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FEATURE

Aerospace looks to composites for solutions

Mark Holmes

New materials to reduce weight and speed manufacturing processes are being demanded by the aerospace industry and composites are rising to the challenge. Reinforced Plastics reports.

The global demand for aircraft is growing and the aerospace industry is calling on composites to meet its needs to reduce weight, as well as improve manufacturing times and save costs. The composites industry is developing new products to meet these needs and increasingly many of these are out of autoclave.

Reducing costs is a major priority in the aerospace industry at present, according to Tim Herr, Aerospace Director at Victrex. ''Aircraft manufacturers are pushing to absorb a 9–10 year backlog and need solutions that reduce manufacturing and operating costs,'' he says. ''In order to increase manufacturing throughput and satisfy growing demands for an ever faster aircraft build rate, one area of focus is composites. Composite manufacturing incorporates the design flexibility and fast production to improve manufacturing efficiencies, with the potential to simplify design, while providing weight savings to lower operational costs.

''As the industry continues to emphasize the buy-to-fly ratio, the efficiencies of continuous manufacturing and material utilization make composite solutions extremely attractive for aerospace applications. Analysts are projecting a 33% growth in the global composite market for aerospace to 96 million lbs. (43.5 million kg) in the next five years. Within that space, thermoplastic composites are expected to reach 2.1 million lbs. (1 million kg) representing 83% growth for reinforced thermoplastic materials.''

In order to meet these market needs Victrex has combined thermoplastic composite engineering and new manufacturing techniques with polyketone material technologies to create novel solutions for the aerospace industry. ''The processing and performance benefits of polyketone composites are too compelling to ignore,'' Herr explains. ''When compared to thermoset composites, polyketone composites can be produced out of autoclave and dramatically reduce cycle times from hours to minutes, increasing throughput up to 90%. For conventional metal solutions, polyketone composites deliver weight savings of up to 60% with equal or better stiffness. Moreover, the design flexibility of polyketone composites enables engineers to design highly-functional components to simplify, standardize and consolidate parts to reduce assembly times and manufacturing costs. Structural or loaded brackets are an obvious choice for polyketone composite solutions. The technology reduces manufacturing processes and time when compared to thermoset and metal components while reducing downtime for maintenance because of the material's high mechanical, chemical and corrosion resistance.''

Commercial aircraft use thousands of brackets and system attachments from the cockpit to the tail of the plane. The total amount of these components on an aircraft can add a significant amount of cost and weight especially if they are made from machined metal or thermoset lay-ups. The VICTREX PAEK-based components (Fig. 1) can be manufactured more efficiently than conventional thermoset alternatives, and can deliver significant weight savings compared to stainless steel and titanium while offering equivalent or better mechanical properties such as strength, stiffness and fatigue.

Chief Executive David Hummel adds that the company has an exciting opportunity to accelerate innovative and differentiated solutions for the aerospace industry in markets where polyketones have a strong advantage. ''Our Aerospace Loaded Brackets program is a great example of how we can offer new forms and components, alongside supplying materials, and build a new supply chain to address the unmet needs of the aerospace industry,'' he says.

According to Victrex, the main advantage of thermoplastic polyketone composites over thermoset composites is rapid manufacturing. ''Thermoplastic composites are suitable for out of autoclave processes and reduce cycle times from hours to

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FIGURE 1
VICTREX AE™ 250 hybrid molded brackets combine composite prepregs with hybrid overmolding delivering greater design freedom and strength versus metal.

FIGURE 2
Polymer forms and parts. Victrex integrated solutions span from polymer to parts and semi-finished products.

minutes,'' adds Tim Herr. ''For OEMs and Tier 1 manufacturers, polyketone composites will reduce process bottlenecks and have the potential to increase throughput by up to 90%.''

In order to accelerate the commercial adoption of polyketone (PAEK*) composite applications within the aerospace industry, Victrex and Tri-Mack Plastics Manufacturing Corporation have established a joint venture, TxV Aero Composites. The multi-million dollar investment includes the establishment of a new US-based manufacturing facility. The new company will be a total solutions provider for polyketone composites, from concept development through commercialization. The companies add that by combining expertise in materials, engineering, development and manufacturing, TxV Aero Composites will be able to address customer challenges with dedicated speed and focus. The intent is to offer a range of PAEK composites, from custom laminates to preformed composite inserts for hybrid molding processes, as well as finished composite parts and complete overmolded hybrid composite components and assemblies. One example is VICTREX AE™ 250 composites, a new lower temperature processing PAEK-based composite product family that enables a hybrid molding process. This innovation is claimed to combine the strength of continuously-reinforced thermoplastic composites with the design flexibility and proven performance of VICTREX™ PEEK injection molding polymers (Fig. 2).

Tri-Mack Plastics is a long-standing partner of Victrex and has a reputation for developing and manufacturing complex parts and assemblies for the aerospace industry. TxV Aero Composites will establish a purpose-built polyketone composite center of excellence in the USA, due to be completed in 2017. Commenting on the joint venture, Will Kain, President of Tri-Mack states: ''With an estimated 35,000 new aircraft to be launched in the next 20 years, the aerospace industry is embracing thermoplastic composites as a cost-effective solution to support this growth. The efficient processing and performance advantages of PAEK thermoplastic composites combined with state-of-the-art automated manufacturing will position TxV Aero Composites to meet the industry's cost and weight challenges.''

Tim Herr also believes that the joint venture offers a great many advantages to advance the use of polyketone technology in aerospace. ''The supply chain for PEEK overmolded hybrid composite components is in its infancy and the learning curve can be lengthy and complex,'' he says. ''TxV Aero Composites brings together Victrex's experience of making markets where polyketones have a strong advantage with Tri-Mack's more than 40 years of specializing in high temperature thermoplastics and thermoplastic composites. TxV Aero Composites is positioned to address the unmet needs of the aerospace industry by combining expertise in materials, engineering, development and manufacturing.''

Herr adds that TxV Aero Composites will operate globally as a total solutions provider capable of assisting customers in all stages from concept development, through prototyping, and on to commercialization.

There are no plans for further manufacturing facilities elsewhere in the world at present. However, he says that Victrex remains open for new challenges and opportunities in the aerospace industry.

The companies believe that there are also likely to be many new applications for polyketones in the future. ''Any applications where weight, cost, efficiency or performance are critical engineering requirements are a good fit for polyketone composites,'' concludes Tim Herr. ''By fine tuning the material properties, we can envision significant opportunities for structural brackets in the fuselage, engine and landing gear, for example. Moving beyond existing design, new electric/hybrid propulsion systems is a topic that may play a significant role in future aircraft. If strength-to-weight ratio and manufacturing efficiency remain key requirements, the future looks bright for polyketone composite solutions.''

Reduced carbon footprint

Saving weight and making aircraft more fuel-efficient to reduce the carbon footprint continue to be the main drivers in the aerospace

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