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HUNTSMAN
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Technical Bulletin

Accelerator 400

Epoxy Curing Promoter for use with JEFFAMINE® Curing Agents

Accelerator 400 is a superior epoxy curing promoter designed for use with amine hardeners. The product was developed specifically for use with JEFFAMINE® curing agents, but it is compatible with most amines and may be used in most amine-cured epoxy systems.

SALES SPECIFICATIONS

Property	Specifications	Test Method*
Appearance	Clear, pale yellow, slightly viscous liquid free of suspended matter	ST-30.1
Color, Pt-Co	200 max.	ST-30.12
Water, wt%	0.4 max.	ST-31.53, 6

*Methods of Test are available from Huntsman Corporation upon request.

ADDITIONAL INFORMATION

Regulatory Information

See SDS for all regulatory information.

Typical Properties

AHEW (Amine hydrogen equivalent wt.)	145
Flash point, PMCC, °C (°F)	90 (194)
Freeze point, °C (°F)	-5.4 (22.3)
Density, g/ml, 25°C (77°F)	1.09
Density, lb/US gallon, 25°C (77°F)	9.10
Specific Gravity, 25/25°C	1.09
pH, 5% aqueous	10.9
Viscosity, kinematic, cSt	
15.6°C (60°F)	1830
25°C (77°F)	811
37.8°C (100°F)	301
65.6°C (150°F)	58

AVAILABILITY

Small evaluation samples can be obtained in North America by contacting any Huntsman Performance Products sales office.

TOXICITY AND SAFETY

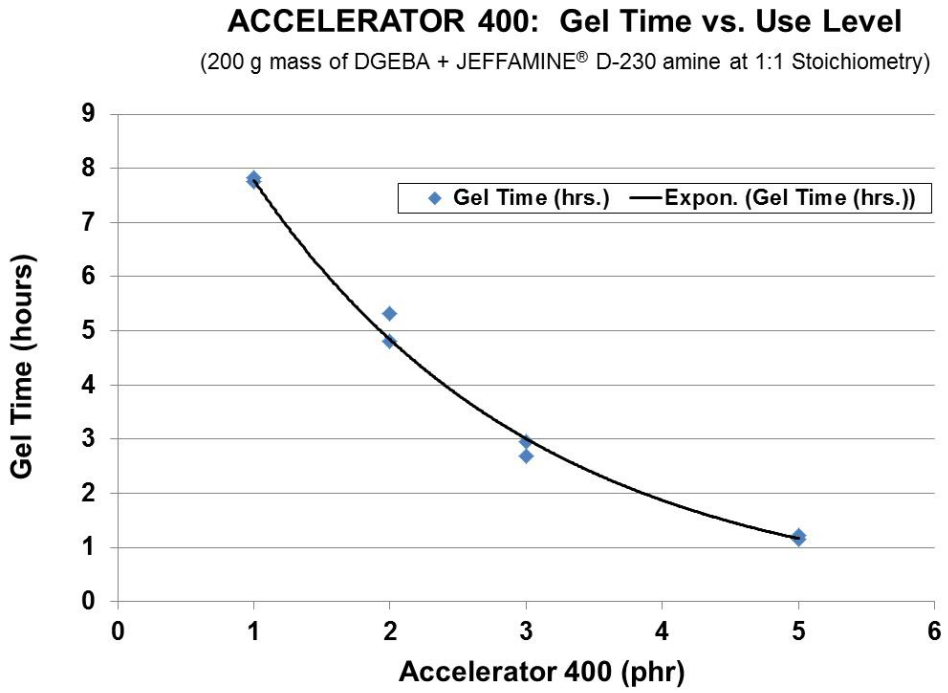
For information on the toxicity and safe handling of this product, consult the Safety Data Sheet prior to use of the product.

PERFORMANCE DATA

Reactivity

Gel time data presented in Figures 1-3 were obtained using a standard DGEBA resin (EEW = 187) with JEFFAMINE® D-230 amine hardener using a 200-gram mass at a one-to-one amine hydrogen to epoxide stoichiometry.

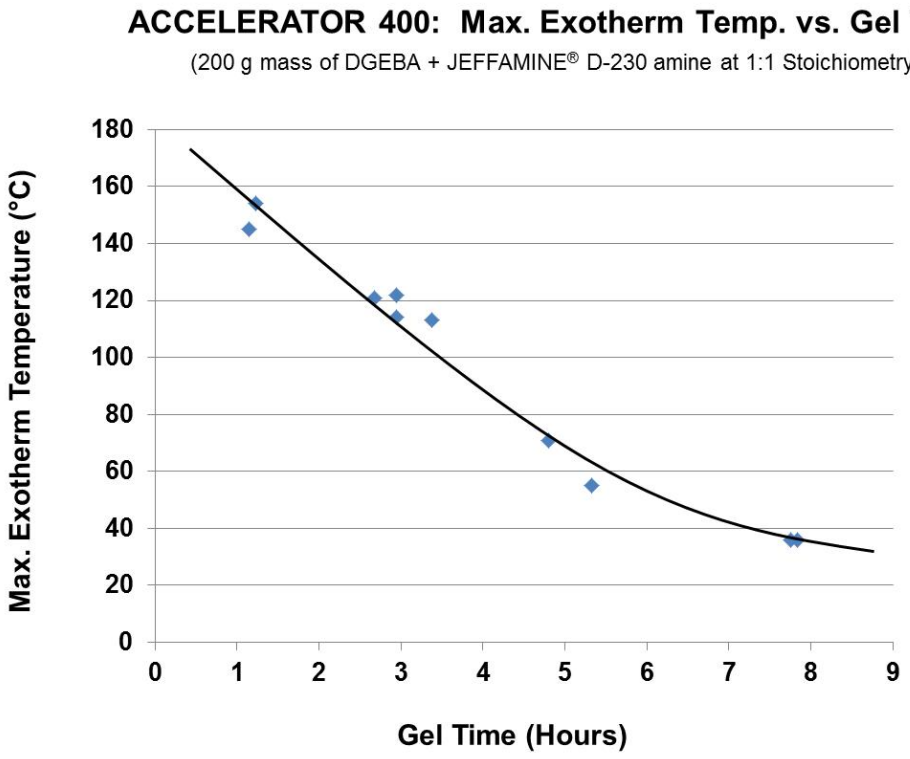
Figure 1



It is evident from Figure 1 that using accelerator levels greater than five phr provides incrementally less reduction of the gel time.

Figure 2 illustrates how maximum exotherm temperatures increase as gel times decrease from addition of greater amounts of accelerator.

Figure 2



Mechanical and Thermal Properties

For verification that Accelerator 400 would provide equivalent mechanical performance when used in place of Accelerator 399, castings of a standard DGEBA type resin and JEFFAMINE® D-230 amine were prepared using 5 phr of each accelerator at a one-to-one stoichiometry of amine hydrogen to epoxide. Properties following an elevated temperature cure are shown in Table 1 and following a room temperature cure, in Table 2. As shown in both tables, no significant differences were observed in mechanical properties.

Table 1: Properties after Elevated Temperature Cure: 3 hours at 80°C + 2 hours at 125°C

Property	Accelerator 400, 5 phr		Accelerator 399, 5 phr	
Glass Transition Temperature (T_g), °C	83.7		82.1	
Tensile strength, psi (MPa)	10,130	(69.84)	9,990	(68.88)
Tensile modulus, psi (GPa)	419,400	(2.891)	420,200	(2.897)
Elongation at break, %	4.43		4.38	
Flexural strength, psi (MPa)	15,670	(108.0)	15,740	(108.5)
Flexural modulus, psi (GPa)	447,300	(3.084)	446,200	(3.076)

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Table 2: Properties after Room Temperature Cure: 7 days at Room Temperature

Property	Accelerator 400, 5 phr		Accelerator 399, 5 phr	
Glass Transition Temperature (T_g), °C	49.9		50.1	
Tensile strength, psi (MPa)	9,170	(63.22)	9,135	(62.98)
Tensile modulus, psi (GPa)	495,000	(3.413)	478,000	(3.296)
Elongation at break, %	1.91		1.97	
Flexural strength, psi (MPa)	11,940	(82.32)	12,270	(84.60)
Flexural modulus, psi (GPa)	508,800	(3.508)	501,200	(3.456)

Calculation of Stoichiometry

Although some users may continue to formulate epoxy systems with minimal regard of stoichiometry, close attention to this detail is important to best assure the long-term performance of the cured epoxy resin. Adhering to a one-to-stoichiometry can often provide assurance that levels of either residual epoxide or amine groups are minimized. In systems that are either off-stoichiometry or under-cured (incompletely polymerized), maximum glass transition temperatures will not be reached, hardness may suffer, and residual groups may react with the environment over time (typically water, carbon dioxide, or oxygen) creating changes in properties.

The amine hydrogen equivalent weight (AHEW) of any blend of amine hardener and Accelerator 400 may be calculated as follows:

$$\text{AHEW of amine hardener + Accelerator 400} = \frac{\text{Grams of amine hardener + Grams of Accelerator 400}}{\frac{\text{Grams of amine hardener}}{\text{AHEW of hardener}} + \frac{\text{Grams of Accelerator 400}}{145}}$$

Since formulation of epoxy resins with reactive accelerators continues to be done using phr (parts per hundred of resin) values, formulators may find it convenient to choose their best estimate of accelerator usage in phr and then calculate the amount of amine hardener needed to attain a one-to-one stoichiometric ratio. This may be done as follows, based on a resin quantity of 100 grams:

$$\textbf{Grams of amine hardener to use in the blend with Accelerator 400} = \left\{ \frac{\text{100 grams of epoxy resin}}{\text{EEW of the epoxy resin}} - \frac{\text{phr of Accelerator 400}}{145} \right\} \textbf{X} \begin{matrix}\text{AHEW} \\ \text{of the} \\ \text{amine}\end{matrix}$$

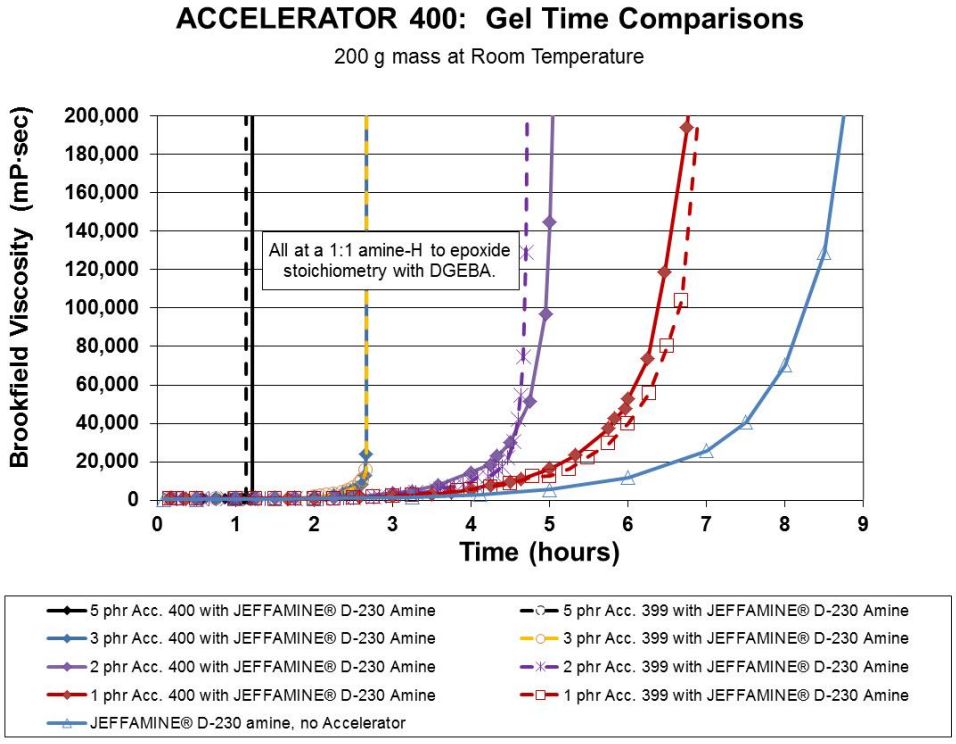
Use in Epoxy Formulations

Accelerator 400 is typically used by incorporating it into the amine side of a two-part formulation at levels up to 5 phr (parts per hundred of epoxy resin). Use of higher levels can further shorten gel times though with diminishing returns, as previously noted. Accelerator 400 not only accelerates curing but can lead to a higher degree of polymerization in some systems due to the plasticizing effect of some of its components. With lower T_g

capable amine hardeners, or in plasticized formulations, use of Accelerator 400 may allow ambient temperature curing in flooring, floor coatings, and potting applications.

Figure 3 shows viscosity vs. time results for Accelerator 400 used at levels of 1, 2, 3, & 5 phr. The vertical or near-vertical portions of the plotted lines indicate gelation or its incipient onset. The slight differences seen in some of the plot pairs are insignificant. Accelerator 400 is a drop-in replacement for Accelerator 399.

Figure 3



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