HUNTSMAN
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Advanced Materials

	System:	A	B
Araldite®	**MY 790-1**	**100**	**100 pbw**
Aradur®	**HY 1102**	**90**	**90pbw**
Accelerator	**DY 9577**	**0.16**	**--pbw**
Accelerator	**DY 073-1**	**0.04**	**--pbw**

(STANDARD MIXING RATIO)
ARALDITE® IMPREGNATING RESIN SYSTEM

GENERAL:

Liquid, hot-curing impregnating system based on distilled Bis-A resin and anhydride hardener with long pot-life, high glass transition temperature and excellent electrical and mechanical end properties.

APPLICATIONS:

Full-bath impregnation of motors and generators with medium and high power ratings and impregnation of single conductors (Roebel bars) in combination with porous mica-tapes.

PROCESSING METHOD:

Vacuum Pressure Impregnation (VPI – process).

PROPERTIES:

- Low viscosity and good impregnation capability
- Solvent free system
- Long pot-life due to high latency (in absence of tape catalyst)
- Excellent mechanical and electrical end properties

PRODUCT DATA:

Araldite® MY 790-1:
Liquid, solvent-free, distilled Bis-A epoxy resin

Viscosity	At 25°C	ISO 12058	mPa s	4'000 – 6'400
Epoxy content		ISO 3001	Equiv/kg	5.60 – 5.90
Chlorine content, hydrolysable			%	≤ 0.05
Density	At 25°C	ISO 1675	g/cm^3	1.15 – 1.20
Flash point		ISO 1523	°C	> 200
Vapor pressure	At 20°C At 180°C	(Knudsen) (Knudsen)	Pa Pa	$< 10^{-3}$ Appr. 133

Aradur® HY 1102:
Liquid, unmodified anhydride curing agent

Viscosity	At 20°C	ISO 12058	mPa s	Appr. 70
Denstity	At 20°C	ISO 1675	g/cm^3	1.13 – 1.17
Flash point		ISO 1523	°C	145
Vapour pressure	At 20°C	(Knudsen)	Pa	< 0.3

Accelerator DY 9577:
Latent accelerator based on BCl_3 (solid or liquid state)

Melting range		DSC	°C	26 – 35
Density	At 20°C	ISO 1675	g/cm^3	1.12 – 1.15
Flash point		ISO 1523	°C	> 118
Vapour pressure	At 20°C	(Knudsen)	Pa	< 0.01

Accelerator DY 073-1:
Latent accelerator based on Amine Complex

Viscosity	At 25°C	ISO 12058	mPa s	5 – 15
Density	At 20°C	ISO 1675	g/cm^3	0.95 – 1.00
Flash point		ISO 1523	°C	82
Vapour pressure	At 20°C	(Knudsen)	Pa	< 6

STORAGE:

Store the components at 18-25°C, in tightly sealed and dry original containers. Under these conditions, the shelf life will correspond to the expiry date stated on the label. Product specific advise regarding storage ca be found on product label. After this date, the product may be processed only following reanalysis. Partly emptied containers should be closed tightly immediately after use.
For information on waste disposal and hazardous products of decomposition in the event of fire, refer to the Material Safety Data Sheets (MSDS) for these particular products.

PROCESSING:

Global processing

Processing details depend very much on the machine type, on customer's defined parameters and type of mica tapes.

Generally the VPI system is used in impregnation vessels up to 30 tons where the rotor or stator are impregnated at elevated temperatures. Machine parts usually are preheated (also under vacuum) in order to remove moisture and to reduce viscosity during impregnation.
After impregnation the VPI bath is pumped into storage tanks and cooled down to 5 to 10°C and should be stored in dry conditions in order to obtain a long bath life. Actual bath life depends on additional parameters, e.g. impregnation temperature and duration of impregnation, impurities in the bath, wash-out of catalyst from mica tapes into the unaccelerated resin system (B), replenishment rate, moisture exposure etc. The viscosity of the bath should be checked periodically in order to maintain a suitable viscosity for impregnation.

Impregnated, yet uncured machine parts in unconditioned atmosphere may pick up moisture. Therefore curing directly after impregnation or storage in a moisture controlled area is recommended. Generally machine parts are rotated when removed from the bath and during the first part of curing in order to avoid drip off.
Evaporation of hardener during the vacuum cycle leads to a change in the resin/hardener ratio in the bath and has to be compensated. Therefore replenishment mixing ratios of 100 to 120 pbw. Of hardener HY 1102 per 100 pbw MY 790-1 are generally used. Replenishment mixing ratios depend on actual processing parameters and conditions and have to be evaluated at the customer site.
Due to the excellent latency of the system (A) MY 790-1 / HY 1102 / DY 9577 / DY 073 the replenishment volume to maintain a constant viscosity is comparatively small, even if impregnation is performed at 40-50°C. (see below and Fig. 4.4)

On single coils and Roebel-bars the mica insulation is normally covered with a tight glass tape to prevent drainage of the impregnation resin.

SPECIFIC INSTRUCTIONS:

Depending on the insulation materials and the accelerating agent in use, a ramped curing schedule is recommended.
In systems with high reactivity, where the accelerator can be included in the mica-tape, a fast gelation can be obtained with a temperature-shock, and draining so be reduced or avoided.

Standard curing with the standard accelerated mixture (System A) is:
12 h at 90°C plus 18 h at 140°C

Replenishment to maintain a stable viscosity for System A: (see also Fig. 4.4)

Impregnation viscosity	40 mPa s	100 mPa s	300 mPa s
Impregnation temperature	56°C	41°C	28°C
Duration of the impregnation	4h	4h	9h
Storage temperature	10°C	10°C	10°C
Storage time	20h	20h	15h
Make-up rate (Q) per cycle (N)	15%	2%	0.5%

PRECAUTIONS:

To determine whether crosslinking has been carried to completion and the final properties are optimal, it is necessary to carry out relevant measurements on the actual object or to measure the glass transition temperature. Different gelling and cure cycles in the manufacturing process could lead to a different crosslinking and glass transition temperature respectively.

PROCESSING VISCOSITIES:

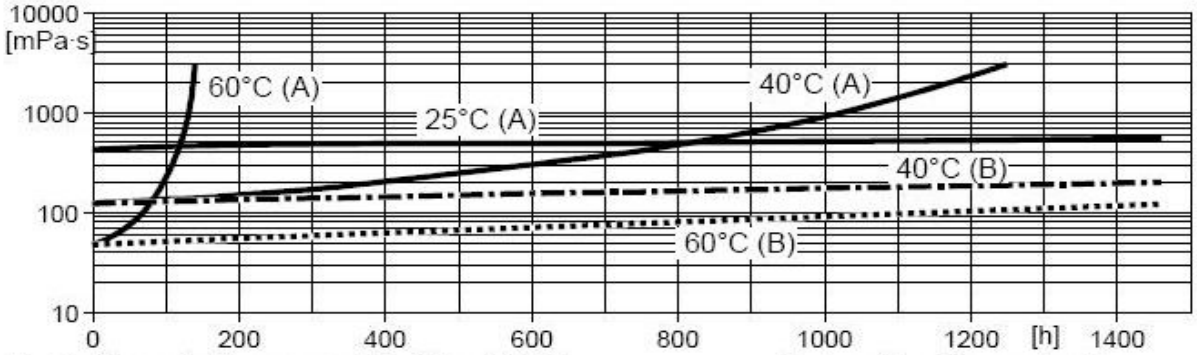

Fig.4.1: **Viscosity increase at 25, 40 and 60°C**
Measurements with Rheomat
(Shear rate: D = 100 s^{-1})

System A: with accelerators
System B: without accelerators

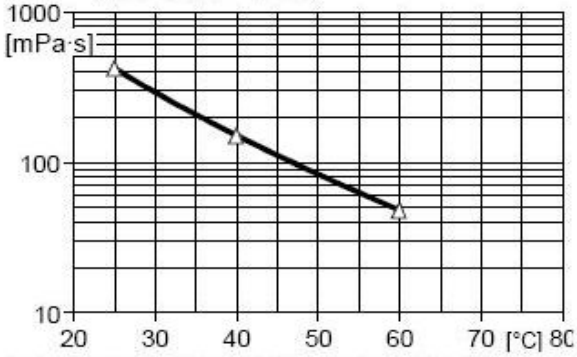

Fig.4.2: **Initial viscosity as a function of temperature (System A and B)**
Measurements with Rheomat (D = 100 s^{-1})

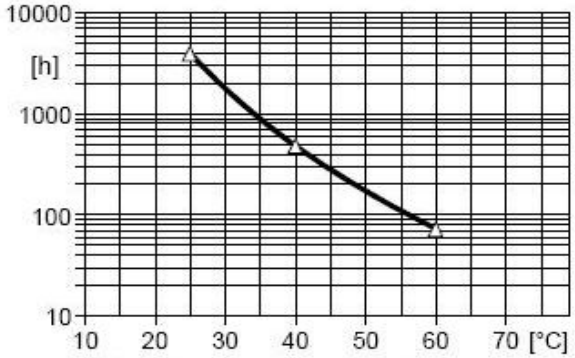

Fig.4.3: **Time for viscosity to double for System A**
Measurements with Rheomat (D = 100 s^{-1})

REPLENISHMENT:

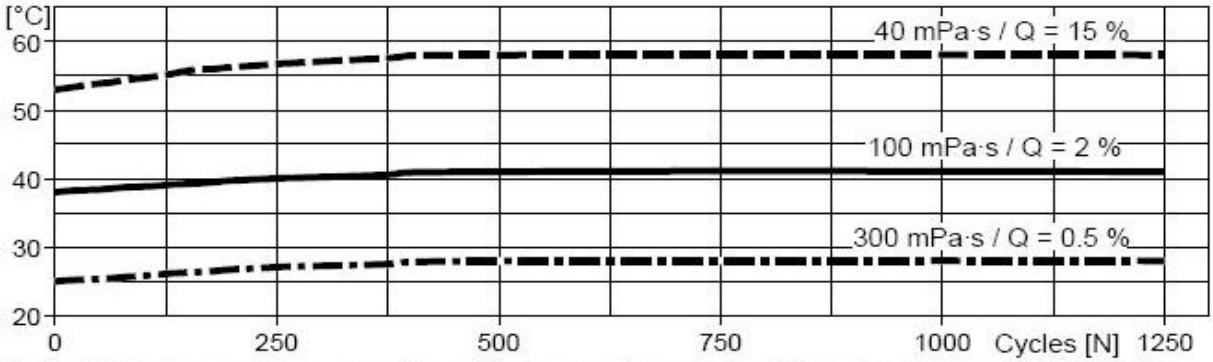

Fig.4.4: **Bath temperature v number of impregnation cycles (N) and make-up rate (Q) in %**
1 cycle = 24h (Impregnation and storage time) (Criteria see page 3)
Theoretical bath stability calculated for System A with the computer program GTRAN.

GELATION-/CURE TIMES

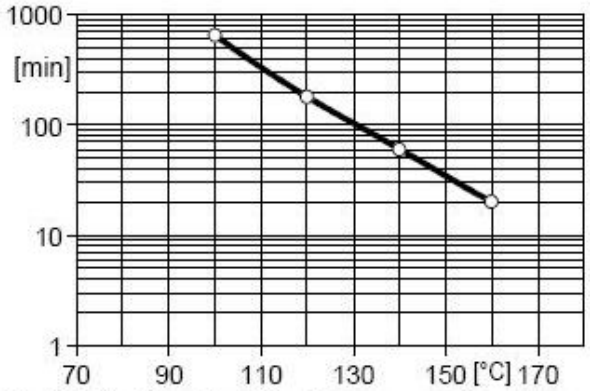

Fig.4.5: **Geltime for thin layers as a function of temperature**
(for System A, DIN 16945/6.3.1)

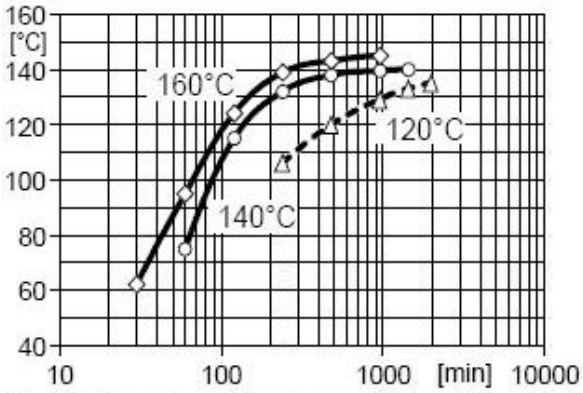

Fig.4.6: **Glass transition temperature as a function of cure time**
(for System A, isothermic reaction, IEC 61006)

PHYSICAL AND ELECTRICAL PROPERTIES:

Determined on unreinforced cast standard test specimen at 23°C
Cured for 24 h at 80°C + 10h at 140°C

Physical Properties:
Measured values for System A

Flexural strength	ISO 178	MPa	125 – 130
Surface strain	ISO 178	%	4.5 – 5.5
E modulus from flexural test	ISO 178	MPa	3100 – 3200
Glass transition temperature (DSC)	ISO 11257-2	°C	135 – 150
Thermal endurance profile (TEP)	IEC 60216		Fig. 5.1 / 5.2
Temperature index (TI):weight loss	(20000h / 5000h)	°C	205 / 224
Thermal ageing class (20000h)	IEC 60085	Class	H
Water absorption (specimen: 50x50x4mm) 10 days at 23°C 60 min at 100°C	ISO 62	 % by wt. % by wt.	 0.10 – 0.20 0.15 – 0.25
Decomposition temperature (heating rate: 10K/min)	DTA	°C	Appr. 300

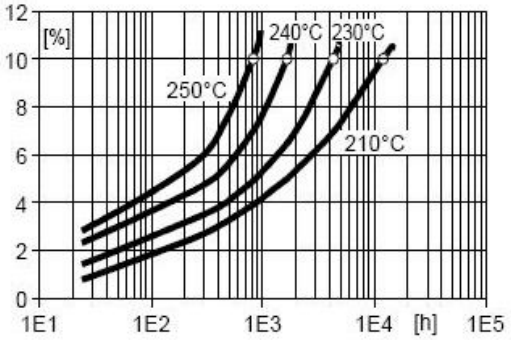

Fig.5.1: **Weight loss (specimen: 50×50×3 mm)** (limit: 10 %)

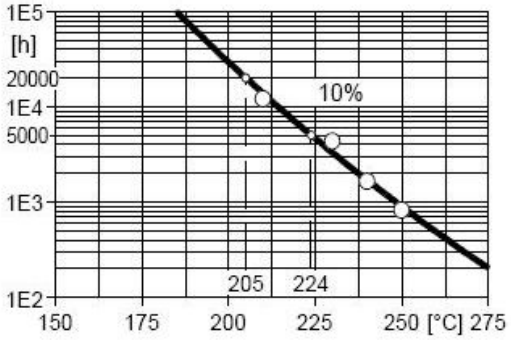

Fig.5.2: **Temperature Index 205 / 224** (weight loss 10 %)

Electrical Properties

Breakdown strength	IEC 60243-1	kV/mm	25 – 30
HV arc resistance	ASTM D 495	S	180 – 185
Tracking resistance with test solution A with test solution B	IEC 60112	 CTI CTI	 >600-0.2 >600M-0.3

Electrolytic corrosion DIN 53489 grade A-1

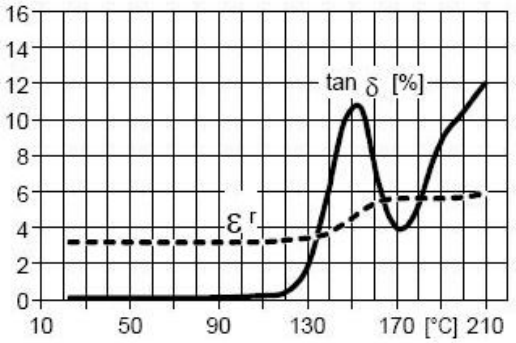

Fig.5.3: **Loss factor (tan δ) and dielectric constant (εr) as a function of temperature** (measurement frequency: 50 Hz, IEC 60250/ DIN 53483)

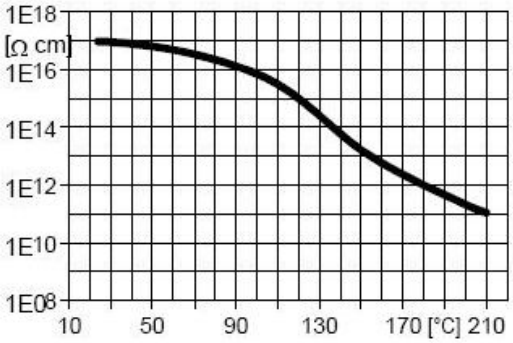

Fig.5.4: **Volume resistivity (ρ) as a function of temperature** (measurement voltage: 1000 V, IEC 60093/ DIN 53482)

HANDLING PRECAUTIONS:

Safety precautions at workplace:	
Protection clothing	yes
Gloves	essential
Arm protectors	recommended when skin contact likely
Goggles/safety glasses	yes
Respirator/dust mask	recommended
Skin protection	
Before starting work	apply barrier cream to exposed skin
After washing	apply barrier or nourishing cream
Cleaning of contaminated skin	dab off with absorbent paper, wash with Warm water and alkali-free soap, then dry with Disposable towels. Do not use solvents
Clean shop of spillage	soak up with sawdust or cotton waste and Deposit in plastic-lined bin
Ventilation:	
Of workshop	renew air 3 to 5 times an hour
Of workplace	exhaust fans. Operatives should avoid inhaling vapours.

FIRST AID:

Contamination of the **eyes** by resin, hardener or casting mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted.
Material smeared or splashed on the **skin** should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (seem above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately.
Anyone taken ill after **inhaling** vapours should be moved out of doors immediately. In all cases of doubt call for medical assistance.

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