

Technical Guide - Motorsport Biocomposites

Evopreg EPC with Flax Reinforcements

Natural fibre composites for motorsport applications

Introduction

There is increasing interest across several motorsport series in the use of natural fibre composites for parts such as aerodynamic devices. This technical guide provides an overview of Composite Evolution's Evopreg epoxy component prepregs with flax fibre reinforcements.

What are Flax Fibres?

Flax fibres are extracted from the stem of the flax plant (other derivatives of flax include linen and linseed oil). As natural fibres are discontinuous, they are then usually combined into a yarn and woven, or bound into a unidirectional or randomly-oriented mat. In terms of performance, flax fibres have a lower density than carbon fibres and a similar stiffness to glass fibres. The properties, quality and availability of flax fibres are generally superior to those of other common natural fibre reinforcements such as hemp and jute.

Key Features & Benefits

- Technical
 - Lightweight - lower density than carbon fibres
 - Good specific stiffness - comparable to glass
 - Good noise and vibration damping properties
 - Thermally insulating
 - Low abrasion and low tool wear
- Environmental
 - Renewably sourced
 - Low production energy
 - CO₂ neutral
 - Biodegradable
- Health & Safety
 - Safe to handle - non-toxic, non-irritating
 - Safe failure modes (no sharp edges)
- Economic
 - Lower cost than carbon fibre

Other Considerations When Using Natural Fibres

Being naturally-sourced products, flax fibres and their composites have some particular considerations that should be taken into account.

- Variability
 - More variation in material properties than synthetic fibres
- Moisture susceptibility
 - Natural fibres absorb moisture - they should be dried before processing to reduce problems associated with volatiles and porosity
 - Coatings or sealants may be necessary to protect the exposed edges of parts
- Temperature
 - Natural fibres can degrade or burn at elevated temperatures
 - This limits cure, post-cure and in-service temperatures
 - We recommend limiting temperature exposure to below 150°C
- Cutting
 - Behaviour is somewhat more like aramid than carbon

Composites Evolution Flax Solutions

- Evopreg EPC flax/epoxy prepregs
 - Available in standard EPC300 120°C curing epoxy, or other resins
 - Range of flax fabrics including woven, unidirectional and multiaxial
 - Can be handled and cured in the same way as carbon/epoxy prepregs using standard processes and equipment
- Biotex dry flax reinforcements
 - For RTM or vacuum infusion processes
 - Range of flax fabrics including woven, unidirectional and multiaxial
- Technical Support
 - We know flax and can help you make a smooth introduction

Suggested Motorsport Products

- We have a family of Evopreg flax/epoxy prepregs to suit the design and manufacturing of motorsport parts
 - Lightweight woven surface ply - 100 g/m² 2x2 twill (EPC300-F100T)
 - Medium weight woven ply - 300 g/m² 2x2 twill (EPC300-F300T)
 - Unidirectional ply - 150 g/m² UD (EPC300-F150U)
- Other fabrics available on request
 - 100 g/m² - 700 g/m² woven, UD, biaxial, etc.
- EPC300 120°C cure epoxy resin - natural colour or black
 - Other resins, including bio-resins, available on request
- We recommend autoclave cure or press moulding for flax prepregs

Technical Data - Evopreg EPC300-F100T

Typical data for laminates made from 100 g/m² woven flax-reinforced epoxy prepreg (Evopreg EPC300-F100T-60) cured in an autoclave for 1 hour at 120°C, 6 bar pressure.

Property	Result	Test method
Fibre content by volume (%)	34%	Internal method
Laminate density (g/cm ³)	1.27	Internal method
Cured ply thickness (mm)	0.20	Internal method
T _g onset / peak (°C)	108 / 123	DMA, internal method
Flexural strength 0° / 90° (MPa)	169 / 189	ISO 14125
Flexural modulus 0° / 90° (GPa)	9.5 / 10.5	ISO 14125
Tensile strength 0° / 90° (MPa)	122 / 127	ISO 527-4
Tensile modulus 0° / 90° (GPa)	11.8 / 13.1	ISO 527-4
Compression strength 0° / 90° (MPa)	151 / 149	ISO 14126
In-plane shear strength +/-45° (MPa)	46.4	ISO 14129
In-plane shear modulus +/-45° (GPa)	1.7	ISO 14129
Apparent ILSS 0° (MPa)	23.6	ASTM D2344, failure mode unclear

Technical Data - Evopreg EPC300-F300T

Typical data for laminates made from 300 g/m² woven flax-reinforced epoxy prepreg (Evopreg EPC300-F300T-50) cured in an autoclave for 1 hour at 120°C, 6 bar pressure.

Property	Result	Test method
Fibre content by volume (%)	48%	Internal method
Laminate density (g/cm ³)	1.32	Internal method
Cured ply thickness (mm)	0.42	Internal method
T _g onset / peak (°C)	99 / 114	DMA, internal method
Flexural strength 0° / 90° (MPa)	236 / 231	ISO 14125
Flexural modulus 0° / 90° (GPa)	13.8 / 14.5	ISO 14125
Tensile strength 0° / 90° (MPa)	162 / 161	ISO 527-4
Tensile modulus 0° / 90° (GPa)	17.5 / 17.5	ISO 527-4
Compression strength 0° / 90° (MPa)	136 / 135	ISO 14126
In-plane shear strength +/-45° (MPa)	50.1	ISO 14129
In-plane shear modulus +/-45° (GPa)	2.0	ISO 14129
Apparent ILSS 0° (MPa)	27.9	ASTM D2344, failure mode unclear
Coefficient of thermal expansion (µm/m/°C)	10.3	TMA

Technical Data - Evopreg EPC300-F150U

Typical data for laminates made from 150 g/m² unidirectional flax-reinforced epoxy prepreg (Evopreg EPC300-F150U-50) cured in an autoclave for 1 hour at 120°C, 6 bar pressure.

Property	Result	Test method
Fibre content by volume (%)	42%	Internal method
Laminate density (g/cm ³)	1.30	Internal method
Cured ply thickness (mm)	0.24	Internal method
T _g onset / peak (°C)	109 / 123	DMA, internal method
Flexural strength 0° / 90° (MPa)	356 / 58.4	ISO 14125
Flexural modulus 0° / 90° (GPa)	26.3 / 3.9	ISO 14125
Tensile strength 0° / 90° (MPa)	269 / 26.0	ISO 527-4
Tensile modulus 0° / 90° (GPa)	30.4 / 4.6	ISO 527-4
Compression strength 0° / 90° (MPa)	166 / 111	ISO 14126
In-plane shear strength +/-45° (MPa)	52.3	ISO 14129
In-plane shear modulus +/-45° (GPa)	2.0	ISO 14129
Apparent ILSS 0° (MPa)	32.7	ASTM D2344, non-shear failure
Coefficient of thermal expansion (µm/m/°C)	4.6	TMA

Effect of Black Pigment

- The black version of the resin has a slightly lower T_g and mechanical properties than the natural colour resin when using a standard cure
- The cure could be adjusted to regain these properties if required

Typical data for laminates made from woven flax-reinforced epoxy prepreg (Evopreg EPC300-F300T-50) cured in an autoclave for 1 hour at 120°C, 6 bar pressure.

Property	Result (natural)	Result (black)	Test method
T _g onset / peak (°C)	99 / 114	88 / 105	DMA, internal method
Flexural strength 0° (MPa)	236	211	ISO 14125
Flexural modulus 0° (GPa)	13.8	12.8	ISO 14125
Tensile strength 0° (MPa)	162	156	ISO 527-4
Tensile modulus 0° (GPa)	17.5	18.4	ISO 527-4

Disclaimer

The information provided here is believed to be accurate but should be considered indicative only. It is the responsibility of the customer to check the suitability of a given product for their specific application prior to use.

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