Succeeding wood, aluminium metal was for a long time the only material capable of providing the desired material performance in relation to its weight. Step by step, composites have replaced aluminium in aircraft structures, gradually reaching the current levels of over 50% of the structural weight of an aircraft. The latest generation aircraft have a very high level of carbon fibre composites in their structure, proving again that the main driver in aerospace is weight saving.

Starting with military and industrial applications and evolving into commercial aircraft structures, prepreg technology has adapted to the market needs. Major developments came from material characteristics providing on-demand performance, including fast cure cycles for industrial applications, high service temperature performance for engines, and impact tolerance for primary structures. Prepreg is a baseline technology in this industry because of its better cost-performance ratio compared to competing materials and its material and technology reliability.

In addition to the constant development of new high-performance composite materials, the market also required more robust manufacturing processes primarily to ensure higher quality standards, especially for large composite structures. Automated fibre placement (AFP) and automated tape laying (ATL) were developed and implemented to provide OEMs the tools for producing these high-quality parts.

The right material and technology at the right place
Despite the maturity of prepreg technology, OEMs are continuously looking for alternatives for the future.

Is prepreg technology the only answer for all the primary structures of next-generation aircraft?

Although, up to now, the cost-performance ratio achieved with prepreg technology has allowed the applications for high-performance composites to increase, this will not necessarily be the case for all next-generation aircraft primary structures. While weight was the main driver for composite applications in the past, a new weight-cost trade-off will drive the material and technology choice for next-generation aircraft. This new situation opens the door to other materials and technologies, including a return to metal with new-generation alloys.

The challenge facing aircraft designers is to find, to develop and to certify the right materials and technology on a part-by-part basis, to balance overall optimum performance and final part costs with a minimum industrial risk and with a mature supply chain.

Alternative composite technologies
From the early days of composite materials, alternative fibre-reinforcement matrix technologies to prepreg have existed. When looking at new cost-performance trade-offs, one category stands out above all others: liquid composite moulding (LCM: RTM and infusion) materials.

LCM materials have been studied and used in aircraft secondary structures.
HiTape® Combining current technology advantages with increased cost effectiveness

Hexcel’s innovative proposal is to combine the benefits of automation and the cost effectiveness of infusion/injection technologies with the high performance of latest-generation prepreg materials.

The new proposal is the missing link between interesting but incomplete current LCM materials and latest-generation prepregs in term of performance-cost ratios.

Performance in composites comes from straight, perfectly aligned fibres; HiTape® is therefore a unidirectional tape. Made from Hexcel’s HexTow® carbon fibre and combined with HexFlow® infusion resin, HiTape® matches the performance of the latest-generation UD prepregs.

While offering the same overall in-plane mechanical performance level as state-of-the-art prepreg materials thanks to the equivalent 60% fibre volume content achieved by vacuum infusion, another major innovation of HiTape® is to improve the toughness of current composites made by LCM technologies.
With standard dry unidirectional tape, through-the-thickness resin permeability is a clear limitation for thick parts. Thanks to proprietary technology, HiTape® is available in different versions enabling vacuum infusion of parts up to 30mm thick with a 58 to 60% fibre volume content.

Moreover, the material does not use any carrier film, so the machines are simpler, not dependent upon room temperature or humidity for tack control, and therefore more efficient. In consequence, outputs of 50kg/h are anticipated depending on part design. In addition, the material does not require any refrigerated storage. Hexcel is working closely with several major OEMs to demonstrate the benefits of this material through various developments and demonstrator programmes.

HiTape® is a Hexcel registered trademark and the product is patented.

More information:
www.hexcel.com