Starting Formulation

SF 8038

Epoxy Resin System for Infusion and RTM of Aerospace Interior Parts
EPON™ FlameX™ Resin 9600 / EPIKURE™ FlameX™ Curing Agent 9700

Introduction

EPON FlameX Resin 9600 cured with EPIKURE FlameX Curing Agent 9700 is a non – halogenated, homogenous epoxy resin system designed for infusion and RTM process requiring fire, smoke and toxicity (FST) performance for aerospace applications. The resin system provides rapid build rates and a combination of performance and flexibility for the most demanding applications. Parts made from this resin system pass the 60s vertical burn FAR25.853(a), smoke toxicity BSS7239 and smoke density BSS7238 standards. The resin system is homogenous (no particulates) and hence no filtering or settling occurs during processing. It can also be used for other liquid composite fabrication processes, such as Filament Winding and Hand Lay Up. In combination with a certified intumescent coating or gel coat, it is will pass the OSU heat release requirement as specified by FAR 25.853, Appendix F, Part V.

Suggested Uses

- Infusion or RTM of Aerospace Interior parts
- Hand Lay-up and Filament Winding processes

Features

- Low system viscosity, 250 – 300 cP at 60°C
- Excellent fire, smoke and toxicity performance
- Homogenous, with no filtering or settling

Typical Properties

Table 1 / Typical Component Properties

	Method	Units	EPON FlameX Resin 9600
Epoxide equivalent weight	ASTM D 1652	g/eq	256
Viscosity @ 25 °C (77 °F), Brookfield	ASTM D 2196	cP or mPa.s	10,448
Density @ 25 °C (77 °F)	ASTM D 1475	g/cc	1.22
	Method	Units	EPIKURE FlameX Curing Agent 9700
Viscosity @ 25 °C (77 °F), Brookfield	ASTM D 2196	cP or mPa.s	650
Density @ 25 °C (77 °F)	ASTM D 1475	g/cc	1.02

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Mix Ratio

Material	Parts by Weight	Parts by Volume
EPON FlameX Resin 9600	100	100
EPIKURE FlameX Curing Agent 9700	1.2 to 5	1.4 to 6.0

Mixing Instructions

The stated mixing ratio should be followed carefully. Adding more or less hardener than desired will result in an incomplete cure with limited performance that cannot be corrected. Resin and curing agent must be mixed carefully. The resin should be heated to 50 – 70 C before addition of the curing agent. Mix until no clouding is visible in the mixing container. Special attention must be paid to the walls and bottom of the mixing container when mixing by hand.

Table 2 /Properties of Resin System

	Units	Value
Viscosity at 40 °C, Brookfield	cP or mPa.s	1,450 – 1,500
Viscosity at 50 °C, Brookfield		575 – 675
Viscosity at 60 °C, Brookfield		250 – 300
Shyodu gel time @ 60 °C		
Shyodu gel time @ 105 °C		24
Pot Life @ 60 °C with 100 : 1.2 mix ratio	Hours	22
Time to 1,000 cP [1]	Minutes	> 24
Pot Life @ 60 °C with 100 : 5.0 mix ratio	Hours	2.1
Time to 1,000 cP	Hours	5.2
Time to 5,000 cP		
Time to 10,000 cP		7.6
Density @ 25 °C	g/cc	1.22

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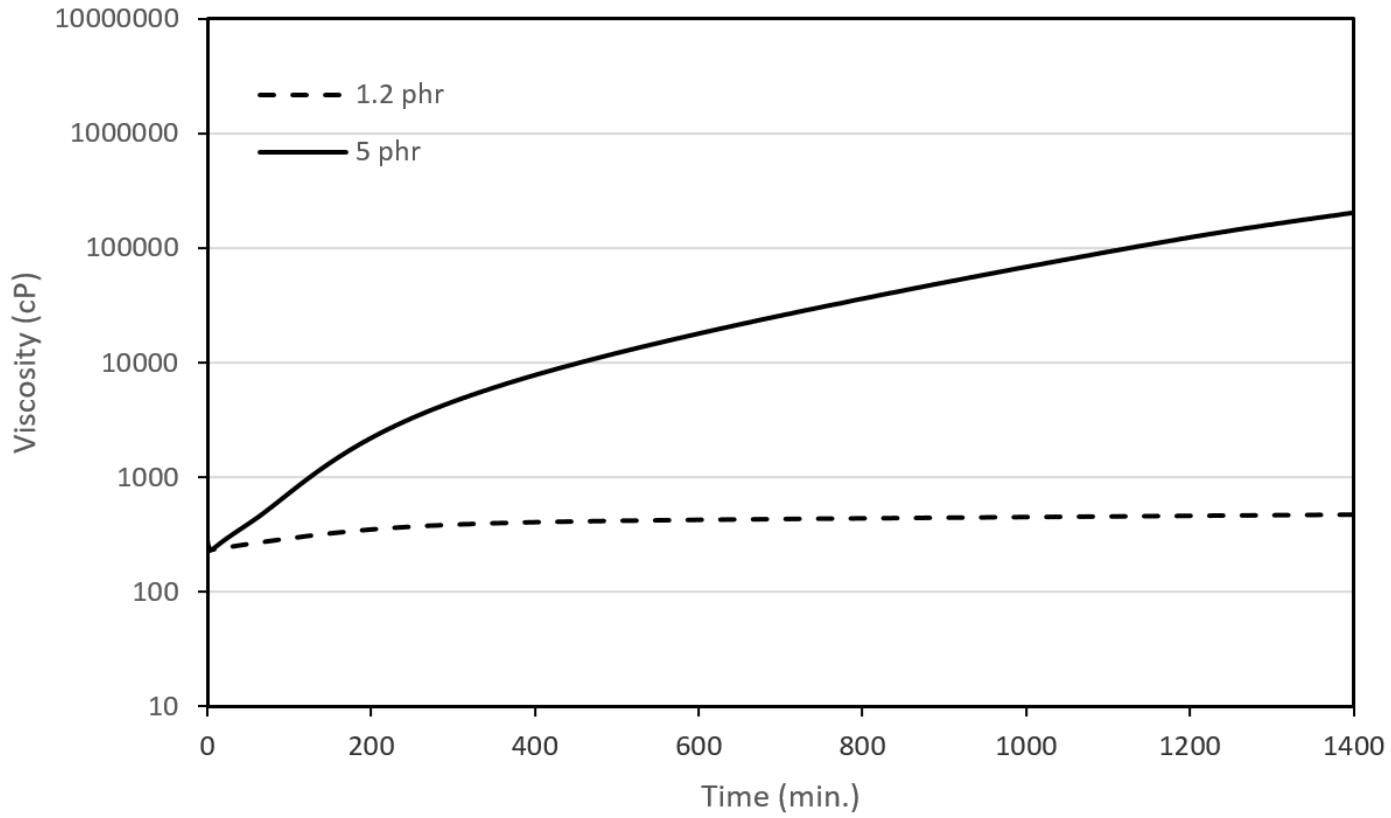
[1] Parallel plate rheometer viscosity

Graph 1 / Viscosity vs. Time at 60□C(Parallel plate rheometer)



Graph 2 / Viscosity over Time at two mix ratios (100 : 1.2 and 100 : 5.0) for a given suggested cure profile(Parallel plate rheometer)

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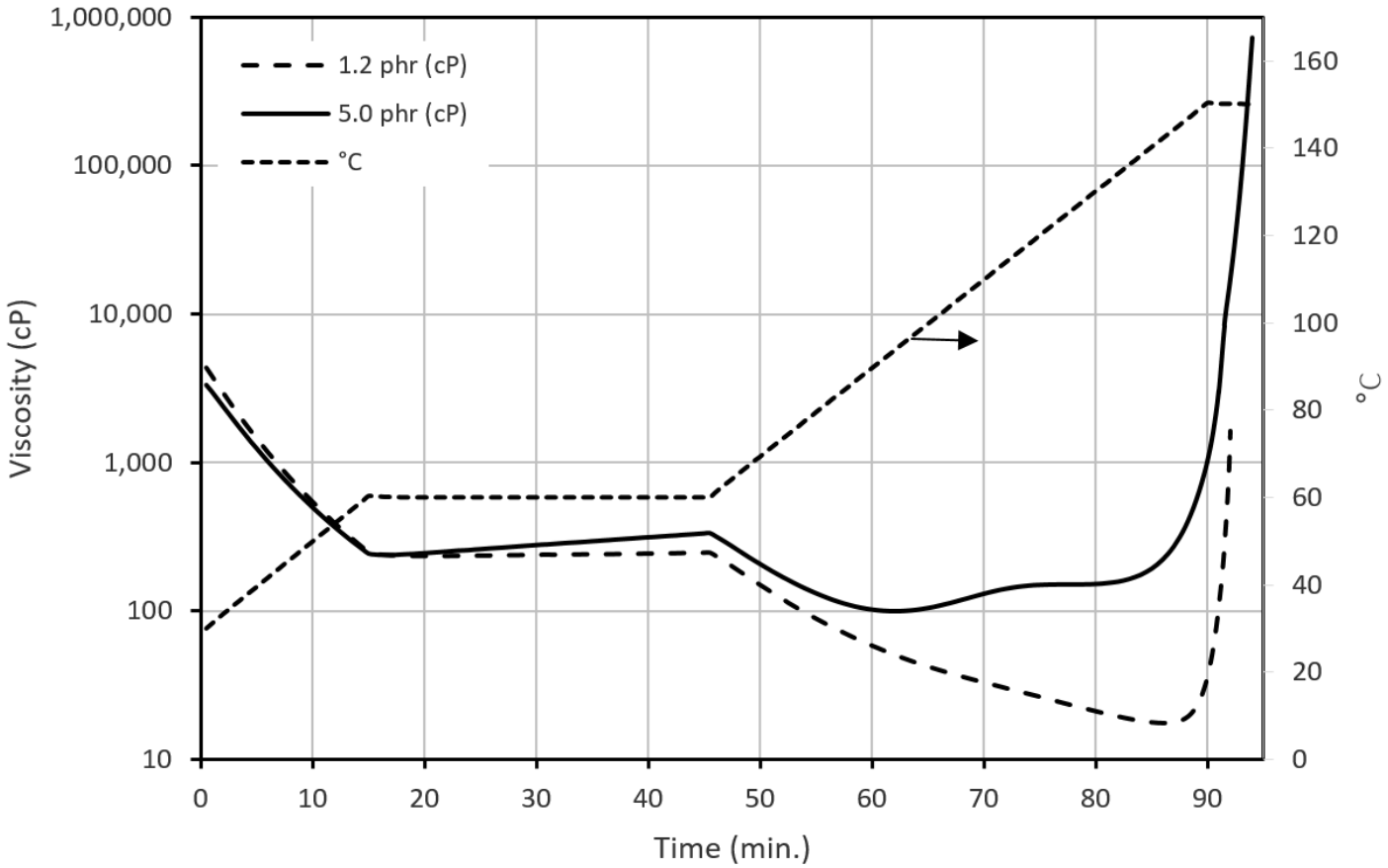

Typical Cured State Properties

Table 3 /Typical cured neat resin system casting properties at a mix ratio of 100 : 1.2 of

EPON FlameX Resin 9600 / EPIKURE FlameX Curing Agent 9700

-	Method	Units	Value
Cure Schedule		hrs/°C	1.5h at 150 °C
T_g by DSC (20°C/min)		°C	85 – 90
T_g by DMA (E' onset)		°C	90 – 95
Tensile	ASTM D-3039		
Strength		MPa	95 yield (91 ultimate)
Modulus		MPa	3,800
Elongation		%	5 to 6

Composite Fabrication

The low viscosity and homogenous compositions of the resin system make it desirable for Infusion, or Hand Layup applications.

Mixing – A mechanical mixer is recommended to insure complete mixing. Mixing time should be kept to a minimum to avoid excess heat build-up of the resin system, as this can reduce the working life of the system.

Resin mixture – The recommended resin mixture temperature is 50 – 70 °C to maximize mixing efficiency.

Degassing of mixed components is highly recommended to achieve optimal wet out and mechanical performance.

Process Conditions:

- Mixing: Mix at 50 – 70 °C use as soon as practical. A mixing head or dispensing unit can also be used.
- Infusion:
  - The resin mixture can be infused using standard infusion (VARTM or RTM) at a temperature of 60 – 70 C. Since the system is low viscosity and homogenous, a range of fabrics from tight weave to loose roving can be selected for the desired application.
  - For sandwich panels, process compatible cores (foam, sealed honeycomb) can be used.
  - For high throughput processing, the use of a flow media is recommended
- Hand lay up:
  - Since the viscosity of the mixture between 50 – 70 °C is low and the formulation is homogenous, a range of fabrics from tight weave to a loose roving can be selected for the desired application.
  - Vacuum bag (wet bagging) should be applied to achieve consolidation of the part when utilizing hand lay-up processes. Typically a vacuum of < 100 mbar is applied till the part

cures or gains green strength

- Cure profile: The resin system has good work life. Please refer to the isothermal viscosity development at 60 °C above. The suggested cure profile with 100 : 1.2 mix ratio is at 150 °C for 1.5hrs. This cure time can be shortened by increasing the curing agent loading to upto a mix ratio of 100 : 5.0.
- Post Cure: A post cure will enhance mechanical properties. It is recommended that a post cure of about 180 °C take place as a free standing or supported part.
- Intumescent coating: The use of an intumescent coating or in mold gel coat can also be used. Acrylic, Vinyl Ester or Epoxy gel coats will adhere well to the resin system, but a small test panel is recommended before production scale parts.

Typical Laminate Properties

Table 4 / Typical laminate properties at a mix ratio of 100 : 1.2 of EPON FlameX Resin 9600 / EPIKURE FlameX Curing Agent 9700[1]

	Method	Units	Value
Cure Schedule		hrs/°C	Ramp to 150 C, hold for 1.5 h
T_g by DSC (20˚C/min)		°C	88
Vertical burn, 60s test	FAR 25.853 (a)	-	PASS
Smoke density	Boeing standard BSS 7238	-	PASS
Smoke toxicity	Boeing standard BSS 7239	-	PASS

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[1] Construction of laminate: 4 ply panel, 8H Satin weave glass fabric, achieving a fiber weight of 50 – 65%.

Typical Sandwich Panel Properties

	Method	Units	Value
Cure Schedule		hrs/°C	Ramp to 150 C, hold for 1.5 h
Smoke density	Boeing standard BSS 7238	-	PASS
Smoke toxicity	Boeing standard BSS 7239	-	PASS
Heat release test	FAR 25.853, Appendix F, Part V	kW / m^2	Peak HRR, 77
		$kW . min / m^2$	Total HR, 62

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[1] Construction of sandwich: 2 ply 8H satin weave glass fabric – FOAM CORE – 2 ply 8H satin weave glass fabric, achieving 40 – 50 % resin to fiber ratio.

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 SDS for the most current Safety and Handling information.

Please refer to the Hexion Inc. web site for Shelf Life and recommended Storage information.

Exposure to these materials should be minimized and avoided, if feasible, through the observance of proper precautions, use of appropriate engineering controls and proper personal protective clothing and equipment, and adherence to proper handling procedures. None of these materials should be used, stored, or transported until the handling precautions and recommendations as stated in the Safety Data Sheet (SDS) for these and all other products being used are understood by all persons who will work with them. Questions and requests for information on Hexion, Inc. ("Hexion") products should be directed to your Hexion sales representative, or the nearest Hexion sales office. Information and SDSs on non-Hexion, Inc. products should be obtained from the respective manufacturer.

Contact Information

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