LINEA SEMI-PREG | SEMI-PREG SERIES

MATES ® SGC 0306

1. Descrizione | Description

Considerando una stretta relazione con la tecnologia prepreg, abbiamo chiamato il nostro prodotto "semipreg": il tessuto è impregnato su un lato con resina sotto forma di foglio. Semipreg è un tessuto impregnato da un lato con resina LETOXIT LFX. Il risultato è una grande variabilità della composizione risultante perché è possibile utilizzare un'ampia gamma di resine LETOXIT LFX. Oltre a tipologie più di base, possiamo realizzare anche semipreg con elevata resistenza termica (250 °C), elevata durezza a impulso o semipreg conforme ai requisiti degli standard FAR 23 e FAR 25.

Considering a narrow relationship to prepreg technology, we called our alternative “semipreg”: fabric has one-side impregnated with foil-like resin. Semipreg is a fabric impregnated from one side with foil resin LETOXIT LFX. The result is a great variability of the resulting semipreg composition because we can come from a wide offer of LETOXIT LFX resins. In addition to basic types, this allows us to use also semipreg with high thermal resistance (250 °C), high impulse toughness, or semipreg complying with requirements of FAR 23 & FAR 25 standards.

2. Vantaggi | Advantages

- Tecnologia senza solventi (nessun rilascio di vapori durante la preparazione e la catalisi)
- Produzione più veloce rispetto alle resine liquide
- Grande variabilità nella composizione
- Su specifica del cliente

- Solvent free technology (no hazard vapours released during the prepration and curing)
- Faster production in comparison with liquid resins
- Great variability in composition
- Customer made

3. Applicazioni | Applicazioni

- Aviazione
- Settore automobilistico
- Costruzione navale
- Produzione di pannelli compositi in sandwich
- Sanità
- Equipaggiamento sportivo

- Aviation
- Automotive
- Shipbuilding
- Composite panel sandwich production
- Health care
- sport equipment

4. Stoccaggio | Storage

Il semipreg può essere stoccato per 1 mese a 20 °C, per 4 mesi a 5 °C e fino ad un anno a -18 °C senza variazione delle proprietà. Non oltrepassare la temperatura di 30 °C durante il trasporto o lo stoccaggio.
Without the change of properties, the semipreg can be stored for 1 month at +20°C, for 4 months at 5°C and up to 1 year for –18°C. The temperature +30°C mustn’t be crossed during transport and storage

Areal weight (gr/m2)	Width (mm)	Reinforcement/resin ratio (%)	Curing	Characteristics
620	1000	61/39	30 min / 120°C	All purpose application, surface finish

Fabric (type, gr/m2, weave)	Resin (type, gr/m2)	Temperature resistance (°C)
Carbon, 600, twill	Epoxy 060, 360	125

LINEA RINFORZI | REINFORCEMENTS SERIES

MATES ® TC 600 T (HR)

1. Descrizione | Description

Tessuto 2/2 twill in fibra di carbonio 12k HR da 600 gr/m^2, disponibile in differenti altezze rotolo fino a 1200 mm. Adatto a processi tramite infusione, laminazione manuale e sottovuoto, compatibile con tutte le principali tipologie di resine.

600 gr/sqm fabric 2/2 twill in 12k HR carbon fiber, available in different roll heights up to 1200 mm. Suitable for processes by infusion, manual lamination and vacuum, compatible with all the main types of resins.

Proprietà fisiche | Physical properties			
Prova | Test	**Unità | Units**	**Valore | Value**	**Norma | Normative**
Peso totale | Mass per unit area	gr/m^2 | gr/sqm	600 (± 5,0%)	ISO 3374
Armatura | Weave	Tipologia | Type	2/2 Batavia | 2/2 Twill	ISO 2113
Resistenza a trazione | Tensile strength	Mpa	4900	TY-030B-01
Modulo elastico | Tensile modulus	Gpa	230	TY-030B-01
Compatibilità | Compatibility	General purpose: Epoxy, phenolic, polyester, vinyl ester		

Costruzione | Construction			
Prova | Test	**Unità | Units**	**Ordito / Warp**	**Trama / Weft**
Descrizione della fibra | Fiber description	Tipologia | Type	Toray 12K T700 50C	Toray 12K T700 50C
Numero di fili | Thread count	Per cm | Ends cm	3,8 (± 5,0%)	3,8 (± 5,0%)
Distribuzione | Weight distribution	gr/m^2 (%) | gr/sqm (%)	300 (50)	300 (50)
Spessore | Thickness	mm	0,60	
Numero filamenti | Filament number	K	12	

Confezioni | Packaging			
Prova | Test	**Unità | Units**	**Valore | Value**	**Norma | Normative**
Altezza standard | Standard width*	mm	1000 (± 2,5%)	ISO 22198
Lunghezza standard | Standard length	mt	50	
* su richiesta | on request: length 100 ml - width 500 - 1200 mm			

TECHNICAL DATA SHEET

Version: 11/2011

Letoxit® LFX 060

Application

Epoxy resin in the form of foil is designed for patent Letoxit Foil Technology (LF Technology). LF Technology is a dry lamination technique, which is suitable especially for production of laminate structures with exactly defined reinforcement and resin content. If it is necessary to increase the amount of resin in a certain place, it is also possible to combine epoxy resin Letoxit Foil with prepregs.

Letoxit Foil LFX 060 can be applied for all types of reinforcement. Various types of glass, carbon or Kevlar fabrics or their combinations are mostly used. Unidirectional oriented reinforcements or 3D fabrics can be used, too. LFX 060 is suitable especially for production of sandwich structures and honeycomb constructions. The produced laminate has very good mechanical properties under stress in temperature range from -75°C to +100°C. Therefore it is used for manufacturing of aircraft parts and transport vehicles.

Type:

Epoxy resin, which contains a hardening system, fire resistant type

Appearance:

A resin is in the form of green translucent foil, 0.1-0.7 mm thick (according to the customer request). It is flexible and shapeable at indoor or increased temperature.

Lamination technique:

Laminate is made by laying foils and reinforcement in order to keep the required predetermined reinforcement/resin ratio. Required shape corresponding to the shape of laminated surfaces is cut out with scissors, knife or other tool from the Letoxit Foil resin. Covering paper is pulled off the foil and the resin is put on the upper layer of the reinforcement. The resin foil pushed against the reinforcement a little and smoothened to avoid reinforcement folds. The reinforcement has to be loosened well to fill the mold perfectly. The second covering polyethylene foil is then pulled off and next reinforcement layer is applied. These steps are repeated until the desired amount of reinforcement layers is reached. It is recommended to work at the manipulation temperature – temperature range, which specifies processability of Letoxit Foil. Below the manipulation temperature, this material is too brittle and it breaks and it is too shapeable and adhesive above this temperature range. The manipulation temperature is thus 15-35°C; the best processability is between 20 and 30°C. It is suitable to use hot-air gun for assembling of more difficult compositions or shaped surfaces, especially when warm table cannot be used.

It is possible to use either more layers of reinforcement alternately with the Letoxit Foil resin or to use one thick layer of Letoxit Foil resin and several layers of reinforcement. It is necessary to have at least one layer of reinforcement between the mold and the layer of Letoxit Foil resin. The amount of Letoxit Foil has to be high enough to fill up the vacant space in the reinforcement structure. Minimal amount of resin content can be calculated with following formula:

$$m_{LF} / \rho_{LF} + m_R / \rho_R = t_C$$

where m_{LF} is a Letoxit Foil area weight (g/m^2), ρ_{LF} is a Letoxit Foil density (g/cm^3), m_R (g/m^2) is a reinforcement area weight (g/m^2), ρ_R is reinforcement density (g/cm^3) and t_R is composite thickness (μm). Area weight can be calculated for all layers of reinforcement or Letoxit Foil. Examples of some reinforcement density can be found in the table.

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Type of reinforcement	Density (g.cm^3)
E-glass	2.58
S2-glass	2.46
Carbon	1.76

Air has to be evacuated from the composition reinforcement-Letoxit Foil before curing. Required pressure is 0.075-0.09 MPa. The composition has to be evacuated longer to achieve required pressure value in all parts of the laminate. It is important particularly for large products or products with high number of layers. It is recommended to perforate the Letoxit Foil with a spiked roller; it allows better evacuation of air before curing. The evacuated composition is cured in the mold at increased temperature under vacuum or in a press or autoclave.
Resin can be also added to prepregs by laying the Letoxit Foil to a specified place, where increased amount of resin is needed. The processing of this composition is the same as in the case of prepregs. Careful evacuation of air and sufficient pressure difference reach perfect impregnation of fibers after temperature rise; thus the quality of the resulting composite is comparable with prepregs without necessity of autoclave use.

Curing:

Letoxit Foil LFX 060 resin is usually cured at temperature 120-125°C for 20 minutes. Laminate is fixed with pressure 0.075-0.09 MPa during curing. Two processes occur during temperature rise of the foil:
1/ The viscosity of Letoxit Foil decreases with increasing temperature and the dry reinforcement is being impregnated
2/ Epoxy resin starts to cure (effect of hardeners) after temperature rise

Therefore it is necessary to ensure sufficient time for impregnation of dry reinforcement during curing at increased temperature before Letoxit Foil reaches the gel point when material is not able to flow and thus impregnate the dry reinforcement. For that reason the following temperatures are determined:

- *Impregnation temperature*, which is the lowest temperature when the viscosity of Letoxit Foil is low enough to impregnate the dry reinforcement. In the case of Letoxit Foil LFX 060, the impregnation temperature is 70°C. Impregnation is easier at higher temperatures, but the time for resin flow is shorter.
- *Curing temperature*, which is the temperature when resin is cured at certain time.

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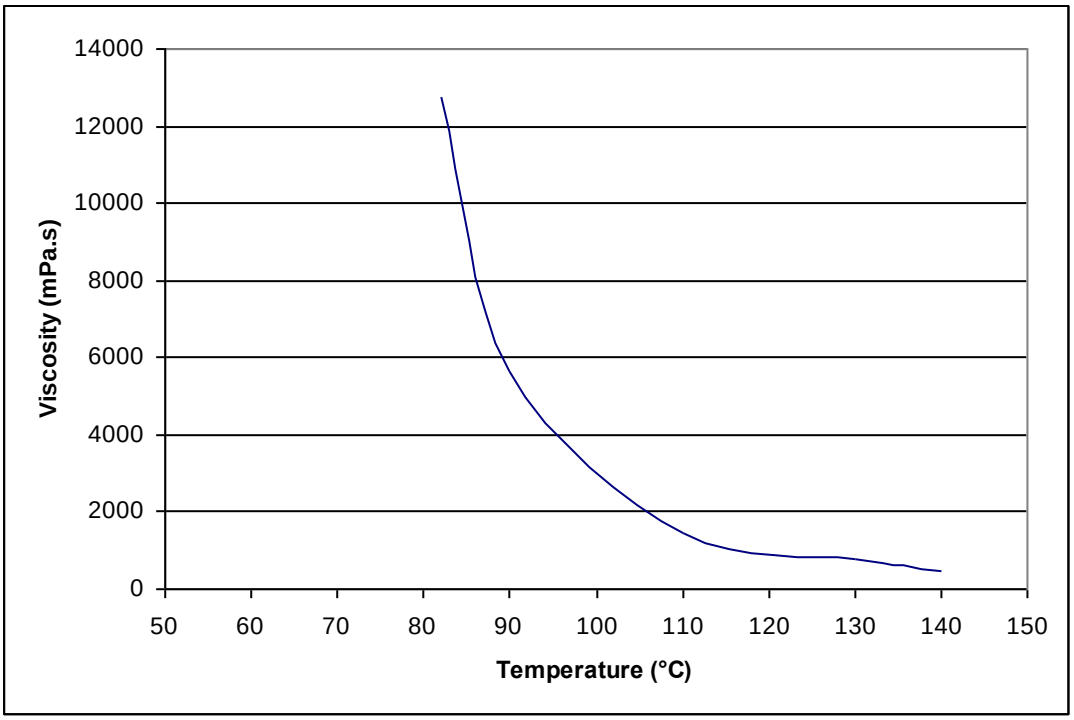

Fig.1: Dependence of viscosity on time at various temperatures.

Curing time is counted from the moment when the temperature within the produced laminate reaches curing temperature. No volatile compounds are released from laminate during preparation or curing. Laminated can be also cured at lower temperature, see following figure and table, which contain curing temperatures and properties.

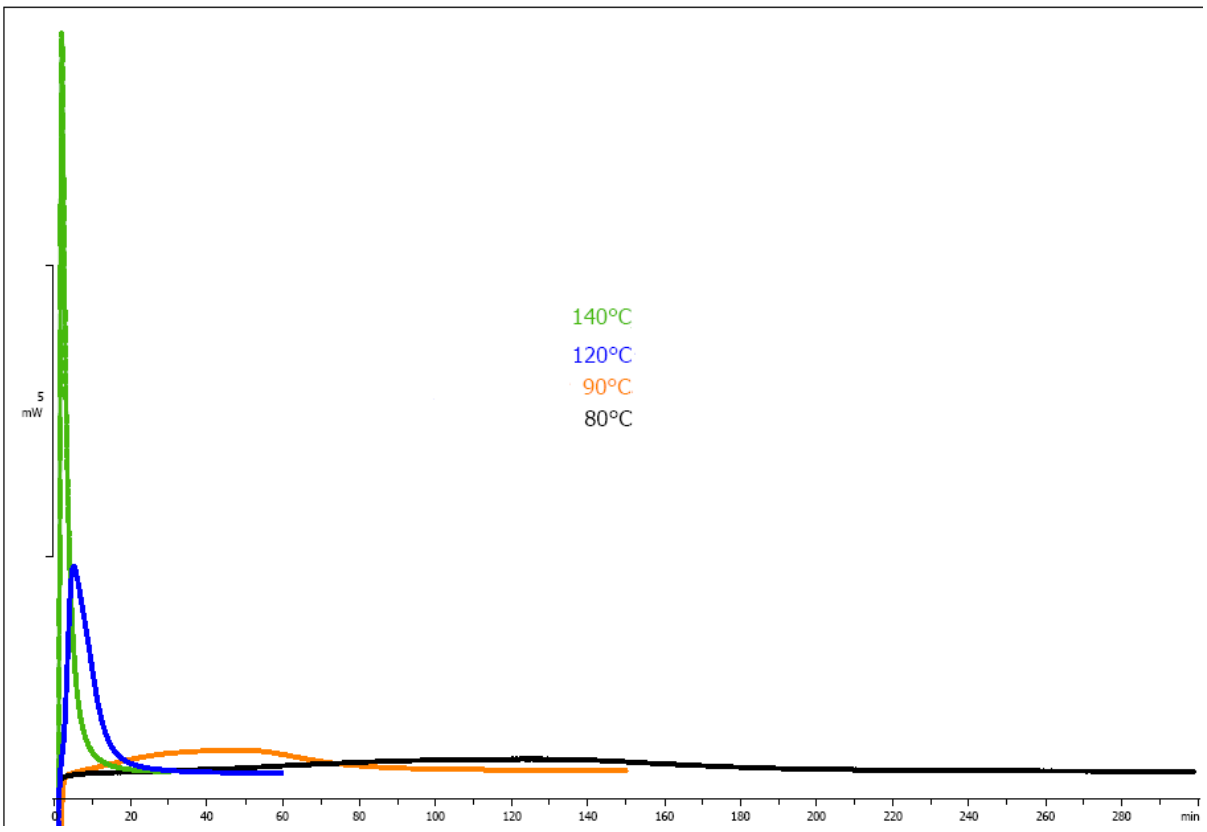

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Fig. 2: Dependence of reaction rates on time at constant curing temperatures 80, 90, 120 and 140°C. Measured at DSC.

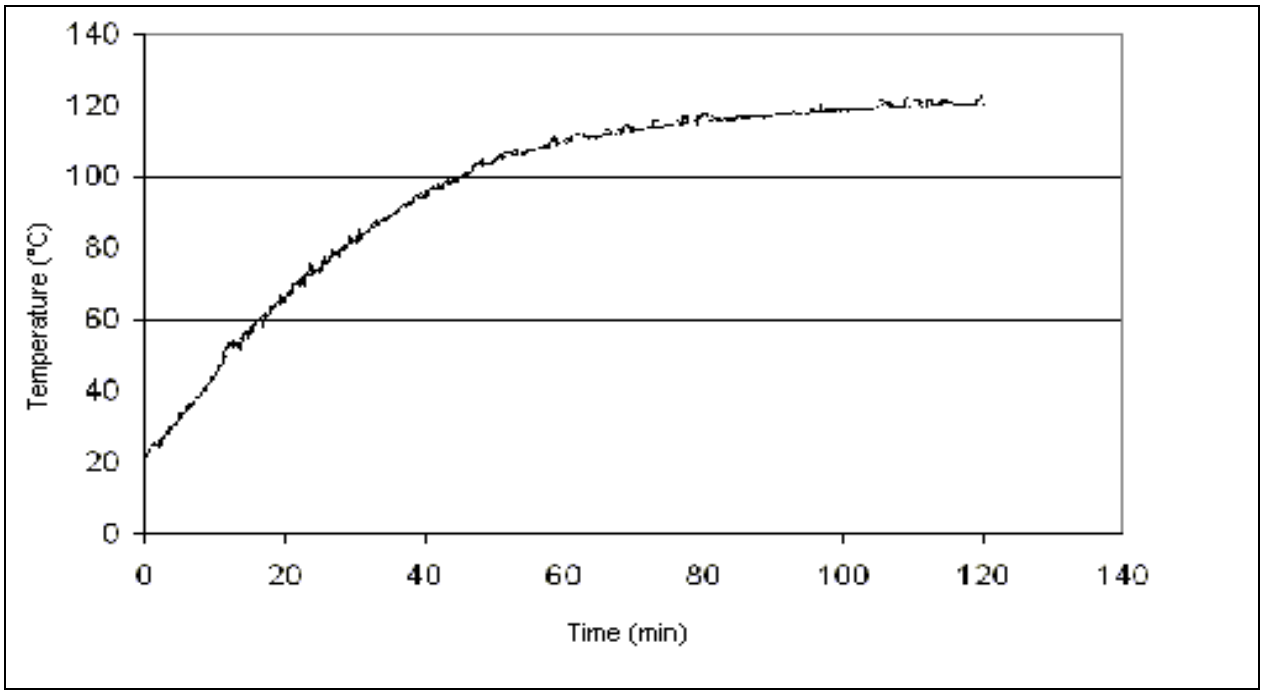

Fig. 3: Dependence of temperature inside the composition carbon fabric-Letoxit Foil 2.3mm thick. The composition was cured under vacuum in a steel mold at 120°C laid in a drying kiln.

It is necessary to keep the composition at the curing temperature for at least the minimal curing time. It is necessary to verify that the curing temperature is reached within whole cross-section of the cured composition. Temperature inside the cured composition can be measured with e.g. thermocouple.

Properties of Letoxit® Foil LFX 060

Density of uncured resin (g.cm^{-3})	1.19	1.19	1.19
Curing temperature (°C)	80	90	120
Peak of reaction (min)	125	48	4,9
Minimal curing time (min)	200	100	20
Recommended curing time (min)	300	120	40
Resin properties*			
Density of cured resin (g.cm-3)			
Density of cured resin (g/cm3)	1.21	1.21	1.21
Shrinkage (%)		0,4	
Hardness Barcol	18 - 21	18 - 21	18 - 21
Tg (°C)	89	120	122
Maximal flexural stress	109	145	125
Flexural modulus of elasticity (GPa)	3,6	3,2	2,9
Impact strength (kJ/m2)	15,7	24,7	36,1

*Stated properties of cured resin were measured after curing at given temperature and recommended curing time

The composition produced by the LF Technology can be cured to lower conversion degree, app. 70% and post-cured outside the mould. However, the composition that is not cured properly is very brittle!

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Composite properties reinforced with glass *

Density (g.cm^{-3})	1.70
Resin content (%)	
Maximal flexural stress (MPa)	487
Flexural modulus of elasticity (GPa)	14
Impact strength (kJ/m2)	183

* Properties of cured composite were measured after curing at given temperature and recommended curing time. Composite constitution: 12 layers of glass fabric - twill weave, 163 g/m^2, and 8 layers of Letoxit Foil LFX 060, 200 g/m^2.

Packing:

The resin is delivered in the form of foil, 250 mm or 1000 mm width, which is protected with polyethylene foil from one side and isolating paper from the other side. It is winded up on the hollow with the total weight up to 10 kg (usually 5 kg rolls are supplied – according to the customer request).

Storage:

Without the change of properties, the resin can be stored for 1 month at +20°C, for 3 months at 5°C and up to 1 year for –18°C. The temperature +30°C mustn't be crossed during transport and storage.

Safety during processing:

see Safety sheet

Producer and Supplier:

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