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Advanced Materials

Araldite® CY 5622 Resin
Aradur® HY 1235 Hardener
Accelerator DY 062
Filler Silica Flour (Silanized)

Epoxy System with Hydrophobicity Transfer and Recovery for Outdoor Applications

DESCRIPTION :

Araldite® CY 5622 Resin / Aradur® HY 1235 hardener is a cycloaliphatic epoxy system that when mixed with DY 062 accelerator and silica flour produces a liquid, hot-curing electrical insulation material. It is designed for use in outdoor medium and high voltage applications that must perform under humid and severe climatic conditions such as apparatus components, pin/post insulators, bushings, instrument transformers and sensors.

PROCESSING :

- Automatic Pressure Gelation process (APG)
- Conventional gravity casting process under vacuum

FEATURES :

- Hydrophobicity transfer and recovery
- Good mechanical properties
- Good dielectric properties
- Very good thermal shock resistance
- High erosion resistance under UV radiation
- High tracking and arc resistance
- Extended insulation life-time

NOTE : The use of silanized silica flour produces stable dielectric properties under humid, outdoor conditions.

TYPICAL PROPERTIES :

Product	**Test Values**	**Test Method**
Araldite® CY 5622		
Liquid modified cycloaliphatic epoxy resin (diglycidylester)		
Viscosity @ 25 °C (77 °F), cPs (mPa s)	3,000 – 5,000	MS DIN 125*
Epoxy content, eq/kg	5.30 – 5.60	ISO 3001
Density @ 60 °C (140 °F), g/cm^3	1.10 – 1.15	ISO 1675
Flash point, °C (°F)	190 (374)	ISO 1523
Vapor pressure, Pa		Knudsen
@ 20 °C (68 °F)	4.5 x 10^{-4}	
@ 60 °C (140 °F)	3 x 10^{-2}	
Aradur® HY 1235		
Liquid modified cycloaliphatic anhydride hardener		
Viscosity @ 25 °C (77 °F), cPs (mPa s)	70 – 80	DIN 53015
Density @ 25 °C (77 °F), g/cm^3	1.18 – 1.20	ISO 1675
Anhydride content, %	≥ 98	DIN 51758
Vapor pressure, Pa,		Knudsen
@ 20 °C (68 °F)	< 1	
@ 60 °C (140 °F)	< 10	
Accelerator DY 062		
Liquid, tertiary amine		
Viscosity @ 25 °C (77 °F), cPs (mPa s)	~10	DIN 53015
Density, g/cm^3		
@ 25 °C (77 °F)	0.88 – 0.92	
@ 60 °C (140 °F)	0.84 – 0.89	
Flash point, °C (°F)	59 (138)	ISO 1523
Vapor pressure, Pa		
@ 20 °C (68 °F)	~300	
@ 60 °C (140 °F)	~1,600	

* Rheomat 115A. Shear rate D = 6.65 s^{-1}

ADDITIONAL INFORMATION :

This product data was based on two system formulations :

	System A	**System B**
	pbw	pbw
Araldite® CY 5622 Resin	100	100
Aradur® HY 1235	82	82
Accelerator DY 062	0.45	0.45
Filler : Silica Flour (Silanized)	325	355

The following color pastes may be used :
Araldite® DW 9134 BD (gray)
Araldite® DW 0126 (brown)

REMARKS :

Araldite® CY 5622 epoxy resin is supplied with a gel-like consistency. It is liquefied by stirring. To adjust a suited viscosity range of the resin, the temperature of the resin at the beginning of the stirring process should be above 6 °C, and below 30°C. In case of longer exposure to temperatures below 6 °C the temperature should be controlled inside in the middle of the packaging before stirring. If the temperature inside the bulk of the product is measured to be below 6 °C the packaging should be heated smoothly from out side (best from below) with max. 30 °C. As this warming process may take up to several weeks depending on size of packaging and temperature conditions, the lead times and storage space should be adjusted in winter accordingly. The resin heats up due to the stirring, the maximum temperature should be 40 °C. Special mixing equipment is needed, as it has to be introduced via the hole of the container. To achieve sufficient and homogenous stirring effect, the stirrer should extend inside the container and a special design is needed for rectangular containers such as a tote. Such design has to ensure that all liquid in edges is sufficiently homogenized. A dynamic torque controlled motor will be needed as the stirring has to start smoothly. Recommendations for suited stirrer equipment are available on request. Transferring the gel-like structure into a normal, low viscous liquid might take several hours. During consumption of the resin, it should be stirred 5 – 15 minutes / hour.

PROCESSING :
(Guideline values)

For optimized processing, Huntsman recommends that users first prepare separate pre-mixtures of both a resin component containing the inorganic filler and a hardener component also containing inorganic filler. These two prepared components can be stored in separate, heated and agitated vessels under constant vacuum prior to use. In this case, the vessel temperatures should be kept between 50°C and 60°C (122°F and 140°F) at a vacuum range of between 1 and 8 mbar.

Preparation of pre-filled resin component

- Stir Araldite® CY 5622 epoxy resin at low shear to liquefy
- Charge liquefied Araldite® CY 5622 epoxy resin to a mixer
  NOTE : Special thin-film mixers are available that facilitate de-airing
- Bring material to an elevated temperature with agitation (typically 50 – 60 °C / 122 – 140 °F)
- Charge selected inorganic filler(s)
  NOTE : the moisture content of the filler should be less than 0.2 % for casting electrical components
- Mix at elevated temperature under vacuum (1 to 8 mbar). Mixing times vary batch size in the range of 0.5 to 3 hours.

Preparation of pre-filled hardener component

- Charge Aradur® HY 1235 hardener to a mixer
  NOTE 1 : Special thin-film mixers are available that facilitate de-airing
  NOTE 2 : Aradur® HY 1235 hardener is a liquid anhydride and will react with moisture. Any prolonged contact of this material with ambient air should be avoided. Once opened, any unused portion in the container should be blanketed with dry nitrogen
- Charge Accelerator DY 062
- Bring to an elevated temperature with agitation (typically 50 – 60 °C / 122 – 140 °F)
- Charge selected inorganic filler(s)
  NOTE : the moisture content of the filler should be less than 0.2 % for casting electrical components
- Mix at elevated temperature under vacuum (1 to 8 mbar). Mixing times vary with batch size in the range of 0.5 to 3 hours

Final Mixing of Prepared Pre-filled Components
In larger plants, particularly those employing the Automatic Pressure Gelation casting process, metering pumps are typically used to feed premixed resin and hardener components to a final continuous static or dynamic mixer. The mixed material is then delivered directly into the casting mold.

In smaller batch operations, the prepared components are typically weighed into a final batch mixing vessel. They are then mixed at temperatures typically of 50 °C to 80 °C (122 °F to 176 °F) with a vacuum of 1 to 8 mbar for a period of 0.5 to 3 hours depending on mix temperature, quantity and particular application.

Typical mold temperatures

APG process	130 – 150 °C (266 – 302 °F)
Conventional vacuum casting	80 – 100 °C (176 – 212 °F)

Typical de-molding times

APG process	10 – 30 minutes
Conventional vacuum casting	2 – 6 hours

Typical cure cycles

APG process	After de-molding, immediately post-cure either : 2 – 3 hours at 150 °C (302 °F) or 4 – 6 hours at 140 °C (284 °F)
Conventional vacuum casting	Gel at 80 – 100 °C (176 – 212 °F) for 2 – 6 hours (depending on part size and application) Parts may be de-molded after gelation then immediately post-cured. Post-curing varies with part size and application. For small parts post-cure can be 2 hours at 150 °C (302 °F)

For large parts, typical post-cures are at lower temperatures for longer times or may be ramped or done stepwise at increasing temperature increments

Process Viscosity
System A : 100 parts Araldite® CY 5622 + 82 parts Aradur® HY 1235 + 0.45 part Accelerator DY 02 + 325 parts Silica flour silanized (System A) **OR** 355 parts (System B).

Fig. 5.1 Viscosity increase at 40°C, 60°C and 80°C*: System A: 64% filler content
*40°C = 104°F; 60°C = 140°F; 80°C = 176°F

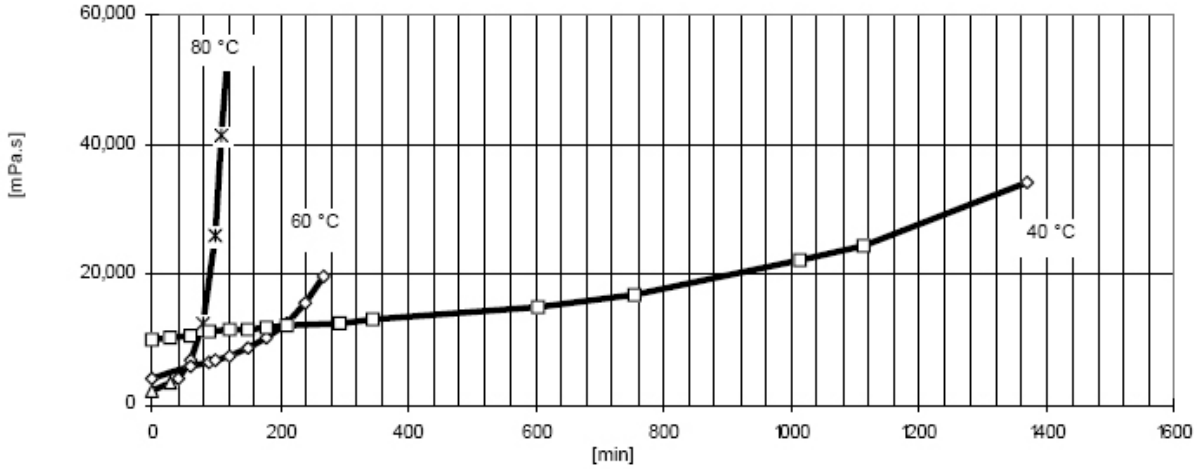


Fig. 5.2 Viscosity increase at 40°C, 60°C and 80°C*: System B: 66% filler content
*40°C = 104°F; 60°C = 140°F; 80°C = 176°F

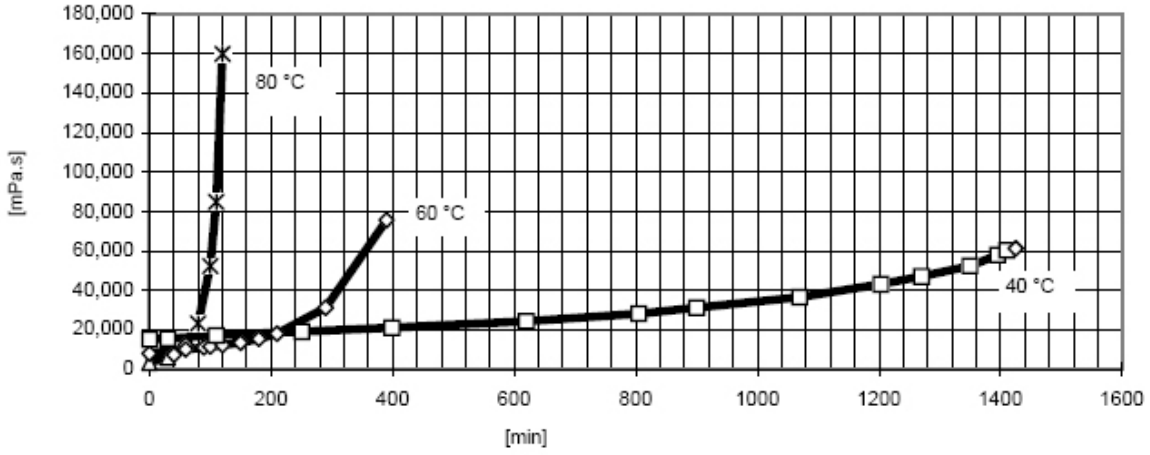


Fig. 5.3 Initial viscosity as a function of temperature System A: 64% filler content

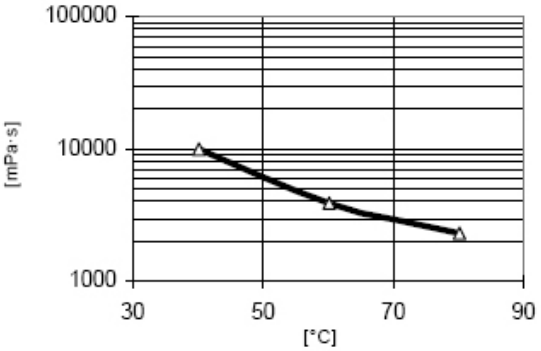
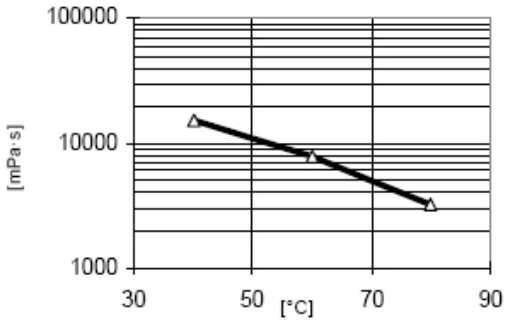


Fig. 5.4 Initial viscosity as a function of temperature System B: 66% filler content



Gelation and Cure Times

System A : 100 parts Araldite® CY 5622 + 82 parts Aradur® HY 1235 + 0.45 part Accelerator DY 02 + 325 parts Silica flour silanized (System A) **OR** 355 parts (System B).
(Measurements with Gelnorm Instrument / DIN 61945)

Fig. 5.5 Gel time measured as a function of temperature System A: 64% filler content

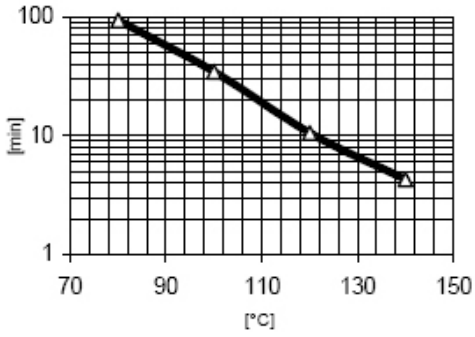
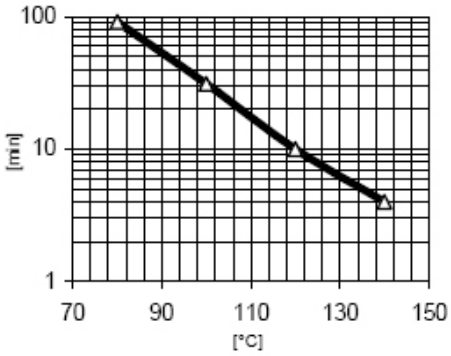


Fig. 5.6 Gel time measured as a function of temperature System B: 66% filler content



TYPICAL MECHANICAL AND PHYSICAL PROPERTIES :
(Guideline values)

Determined on standard specimen at 23 °C (73 °F)
Cured for 6 hours at 80 °C (176 °F) + 10 hours at 140 °C (284 °F)

			Test Values		
			System A	**System B**	**Test Method**
Tensile Strength,	MPa		65 – 90	80 – 105	ISO 527
	Psi		9,425 – 13,050	11,600 – 15,225	
Elongation at break, %			0.80 – 1.20	1.20 – 1.60	
E modulus from tensile test,	MPa		10,600 – 11,000	11,300 – 11,700	
	Ksi		1,537 – 1,595	1,638 – 1,696	
Flexural Strength,	Mpa		125 – 145	130 – 150	ISO 178
	Psi		18,125 – 21,025	18,850 – 21,750	
Surface Strain, %			1.30 – 1.60	1.35 – 1.65	
Emodulus from flexural test,	MPa		11,000 – 11,500	11,300 – 11,800	
	Ksi		1,595 – 1,668	1,638 – 1,711	
Double Torsion Test,					CG 216
Critical stress intensity factor (K_{IC}), MPa m.$^{1/2}$			2.30 – 2.50	2.40 – 2.60	
Specific energy at break (G_{IC}), J/m^2			460 – 500	490 – 530	
Glass transition temperature, DSC,		°C	100 – 115	100 – 115	IEC 61006
		°F	212 – 239	212 – 239	
Coefficient of linear thermal expansion,					ISO 11359-2
Mean value for temperature range :					
20 – 80 °C (68 – 176 °F), K^{-1}			34 – 37 x 10^{-6}	32 – 35 x 10-6	
Thermal Conductivity, W/m-K			0.90 – 1.00	0.95 – 1.05	ISO 8894
Water Absorption (specimen: 50 x 50 x 4 mm)					ISO 62
10 days at 23 °C (73 °F), % by wt.			0.10 – 0.15	0.10 – 0.15	
60 min. at 100 °C (212 °F), % by wt.			0.07- 0.12	0.07 – 0.12	
Oxygen Index, %			--	28	ASTM D-2863
Decomposition Temperature,					
Heating rate : 10 K/min., °C (°F)			350 (662)	350 (662)	DTA
Density, g/cm^3			1.83 – 1.92	1.85 – 1.95	ISO 1183
Filler Content, %			64	66	

TYPICAL ELECTRICAL PROPERTIES :
(Guideline values)

Determined on standard specimen at 23 °C (73 °F)
Cured for 6 hours at 80 °C (176 °F) + 10 hours at 140 °C (284 °F)

	Test Values		
	System A	**System B**	**Test Method**
	Filler load : 64 %	Filler Load : 66%	
Breakdown Strength, kV/mm	21 – 26	21 – 26	IEC 602243-1
HV Diffusion breakdown strength, Class	HD – Class 2	HD – Class 2	DIN 57 441
Temperature of specimen after test, °C (°F)	< 24 (75)	< 24 (75)	
HV Arc Resistance, s	183 – 186	184 – 186	IEC 61621
Tracking Resistance, CTI			IEC 60112
With test solution A	> 600 0.0	> 600 0.0	
With test solution B	> 600 M 0.1	> 600 M 0.1	
HV Tracking Resistance, Class	1B3.5	1B3.5	IEC 60587
Electrolytic Corrosion, Grade	A-1	A-1	IEC 60426

Fig. 7.1 Loss factor (tan δ) and dielectric constant (ε_r) as a function of a function of temperature System A: 64% filler content

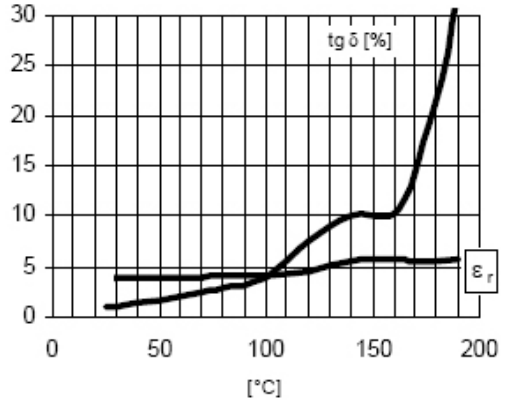


Fig. 7.2 Loss factor (tan δ) and dielectric constant (ε_r) as a function of a function of temperature System B: 66% filler content

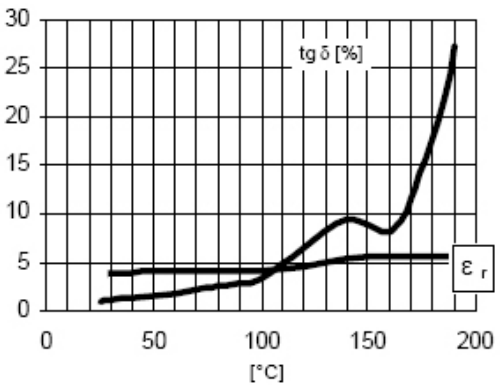


Fig. 7.3 Volume resistivity (ρ) as a function of temperature System A: 64% filler content

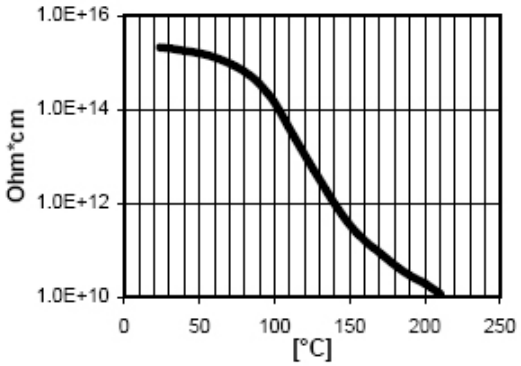
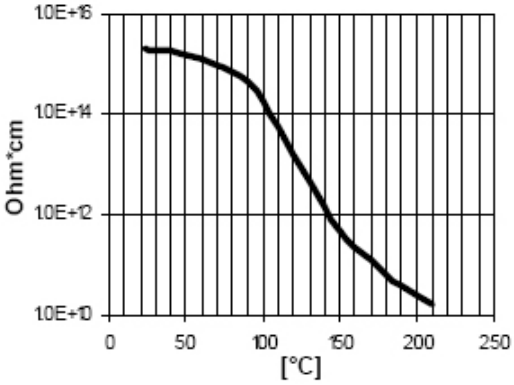


Fig. 7.4 Volume resistivity (ρ) as a function of temperature System B: 66% filler content



STORAGE:

Araldite® CY 5622 epoxy resin should be stored in their original sealed containers in a dry location at a temperature of 2°C to 40°C (35.6 °F up to104 °F). Under these storage conditions the shelf life is 18 months. Aradur® HY 1235 should be stored in their original sealed containers in a dry place at a temperature of 18 °C up to 40 °C (64.4°F up to 104 °F). Under these conditions the shelf life is 1 year. The Aradur® HY 1235 Hardener is very sensitive to moisture and is packaged under a dry nitrogen blanket. Partially used containers should be blanketed with dry nitrogen and tightly re-sealed after each use. Accelerator DY 062 should be stored in their original sealed containers at a temperature of 2°C to 40°C (35.6°F to 104°F). Under these conditions the shelf life is 3 years. Do not expose any of these materials to direct sunlight. Tightly re-seal all containers after use to prevent contamination

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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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Main Offices :
Huntsman Corporation
10003 Woodloch Forest Dr.
The Woodlands
Texas 77380
(281) 719-6000

Huntsman Advanced Technology Center
8600 Gosling Rd.
The Woodlands
Texas 77381
(281) 719-7400
Website :
www.huntsman.com/advanced_materials