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Advanced Materials

Araldite® GY 6010 Liquid Epoxy Resin

GENERAL

Araldite® GY 6010 is a medium viscosity, general purpose unmodified liquid epoxy resin applied widely in both room temperature and heat cured systems. It is the standard from which a great number of variations were developed.

CHEMICAL DESCRIPTION

Araldite® GY 6010 is an unmodified liquid epoxy resin based on bisphenol A and epichlorohydrin.

APPLICATIONS

Coatings	Matrix
Electrical	Adhesives
Civil Engineering	

ADVANTAGES

Superior mechanical and electrical properties
Excellent chemical resistance
Good heat resistance
Excellent adhesion
Outstanding versatility
Easy to cure with a variety of different type hardeners
Compatible with many different fillers, diluents and accelerators
Conforms to FDA listings in 21 CFR 175.300

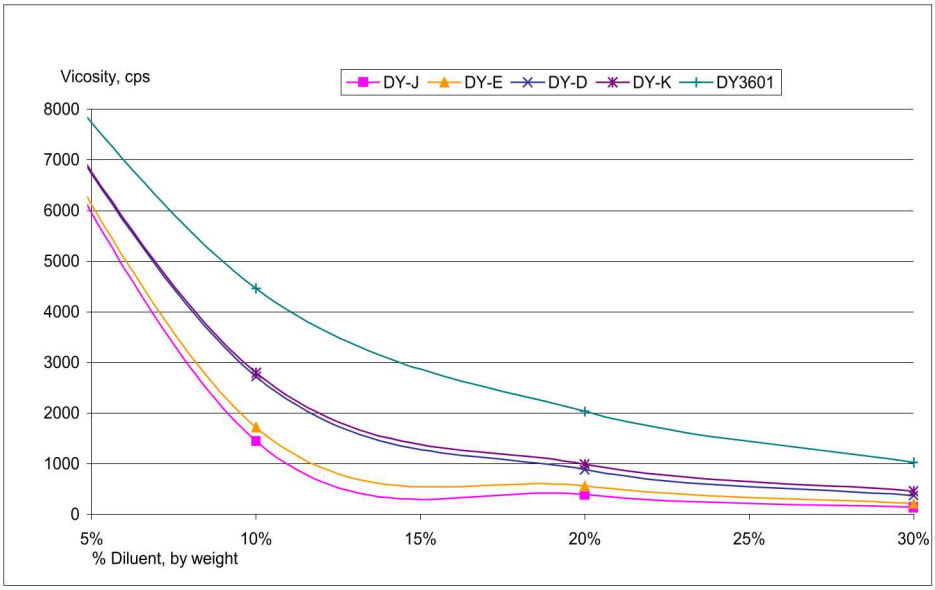
TYPICAL PROPERTIES*

Visual Appearance	Clear, no contamination
Color, Gardner, max	1
Epoxy Value, eq./kg	5.2 - 5.5
Epoxy Equivalent, g/eq.	182 - 192
Viscosity @ 25°C (77°F), mPa s (cPs)	11,000 - 14,000
Density @ 25°C (77°F), g/cm^3 (lb/gal.)	1.15 - 1.18 (9.6 - 9.8)
Flash Point, Closed Cup, °C (°F)	254 (490)

* Typical properties are based on Huntsman's test methods. Copies are available upon request.

REDUCING VISCOSITY OF Araldite® GY 6010

The graph below represents the viscosity of modified Araldite® GY 6010 vs % diluent (by weight) for five reactive diluents.



The addition of reactive diluents to Araldite® GY 6010 influences wet properties of coatings and performance of the cured films. Depending on the diluent used, it is expected that:

1) The viscosity and the reactivity of the system will be reduced.

2) Mechanical properties of the cured system will be impaired.

3) Thermal stability of the system will be reduced.

4) Resistance to water and aqueous solutions at elevated temperatures will be reduced.

5) Resistance to acids and organic solvents at ambient temperatures will be reduced.

The extent to which the above properties are affected depends on the reactive diluent content and its chemical nature.

HARDENERS

The final properties of a cured Araldite® GY 6010 system at ambient temperature depend, to a great extent, on the hardener selection. Because of its versatility, Araldite® GY 6010 can be cured with most types of hardeners such as:

Type	Huntsman Aradur®	Mixing Ratio phr*	Pot Life 100g mass @ 25°C (77°F) Hrs:Min
Modified Aliphatic amines	Aradur® 956-2	25	0:35
	Aradur® 943	20	0:15
	Aradur® 3440	35-45	0:35
	Aradur® 3441	60-80	0:75
Cycloaliphatic amines	Aradur® 2964	50	0.35
	Aradur® 2963	45	0:45
	Aradur® 1341	60	0:25
	Aradur® 265	50	0:40
	Aradur® 355	26	0:30
	Aradur® 847	40	0:40
Polyamides	Aradur® 115-2	35+	10:00
	Aradur® 125-2	35+	6:30
	Aradur® 140-2	35+	3:30
	Aradur® 283	70	2:30
	Aradur® 360	60	7:30
Anhydrides	Aradur® 906 NMA	80-90	-
	Aradur® 917 MTHPA	80-90	-

*per hundred parts by weight resin

+Depending on desired properties it can be 35-100 phr

CURING TIME

The curing time depends on the hardener used, the temperature applied and the mass of the resin/hardener mix. We recommend the following cure schedules for achieving the optimum properties of Araldite® GY 6010 systems.

Aradur® 906*	2 hr @ 10°C (212°F) +2-4 hr @150-200°C (302-398°F)
TETA Hardener	7 days @ room temperature or 24 hr @ 40°C or 2-9 hr @ 100°C (212°F)
Aradur® 956	7 days @ room temperature or 24 hr @ 40°C (104°F) or 2-8 @ 100°C (212°F)
Aradur® 125-2	7 days @ room temperature or 2-8 hr @ 100°C (212°F)
Aradur® 976-1	Gel @ 120-150°C (248-302°F) + 2-4 hr @ 175-200°C (347-392°F)

* Accelerators such as Accelerator 960-1, DY 062 (benzyldimethyl amine), etc., are usually used with Aradur® 906.

FORMULATIONS

Product	Parts by weight
Araldite® GY 6010	100
Aradur® 2964	50
Physical Properties	
Viscosity mixed @25°C, cPs	1000
Gel time, min., @25°C	30
Dust dry time, hr, @25°C	4
Full-cure time, hr, @25°C	7
Flow @25°C	Very good
Transparency	Clear
Surface appearance	Smooth, glossy
Exudation	None
Impact test	
2 months @ 20°C (68°F), in/lb	70
2 months @ 60°C (140°F), in/lb	70
Mandrel test	15mm mandrel
2 months @ 20°C (68°F)	180°
2 months @ 60°C (140°F)	60°
Boiling water test 6 hr @ 96°C (205°F)	
Adhesion on sandblasted mild steel sheet	Unchanged
After curing @ 20°C (68°F)/100% RH	
Full-time cure, hrs.	Approx. 30
Surface appearance	Smooth, glossy
Transparency	Clear
Exudation	None

FORMULATIONS (CONTINUED)

Chemical Resistance

	Test time, Months													
	¼	½	1	2	3	4	5	6	7	8	9	10	11	12
Water, deionized	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Seawater, synthetic	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sulfuric acid, 10%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sulfuric acid, 30%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Sulfuric acid, 70%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hydrochloric acid, 10%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hydrochloric acid, 20%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hydrochloric acid, 36%	+	+	+	+	A	D								
Acetic acid, 5%	+	+	+	+	D									
Acetic acid, 10%	+	A	D											
Ammonia, 10%	+	+	+	+	+	+	A	A	A	A	A	D		
Ammonia, 25%	+	+	A	D										
Caustic soda, 20%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Acetone	D													
Butanol	D													
Butyl acetate	+	+	+	+	+	+	+	+	+	+	+	+	+	(+)
Diacetone alcohol	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ethyl glycol	A	A	A	A	A	A	A	A	A	A	A	D		
Ethanol, 50%	+	+	+	A	A	A	A	A	A	A	A	A	A	A
Ethanol, 96%	D													
Octanol	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Xylene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Toluene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Benzene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Trichloroethylene	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Crude oil	+	+	+	+	+	+	+	+	+	+	+	+	+	+

(+) = slight softening initially but regenerate very rapidly
\+ = resistant
A = attacked
D = destroyed Hot Curing Casting Applications

Systems containing GY 6010 and polyamide hardeners such as Aradur® 939 reacting rapidly at relatively moderate temperatures (e.g., 5 min @ 100°C), provide excellent properties after curing at 150°C. Table 1 provides information on the effect of cure times on Adhesive Tensile Shear Strength.

The mixing ratio of Aradur® 939 is not critical and can be varied. As might be expected, the physical properties are dependent on the amount of hardener that is used. Table 2 illustrates several variations in the mix ratio.

Product	**Parts by weight**
Araldite® GY 6010	100
Aradur® 939	35

Physical Properties

Viscosity of mixture @ 25°C, cPs	120,000
Gel time (1g on cure plate), sec	
@ 100°C	300
@ 121°C	124
@ 150°C	54

Cure schedule: Gel @ 90°C + 3 hrs @ 150°C

FORMULATIONS (CONTINUED)

Mechanical Properties @ 25°C (ultimate)

Heat deflection temperature, °C	97
Tensile strength, psi	11,500
Elongation, %	4.6
Tensile modulus, psi x 10^5	4.9
Weight loss after 48 hrs @ 200°C,%	2.0

Electrical Properties

Volume resistivity (ohm·cm)	
@ 25°C	1.1 x 10^{16}
@ 100°C	9.0 x 10^{12}
@ 150°C	1.3 x 10^9

Table 1: Effect of Cure Time/Temp. on Adhesive Tensile Shear Strength

	Parts by Weight
Araldite® GY 6010	100
Aradur® 939	35
Cure: 6.5 min @ 150°C	
Tensile shear strength, psi	
@ 25°C	1620
@ 82°C	1050
@ 149°C	100
Cure: 10 min @ 159°C	
Tensile shear strength, psi	
@ 25°C	1630
@ 82°C	1050

Tensile shear strength (psi)	Tested @	
Cure: 10 min @:	25°C	82°C
100°C	560	-
121°C	560	880
150°C	1560	1050
177°C	1630	820

Table 2: Effect of Mix Ratio on Physical/Mechanical Properties

Aradur® 939 (phr) with Araldite® GY 6010	**Gel time @ 150°C, sec**	**HDT,°C**	**Tensile Shear Strength @ 25°C, psi**
25	76	78	1270
30	58	90	-
35	54	97	1620
40	45	95	1480
45	41	90	1690

FDA STATUS

Araldite® GY 6010 is included in Section 175.300 of Title 21 of the Code of Federal Regulations (21 CFR 175.300) for resinous and polymeric coatings.

STORAGE

Araldite® GY 6010 is supplied in 500 pound steel drums. This product should be stored in a dry place, in the sealed original container, at temperatures between +2°C and +40°C (+35.6°F and +104°F). Under these storage conditions, the shelf life is 3 years. The product should not be exposed to direct sunlight.

Araldite® GY 6010 is also supplied in bulk and 2500 pound totes. This product should be stored in a dry place, in the sealed original container, at temperatures between +2°C and +40°C (+35.6°F and +104°F). Under these storage conditions, the shelf life is 5 years. The product should not be exposed to direct sunlight.

Like most liquid epoxy resins, Araldite® GY 6010 may crystallize when stored below room temperature. Heating the resin to 60-70°C (140-160°F), preferably in a water bath, for several hours, will reliquify it and restore its original properties.

PRECAUTIONARY STATEMENT

Huntsman Advanced Materials Americas LLC maintains up–to-date Material Safety Data Sheets (MSDS) on all of its products. These sheets contain pertinent information that you may need to protect your employees and customers against any known health or safety hazards associated with our products. Users should review the latest MSDS to determine possible health hazards and appropriate precautions to implement prior to using this material.

First Aid!
Refer to MSDS as mentioned above.

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