

The future of flight looks bright for PEEK

By

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The introduction of unidirectional tape and laminate panels under the name Victrex AE™ 250 composites allow the production of continuously-reinforced components that can perform under load. Victrex believes the future for thermoplastics in the aerospace industry will continue to be bright, which means the company will continue to be busy.

A promising tomorrow for thermoplastics

Victrex sees a great fit within brackets, clips, clamps, connectors, fasteners and other system attachments in primary and secondary structures as well as in fuel management because of the ability to reduce weight, consolidate several components into one part, design costs out, and improve production or installation speed in some cases. The company believes there will be a continued need for lightweight thermoplastic films and tubing for various aircraft systems beyond thermal acoustic insulation and drainage lines.

Victrex AE™ 250 composites have shown weight savings of up to 60 per cent under certain circumstances when compared to metals such as aluminium, stainless steel and titanium.[1]

That weight reduction could translate into

After a busy 2015, you could forgive Victrex for thinking this year would be a good chance to take it easy. After all, the British manufacturer of PAEK polymer solutions found its products specified in Bombardier's Learjet and Global aircraft, as well as for the first time in a primary structural component on the Airbus A350 and launched new composites for the aerospace industry.

significant gains in fuel-efficiency and reduced CO₂ emissions. The composites have also shown an up to five times higher specific strength compared to those of metals.[2] With this composite solution being used as inserts in existing injection moulding equipment, the hybrid moulding process enables the overmoulding of a continuously-reinforced thermoplastic composite with Victrex® PEEK injection moulding polymers.

Introducing hybrid moulding technology

The hybrid moulding technology offers major advantages, including improved cycle times, lower energy requirements, and the elimination of scrap and secondary operations.

These factors help to reduce total system cost, a high priority in the industry's effort to move planes off the assembly line faster and more cost-effectively. Analysts believe[3] that more than 35,000 new aircraft will be needed over the next 20 years in order to replace ageing fleets and to meet civilian flight demands.

Besides the great mechanical properties associated with thermoplastic composites, the differentiator between Victrex AE 250 composites and other PAEK-based offerings is that it can be processed at a lower temperature. This led Victrex to the development of the hybrid moulding

technology which uses the composite components as inserts and allows for processors to overmould a short-fibre filled PEEK polymer on to the composite insert without the need of pre-heating the organosheet up to its melt temperature prior to overmoulding. Thus users get the design freedom of injection moulding and the strength of composites to manufacture components that were not achievable in the past.

Successful growth strategy

Victrex was formed with just over 60 employees in 1993 after a management buyout of the Polyetheretherketone (PEEK) polymer business from Imperial Chemical Industries (ICI). ICI had been



Bracket/fitting in Airbus A350 is the first primary structural component made from Victrex® PEEK polymer © Airbus Helicopters

interview



TIM HERR,
AEROSPACE DIRECTOR
VICTREX

JEC Composites Magazine: Can you introduce your position and tasks at Victrex?

Tim Herr: I joined Victrex in 2001. For the past two years I've been tasked with the creation and implementation of the company's strategy for growth in the commercial aerospace market.

JCM: What is the potential of the Victrex AE™ 250 Composites material in the Aerospace industry?

T.H.: I'm totally convinced that the new composite has the potential to "revolutionise" the future of aviation: With cost reductions being a high priority of the industry, you can imagine how this material and processing technology enables new levels of part consolidation through hybrid moulding, the use of existing manufacturing infrastructure and reduces energy requirements and processing time which all lead to system cost savings.

manufacturing PEEK since it filed a patent for the polymer in 1978. By 2003 the company, headquartered in North West England, extended its plant to produce 2,800 tonnes a year. Today, Victrex employs more than 700 people worldwide, is listed on the London stock exchange (FTSE 250) with a market capitalisation of around GBP1.5 bn and has a manufacturing capacity of 7,000 tonnes with annual sales of GBP263.5 m in 2015.

The company also has a number of "downstream" manufacturing plants including for film, composite tape, pipe and medical components. In 2016

JCM: What are the most important growth drivers for thermoplastics?

T.H.: There is a need for performance and cost improvements in several areas of the aircraft ranging from seating and interiors to engines and fuel systems. There are significant opportunities within the commercial aerospace market due to the combination of benefits that thermoplastics can provide. As we have seen with the A350 and the Boeing B787, there is a continued push for lightweight plastics and composites within the industry.

JCM: What are the strengths of Victrex composites in the aircrafts lightweighting race?

T.H.: First and foremost, thermoplastics are inherently lighter in weight than traditional metals. The design of the component allows for significant improvements. For example, the Victrex PEEK 90HMF40 polymer allows for a 70% weight reduction compared to steel, a 55% weight reduction compared to titanium and a 40% weight reduction compared to aluminium while achieving equivalent stiffness.[6] The polymer part will need a nominal increase in thickness, but these benefits make it a viable metal replacement material.

JCM: Do you have any specific examples?

T.H.: Airbus Helicopters selected the 90HMF40 material for a structural bracket in the A350 aircraft door. Overall, the thermoplastic component

Victrex pledged further investment in more downstream manufacturing to support its "mega-programmes". As the market for composites, according to some analysts, is predicted to double by 2020 [4], these investments confirm the company's will to capture this growing market. Victrex's investments includes a new PEEK composite tape facility, with UD tape being used in the Magma Oil & Gas mega-programme, in medical and also in aerospace. Those efforts are also supported by the opening in April 2015 of a new state of the art plant as a third polymer production facility. Last year saw Victrex make several in-

is 40% lighter, achieved a 40% cost reduction and performed better in moisture than the incumbent aluminium material. Beyond offering viable metal replacement solutions, we have expertise in the areas of stress analysis, part and tool design, processing, design allowables data, and material and part testing to help our customers achieve their weight and cost savings goals.

JCM: What is your growth strategy?

T.H.: Victrex monitors the trends of the industry and has ongoing discussions with market leaders to understand what is happening now and in the future. Several years ago, a decision was made to invest in the third polymer production plant that would push our capacity to over 7,000 tonnes per annum. We understood then what challenges the aerospace industry would be facing today and invested in capacity ahead of the anticipated increase in demand. Beyond our polymer production, we are also investing in production capacity 'downstream', so for more 'semi-finished' products such as composite tape and polymer film that has a lot of know-how locked up in them. That wasn't the only reason for the expansion though as we have several 'mega-programmes' in our pipeline spread across the aerospace, automotive, energy, electronics and medical industries as well. Security of supply and exemplary customer service continue to be a high-priority for Victrex. ■

roads in the aerospace sector, with Denroy Plastics Ltd, the UK-based precision plastics injection moulding specialist, developing optimized brackets in close collaboration with Bombardier and Victrex.

Made of an electrostatically dissipative Victrex PEEK grade, Victrex® PEEK-ESD™ polymer, that has been used in harsh environments including aggressive aerospace fluids, this Victrex solution is for the first time specified in commercial aircraft, such as Bombardier's CSeries, Global and Learjet aircraft.

Denroy's target was to replace small to medium-sized machined aluminium and



Launching of a new product family: "Victrex AE™ Composites" for Aerospace. © Victrex

titanium brackets intended to last for the life of the aircraft even though many of these brackets are constantly immersed in fuel.

Streamlined manufacturing

In addition to developing a reliable solution, weight and cost savings were keys to success. With cost savings and streamlined manufacturing among the advantages of using injection-moulded polymers, the new bracket technology is now being introduced to the aircraft industry.

Meanwhile in September Airbus Helicopters announced it was replacing aluminium in a fitting in the aircraft door of the Airbus A350-900 with a high-modulus, carbon fibre-reinforced high-performance polymer. The fitting, manufactured from Victrex® PEEK 90HMF40, has been developed by Air-

bus Helicopters and is in mass-production for commercial use after receiving the relevant component qualification. The successful substitution of metal has resulted in a 40% reduction in weight and costs and the injection-moulded polymer solution replaces the higher cost manufacture of the bracket machined from an aluminium block.

Victrex PEEK 90HMF40 is a high-performance polymer with high-modulus fibres based on the Victrex 90-Series polyaryletherketone, which is primarily used in very thin-walled injection-moulded components. High-strength components can be manufactured from this free-flowing, easily processed material. For example, Victrex PEEK 90HMF40 has up to 100 times longer fatigue life and up to 20% greater specific strength and stiffness than aluminium 7075-T6 under the same conditions.[5]

Delivering continuous innovation

Based on such successes, the aerospace industry will remain an important area of development for Victrex in the coming years as the company will continue to focus on delivering innovative solutions in order to help its customers meet their goals in reducing costs and weight while improving production speed. Thermoplastic PEEK polymers have been used on commercial aircraft for several decades now in a range of interior



Durable Victrex® PEEK-ESD™ brackets for wing, centre box and fuel tank applications. © Denroy Plastics Ltd

and exterior applications in the cockpit to the tail of the plane, and everywhere in between. The company has seen a particular interest in primary and secondary structural brackets and offers several short-fibre filled polymers that can handle the requirements of structural applications including its carbon fibre and high-modulus fibre grades. ■

More information:
www.victrex.com

References

- [1] Victrex® PAEK composites have exhibited up to 60% weight savings vs. Steel AISI 4130. Savings also achievable vs. Titanium TA6V, Aluminium, 7075-T6, Magnesium ZK60A-T5, (Metals data from CES selector 2012, Granta Design. Polymer data from Manufacturer)
- [2] Victrex® PAEK composites have exhibited up to 5x higher specific strength than Steel AISI 4130. Improvements also achievable vs. Titanium TA6V, Aluminium, 7075-T6, Magnesium ZK60A-T5, (Metals data from CES selector 2012, Granta Design. Polymer data from Manufacturer)
- [3] www.materialstoday.com/composite-applications/news/paris-air-show-2013-boeing-forecasts-demand-for/
- [4] Lucintel Growth opportunities in Continuous Fibre Thermoplastics Market 2015-2020
- [5] Victrex internal data on the material. Available upon request. The aluminium data is taken from CES Selector 2012
- [6] Internal Victrex case study. Data available on request.



VICTREX® PEEK 90 HMF40, developed by Airbus Helicopters, is in mass production for commercial use © Thinkstock