Technical Datasheet

INEOS Composites

HETRON™ 800 Furan Resin

HETRON 800 resin is a thermosetting furan polymer derivative of furfuryl alcohol and furfural. A phthaloyl chloride catalyst is used to cure this resin. When cured, fiberglass reinforced plastic (FRP) laminates made with HETRON 800 furan resin exhibit excellent corrosion resistance properties. These properties include resistance to alkali, solvents and corrosive combinations of acid and solvent media-environments which would be unsuitable for FRP equipment made with polyester resins.

HETRON 800 furan resin has limited resistance to oxidizing chemicals and should not be used for FRP equipment which will be in service for chromic and nitric acids, peroxides or hypochlorites.

APPLICATIONS AND USE

HETRON 800 resin can be used for corrosion resistant FRP equipment including pipes, tanks, fume hoods, ducts, linings and flake glass coatings where fire retardancy is not required.

Recommendations for specific services and environments can be provided by contacting us at hetron@ineos.com.

TYPICAL LIQUID RESIN PROPERTIES

Property(1) at 25°C (77°F)	Value	Unit
Viscosity, Brookfield	240	mPa·s (cps)
pH	6.5	%
Color	dark brown	
Specific Gravity	1.21	gm/cc

(1) Properties are typical values based on material tested in our laboratories. Typical values should not be construed as a guaranteed analysis of any specific lot or as specification items.

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TYPICAL CURING CHARACTERISTICS

Typical(1) HETRON 800 resin gel times with phthaloyl chloride catalyst(2).

Although fiberglass reinforced equipment will normally cure to a rigid state within 24 hours, HETRON 800 resin cure is dependent upon both ambient air and mold temperatures and the amount of catalyst used.

Table 1 - Temperature, °C (°F)	Catalyst(2) phr(3)	Gel Time, minutes
19°C (65°F)	2.5	33.0
	3.0	27.5
	4.0	19.0
	5.0	16.0
25°C (77°F)	2.5	17.5
	3.0	15.0
	4.0	11.5
	5.0	10.0
32°C (90°F)	2.5	10.0
	3.0	8.5
	4.0	6.5
	5.0	5.5

Table 2 - HETRON 800 furan resin quantity	Desired catalyst level, %	Catalyst volume, cc	Catalyst volume, fl.oz.
1 Pint; 572 grams (1.26 lb.)	2.5	10.7	0.27
	3.0	13.0	0.32
	4.0	17.3	0.42
	5.0	21.5	0.53
1 Quart; 1148 grams (2.53 lb.)	2.5	21.4	0.54

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	3.0	26.0	0.64
	4.0	34.6	0.84
	5.0	43.0	1.06
1 Gallon; 4585 grams (10.1 lb.)	2.5	85.0	2.16
	3.0	104	2.56
	4.0	138	3.36
	5.0	172	4.24

(2) The phthaloyl chloride catalyst used typically contains 7 - 20% dimethyl phthalate.
(3) Parts by weight per 100 grams of resin; 300 grams used per gel time test

CURING OF FURAN RESINS: The nature of their chemistry makes furan resins very reactive to acidic catalysis. This causes spontaneous polymerization which generates heat. Unlike polyester resins which also polymerize exothermically, furan resins polymerize with the formation of water during the exothermic reaction, which can vaporize rapidly unless carefully controlled. Vapor formation can result in delamination and blistering within the FRP laminate.

The furan condensation polymerization reaction is more sensitive to temperature effects and over-catalysis than the corresponding polymerization reaction of polyester resins. Low fabrication temperatures, 15.5-18.5°C (60-65°F) usually result in a composite which may take extensive periods of time to cure and may not develop satisfactory corrosion resistance. At low temperatures, the use of increased levels of catalyst will result in only minor improvements in cure; therefore, it is recommended that furan resin fabrication not be attempted at temperatures below 18.5°C (65°F).

Higher ambient temperatures, 29.5-32°C (85-90°F) may present other problems such as reduced pot life or working time or the blistering and delamination of the thicker sections of the laminate. In spite of the highly exothermic nature of the curing reaction, furan resin does not cure very rapidly at room temperature in thinner films. To achieve optimum strength and corrosion resistance, applications must undergo a post-cure schedule at carefully selected temperatures depending on the laminate thickness.

CATALYSIS: This system has a limited gel time range at temperatures between 18.5 and 32°C (65 and 90°F) as shown in Table 1. It is recommended that the catalyst be used between 2.5 and 5.0 parts per 100 parts by weight of resin and that no more than 11 liters (three gallons) of HETRON 800 resin be catalyzed at one time. Refer to Table 2 for proper levels of catalyst in cc's or fl. oz. for

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resin volumes. Once mixed, the resin should be dispensed as rapidly as possible onto the mold or mandrel surface. The short pot life, however, will not be encountered once the catalyzed resin is dispensed over the mold surface. This will allow for sufficient working time followed by a rapid gel and cure development. In hot climates, HETRON 800 resin should be cooled prior to use.

Catalyzation of large amounts or resin can result in an uncontrollable exothermic reaction which could pose a hazard to workers and the workplace. However, exotherming resin in a pot may be effectively controlled by total immersion in a container of water.

All furan resin FRP fabrications using 18 g/m^2 (10 mil) C-glass surfacing veil in the liner must be post-cured to a Barcol hardness development above 45 prior to placing any FRP equipment into service. Synthetic surfacing veil is not recommended in the liner. As soon as the fabrication attains structural stability (this will depend on the part design and thickness), it should be removed from the mandrel or mold to allow the inner furan surface to be exposed to the air. Surface condensate retards curing and for this reason, air and heat must be allowed to carry off any moisture build-up. Under ambient conditions, the exposed laminate surfaces will cure first and register higher Barcol values than the laminate interior. For these reasons, furan resin fabrications must be post-cured or literally "baked" to drive out reaction condensate to promote full cross-linking and cure.
Post-curing is generally carried out in 11°C (20°F) temperature increments starting at 49°C (120°F), particularly on green or new fabrications to avoid delaminations and blistering. Furan fabrications that are several weeks old and have developed an initial Barcol hardness under ambient conditions can generally be post-cured immediately at 82°C (180°F) to attain optimum performance characteristics. Length of post cure will depend upon part thickness. For process conditions not covered in this technical data sheet, contact your INEOS Composites technical representative.

Read the Material Safety Data Sheets carefully. Make certain that you understand them prior to using these materails. The hazards associated with this system are significantly different from other materials typically used in composite manufacturing operations.

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Suggested HETRON® 800 Resin Laminate Cure Profile

(hours at temperature)

	Initial Ambient Cure Times		Post Cure Steps				
			Step 1	Step 2	Step 3	Step 4	Step 5
Laminate Thickness (mm / in)	16 - 24° C -or- 60 - 75° F	24 - 38° C 75 - 100° F	50° C 120° F	60° C 140° F	71° C 160° F	82° C 180° F	93° C 200° F
4.8 / 0.188	36	24	2	2	2	2	-
6.4 / 0.250	36	24	3	3	3	3	-
9.5 / 0.375	36	24	4.5	4.5	4.5	4.5	-
12.7 / 0.500	48	36	6	6	6	6	-
15.9 / 0.625	48	36	7.5	7.5	7.5	7.5	-
19.1 / 0.750	72	48	9	9	9	9	9
25.4 / 1.000	96	72	12	12	12	12	12

For initial cure, hold for the time period specified (hours) depending on the ambient temperature range.

Post Cure - Hold each step at the temperature shown unitl the greater of the two criteria listed - Barcol Hardness or Time - is achieved.
Hold Step 1 for the minimum time listed (hours) and then until the laminate reaches a minimum Barcol Hardness of 10.
Hold Step 2 for the minimum number of hours shown.
Hold Step 3 for the minimum time listed and then until the laminate reaches a minimum Barcol Hardness of 30
Hold Step 4 for the minimum time listed and then until the laminate reaches a minimum Barcol Hardness of 45 unless thickness requires step 5.
Hold Step 5 for the minimum time listed and then until the laminate reaches a minimum Barcol Hardness of 45

TYPICAL MECHANICAL PROPERTIES

Property[1] of a cured casting at 25°C (77°F)	Value (SI)	Value (US)	Method
Barcol Hardness	40	40	ASTM D2583
Tensile Strength	35 MPa	5200 psi	ASTM D638
Tensile Modulus	3.8 GPa	5.7 x 10[5] psi	ASTM D638
Tensile Elongation	1.0%	1.0%	ASTM D638
Flexural Strength	71 MPa	10,500 psi	ASTM D790
Flexural Modulus	3.9 GPa	5.8 x 10[5] psi	ASTM D790
Heat Distortion Temperature	100°C	212°F	ASTM D648

CERTIFICATES AND APPROVALS

The manufacturing, quality control and distribution of products, by INEOS Composites, comply with one or more of the following programs or standards: Responsible Care, ISO 9001, ISO 14001 and OHSAS 18001 by .

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STANDARD PACKAGE	Non-Returnable Drum with Net Weight of 250 Kgs (551 Lbs) DOT Label Requirement: Flammable Liquid
COMMERCIAL WARRANTY	Three months from date of shipment, when stored in accordance with the conditions stated below.
STORAGE	Drums - Store at temperatures below 25°C (77°F). Storage life decreases with increasing storage temperature. Avoid exposure to heat sources such as direct sunlight or steam pipes. To avoid contamination of product with water, do not store outdoors. Keep containers sealed to prevent moisture pick-up and monomer loss. Mild mixing is recommended after prolonged storage. Rotate stock. Bulk - See INEOS Composites's Bulk Storage and Handling Manual for Polyesters and Vinyl Esters. A copy of this may be obtained from INEOS Composites at +1.614.790.3333 or 800.523.6963. All other conditions being equal, higher storage temperatures will reduce product stability and lower storage temperatures will extend product stability.
Notice	All information presented herein is believed to be accurate and reliable, and is solely for the user's consideration, investigation and verification. The information is not to be taken as an express or implied representation or warranty for which INEOS Composites assumes legal responsibility. Any warranties, including warranties of merchantability, fitness for use or non-infringement of intellectual property rights of third parties, are herewith expressly excluded. Since the user's product formulations, specific use applications and conditions of use are beyond the control of INEOS Composites, INEOS Composites makes no warranty or representation regarding the results which may be obtained by the user. It shall be the sole responsibility of the user to determine the suitability of any of the products mentioned for the user's specific application. INEOS Composites requests that the user reads, understands and complies with the information contained herein and the current Material Safety Data Sheet.

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INEOS Composites is committed to the continuous evolution of technology and service solutions that promote health, safety and environmental protection around the world.