) viscosity, solids content, solvent volatility, accelerator concentration and age of the varnish;

(2) clearances and fabric tension on squeeze rolls and/or doctor bars;

(3) residence time of impregnated fabric in the drying tower; and (4) air temperature and air velocity in the drying tower.

Impregnation of the lightweight glass used in thin laminates is easily accomplished with this system using conventional wetting and squeeze-off assemblies. Use of higher solvent (acetone) levels in this compound might be necessary to provide the wetting characteristics needed when using lightweight cloth.

Optimum conditions for prepreg production must be established for each manufacturing line, since industrial equipment varies considerably with respect to air velocity, the ratio of air exhausted to air recirculated, fabric tension, and varnish squeeze-off devices. Air temperatures as high as 175 °C are commonly used in commercial drying towers to process epoxy/ dicy prepregs at high production speeds.

The usable life of these prepregs should be approximately four months when stored at normal

room temperature or below in a low humidity environment.

Prepreg Properties

Table 2 / Prepreg Properties[1]

	Units	Value
B-stage schedule	min.	10
125 °C in a forced air oven		
Resin pick-up	%	38-42
Percent flow, cured at 175 °C and 150 psi	%	12-18

[1] Style 181 glass prepregs were prepared from laminating solutions aged at room temperature for periods ranging from

2 hours to 3 weeks.

Cure Properties

Table 3 / Press Cure Conditions and Laminate Properties

	Units	Value
Contact period		None
Platen temperature	°C	175
P		150

Pressure		psi	150
Time in press		min.	40
Post cure at 175 °C		hrs	1

Formulation vs. Requirements

Table 4 / Properties of Formulation No. 8000 Glass Laminate[1] NEMA G-11 Requirements

Laminate property	Conditioning	NEMA G-11 requirements	Units	Test Results
Resin content	—	—	wt %	25
Thickness	—	—	inch	0.10
Flexural strength				
Lengthwise	23 °C, 50% RH	6×10^4 min.	psi	8.1×10^4
Crosswise	23 °C, 50% RH	5×10^4 min.	psi	7.2×10^4
Flexural strength				
Retention at 150 °C				
Lengthwise	1 hour at 150 °C	40 min	%	76
Izod impact, notched				
Lengthwise	48 hours at 50 °C	7.0 min.	ft•lb/inch	16.2
Crosswise	48 hours at 50 °C	5.5 min.	ft•lb/inch	13.2
Peel strength, width				
1 oz. copper	1 hour at 150 °C	3.0 min.	lb/inch	6.0
1 oz. copper	20 sec. solder dip	8.0 min.	lb/inch	8.5
Water absorption	24 hours at 23 °C	0.20 max.	%	0.04
Volume resistivity	96 hours at 35 °C, 90% RH	10^6 min.	megohm•cm	4×10^8
Surface resistivity	96 hours at 35 °C, 90% RH	10^4 min.		2×10^6
Dielectric constant, at 1 megacycle	23 °C, 50% RH	5.2 max.		5.1
	24 hours at 23 °C, in water	5.4 max.		5.3
Dissipation factor, at 1 megacycle	23 °C, 50% RH	0.025 max.		0.012
	24 hours at 23 °C, in water	0.035 max.		0.015
Dielectric breakdown (KV), parallel to laminations	23 °C, 50% RH	45 min.		> 56
	48 hours at 50 °C	40 min.		> 56

[1] Twelve-ply 181 style. 1-550 finish glass.

Glass vs. Requirements

Table 5/ Propertles of Glass Laminate [1] vs. MIL-P-55617A, Type GE and NEMA G-10-UT Requirement

Laminate property	Conditioning	Specification requirements	Units	Test results
Resin content	—	—	wt %	59
Thickness	—	0.031 max.	inch	0.003
Visual effect of solder dip	20 seconds at 200 °C	No effect		No effect
Peel strength [2]				
at 25 °C	20 second solder dip	6 min.	lb/inch	7.1
at 25 °C	5 temperature cycles [3]	6 min.	lb/inch	7.7
at 25 °C	1 hr. at 125 °C	7 min.	lb/inch	7.7
at 25 °C	Exposure to plating solution [4]	5 min.	lb/inch	7.2
at 125 °C	None	5 min.	lb/inch	6.8
Volume resistivity				
at 25 °C	96 hours at 35 °C, 90% RH	10^{12} min.	ohm•cm	1.5×10^{13}
at 125 °C	24 hours at 125 °C	109 min.	ohm•cm	4.5×10^{11}
Surface resistivity				
at 25 °C	96 hours at 35 °C, 90% RH	10^{10} min.	ohm•cm	1.5×10^{12}
at 125 °C	24 hours at 125 °C	10^{9} min.	ohm•cm	1.5×10^{11}
Dimensional stability	Etching	0.0005 max.	inches/inch	0.00032
	30 minutes at 170 °C	0.0005 max.	inches/inch	0.00045
	5 temperature cycles [3]	0.0003 max.	inches/inch	0.00006
Dielectric strength	48 hr. water immersion at 50 °C	750 min.	volt/mil	925
Dielectric constant, at 1 megacycle	None	5.4 max.		4.6
Dissipation factor, at 1 megacycle	None	0.035 max.		0.02

[1] Two-ply laminates prepared from Style 106, GB-399 Finish Glass.

[2] One ounce per square tool copper with “TC” treatment.

[3] Cycle conditions: 30 minutes at 125 °C, 15 minutes at 25 °C, 30 minutes at -65 °C, and 15 minutes at 25 °C.

[4] Exposed to hot trichlorethylene vapor, hot aqueous sodium hydroxide/sodium carbonate, hot aqueous sodium cyanide, and hot aqueous sulfuric acid/boric acid and solutions.

Storage Recommendations regarding storage conditions can be obtained by visiting our web site at www.hexion.com

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General Information

These are starting formulations and are not proven in the user's particular application but are simply meant to demonstrate the efficacy of the products and to assist in the development of the user's own formulation. It is the user's responsibility to fully-test and qualify the formulation, along with the ingredients, methods, applications or equipment identified herein ("Information"), by the user's knowledgeable formulator or scientist, and to determine the appropriate use conditions and legal restrictions, prior to use of any Information.

Safety, Storage & Handling

Please refer to the MSDS for the most current Safety and Handling information.

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