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Travelling light

The shark in the sky: With the help of French pilot Eric Barberini, Shark aircraft set a new ULA world speed record in December 2011

Oxeon explains how its TeXtreme spread tow fabrics are helping to reduce the weight of its customer, Shark Aero's ultra light aircraft by optimising carbon reinforcement.

S lovakian ultra light aircraft (ULA) manufacturer, Shark Aero has drastically reduced the weight of the composite parts in its aircraft. A large part of the weight savings is attributed to the use of Oxeon's TeXtreme spread tow fabrics that help reduce weight and improve the mechanical properties of ULAs.

Shark Aero, a new entrant for manufacturing premium European ULAs was established in 2008 to manage the production and sale of Shark aircraft. Based on the collaboration between the Gryf Design and Comp-Let in the MD-3 Rider aircraft development and is its logical continuation, the Shark aircraft combines the manufacturer's experience with composites and the design team's know-how gained during a large number of ULA designs.

The company approached Oxeon in late 2008 when it began designing its first prototype ULA, and with a view to reducing weight on its composite parts in order to build faster aircraft. Speed and weight are key aspects to be kept in mind for designing the aircraft as an important goal is to reach the dream top speed of 300km/h for ULAs and to still keep the weight to a maximum of 300kg.

Founded in 2003 in Sweden, Oxeon has quickly established itself as one of the market leaders in spread tow carbon reinforcements. Their use is said to increase the mechanical performance of composite material products and reduce the weight. The company's thin TeXtreme spread tow tapes are used to weave carbon fabrics with virtually no crimp to realise mechanical properties similar to a cross ply of uni-directionals (UD). TeXtreme is based on combining two novel technologies: spread tow and tape weaving. First the carbon fibre tow is spread into thin flat spread tow tapes and then these spread tow uni-directional tapes are used to weave a spread tow fabric.

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The spread tow know-how

Oxeon has recently introduced a groundbreaking innovation – the + α /- β variants of TeXtreme spread tow fabrics, with the initial offering of +45/-45 type. This proprietary process enables continuous-length production of novel fabrics by interlacing two sets of spread tow tapes in different angles + α /- β , for example +45/-45, +30/-60, +50/-25 etc. These fabrics complement the existing 0/90 type of TeXtreme to realise easily and quickly an optimised multidirectional reinforcement by direct plying. TeXtreme can be delivered both as dry fabric and as prepreg, which gives the manufacturers the opportunity to choose what is best suitable.

Besides keeping the ULA within the weight restrictions, the main requirement for weight savings are that it enables many improved flight features. A lighter aircraft will normally have quicker reactions, and if you are lighter with identical aerodynamic configuration, then less power is needed to fly and consequently be more fuel efficient. When reducing weight, the payload is also improved, take-off and landing distance is reduced and the climb rate tends to be a little better as well. These flight features are all important aspects to deliver to

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Back in black: A Shark stabiliser and elevator mould with first surface layer of TeXtreme 80gsm

Body and soul: A laminated Shark left fuselage shell, ready to glue ribs, bulkheads, interior, firewall and spars

the buyers of an ULA – and TeXtreme was chosen to help accomplish this requirement.

Accordingly, a test programme was initiated in which Shark evaluated different TeXtreme variants and tested the mechanical properties of the resulting composite parts. Concluded in early 2010, the test programme clearly showed that the use of TeXtreme brought several mechanical and process advantages over the presently used materials in the industry. In particular, use of TeXtreme enabled composite parts to be redesigned to be significantly lighter without sacrificing on essential strength properties. Furthermore, the surface smoothness benefits of TeXtreme eliminated the need for using glass fabric as an outermost layer, whereby a laborious step in the manufacturing process was eliminated. Consequently, Shark Aero replaced its 200gsm and 90gsm fabrics with 160gsm and 80gsm TeXtreme fabrics respectively.

"By changing to TeXtreme we saved an impressive 50kg in total," explains Shark Aero's CEO, Vladimir Pekar. "On average the weight of smaller parts such as the stabiliser, elevator, rudder, spinner and landing gear doors, have been reduced by 60%. Weight savings of this magnitude are paramount in this category of aircraft as it allows us to build faster aircraft. Our aim is to use the best possible materials and TeXtreme qualifies for this."

Some light relief

When producing Shark's fuselage in series, it weighed 41kg, which is 25kg less than the 66kg prototype produced using conventional fabrics.

"As a consequence of switching to TeXtreme and after recalculating the whole Shark fuselage with FEM, a saving of 25kg for the fuselage alone was very good as it was more than planned," Pekar continues. "With such weight savings from use of TeXtreme, Shark Aero could meet the specifications demanding maximum empty weight of 300kg for a single seat ULA directly and at the same time improve many crucial flight features."

The significant reduction of crimp angle, the number of interlacing points and the thickness of spread tow fabrics uniquely contributes to improving the mechanical properties and fabric's surface smoothness. Furthermore, due to smaller and fewer resin rich pockets in the final laminate, TeXtreme enables the final composite material product to have a smoother surface, something that the Shark aircraft have benefited from.

"Another benefit besides the weight savings and surface smoothness is the ease of handling TeXtreme," concludes Pekar. "It is really easy to work with TeXtreme and it only gets better when you get to know this new fabric."

With the help of these weight savings from TeXtreme's spread tow reinforcement, Shark aircraft are presently up in the air and competing for world speed records with the aim of reaching the ultimate dream ULA limit of 300km/h in the very near future.



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