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– Andy Walton, Director for Automotive, Victrex. Page 10

Powertrain: a PEEK into smart solutions

By: James Hilton

Developing next-generation automotive powertrain technology is a complex challenge. Design engineers need to translate global demands into cost-effective, pioneering solutions and stay ahead of competitors.

Polymers such as “PEEK” are helping engineers to rethink the way vehicles are designed and built. British company Victrex has over 750 people around the globe supporting the development of its high-performance VICTREX™ PEEK polymers. Their automotive powertrain team has shown that it is in the small components used in the most demanding environments where PEEK can provide the most benefits. Parts in more than 200 million ABS/ESC systems are just one of many examples of a proven automotive track record.

Components include high-performance precision engine gears, which are part of a growing portfolio of parts that reduce noise and vibration (NVH) and reduce weight while offering savings in both cost and time-

Victrex says PEEK can contribute to improved performance and commercial benefits, largely around reducing weight and inertia/friction, whilst reducing total system cost. The company has often been first in complementing or replacing metals and helping OEMs/Tier 1s to reduce CO₂ emissions. A fully integrated 360° approach from conception to high-volume manufacturing has led to the introduction of PEEK gear components.

Today’s move to e-mobility brings new challenges, such as increased power density and performance, thermal management, and reduced cost of manufacture in high-voltage electric motors.

With its PEEK-based insulation Victrex says it is providing a viable solution that can help address these challenges.

Automotive Industries (AI) asked Andy Walton, Director for Automotive, Victrex what he sees as the future for high-performance plastics in cars.

Walton: We all know that the entire industry is facing a variety of monumental changes, by far the biggest in the last 100 years. They include the downsizing of engines, increasing electrification, connectivity and autonomous driving! In addition, safety, reliability and reduction of CO₂ emissions and improved driving experience and comfort are key, while reducing cost is a must.

The tougher and more complex powertrains become, the more PEEK can be a better fit than other polymers or metals. PEEK is among the highest-performing polymers, and while metals might be cheaper in raw material cost, they can result in higher overall component costs due to the necessary manufacturing steps, plus their heavier weight can translate into poorer fuel efficiency.

AI: Tell us about Victrex’s expertise in gear manufacturing.

Walton: Following the acquisition of Kleiss Gears in 2015 we have been able to offer a fully integrated and highly innovative approach to PEEK gear design. We look at the whole system, not just the gear, so we not only have a high-performance material and technology, but also the expertise and capability to turn challenges

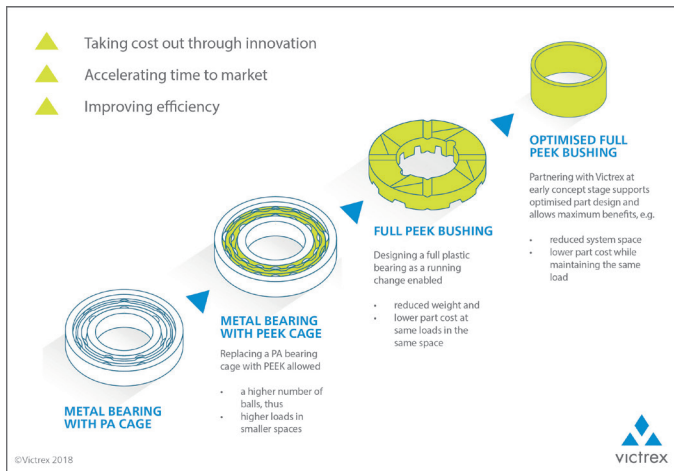
Andy Walton, Director for Automotive, Victrex.



to-market. Key industries including the aerospace, electronics, energy, medical and automotive all use the company’s innovative materials developed over the past 35 years.

PolyEtherEtherKetone (PEEK) polymer offers excellent mechanical and chemical characteristics to support a combination of multiple requirements. For example, the lightweight, high strength material provides high resistance to wear, temperature, fatigue and aggressive fluids/chemicals, which can contribute to:

- Enhanced fuel efficiency
- Improved safety
- Extended part life
- Greater comfort (smooth operation, less noise)
- More design freedom, and/or
- Production cost efficiencies



Victrex maximized benefits.

into advantages. This includes feasibility analysis, gear design, prototyping, testing, inspection, and of course manufacturing.

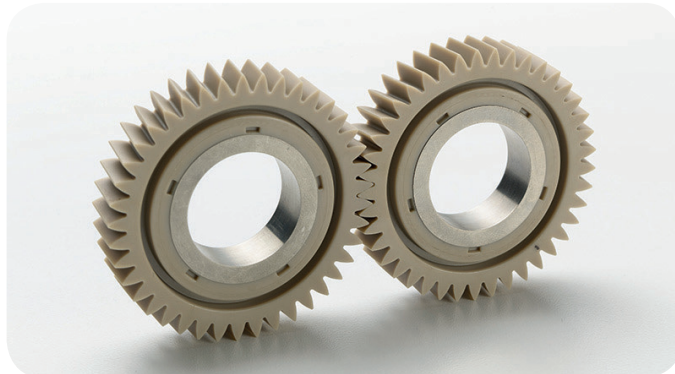
We partner with OEMs and Tier 1s to fully understand their needs. In close collaboration we then develop the right approach to realise the desired benefit for the customer. In doing this, we aim to work with them to help them reduce system complexity and cost and accelerate time-to-market. In March, a major automotive OEM was first to start production with PEEK gears in engine applications.

AI: What are the day-to-day benefits using the material for gears?

Walton: Associated with smaller and downsized engines NVH today is one of the biggest challenges for OEMs and Tier 1s. VICTREX HPG™ gears have demonstrated to reduce rattle and noise issues in engine applications. Furthermore, compared to cast iron gears, their weight and moment of inertia is considerably lower, which contributes to higher system efficiency. In addition to getting rid of gear whine and improving efficiency, PEEK gears provide the potential for a system cost reduction when compared for example to metal scissor gears.

AI: Taking out costs through innovation seems somehow contradictory. Can you explain further and provide examples?

Walton: We have found that the maximum benefit is possible when we are allowed to work directly with OEMs and Tier 1s from the beginning of the design phase, so that we can be a partner in development. Our innovation objectives are to help our customers to enhance CO₂ efficiency; increase performance in application;



VICTREX HPG™ Engine Gears. © American Axle & Manufacturing

and to reduce overall part or system cost. We thrive to improve on the status quo by employing advanced application development techniques to uncover value over and above material cost. Our focus is on improving the total performance-to-total system cost equation. The development of bushings from a metal bearing with a nylon cage to an optimised full PEEK bushing is a good example of enhancing a design and allowing functional integration. Less material and space are needed, while the loads remain the same. As a result, overall system complexity and costs were lower and the time to market is quicker.

AI: Is there more potential to replace metals in transmission and braking systems?

Walton: New challenges in the industry require new thinking. Across a variety of under-the-hood applications PEEK has become a material of choice for OEMs and Tier 1s to increase energy efficiency. In friction applications such as seal rings or thrust washers, PEEK has been found to offer longer component life due to its resistance against aggressive fluids and excellent wear properties which help outperform metals and other polymers. Another benefit is the ability of functional integration/miniaturisation in smaller spaces as a result of engine downsizing while withstanding the high loads and high temperatures. Solving such industry challenges also demonstrates that small components can have a big impact and potentially avoid costly recalls. We think that the key to achieving this is to be involved in the design process from an early stage, so together we can obtain the maximum benefit.

AI: What R&D does Victrex undertake for the automotive sector?

Walton: Our R&D programs aim to help reduce CO₂ and total system/part cost in combustion engine platforms, and to increase performance via power density improvements in electric platforms. As we are moving downstream from supplying not only the resin, but also forms and parts in selected areas, continual innovation that can lead to improvement in application performance is an integral part of our strategy for success. As a proactive investment in the development of next-generation thermoplastic solutions we opened a world-class £10 million Polymer Innovation Centre in 2017. This centre is dedicated to material innovation and different aspects of polymer R&D. Our team includes researchers with a Tier 1 background and external consultants able to offer an OEM/Tier 1 perspective. As you see, the focus is always to create customer value in finding the right answers to each customer's unique needs.

AI: Can you mention specific examples to reduce emissions?

Walton: There are numerous examples that contribute considerably to lowering a vehicle's carbon footprint – pump vanes, thrust washers and gears, for example. In ICE (internal combustion engine) vehicles, the powertrain is still considered the area with the greatest potential for improved CO₂ efficiency. What is more important, our approach to e-mobility and other forms of future mobility goes beyond the vehicle itself, and we are looking into a variety of factors within the automotive ecosystem, such as for example charging infrastructure.

Building on our expertise in a variety of focus industries, including electronics, energy and aerospace, we believe that solutions developed in other business units, such as VICTREX PEEK thermoplastic composites, often translate very well when applied to the automotive world. **AI**

Editor's note: Supporting information on all claims is available upon request from Victrex.