Voltatex® 4204

Impregnating Resin

Chemical base
Unsaturated polyester imide resin, low emission

Product description
Our Voltatex® 4200 product line offers a full range of low emission, ready to use impregnating resins.

Voltatex® 4204 is compliant with the EU-directives
- 2003/11/EU (polybrominated diphenyl ethers)
- 2006/121/EU (REACh-directive)
- 2011/65/EU (RoHS- directive)

Special properties
- single component
- low emission / VOC-free
- very low viscosity
- environmentally friendly
- minimum exposure in the working area
- no risk of fire or explosion
- based on renewable raw materials

The cured resin compound is characterised by:
- very low tendency to crack
- very good adhesion

UL-approval
UL-File-No.: E101752 (M) Underwriters Laboratories Inc, USA

Application area
- electric motors
- generators, also for large drives
- transformers
- in particular for mica tape insulated flat rolled litz wires
- suitable for: insulation systems of **thermal class 180 (H)** acc. to IEC 60085
- suitable for applications in **medium and high voltage area**
  (further information may be obtained on request)

No mixing of components required
Voltatex® 4204 is supplied ready to use and does not require the addition of extra hardener or accelerator.

Processing

The impregnating resin can be applied by using

- all kind of conventional dip & bake equipment
- continuous, vacuum dip and VPI processes
- dip & roll equipment
- trickle feed machines

Unlimited tank stability with resin Voltatex® 4204 can be achieved as long as the material is kept below 25°C and at least 20 % of the tank content is used and replaced with fresh resin per month.

Curing

Voltatex® 4204 is a low emission product, nevertheless to minimize evaporation of reactive components during curing; the impregnated objects should be heated up to curing temperature in the shortest possible time. The air flow in the curing oven should also be kept to the minimum permitted by safety considerations.

Cleaning

Cured Voltatex® 4204 is almost insoluble. Therefore, application equipment should be regularly cleaned with cleaner Voltatex® T050. All equipment cleaning and maintenance should be carried out in accordance with the equipment manufacturer's instructions.

Delivery & Storage

Voltatex® 4204 is supplied in one-way-cans containing 25 kg or 200 kg. In closed original cans the resin can be stored for 6 months if provided storage temperature does not exceed 25°C.
Opened containers have to be closed immediately to protect the material from daylight!

Health & Safety

Cured Voltatex® 4204 is biologically inactive and not dangerous to health. When processing the liquid resin, please refer to the Material Safety Data Sheet (MSDS) for Voltatex® 4204 and the regulations of your local authority.

Table 1: Properties of the liquid resin Voltatex® 4204

Appearance	yellow – amber, slightly cloudy	
Viscosity at 25°C in acc. with DIN 53019		
at 25°C	315 ± 25 mPa·s	
at 40°C	130 ± 25 mPa·s	
Storage Stability, Shelf Life at 25°C	6 months	
Reactivity at 100 °C in acc. with Company Standard Energy Solutions - 014[1)]		typ. value
Gel Time	8,5 – 10,0 min	9,6
Reaction Time	10,0 – 12,0 min	11,6
Curing Time [2)]		
Trickle Feed Process at 130°C	15 – 30 min	
Trickle Feed Process at 150°C	15 – 20 min	
Dip & Bake Process at 130°C	2 h	
Dip & Bake Process at 150°C	1 h	
Effect on Enamelled Wire [3)]	compatible with all common magnet wires	
Emissions in acc. with DIN EN 60455-3-5: 2006	approx. 1,7 % (by weight)	

Information regarding health and precautions for the safe handling, transport regulations and labelling of this material are subjects of permanent adaptation to law regulations. They are given in the MSDS.

(1) Company Standard Energy Solutions – 014 „Measurement of Reactivity", in acc. with DIN 46448. Shown values relate to the time of manufacture. In dependence of storage time reactivity can vary.

(2) Curing time begins when objects come up to the indicated curing temperature. For objects having to endure high mechanical or chemical stress during service, longer curing times are recommended.

(3) Test in acc. with IEC 60851-4: 1996 “Winding Wires Test Methods”, part 4: Chemical Properties. The quoted solvent is replaced by the respective impregnating resin.

Table 2: Tests on cured Voltatex® 4204 in acc. with IEC-60455-3-5

Curing Conditions for Test Specimens: 1h 150°C		
Water Absorption in acc. with Company Standard Energy Solutions – 015, in acc. with ISO 62		typ. value
after 96 h at 23°C	0,5 – 0.7 %	0,6
Tracking Resistance in acc. with IEC 60455-2, Test Method acc. to IEC 60112, paragraph 6.2	CTI 600 M, test passed	
Glass Transition Temperature (DSC – Method)	approx. 50-130°C	
Volume Shrinkage in acc. with Company Standard Energy Solutions - 003	8 – 9 %	typ. value 8,6 %
Dielectric Strength in acc. with IEC 60455-2, Test Method in acc. with IEC 60243-1		typ. value
at 23°C and 50 % rel. humidity	(55 – 80) kV/mm	70
at 155°C	(30 – 80) kV/mm	60
at 23°C after 96 h storage at 90 % rel. humidity	(20 – 70) kV/mm	52
at 105°C after 168 h storage in oil	(50 – 105) kV/mm	67
Relative Permittivity ε_r in acc. with IEC 60455-2, Test Method in acc. with IEC 60250		
at 23°C between 50 Hz and 1 MHz	(3,8 ± 0,6)	
Dielectric Dissipation Factor tan δ in acc. with IEC 60455-2, Test Method in acc. with IEC 60250		typ. value
at 155°C and 50 Hz	$(75 \cdot 10^{-3} – 190 \cdot 10^{3})$	$150 \cdot 10^{-3}$
Intersection 0,2 = $200 \cdot 10^{-3}$	(160 - 190)°C	178°C
Volume Resistivity in acc. with IEC 60455-2, Test Method in acc. with IEC 60093		typ. value
at 155°C	$(10^{09} – 10^{11})$ Ω cm	$3,6 \cdot 10^{10}$
at 180°C	$(10^{09} – 10^{11})$ Ω cm	$3,5 \cdot 10^{10}$
after 168 h Water Immersion	$(10^{14} – 10^{16})$ Ω cm	$1,8 \cdot 10^{15}$

Shore-D-Hardness in acc. with IEC 60455-2, Test Method in acc. with ISO 868	
Room Temperature	(76 ± 5)
Bond Strength of Twisted Coils in acc. with IEC 60455-2, test acc. to IEC 61033, testing method A	
Room Temperature	(200 ± 40) N
at 155°C	(57 ± 10) N
Modulus of Elasticity in acc. with ISO 527	
Manufacturing of Test Specimens in acc. with Company Standard Energy Solutions - 016[1)]	
Room Temperature	approx. 650 MPa
Modulus of Elasticity (DMA – Method)	
Manufacturing of Test Specimens in acc. with Company Standard Energy Solutions - 016[1)]	
Room Temperature	approx. 1.000 MPa
at 130°C	approx. 220 MPa
at 155°C	approx. 215 mPa
at 180°C	approx. 210 MPa

For orientation and comparison modulus of elasticity of different materials:

- steel	210 GPa
- copper	120 GPa
- glass	50–90 GPa
- epoxide resin	approx. 2,5 GPa
- polyamide	2–4 GPa
- polyethylene	0,7 GPa

source: wikipedia.org

- Voltatex® 4250 approx 0,36 GPa

(1) Company Standard Energy Solutions – 016 „ Preparation if specimen for E-Modulus measurements“, in acc. with ISO 527.

Table 3: Resistance

Effect of Liquid Chemicals in acc. with Company Standard Energy Solutions - 017	resistant to - transformer oil - destilled water
Effect of solvent gases in acc. with Company Standard Energy Solutions - 019	in examination

Table 4: Thermal Properties, Thermal Class

Temperature Index in acc. with IEC 60455-3-5, Testing Method in acc. with IEC 60216	**Type 180**
Bond Strength acc. to IEC 61033, Method B End-Point Criterion 22 N	IEC 60317-8/MW 35: 209°C IEC 60317-13/MW 80:183°C
Proof Voltage in acc. with IEC 60172	IEC 60317-8/MW 35: 191°C IEC 60317-13/MW 80: 170°C

Table 5: UL-Approval

Temperature Class in acc. with UL 1446		
	Twisted Pair ASTM D2307	MW 35: 180 MW 80: 155
	Helical Coil ASTM D2519	MW 35: 200 MW 80: 180

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