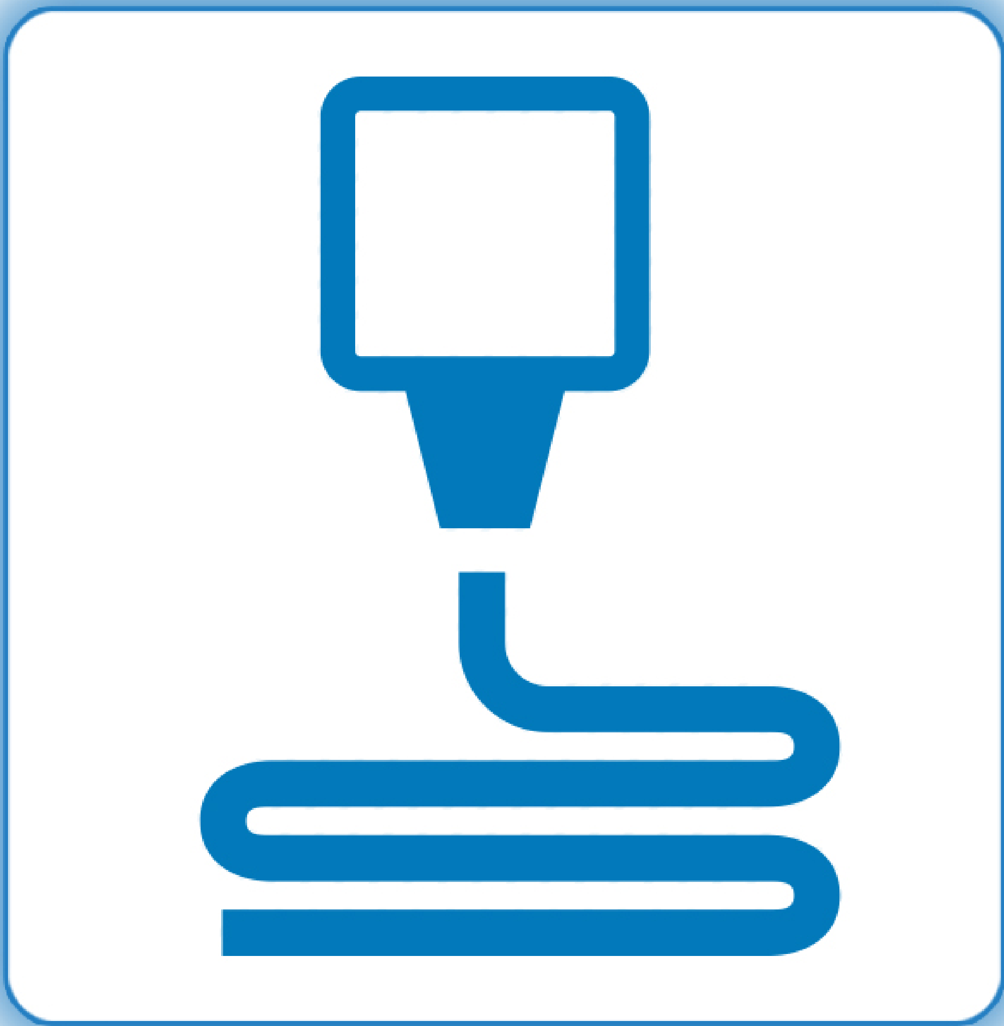
Additive Manufacturing and 3D



Jabil realizes distributed manufacturing vision

Jabil has introduced the Jabil Additive Manufacturing Network™ to drive greater manufacturing speed and agility while helping customers improve how they design, make and deliver products. A major milestone in Jabil's digital transformation journey, this unique cloud network empowers customers to move manufacturing workloads to regions and into markets that make the most business sense and enable easier product personalization.

"Jabil's digital thread fuels a growing footprint of 3D printers and additive manufacturing capabilities to benefit customers through localized production, consolidated supply chains, reduced costs and faster time-to-market," said John Dulchinos, vice president of digital manufacturing, Jabil. "Our new Jabil Additive Manufacturing Network is the connective tissue that scales globally to integrate every printer, facility and work order across our enterprise and crystalize our vision of truly distributed manufacturing."

Over the past year, Jabil has increased its 3D printing capacity steadily with more than 100 3D printers now in operation at facilities in the United States, China, Hungary, Mexico, Singapore and Spain. A variety of 3D printing machines have been installed for high-speed sintering, fused filament fabrication, polymer and metal laser sintering and other processes, to address emerging customer needs in the footwear, industrial machines, transportation, aerospace and healthcare industries. Jabil's distributed manufacturing strategy is anchored by this growing ecosystem of 3D printers, which includes a dozen production-ready HP Jet Fusion 4200 3D printers, following the recent installation of six additional printers at Jabil's Singapore facility.

"Working with Jabil has allowed us to fully leverage distributed manufacturing and create new efficiencies in our production process across far-flung locations," said Stephen Nigro, HP's president of 3D Printing. "Together, Jabil's Additive Manufacturing Network and our Multi Jet Fusion printers have helped optimize the high-volume production of functional parts for our own 3D printers, and shown how traditional supply chains are being upended and reinvented for the digital manufacturing age."

Distributed manufacturing boosts business agility

Jabil currently unites product designers in Silicon Valley with Singapore-based manufacturing teams to accelerate the distributed manufacturing of products developed using HP Multi Jet Fusion technology, including parts for HP's 3D printers. More than 140 parts for HP's Jet Fusion 300/500 printers are being produced by Jabil using its world-class combination of Multi Jet Fusion technology, the Jabil Additive Manufacturing Network along with its proven manufacturing rigor and stringent quality control.

Empowering customers to achieve significant cost/time savings

Jabil has enhanced its end-to-end process control capabilities while applying Design for Additive Manufacturing (DfAM) methods to deliver steady increases in part/assembly consolidation, manufacturability, reliability and quality of 3D-printed parts. The speed and scope with which Jabil can manage the complexity of small manufacturing lot sizes empowers customers to achieve significant economies of scale and accelerated time-to-market for a growing roster of customers. With its Additive Manufacturing Network, Jabil now seamlessly can integrate digital additive production processes into diverse manufacturing applications to produce functional parts at a fraction of the cost and time required by traditional manufacturing.

Scaling additive manufacturing with proven rigor

Built from the ground up as an end-to-end framework for additive manufacturing, Jabil's network provides full traceability of manufacturing rigor to address the complexity of scaling 3D printing across a distributed network. Moreover, the platform integrates seamlessly with Jabil's Intelligent Digital Supply Chain (IDSC) to align materials, printers and customer orders with supply chain demands.

At its Singapore facility, Jabil leveraged proven engineering and manufacturing experience to ensure HP Jet Fusion process compliance in distributed ISO9001 facilities. The use of Failure Modes and Effects Analysis (FMEA) tools, as well as process control documentation, enables Jabil to scale its use of additive manufacturing technologies rapidly. This ability to integrate end-to-end digital threads will speed adoption of distributed manufacturing while improving management of entire product lifecycles, from ideation to end-of-life.

About Jabil

Jabil (NYSE: JBL) is a product solutions company providing comprehensive design, manufacturing, supply chain and product management services. Operating from over 100 facilities in 29 countries, Jabil delivers innovative, integrated and tailored solutions to customers across a broad range of industries.

Game-changing performance for printed parts

Solvay Specialty Polymers takes additive manufacturing to the next level

Solvay aims to take additive manufacturing (AM) to the next level with the launch of three specialty polymer filaments that promise to introduce game-changing performance for 3D-printed parts.

Solvay introduced 3 specialty polymer filaments for additive manufacturing.

Based on the company's high-performing KetaSpire® PEEK and Radel® PPSU polymers, the three filaments represent the first products in what Solvay plans to become a broader portfolio of specialty polymer filaments and powders designed specifically for high-end AM applications.

Two of the three filaments leverage Solvay's high-performance KetaSpire® polyetheretherketone (PEEK) polymer: a neat PEEK product and a 10-percent carbon fiber-reinforced grade. Both PEEK filaments are designed to allow excellent fusion of printed layers, enable high part density and deliver exceptional part strength – including in the z-axis.

The third new filament is based on Solvay's Radel® polyphenylsulfone (PPSU). Also formulated to allow excellent fusion of layers, this high-performance PPSU material offers high transparency, excellent elongation and superior toughness for 3D-printed parts.

Looking ahead, Solvay is further developing an AM-ready powder based on its NovaSpire® polyetherketoneketone (PEKK) polymer, which will target AM applications in aerospace and healthcare.

"Solvay's new AM filaments signalan important convergence between additive manufacturing and specialty polymers technology, which is needed to deliver on the promise of high-end 3D printing," said Christophe Schramm, business manager for additive manufacturing at Solvay's Specialty Polymers global business unit. "With today'slaunch, Solvay is laying the foundation of its strategy to become the leading global supplier of advanced AM-ready polymer solutions for 3D printing technologies. We'realso collaborating with leading industry innovators in printing, process and design to develop new material solutions based on ourspecialty polymersportfolio."

About Solvay
Solvay is an advanced materials and specialty chemicals company, committed to developing chemistry that address key societal challenges. Solvay innovates and partners with customers worldwide in many diverse end markets. Its products are used in planes, cars, batteries, smart and medical devices, as well as in mineral and oil and gas extraction, enhancing efficiency and sustainability. Its light-weighting materials promote cleaner mobility, its formulations optimize the use of resources and its performance chemicals improve air and water quality. Solvay is headquartered in Brussels with around 24,500 employees in 61 countries. Net sales were €10.1 billion in 2017, with 90% from activities where Solvay ranks among the world's top 3 leaders, resulting in an EBITDA margin of 22%.

Solvay Specialty Polymers
Solvay Specialty Polymers manufactures over 1500 products across 35 brands of high-performance polymers – fluoropolymers, fluoroelastomers, fluorinated fluids, semi-aromatic polyamides, sulfone polymers, ultra-high performance aromatic polymers, and high barrier polymers – for use in Aerospace, Alternative Energy, Automotive, Healthcare, Membranes, Oil and Gas, Packaging, Plumbing, Semiconductors, Wire & Cable, and other industries.

Injection moulding: Possibility of earlier test run with samples

The production of tools for prototype injection moulding is extremely complicated and costly, especially when steel or aluminium is used for the production. The tools must therefore be milled and hardened, which means that not only is their production relatively expensive, it may well take a week. But the time pressure on companies is increasing. In order to provide tools in a significantly more time and cost-effective manner, Hans Geiger Spritzgießtechnik GmbH recently tested the process of additive manufacturing for production. With this method, the first tools can be made available for viewing in just under six hours. The printing process uses a special synthetic resin that is much cheaper to buy than the materials used so far, which reduces production costs by up to 70 per cent. By eliminating milling and hardening, the prototype can be tested in just a few hours instead of several days – up to 90 per cent time savings.

Injection moulding tools have to withstand enormous loads. For this reason, mainly resistant metals are preferred in production, which requires an expensive and time-consuming manufacture. This is not a problem for mass production – thousands of operations mean investment costs pay off shortly. But the fixed costs are out of proportion in particular for small batch sizes or individual pieces needed to produce prototypes – especially if the prototype does not lead to the order acquisition. In addition, time is playing an increasingly important role. An alternative is 3D printing. Initial tests have already been carried out at Hans Geiger Spritzgießtechnik GmbH, resulting in significant advantages for the manufacturer and the customers.

Previously, manufacture at Geiger took several days. With the help of additive manufacturing, it was possible to shorten the duration to just 6 hours: “That significant reduction in time has made it much easier to test whether an object can actually be injection-moulded as planned,” explains Hans Kolb, process engineer at Geiger. Consequently, tool manufacturers can test quickly whether a prototype is fully functional or if any improvements are necessary. “3D printing even makes a functional test, an early test run with series-like moulds, possible quite quickly,” adds Kolb. This means that not only can prototypes be tested for their functionality, it is also possible to choose a design and materials early on. With the accelerated process comes a cost minimisation of up to 70 per cent, which greatly reduces the financial risk involved in prototype manufacture and makes it possible to offer more attractive prices: “It is easy to demonstrate quickly how certain requirements can be met without any great time and money expenditure,” says Kolb. This is a significant advantage in the tendering phase, for instance.

Fast and efficient: PolyJet process with synthetic resin

There are several ways to make tools using 3D printing: a liquid starting material can be hardened layer by layer, or a powder can be selectively melted. With the PolyJet process, as used by Geiger, the workpiece is built up in layers. First, tiny droplets are sprayed onto a building platform and crosslinked via UV light. “We use synthetic resin for printing. The best results have been achieved with Digital ABS, especially for complex geometries,” explains Kolb. Following the UV curing, the support material is removed in a water bath or with a jet of water. If necessary, the printed workpiece is reworked by hand.

The components can be used directly from the 3D printer – post-curing is not necessary. This has the advantage of generating less waste than milling, cutting or casting, which keeps material costs down and makes disposal easier. The precision of the prints is about 1/10 mm. “Not every little detail can always be accurately represented; occasionally you have to reprocess a part mechanically,” explains Kolb. “But for prototypes, the focus is not primarily on exact details but on the option of testing different solution procedures.” It is also possible to print finished parts directly for viewing – in this case, Geiger uses polyamide with glass fibre reinforcement.

Suitable for thermoplastic injection moulds

In principle, 3D printing is suitable for all thermoplastic injection moulding tools, but it may be advisable to reinforce the workpieces in part with steel or aluminium. At Geiger, components can be printed up to a size of 165 ccm. The injection moulding machines, which are suitable for 3D printing processes, range between 100 and 800 kN. “Certain concessions to draft angles, radii or geometry of the parts may need to be made,” explains Kolb. “After all, these are prototypes that are produced for testing and with a focus on low-cost and fast manufacturing, not durable tools.” Depending on the material used, the prototypes last about 20 cycles. The parts are manufactured according to CAD plans submitted by the customer and converted to STL. This allows the customer to gain an idea of what his work piece looks like and how it fulfils its functional purpose within a very short time. “If a tool does not meet the manufacturer’s expectations, the manufacturer has not invested large sums of money and valuable time, but can use this knowledge to make immediate improvements to the product – and re-test it a little later thanks to 3D printing,” concludes the process engineer from Geiger. “For our customers, this means faster processes with reduced risk: a clear verdict for the new technology.”

Eastman introduces Amphora

Global specialty materials company Eastman introduces Eastman Amphora™ SP1621 3D polymer — its first-ever powder-based material for industrial 3D printing. Amphora SP1621 powder will be manufactured in collaboration with Advanced Laser Materials (ALM), a company specializing in material research, development and consultation for industrial 3D printing, otherwise known as additive manufacturing (AM).

Traditionally, AM has been used primarily to make prototypes and low-volume, customizable products. Large-scale manufacturing was hindered by a narrow choice of materials and limited printing technologies. Eastman Amphora SP1621 challenges these limitations. The polymer is an advanced, production-ready material for laser sintering. Amphora SP1621 is a high-performing material that enables new product designs from concept to solid 3D objects in a fraction of the time it takes for traditional manufacturing. The polymer's uniquely tailored properties enable Amphora SP1621 to have superior in-process and postproduction capabilities, including high recyclability, toughness and flexibility, and ease of processing.

"Together with our customers, we're realizing the value and potential industrial 3D printing has for the industries we support," said Bill McAdams, marketing director of emerging markets in specialty plastics at Eastman. "Eastman's long history of innovation and manufacturing capabilities allows it to work with companies like ALM to offer specifically designed materials that provide customers with enhanced customization, efficiency and productivity."

After careful research, Eastman chose to work with ALM to offer a material specifically for a laser sintering (LS) process. Preferred for creating high quality, functional parts, LS employs a laser to sinter powdered material at points in space defined by 3D modeling. ALM specializes in creating materials designed and optimized for laser sintering. In collaboration with Eastman, ALM is expanding the types and functionalities of materials available for use in the LS process.

ALM is ISO 9001 certified and has a centralized location with a global distribution network. The company supplies materials for sale across the whole powder-bed AM industry, including many other OEMs of 3D printing platforms. ALM's broad capabilities — including grinding, heat treating, compounding and advanced laboratory services — make it the ideal full-service powder manufacturer and distributor for Eastman Amphora SP1621.

"We're proud to be collaborating with Eastman to make materials that our customers need," said Donnie Vanelli, president of ALM. "The first material we will offer with them is one of the most advanced in the polymer market today and expands our offering to customers who prefer the quality of laser-sintering 3D printing.

As the market for industrial 3D printing technology grows at an exponential rate, so does the global demand for new 3D production materials. With the introduction of Amphora SP1621, Eastman is at the forefront of this growing market

About Eastman Chemical Company
Eastman is a global advanced materials and specialty additives company that produces a broad range of products found in items people use every day. With a portfolio of specialty businesses, Eastman works with customers to deliver innovative products and solutions while maintaining a commitment to safety and sustainability. Its market-driven approaches take advantage of world-class technology platforms and leading positions in attractive end markets such as transportation, building and construction and consumables. Eastman focuses on creating consistent, superior value for all stakeholders. As a globally diverse company, Eastman serves customers in more than 100 countries and had 2016 revenues of approximately $9.0 billion. The company is headquartered in Kingsport, Tennessee, USA, and employs approximately 14,000 people around the world.

About ALM
Advanced Laser Materials (ALM) specializes in material research, development and consultation for industrial 3D printing and additive manufacturing. Founded in 2004, ALM remains focused on providing customers with application-specific, quality-tested materials and engineering support to meet the most complex product specifications and production requirements. ALM offers the largest selection of laser sintering solutions with on-site capabilities to produce standard and specialized materials in varying quantities. Based in Temple, Texas, ALM is a wholly owned subsidiary of EOS Group.

Time and cost-saving additive manufacturing of casting molds for injection molding

Introduction

Figure 1: PEEK mold inserts with ABS(black) and Polyurethane(transparent) molded parts

Additive Manufacturing is without a doubt an empowering manufacturing tool. Though with inherent disadvantages, its benefits extend to industrial situations of diverse economic ramifications. For instance, in the mass production field of injection molding an attendant set of challenges have often been the production of mold inserts which have complex forms as well as the machining cost and fabrication time. These constraints prompt a search for alternative ways of manufacturing mold inserts. Additive manufacturing methods such as 3D printing technologies now make it possible for the fabrication of mold inserts in a short time as well as the implementation of an iterative mold testing routine proven to be expensive in conventional manufacturing. Due to cost considerations, polymers have in recent times been exploited as choice material for the 3D printing of molds. However only few polymeric materials can structurally withstand temperatures up to 260 °C which is typically applicable in commercial injection molding of polymers. These polymers still do not feature in 3D printing technologies although the high temperature polymer PEEK has only recently been demonstrated as technically processable using selected laser sintering/melting (SLS, SLM) and fused filament fabrication (FFF) 3D printing technologies. The laser based systems are generally cost exorbitant in terms of machine price and system running cost whilst the FFF system is markedly affordable requiring comparatively minimal running cost. The combination of high temperature stability of PEEK and the FFF 3D printing technology especially leverages for applications in cost effective mold insert manufacturing.

Mold making flexibility of Fused Filament Fabrication 3D Printing technology

The FFF 3D Printing technology is especially designed for thermoplastic materials i.e. those polymers that exhibit a melting range. Such polymers can be applied in various engineering scenarios in pure form or filled with different materials to create properties previously not found in the pure polymer. One of the key challenges in mold material design is the conduction of heat from the liquid material which is filling the mold to regions far off the filling cavity. The reason for this being that if the heat in the mass melt remains latent in the cavity then timely solidification process and form shape formation by the melt material are negatively affected. The thermal mass of the melt needs to quickly reduce once the mold cavity is filled and this process is aided using mold insert material that exhibit appreciable thermal conductivity.

Most engineering polymers have thermal conductivity in the range 0.03 to 0.5 Wm-1K-1. This value is markedly insufficient to quickly transfer heat away from the melt to other portions of the machine. Even in the absence of cooling media assisted processing, the use of mold insert materials which ensure adequate thermal conductivity remains a preferred engineering solution. Therefore, mold inserts made from polymeric materials filled with highly thermally conducting materials (such as graphene , carbon nano tubes , graphite or aluminium) can provide a viable solution.

Surface quality is a concern inherent to parts manufactured by 3D printing technologies because the material build-up process leading to part formation/fabrication occurs in a layer by layer fashion. This layering process creates features at the layer – layer interface which add to the surface texture and topography of the 3D printed part. Therefore, for mold inserts where smooth surfaces are desirable a polishing (mechanical or chemical) step or coating step may be applied to the surface of the 3D printed mold part.

There are mold design rules which are still not fully developed for 3D printing technologies. These rules consider aspects of injection molding process such as placement of ejector pins, gate designs and the location-specific nature of these features with respect to the direction of the melt flow into the mold cavity. Whilst meeting these design rules is imperative, once met though structurally fit mold inserts can be fabricated from FFF 3D printers.

Materials and technology based challenges on FFF 3D printed mold inserts

Demolding can be a process challenge in injection molding. This challenge can be mitigated by applying lubricants on the insert surface, high speed filling of the mold at higher pressures and rapid cooling of the insert. Therefore, additives which bring along lubricating properties can be included in the polymer material. The stiffness requirements of the mold insert can be realized or compensated by designing the part for thicker sections, in case of fairly ductile/flexural materials, or filling the polymer with materials which have relatively high mechanical stiffness.

The size of the molds to be produced using FFF 3D printing is limited by the fact that objects in the volume range of 200 mm x 200 mm x 200 mm can best be printed; above this size dimensional challenges increase. Although FFF 3D printers which have effective build volumes in the order of 1 m3 now exist, it still remains a challenge to control the tolerances of parts fabricated within such a space. Also, mold features below 0.5 mm in lateral thickness can be difficult to produce using an FFF 3D printer thus there might be a need to conduct post processing steps such as drilling and other material removal processes to meet design specification.

Due to the compositional nature of polymers, the thermal cycling and mechanical loading during injection molding processing allows for only a limited use of the mold material. The thermo-mechanical fatigue resulting from these cyclic processes leads to structural failure of the material. This means that the number of injection shots derivable from the polymer mold is limited (50 to 100 shots) in comparison to metallic mold inserts where shots of up to 10,000 are achievable. Clearly mold inserts fabricated by FFF 3D printing technology is not for extended mass production purposes.

The business strategy for FFF 3D printed mold inserts

Given that the economics which presently accompanies mold manufacturing is poor. This is because most molds take a long time to be designed, machined out from metallic blocks, tested and then deployed to production lines. Some reports suggest that the time taken for the production of molds using traditional manufacturing methods such as machining can be reduced by up to 90% if done using 3D printing technology. Also, the overall manufacturing cost of the mold can be cut down by up to 70% using 3D printing technology. This is a huge form of savings in development and manufacturing cost. Therefore, based on this fact and even notwithstanding some of the constraints alluded to above regarding FFF 3D printed molds, it goes without saying that 3D printed mold inserts bring along key benefits to the economics of an injection molding business.

It is typical that in the development cycle of most consumer products, several models of different designs are required before conclusive decision is made on which would be launched as a final product. Each of the models in review often requires a mold insert so that tangible sample pieces can be fabricated and assessed under real operating conditions. The cost of producing the mold inserts is simply high thus a technology like 3D printing which offers low cost mold insert fabrication and ease of implementing alterations in designs is attractive for industry.

Conclusion

FFF 3D printed mold inserts is currently the most affordable and quickest way of fabricating mold inserts for small batch production of parts. Materials for 3D printing the mold inserts is a critical factor. The development of polymeric based materials which exhibit mechanical stability up to 260 °C as well as thermal conductivity suitable for FFF 3D printing processing is imminent. Research efforts back this imminence where new knowledge on behaviour of advanced materials stable at extreme operating conditions and commercially accessible for industrial applications now makes entry into mold insert making by FFF 3D printing possible. This together with the fact that understanding of the different applications of 3D printing technologies in different industries is improving rapidly giving encouraging impulse that FFF 3D printed mold inserts for long production runs may well be underway.

Figure 1 shows PEEK mold inserts fabricated using an Apium P 155 FFF technology 3D printer. The mold insert surface is untreated. Production time for the shown mold inserts, measuring 30 mm x 30 mm x 10 mm, added up to 6 hours per part. Raw material costs are 13 € for one mold insert. To generate the required pressure, the mold inserts have been cased in metal blocks and fixated with screws.

Apium Additive Technologies GmbH is a German company specialised in the Fused Filament Fabrication 3D printing technology. As pioneers for 3D printing PEEK they develop new high performance polymers for this technology and the 3D printers to process them in the best possible quality.

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Promoulding cuts injection moulding lead times with 3D printing

Using Stratasys Polyjet 3d printing technology, Promolding has expanded its operations with the introduction of a 3D-Printed Injection Moulding division (PRIM). Utilising Stratasys PolyJet 3D printing solutions to produce moulds, the company has slashed its injection mould lead times for its customers, producing moulds in just three days.

Stratasys' Objet500 Connex color, multi-material 3D Printer has been a key driver in the launch of PRIM.

With a reputation for creating high-tech plastic parts using high performance polymer-based solutions, Promolding provides advanced designs and products to a diverse customer base, including household names such as Heineken and Airbus. Having initially utilised Stratasys PolyJet 3D printing to solve a number of complex applications within product development, the company has extended the use of its Objet500 Connex 3D Printer to enhance the injection moulding process – opening the door to a new business opportunity.

"We became increasingly aware of the need for a 3D printer that would help us optimise our product development process," said Jeroen Gross, Product Development Manager, Promolding. "We looked at several different options, but fell in love with Stratasys' Objet Connex 3D Printer and its ability to not only improve our prototyping, but also become a key driver for our PRIM business. Traditionally, injection mould development required at least a six-week lead time, but by designing and 3D printing the moulds in-house, we can produce moulds in just three days.

"PRIM is available to our customers as an additional service in parallel to prototyping and traditional injection moulding," he added. "In the future, we believe PRIM will be seen as a commonplace process of its own. We have come a long way and we'll continue to explore further applications in which PolyJet 3D printing can enhance our offering."

With increased flexibility and significant time efficiencies a key part of the PRIM division's value proposition, Promolding is able to rapidly design and develop very complex parts and products for its customers.

Fugro fibre optic sensor housings in PBT material produced via 3D printed injection moulds on the Stratasys Objet500 Connex 3D printer.

When recently designing a fibre optic sensor house for Fugro, a world leader in integrated geotechnical, survey, subsea and geoscience services, the company quickly produced a series of complex moulds using its Objet500 Connex 3D Printer in order to meet the customer's tight deadline. Each mould enabled the production of over 50 samples of the intricate sensor housing in a number of final product materials, including PP, TPE and PBT.

"Particularly with the development of bigger and more complex products, it is crucial as a business that we are as efficient as possible throughout the product development process, without compromising on quality," explained Gross. "Having our 3D printer has enabled us to achieve this and given us an incredible level of flexibility. We can use the technology in the early development phases to speed up the design process and develop, review and adapt prototypes earlier, but also extend the efficiencies into production through our PRIM process. It really has been a game-changer and we've seen the benefits passed onto our customers."

"Additive manufacturing has the power to transform business models and Promolding is a prime example," stated Andy Middleton, Stratasys EMEA President. "We are seeing more and more customers realise the full potential of our PolyJet 3D printing technology, going beyond the immediate efficiencies within product design and pioneering the disruption of traditional manufacturing processes. In the case of injection moulding, 3D printed injection moulds are redefining the price-performance benchmark for low volume production, giving manufacturers the flexibility to produce products in the final injected material faster than ever before."

Instantly printed mouthguards for sportsmen

Royal DSM, a global science-based company active in health, nutrition, and materials, today announced a partnership with 3Dmouthguard. The companies will develop custom-made and instantly printed 3D mouthguards to protect teeth and mouth injuries in any type of sport that involves bats, balls, sticks or person-to-person contact. Together with Carestream Dental and NHL Stenden Hogeschool, the companies have developed a new technology to print custom-made mouthguards in 3D on the spot.

According to the Centers for Disease Control and Prevention (CDC), sports-related dental injuries account for more than 600,000 emergency room visits each year in the USA alone. And an average of 26% of all dental injuries are sports-related. In over 20 sports, basketball, hockey, martial arts and boxing carry the highest risk.

Printed on the spot

By scanning the upper jaw with video technology and digitally capturing all curves and shapes of mouth and teeth, a perfectly fitted mouthguard can be printed on the spot using fused filament technology. The additive manufacturing (AM) process uses a continuous filament of DSM's Arnitel®, a bio-based material that meets all strength, flexibility and health requirements. The new AM technique, combined with the 3D filament material characteristics, completely automates and digitizes the process of producing customized mouthguards and prints them instantly.

In the coming months, the first 3D printed mouthguards will be thoroughly tested by athletes of Dutch field hockey clubs. The partners' scientists and developers will use the data captured to further finetune and scale-up the AM process, combining the extensive materials, technology, marketing and scientific knowledge of DSM, 3Dmouthguard, Carestream Dental and NHL Stenden Hogeschool.

Hugo Ferreira da Silva, Vice-President at DSM Additive Manufacturing comments: "We are pleased that our materials and AM/3D knowledge can help to transform the mouthguard market by making the production of high quality mouth protectors fast and easy, helping prevent oral injuries. Providing the right material and the right platform for specific applications is key to accelerating the adoption of 3D printing into real manufacturing. Collaboration in the industry will allow more applications to benefit from the great advantages of additive manufacturing, at an affordable cost."

Arno Hermans, CEO of 3Dmouthguard said: "We believe that in a few years from now, 3D printed mouthguard machines will be a must have in every sports facility around the world. For us the technology is also a start of a whole field of new applications. It enables us to learn, develop and explore new products like shinguards, helmets, and elbow protection, and it can benefit markets beyond sports such as healthcare."

About 3Dmouthguard

3Dmouthguard improves the way athletes enjoy their favorite sport by using cutting edge technology to produce sports apparel. Together with its partners, 3Dmouthguard automates and digitizes the complete process of producing customized mouthguards. Turning part of the production process digital allows better access, accuracy, delivery and personalisation. 3Dmouthguard combines comfort and safety and is "fit to score".

About Carestream Dental

Carestream Dental provides industry-leading dental digital product lines and services, including imaging equipment, CAD/CAM systems, software and practice management solutions, for dental and oral health professionals. With more than 100 years of industry experience, Carestream Dental technology captures two billion images annually and delivers more precise diagnoses, improved workflows and superior patient care.

New advanced products for additive manufacturing

PEEK* polymer pioneer Victrex announces newly developed materials for Additive Manufacturing (AM). The first of these is a high strength material for laser sintering (LS) which attains lower refresh rates, resulting in improved recycling for unsintered powder. The second is a filament with better Z-strength than existing PolyArylEtherKetone (PAEK) materials and better printability for filament fusion (FF). The detailed technical results are presented at the bi-annual Additive Manufacturing conference of the University of Exeter Centre for Additive Layer Manufacturing (CALM), in September 2018.

Victrex is progressing solutions for Additive Manufacturing: Design optimized bio-mimetic bracket –3-D printed from new VICTREX™ PAEK Polymer © 3T-RPD

Jakob Sigurdsson, Victrex CEO, commented: “These next-generation VICTREX PAEK materials for Additive Manufacturing mark a decisive step forward, having potential to transform multiple applications, including Aerospace and Medical. The exciting progress is based on continued intense R&D at Victrex and excellent collaboration within the Victrex led consortium of companies and institutions** pursuing innovation in Additive Manufacturing. Through this consortium we’re already seeing demonstrator parts that show how AM processes, coupled with high-performance materials, transform thinking to create truly innovative parts based on increased design possibilities.”

Advantages of additive manufacturing can be deployed to reduce costs, shorten time to market, and enable the production of parts too complex to be manufactured using traditional methods. The PAEK incumbent materials on the market today, although used in some AM applications, were designed for conventional manufacturing methods, such as machining and injection molding. Because of this, they have some features that aren’t optimal for additive manufacturing processes. A first generation of PAEK material for Laser Sintering can only be recycled in a very low extent and required nearly full refresh of the printing bed with new powder, and PEEK filaments available for FF have poor interlayer bonding, leading to a loss in Z-strength.

The new polymer grades developed by Victrex have shown encouragingly low refresh rates (improves recycle for unsintered powder) with similar mechanical properties in LS, and in FF good mechanical properties and printability.

John Grasmeder, Chief Scientist at Victrex explains: “Breakthrough technology is paving the way for an exciting future for Additive Manufacturing PAEK. The powder recycle work for Laser Sintering, using the new Victrex development polymer grades has gone very well, with no measurable loss of properties when test components were made from partially recycled powder. We believe it will be possible to re-use all of the non-sintered powder that is recovered after a build run. This will result in a significant reduction in material costs compared to current PolyArylEtherKetone materials where up to 40% of the polymer is wasted and cannot be recycled.”

Partnering for progress in AM

Victrex is leading a consortium of companies and institutions and was awarded funding from the UK's agency for innovation, Innovate UK, in 2016 to carry out intensive pioneering research and development to advance AM technologies, in particular high-temperature, affordable polymer composites for AM aerospace applications. The other members of the consortium are Airbus Group Innovations, EOS, University of Exeter Centre for Additive Layer Manufacturing (CALM), E3D-Online, HiETA Technologies, South West Metal Finishing, and 3T-RPD.

The new VICTREX PAEK filament and powder tie in with technologies developed by other members of this Innovate UK project. EOS has recently released a new automation-ready manufacturing platform for laser sintering of plastic parts on an industrial scale (EOS P 500) with the capability to print high-performance polymers at high temperatures. Selected materials of the consortium are evaluated at EOS R&D facilities for processability on current EOS systems as well as for use with the EOS P 500 platforms. Victrex is planning to continue pre-commercial testing of a new PAEK filament product in conjunction with consortium partner E3D, who has recently commercially released a new water-cooled filament extruder head especially optimized for this new PAEK filament.

Victrex has more than 35 years of knowledge in developing and applying novel PAEK/PEEK polymer based solutions spanning polymers, forms and parts in selected areas. The lightweight, high-strength PEEK polymer uniquely supports a combination of multiple requirements as it provides high resistance to wear, high temperatures, fatigue and aggressive fluids/chemicals, and together these properties can contribute to more design freedom and cost-efficient production.

* PEEK, Polyetheretherketones such as VICTREX™ PEEK are a member of the PAEK, Polyaryletherketone, family of high-performance thermoplastics.
** The following companies partner in the Additive Manufacturing consortium headed by Victrex and funded by Innovate UK: Airbus Group Innovations, 3T-RPD Ltd, E3D-Online, EOS, University of Exeter Centre for Additive Layer Manufacturing (CALM), HiETA Technologies, South West Metal Finishing, Victrex

Investing into the future growth

Arkema will open its 3D Printing Center of Excellence, located at its Sartomer Exton, PA facility. In this advanced R&D lab, Sartomer and its partners will further develop cutting-edge 3D printing resins through innovative material research and collaboration. This new center will complete the Arkema’s worldwide R&D network dedicated to the development of advanced material for additive manufacturing.

Sartomer, a Business Line of Arkema, is a pioneer in designing engineered resins for UV-curable additive manufacturing marketed under its N3xtDimension® brand. These photo-cure 3D printing materials yield products with thermoplastic-like mechanical properties for applications such as dental, sports and electronics.

The 3D Printing Center of Excellence will house most UV based technologies: stereolithography (SLA), Digital Light Processing (DLP), and Multi Jet Printing (MJP) to name a few. It provides a collaborative space for chemists and application engineers to develop custom resins for customer needs.

This advanced lab will complete the existing R&D network of the Group dedicated to the fast growing 3D Printing market, a driver of Arkema’s future growth.

"Sartomer is an historic partner for 3D printing pioneers. We're launching the 3D Printing Center of Excellence to deepen our support of the visionaries working to develop innovative 3D printed materials." - Sumeet Jain, Global director 3D printing at Sartomer.

Arkema is ideally positioned to bring 3D Printing to a full manufacturing scale with a unique line-up of polymer materials available in filament for extrusion, in powder for sintering and in liquid for UV curing, backed by a deep understanding of end-user applications and needs.

"3D printing will further expand in to mass manufacturing through innovative advanced material technologies and partnerships with market leaders." - Guillaume de Crevoisier, Global business director 3D printing at Arkema.

The grand opening of Sartomer's 3D Printing Center of Excellence, based in Exton, PA, is scheduled for July 30th 2018.