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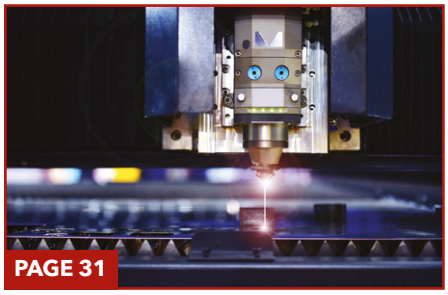
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German packaging firms report varied Covid-19 impacts

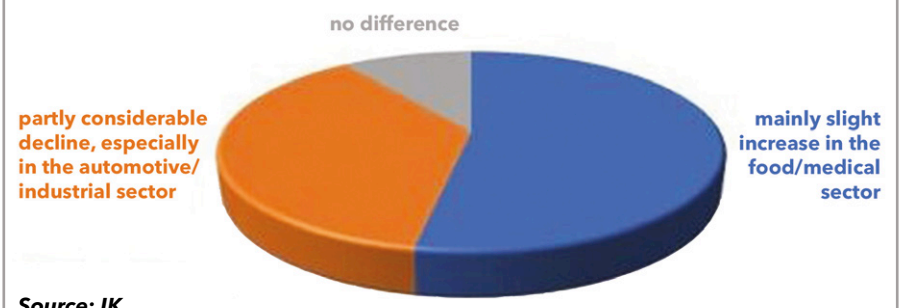
A survey of members of Germany's plastic packaging industry association, the Industrievereinigung Kunststoffverpackungen (IK), has shown that the effects of the Covid-19 epidemic on the companies varied considerably in April. This was largely a function of the industries they serve.

In all, 120 mostly medium-sized companies responded and 37% of them had fewer orders compared to March, with 25% of them reporting declines of over 20%. This was most marked in companies serving the automotive industry, where demand has slumped. The industrial sector also saw falls.

By contrast, slightly over half reported an increase in orders in April, mostly of around 10-20%. "Manufacturers of system-relevant packaging for food, pharmaceutical and medical products are in some cases reaching the limits of their capacity," the IK noted.

Martin Engelmann, Director General added, however, that this positive picture is "only a snapshot" and that 56% expected a decline to follow.

HOW DOES THE CORONA-PANDEMIC AFFECT THE ORDER SITUATION IN THE PLASTICS PACKAGING INDUSTRY?



Source: IK

"After frequent panic buying in many places in mid-March, less food and daily necessities are now being stockpiled again. However, the demand for hygiene and cleaning products remains high," he said.

Just under 80% of the companies have managed to fulfil all orders received, but around half reported corona-related restrictions. Shortage of personnel is the key issue, albeit less markedly than in other sectors of the plastics processing industry. Almost 40% of respondents were short of personnel, while almost 25% had to introduce reduced hours. Engelmann said there is a high level of commitment and team spirit in the workforces.

One positive knock-on effect is that public perception of plastic packaging has changed, thanks to the industry's contribution to fighting Covid-19. "The function of the packaging – the hygiene and protection of the product – is being perceived more strongly again. We hope that this will contribute to a more objective discussion about plastic packaging in the future," Engelmann said.

› **www.kunststoffverpackungen.de**

Arburg makes Covid-19 face masks

A filter housing will be added to the mask in the next stage

Arburg has started injection moulding face masks from LSR and PP at its plant in Lossburg, Germany. The masks are designed for multiple use and can be easily sterilised.

About 3,500 masks per day are expected to be produced. The masks will initially be used to protect Arburg's employees worldwide from Covid-19 and will then be distributed via the district of Freudenstadt, Germany, to hospitals and care facilities.

Arburg designed the mask in-house and additively manufactured the first prototypes with its Freeformer machine. The project involved various technology partners: Polar-Form, Foboha, Ewikon, Männer, Barth Mechanik and Packmat.

In the next stage, a filter housing will be produced. Arburg intends to make this component in cooperation with partners including Weber, Günther, Küfner, Herrmann Ultraschall and Packmat.

› **www.arburg.com**

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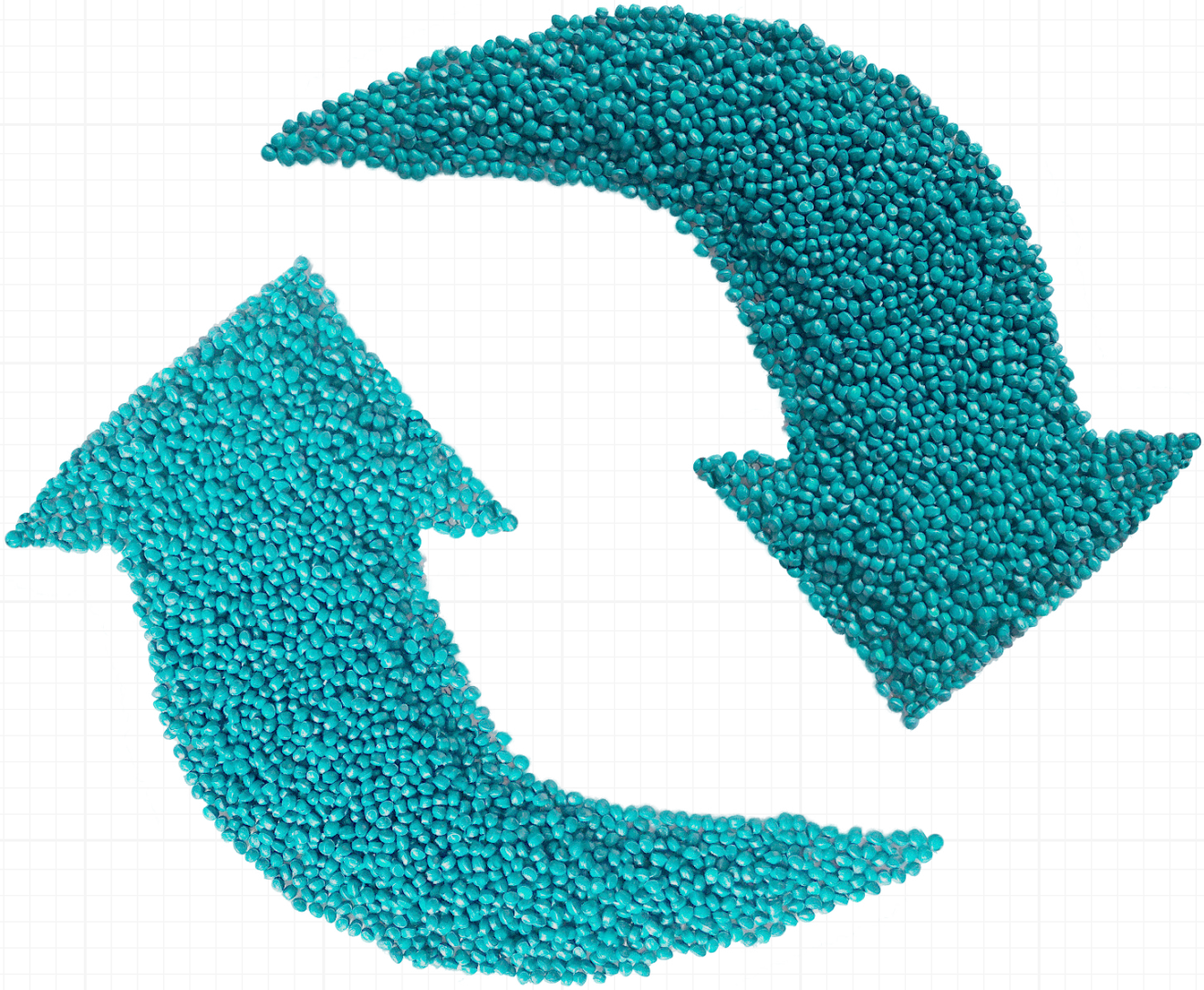

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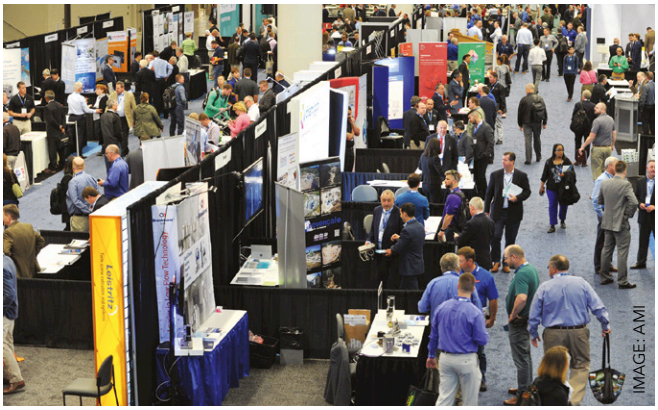
AMI's first US plastics exhibition shortlisted for industry awards

AMI's first plastics industry exhibition in the US has been selected as a finalist for two prestigious awards organised by the UK's Association of Event Organisers (AEO). The exhibition, which was held in Cleveland, Ohio, on 8-9 May last year, included the Compounding World Expo, Plastics Recycling World Expo, and Plastics Extrusion World Expo.



View of the packed showfloor at the first Compounding World Expo in Cleveland in 2019

The event has been shortlisted by the AEO in both the 'Best Event Launch' and the 'Best International Show – Americas' categories. The winners will be announced at a ceremony in London on 4 December 2020.

"We are delighted that the success of our American expos has been recognised in the AEO Excellence Awards 2020," said Rita Andrews, AMI's Head of Exhibitions. "AMI has a long history of organising conferences, but this was only our second big tradeshow and the first outside of Europe, so it's a fantastic result to be shortlisted alongside lots of established players."

The Cleveland Expos attracted 261 exhibitors and 4,375 visitors from 42 countries to the city's Huntington Convention Center. In addition, more than 1,000 people attended the evening networking party at The Rock & Roll Hall of Fame.

"The focused nature of the expos worked very well for visitors from the compounding, plastics recycling and extrusion sectors," said Andy Beevers, Events Director at AMI. "They could meet with key suppliers and participate in highly relevant conference sessions all under one roof. Similarly for exhibitors, the clear focus of the events meant they were meeting large numbers of buyers with a very specific interest in their products and services".

The Plastics Recycling World Expo, Compounding World Expo and Plastics Extrusion World Expo next take place at Messe Essen in Germany on 7-8 October 2020, and they return to Cleveland, Ohio, on 4-5 November 2020. At both locations, they will be joined by the new Polymer Testing Expo.

For more information on booking a stand or registering for a free ticket for either event, please visit:

› https://www.ami.international/exhibitions

Automotive HMI uses TactoTek's technology

Finland's TactoTek, the pioneer in in-mould structural electronics (IMSE), and Alps Alpine, a major supplier of electronic components and vehicle on-board information equipment, have jointly developed an IMSE human-machine interface (HMI) for an unnamed German automotive OEM.

TactoTek now makes the part at its site in Oulu. This includes printed electronics for circuitry, seven digital touch buttons and one slider, plus seven LEDs for backlighting controls, all encapsulated within the 3D injection moulded structure.

The part also "meets several other objectives including light-weighting and space saving in a seamless single piece design", Alps Alpine said.

The HMI part is 2.5mm thick, with a seamless cosmetic surface that gives easy cleaning and sterilisation, and it requires no manual assembly of in-mould electronics, the partners said.

› www.tactotek.com

› www.alpsalpine.com

Chinaplas 2020 show cancelled

Adsale Exhibition Services, organiser of the annual Chinaplas show, has announced that this year's Shanghai show, previously postponed from May to August 2020 due to coronavirus restrictions, will not take place. The next Chinaplas will take place on 13-16 April 2021 at the World Exhibition & Convention Centre in Shenzhen.

The decision follows a statement by the Chinese government that "all kinds of exhibitions have to be stopped for the time being" despite improved containment of Covid-19 in the country. Adsale said it will make necessary arrangements and notify exhibitors and visitors regarding fees paid.

› www.chinaplasonline.com

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Plastic camshaft module breakthrough revealed

A project funded by the German Federal Ministry for Economic Affairs & Energy and led by the Fraunhofer Institute for Chemical Technology (ICT), in partnership with the Mahle Group, Daimler, SBHPP/Vyncolit and Georges Pernoud has succeeded in developing a camshaft module from fibre-reinforced thermoset polymers. This is now available as a functional demonstrator.

Camshaft modules are used in automotive powertrains to enclose the camshaft, which itself ensures that the charge-cycle valves are opened and closed reliably and precisely. Traditionally, they have been made from aluminium. A plastic alternative has long been sought to reduce engine weight and cut assembly costs, thus reducing CO2 emissions and lowering the vehicle's centre of gravity.

The module features a monolithic design with integrated bearings, making for reduced assembly time and eliminating the need for separate installation of the camshaft. Fraunhofer ICT added that after 600 test hours on the engine test stand, it passed all the requisite tests, despite the polymer being four times less stiff than aluminium.

The polymers were chosen for their ability to withstand high temperatures and mechanical and chemical stresses. They also allow near-net-shape manufacturing, with little reworking, while the service life of thermoset polymer injection moulds is significantly higher than that of aluminium high-pressure die cast moulds. Finally, their damping characteristics help to reduce engine noise.

› **www.ict.fraunhofer.de**

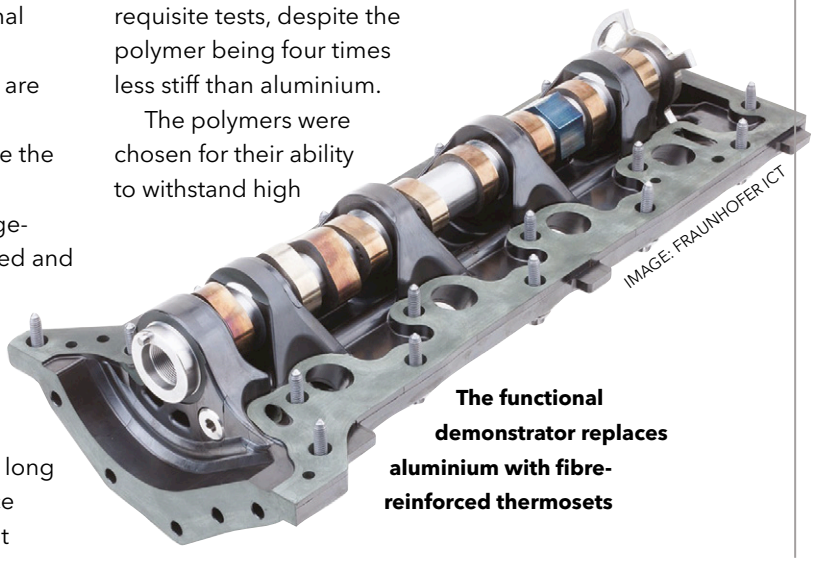

IMAGE: FRAUNHOFER ICT

The functional demonstrator replaces aluminium with fibre-reinforced thermosets

Machine safety standard

The ISO 20430 standard for injection moulding machines – the first international safety standard for plastics and rubber machinery – was published in April after seven years of discussions. The EN ISO version of the standard, which creates the link to the European Machinery Directive with the additional annex ZA, will be published within the next few months.

ISO 20430 was based on an existing European standard, EN 201, and came out of a project in which about 40 experts from machine manufacturers, associations and health and safety organisations from 13 countries took part. It was convened and based in Germany, with the VDMA industry body taking the key role.

› **www.vdma.org**

Hot runner patent judgement in Germany

US hot runner technology firm Synventive announced it has won an injunction in a patent infringement lawsuit against INglass and its German HRSflow subsidiary in the Mannheim Regional Court in Germany. It said in a statement the ruling includes a damages award in principle, as well as ancillary awards in its patent infringement lawsuit based on European Patent EP 2 620 266 B1. The lawsuit, which covers products sold in Germany, relates to HRSflow's FLEXflow and FLEXflow ONE hot runner products. HRSflow previously had a licence agreement with Synventive.

INglass responded in a statement that the patent judgement in favour of Synventive relates to an old product series, not HRSflow's current HRS FLEXflow Evo products. The Mannheim court ruling "does not affect any customer and their operations of HRSflow systems, which are or will be all upgraded to HRSflow FLEXflow Evo", said INglass. "The court proceedings mentioned by Synventive relate to the past. They do not affect the present and the future of our products," it said.

Synventive also said in its statement: "A further decision by the Mannheim Court regarding a proposed redesign of HRSflow's product ('stepped profile') is expected during the summer of 2020."

In response, INglass said: "The mentioned ongoing proceedings regarding the 'stepped profile', for which there is actually no judgment, do not relate to the current 'HRSflow FLEXflow Evo' sold and for sale worldwide."

› **www.synventive.com**

› **www.inglass.it**

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Caps company deal in Italy

Italian medical blow-moulded plastics packaging specialist Bormioli Pharma has acquired its compatriot GCL Pharma from the Guala Closures Group for €8.9m. CEO Andrea Lodetti said that Bormioli's aim is "to strengthen our industrial footprint by adding new technologies that allow us to extend our product range, especially in the oral and parenteral segments, activating further business synergies".

Based at Vasto in Chieti province, GCL specialises in the production of plastic, rubber and aluminium closures for pharmaceutical applications. It had sales of about €8m in 2019. Guala itself is seeking to focus on its core business of aluminium safety closures for spirits, wines and beverages, where it is one of the major players in the field, and which have higher added value, it said.

› **www.bormiolipharma.com**
› **www.gualaclosures.com**

Wittmann Battenfeld supports Covid projects

Injection moulding machines from Wittmann Battenfeld are being used in two manufacturing campaigns for key equipment in the fight against Covid-19. In Altenmarkt, Austria, Mack is using them to make the frames and straps for a face shield, while Oldrati Guarnizioni Industriali is making valves for respiratory masks at its Silital subsidiary site in Italy.

Mack said that it has been working with Wittmann Battenfeld, which supplied 15 of the 18 machines at its site, for 25 years. The new shields, which are designed to protect the wearer's eyes, nose and mouth, weigh only 68 g. As of May, they can also be individually labelled and are available worldwide.

The straps are produced on an HM hydraulic machine, the frame on a servo-hydraulic SmartPower series machine with 600 kN clamping force. This is equipped with a WP80 sprue picker from Wittmann, which also supplied much of the auxiliary equipment Mack uses.

IMAGE: OLDRATI/WITTMANN

Valves for respiratory masks made by Oldrati in Italy

Oldrati, which has been making full-face snorkelling masks for many years, has now converted a line to make respiratory masks for use in hospitals. The PP valves for these are manufactured on a Wittmann Battenfeld EcoPower 180 Combimould machine, which is equipped with a W822 robot, also from Wittmann.

Wittmann Battenfeld has supplied Oldrati and Silital since 2015, mainly from the SmartPower and the all-electric EcoPower series. Five more SmartPower machines are due to be installed at the Silital site in May and June.

› **www.wittmann-group.com**

Beck opens in Philippines

In-mould labelling (IML) specialist Beck Automation has officially opened its new customer service location in the Philippines. This is led by Bernardo Deleon, who has 15 years of experience in the plastics industry mostly as an engineer with Beck and others in the IML field. He is now the first point of contact for customers in Asia.

"The key advantages for our customers and partners, is naturally to have a fast response time, reduced expenditures on service interventions, as well as bringing a new dimension to the local market."

› **www.beck-automation.com**

Barnes Group's Q1 sales drop by 12%

Barnes Group in the US has reported sales of $331m in Q1, 12% down from the same quarter in 2019. This was partly due to a divestment; organic sales were down by 8%. Net income was $29.7m.

The company's Moulding Solutions division comprises hot runner companies Synventive and Thermoplay, mould makers Männer and Foboha, cavity sensor technology firm Priamus, and hot runner controls firm Gammaflux.

The automotive, tool and die, and packaging end markets were already "experiencing lingering softness" before Covid-19, the company said. Medical markets have remained strong and this is expected to continue.

Barnes expects its Q2 result to be "significantly impacted" by the global shutdown in some of its end markets, but hopes for a recovery in Q3.

› **www.barnesgroupinc.com**

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BMB expansion enables it to build larger machines in Italy

Injection moulding machinery maker BMB has added a fourth production unit at its Italian headquarters in Brescia, following an increase in market share.

The new production building covers more than 6,400 m² and will be used for the assembly of medium and large injection moulding machines. It is equipped with four cranes with a capacity of 100 tonnes and an automated painting department.

The expansion at Brescia enables BMB to produce larger tonnage machines. Its existing range from 100 tonnes to 3,500 tonnes clamp force is being extended up to 4,500 tonnes clamp force. Two 4,500 tonne models are in the final assembly stages in the new production unit.

The company said its eKW all-electric machine range has now been increased to 1,300 tonnes and its eKW hybrid range has increased to 2,800 tonnes clamp force.

IMAGE: BMB

BMB has completed construction of a new fourth production unit at its facility in Brescia

Many of the major BMB components are made in-house, or supplied from within a small radius of its headquarters, with all proprietary components sourced in Europe. All raw materials for parts such as platens and bases are made from Italian steel, it said.

BMB's investment in the new unit, which has taken just over 12 months to complete, is a sign of its commitment to the future growth of the plastics industry, it said. The new smart factory will allow the company to operate more efficiently and meet the increasing demand from new and existing customers, it said.

According to BMB, the recent restrictions relating to the Covid-19 pandemic implemented by various countries have highlighted how the world is now adapting to a new type of 'smart working'.

The firm's Industry 4.0 technology will enable customers to explore new possibilities for process control and smart control, it said. BMB has provided telesales support for all of its customers remotely since 2001, which it says is free-of-charge for the life of the machine.

› **www.bmb-spa.com**

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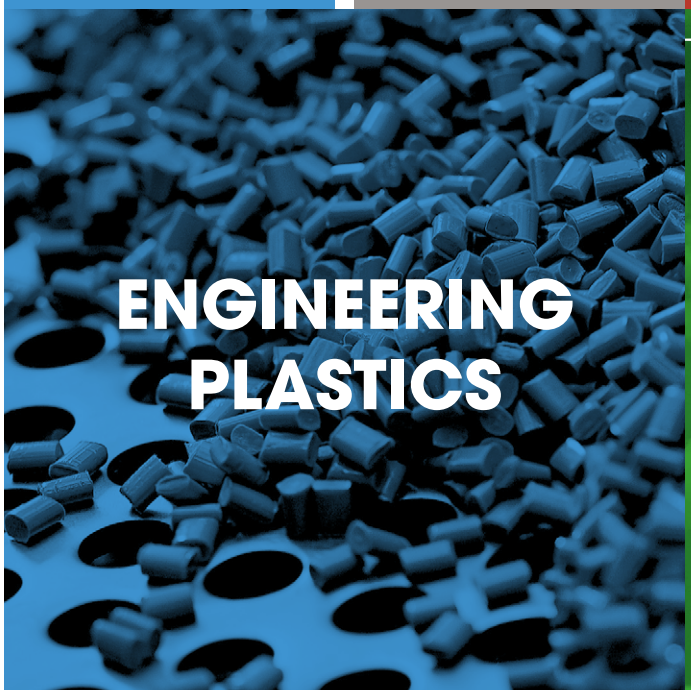

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IMAGE: SHUTTERSTOCK

Under-the-hood automotive applications are undergoing a transformation. Mark Holmes reports on developments in the injection moulding industry to meet the challenges of electric and hybrid vehicles

No grille: Moulding meets electromobility challenges

The move in automotive to electromobility is driving many changes in vehicle design and manufacture. In turn, this is affecting the injection moulding industry. Manufacturers of injection moulding machinery are reconfiguring processes to accommodate new designs and structures for parts, often with complex geometries. In addition, new plastic materials are needed to meet a different set of challenges to those posed by conventional vehicles and resin manufacturers and compounders are now bringing these to the market.

The main current trend influencing plastic injection moulding for under-the-hood automotive applications is the move from standard internal combustion engines to electric drives, reports machinery manufacturer **KraussMaffei**. "The simple fact that there is no more need for an extensive cooling device dominating the design of the automotive front grille will completely change the design of vehicles outside and inside, where new main pathways for electric energy supply are required," says Martin Würtele, Head of Technology Development. "In addition, there are completely new challenges in handling new weights blocks, such as battery packs underneath the car in the middle of the chassis. All this is combined with the major trend of replacing materials with more sustainable solutions, such as parts from recycled plastics, as well as higher cost pressures resulting from R&D on a new generation of vehicles."

He continues: "These factors will lead to new structural parts both in under-the-hood and bottom-of-the-car body applications, with new challenges in mechanical properties and lighter weight requirements. This will involve hybrid thermoplastic lightweight parts manufactured with technologies such as FiberForm from KraussMaffei using a combination of unidirectional [UD] tapes and organosheets, as well as plastics and the option of some steel. In addition, further weight reduction by partially foaming these hybrid parts will be an option for some parts, which is being looked at in the ReLei project. In the classical under-the-hood area we will also see much more electronics dealing with all the information from the sensors required for autonomous driving. This will require parts with less heat resistance but more passive resistance against moisture to avoid short

Main image: VW's ID3 shows new design possibilities for EV front-ends

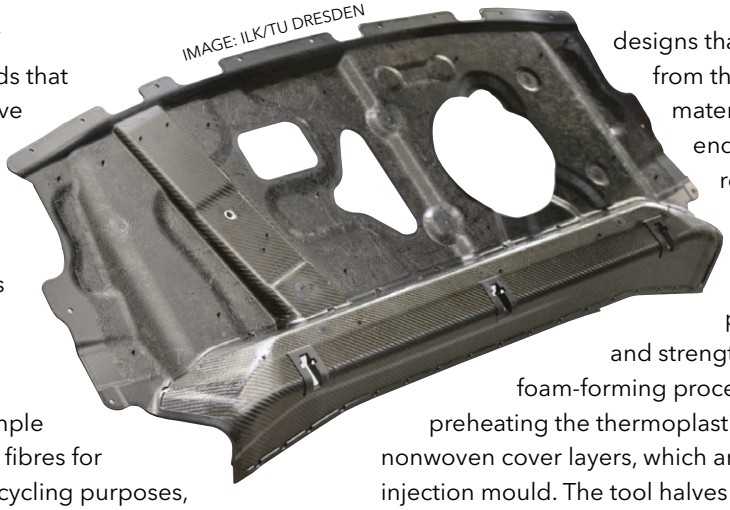
IMAGE: ILK/TU DRESDEN

Right: Technology demonstrator part developed in the ReLei project

circuiting reactions."

The company adds that realising cost effective hybrid-lightweight parts and the further integration of functions into plastic parts remains crucial. "When it comes to cost reduction by direct processing, for example with natural or glass fibres for lightweighting or recycling purposes, KraussMaffei has been addressing the direct compounding of parts with single- and twin-screw extruders for several years," says Würtele. "However, we are working with many industry partners to develop new solutions. As well as FiberForm and their derivatives, there is also the ReLei project and a new combination of reaction processing and injection moulding technology. The Opto-Light 2-K-Composites project will enable photonics within the production cell for high quality manufacturing of functional integrated lightweight plastic parts with different reinforcement combinations."

The FiberForm process works with composite materials including UD tapes and organosheets. The one-stage process starts with organosheet intake followed by heating. The material is then transferred to an injection mould for forming and the part is then injection moulded and removed. KraussMaffei says that a 49% weight saving can be achieved for a series component compared with steel and it is also cost efficient because of simplified assembly of the parts. In addition FiberForm can be used for plastic and plastic hybrid parts with local reinforcement and be given QR codes for traceability. Under-the-hood applications can include bumper carriers, airbag housings and battery trays.

ReLei will also be part of the production process, offering constructive lightweight designs that involve recycling from the beginning. These materials have an endless fibre-reinforced top coat with cores of variable thicknesses to provide stiffness and strength. The one-shot foam-forming process involves preheating the thermoplastic sheets and nonwoven cover layers, which are fed into the injection mould. The tool halves are closed and the cover layers preformed. The melt is injected in-between and final shaping of the cover layers is done by melt pressure. The tool halves are opened by a few millimetres and through open compression moulding the melt is foamed using the MuCell process.

Opto-Light provides a combination of reaction technology and injection moulding for lightweight material design incorporating photonics. Due to the combination of materials, parts can be designed with high strength and stiffness in combination with a low creep tendency, as well as offering higher design freedom and functionalisation. Currently in production, integration is possible but with long cycle times using continuously reinforced thermosets through resin transfer moulding and wet moulding. Alternatively, with the connection of thermoset laminates and thermoplastic composites in a photonics-enabled process chain based on an injection moulding machine with a turning plate, a high degree of manufacturing integration at low cycle times can be achieved by hybrid moulding through thermoforming and back moulding.

Injection moulding machinery manufacturer **Sumitomo (SHI) Demag** says it is observing a number of trends in the automotive sector for under-the-hood applications. "For exhausted engine vehicles we see a major trend in noise reduction, efficiency, weight reduction, all related to general emission reduction," says Henrik Langwald, Business Development Director Automotive for Europe. "Additionally, for hybrid vehicles there is a focus on improving and regulating the thermal management of the temperature to ensure the system can adapt to the ambient temperature and maintain comfort for passengers. Trend-wise, the current material mix under-the-hood remains virtually the same. For all-electric vehicles, current trends are focused on improving the protection against the current.

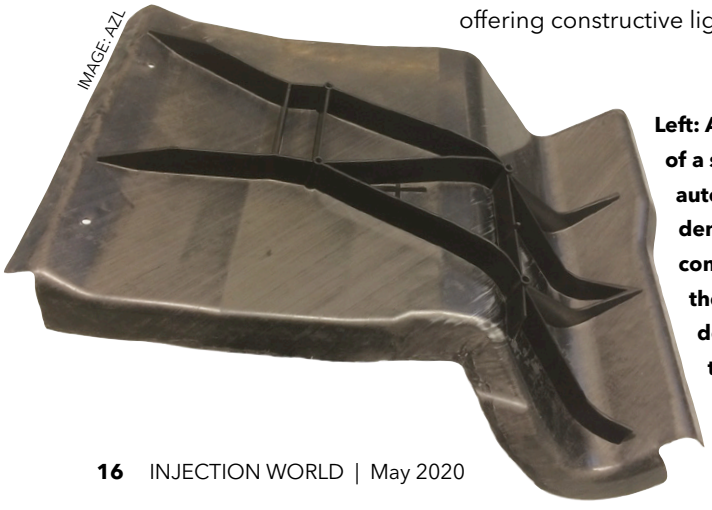
IMAGE: AZL

Left: A section of a structural automotive demonstrator component of the BMW i3 developed in the Opto-Light project

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Sumitomo (SHI) Demag has developed a new LSR package for applications such as moulding an automotive matrix light

Materials like thermosets are experiencing a renaissance. Additionally, the vibration and resonance behaviour of an all-electric car is totally different and needs a new selection of materials and part design. The front of all-electric vehicles will be more design influenced. Unlike conventional passenger cars, designers will not be constrained by internal combustion engines and fuel tanks. This means they can package up functional parts differently, and the engine bonnet or hood will be more of a design element."

Fuel cell technology is one area that requires a new generation of parts, and consequently new supply chains. "It is an area where Sumitomo (SHI) Demag is regarded as a strong development partner, working with customers to determine the best solution," says Langwald. "We are currently supporting several projects to establish new market concepts. In general, the ecological trend is influencing moulders to use more recycled materials and bio-fibres to increase stiffness in parts. However, the use of different materials means undergoing a complete validation, test and approvals process across the entire supply chain."

The company has also developed a new liquid silicone rubber (LSR) system that has particular relevance for under-the-hood applications in electric vehicles. "This technology is currently being utilised in combination with others to produce parts for hybrid vehicle fuel cells," adds Langwald. "In this application field you need a high level of machine control. Our IntElect series uses our own in-house developed motion control technologies like frequency converters and our own drive units built by Sumitomo in Japan. This enables extremely precise control of resin flow even with viscous resins like LSR and high-precision moulds such as light guides, contributing to a reduction in defect rates."

IMAGE: SUMITOMO (SHI) DEMAG

He continues: "Our current development focus continues to follow our overriding efficiency and all-electric precision principles, clearly illustrated by our new LSR package which uses our best in class drive technology. At the moment we are building one of the most efficient injection moulding machines on the market and we are going further in this direction to improve this efficiency step-by-step. With less energy consumption and higher part quality we can make a contribution for a better environment and help save limited resources."

At K2019, **Arburg** demonstrated the capabilities of its machinery for two under-the-hood automotive applications. The company says that it established an intelligent process chain for the manufacture of hybrid connectors suitable for use in the automotive industry in the field of electric mobility. A first production step was on a vertical Allrounder 375 V that automatically produced connector inserts. The next step processed the pre-moulded parts into finished hybrid connectors. An electric Allrounder 470 A was used for this purpose. In practice, it is possible to interlink the two injection moulding machines to form a fully automated turnkey system.

With a Multilift Select robotic system mounted on the machine base, the vertical Allrounder 375 V with 500 kN of clamping force featured compact and space-saving automation. The pre-stamped metal inserts were provided on a reel from an upstream stamping/bending cell, formed and then fed to the injection mould. In the mould, three contacts were overmoulded to form an assembly each and then cut out of the stamped reel. In a cycle time of around 30 s, three metal pins at a time were overmoulded with glass-bead filled PA6 (GB30).

The Multilift Select removed the pre-moulded parts from the mould and set them down on

Below: A vertical Allrounder 375 V from Arburg overmoulds metal inserts with plastic during K2019

IMAGE: ARBURG

workpiece carriers in a drawer system. For easier positioning in the mould of an electric Allrounder 470 A with a clamping force of 1,000 kN, the stamping frames contained two pre-moulded parts each. The inserts were first cleaned with Openair-Plasma and coated inline using the Plasma-SealTight (PST) process. A vertical Multilift V robotic system combined two identical parts into one assembly, which is then placed in the mould as an insert. Next, the Allrounder 470 A overmoulded the inserts with glass-sphere reinforced PA6 (GB30) to produce the finished hybrid connector. The plasma coating ensured media-tight and corrosion-free connectors without needing to use solvent-based primers. The cycle time was around 60 s.

Arburg also demonstrated how highly flexible production can be achieved without conversions using an electric Allrounder 370 E Golden Electric. The standard machine was equipped with a family mould and alternately produced magnetic cog wheels and rotors to demonstrate that it is possible to work with two injection and mould programs without additional programming effort. The magnetic parts can, for example, be used in the field of e-mobility.

IMAGE: ARBURG

The electric Allrounder 370 E Golden Electric with a clamping force of 600 kN was equipped with a 1+1-cavity family mould. When changing products, the second stored injection and mould program simply needs to be selected and the sprue channel in the mould is changed. A magnetised cog wheel with eight poles and a diameter of 48 mm, or a rotor with four poles and a diameter of 34 mm, can be produced alternately in a cycle time of around 85 s. The exhibit processed a plastic-bonded magnetic compound based on

Above: An Allrounder 370 E Golden Electric alternately produces a cog wheel and a rotor from plastic-bonded magnetic material

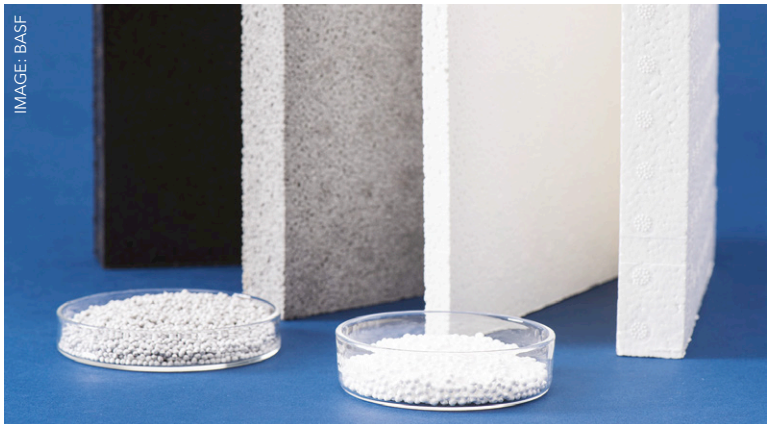
IMAGE: BASF

Above: BASF has introduced a particle foam based on a combination of several PA6 grades

PA6. The magnetisation of the ferrite contained in it takes place directly in the mould via permanent magnets.

A Multilift Select robotic system performed the handling tasks. Before the robotic system sets down the component on a conveyor belt, it is guided over a magnetic film to visualise the magnetic field. The Multilift Select featured three servo-electric movement axes and one pneumatic gripper axis for freely programmable pick-up and set-down patterns. The two-component vacuum gripper was additively manufactured as a functional hard/soft part on an Arburg Freeformer 300-3X and specially designed for the pick-up tasks of the application. It is made of hard ABS and a soft TPU component that adapts to the part contour. For an efficient and energy-saving compressed air supply, the robotic system featured a smart vacuum unit with an air-saving function as standard. This was supplemented by load-dependent lubrication interval calculation depending on the set speeds, distances and times. These digital features save resources and working hours, says Arburg.

New materials

Ascend Performance Materials has launched several new speciality polyamides suitable for under-the-hood applications. Vydyne XHT is a new portfolio of heat-stabilised PA66 and copolymers, capable of withstanding prolonged exposure to temperatures of up to 230°C. Using a combination of polymer chemistries and multi-stage heat stabilisation technology, the company says that XHT products extend the boundaries of temperature resistance without sacrificing the processability, durability and mechanical properties of PA66.

"Consistent high heat performance is critical in under-the-hood applications to accommodate for various load, torque and speed conditions in engines," says Vikram Gopal, Senior Vice-President of Technology. "We created Vydyne XHT to perform across a broad operating window for our customers, who are today limited to products with narrow operating windows and poor performance outside those windows."

The Vydyne XHT portfolio includes four glass-filled grades ideal for use in demanding automotive applications, such as charge air coolers, integrated air intake manifolds, exhaust gas recirculators and resonators. All XHT grades exhibit good flow and are regrindable, allowing excess material to be reprocessed which improves production efficiency.

Ascend has also introduced a new portfolio of PA610 and PA612 long-chain polyamides. With low moisture absorption, high chemical and UV resistance, the LCPA materials are engineered for a variety of applications, including monofilaments, battery seals, cable ties, automotive cooling and fuel connectors. The company is also expanding into high-temperature polyamides. New HTPA grades offer higher strength, stiffness, chemical- and temperature-resistance for metal replacement and high-heat automotive applications.

BASF has introduced a particle foam based on a combination of several PA6 grades targeting engineering applications. The particle foam offers a wide range of characteristics, including high temperature-resistance, good stiffness and strength as well as good chemical resistance, for example in contact with fuels, oils and lubricants. Additionally, the closed cell foam structure offers good compressive strength, a requirement for the use in crash relevant components that are exposed to high mechanical demands. Moulded part densities can be adjusted across a wide range of 150-600 g/L. Because of this versatility, lightweight applications are possible as well. ›


IMAGE: ASCEND

Above: Vydyne XHT from Ascend Performance Materials is a new portfolio of heat-stabilised PA66 and copolymers, capable of withstanding prolonged exposure to temperatures of up to 230°C

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Right: Lanxess has developed a new PBT product range Pocan XHR (Xtreme Hydrolysis Resistance)

"BASF continues its long tradition of developing particle foams. We started this project in close co-operation with our customer and now we are able to successfully produce various prototypes", says Daniela Longo-Schedel, Research Engineer. "Thanks to the temperature stability and adjustable mechanical characteristics, the particle foam is suitable for a wide range of applications. Furthermore, it can be effortlessly processed on conventional EPP-moulding machines as well as with water steam-free technologies. We are working closely together with our customers to finalise the product development."

Lanxess has developed a new polybutylene terephthalate (PBT) product range: Pocan XHR (Xtreme Hydrolysis Resistance). The company says that compounds based on PBT need greater resistance to hydrolysis and ageing in hot and humid environments when used in automobiles. For instance, the high electrical power densities of high-voltage systems in electric vehicles lead to greater temperature loads. Furthermore, additional thermal loads arise when charging the battery. In combustion engines, there is a trend towards turbocharged engines, which results in increased temperatures in the engine compartment.

According to Lanxess, the compounds have achieved good results in the SAE/USCAR-2 Rev. 6 long-term tests of the American Society of Automotive Engineers (SAE). "In the automotive industry, these tests on the finished part are the absolute benchmark in terms of hydrolysis resistance," says Claudia Dähling, PBT material expert. "In our very strict internal specimen tests, based on the USCAR specification procedure, the new compounds achieve Class 4 or even Class 5, the two highest gradings. This makes them the material of choice for PBT components, which have to work reliably

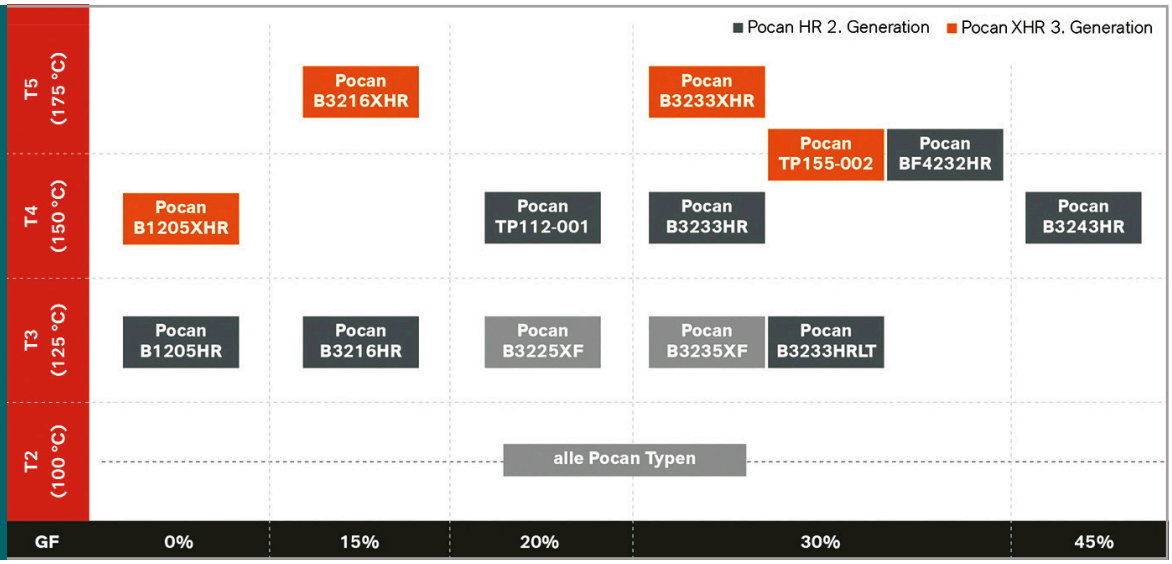

IMAGE: LANXESS

under the influence of humidity and temperature throughout their service life."

As well as its good hydrolysis resistance, Pocan XHR has other benefits. For example, its elongation properties and high resistance to alternating temperatures make it suitable for overmoulding of metal parts that are exposed to temperature fluctuations. Further strengths are its improved chemical resistance to substances such as caustic soda, and a much greater long-term temperature stability than standard PBT types, even in dry environments. (For information on Pocan XHR grades for laser welding, see feature on Joining technologies, p31).

Lanxess has also developed Durethan TC (Thermally Conductive), a range of thermally conductive polyamide compounds that will include two PA6 compounds available under the names Durethan BTC67ZH3.0EF (currently available as Durethan TP430-004) and Durethan BTC77ZH3.0EF (currently available as Durethan TP430-003). The

Comparison of Lanxess Pocan XHR with HR materials.



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Right: Teknor Apex has developed Creamid P Series PA 6 compounds that absorb nearly one-third less water at saturation than standard grades

company says that the compounds will meet the growing worldwide demand for plastics for thermal management. This can be attributed to a number of factors, including the trend toward electromobility, the increasing digitalisation of everyday life through smart home systems and the miniaturisation of electrical and electronic components.

"Both plastics are characterised by their significantly higher impact resistance and greater strain capability in tensile and bending tests than the other materials in our TC product range," says Elisabeth Gau, a Durethan product development expert. "This makes them ideal for components that require high impact resistance or feature fasteners such as snap fits." Potential applications include connectors with snap fits, heat sinks, heat exchangers and mounting plates for electronic components.

The new compounds are filled with 67% or 77% by-weight inorganic, functional filler with high thermal conductivity. Their thermal conductivity is nearly isotropic – virtually the same in all directions. In the direction of flow, this is 1.1 or 1.8 W/m K (Nanoflash process). Both materials are optimised with regard to their flowability due to their high filler content (EasyFlow). This means that Durethan BTC77ZH3.0EF flows much more easily than Durethan BTC75H3.0EF, which has already become established in series production applications, and that Durethan BTC67ZH3.0EF flows better than Durethan BTC65H3.0EF. "They enable thinner wall thicknesses and more complex component geometries," says Gau. In tests conducted by the Lanxess technical centre, they are also much less abrasive and, in turn, gentler on tools during processing.

In addition to toughness (in its conditioned state, for example, Durethan BTC67ZH3.0EF is around five times more impact-resistant than Durethan BTC65H3.0EF), the materials also feature other good mechanical properties. The elongation at break of

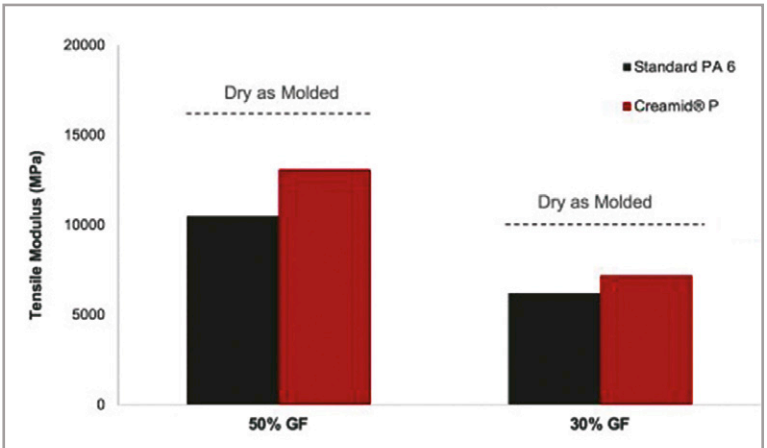

Figure 1: Comparison of tensile modulus: Teknor Apex Creamid P versus PA6 50% GF and 30% GF

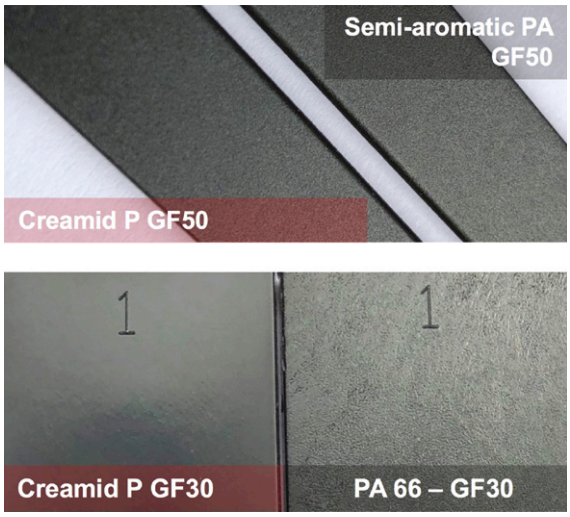

IMAGE: TEKNOR APEX

Durethan BTC77ZH3.0EF in its conditioned state, for example, is more than double that of Durethan BTC75H3.0EF, which is filled with 75% by-weight thermally conductive mineral. "This means that the material can absorb more energy during deformation, which in turn prevents the component from breaking so quickly under load," says Gau.

Lanxess is also further expanding its range of thermally conductive PA6 types. Durethan BTC965FM30 is a halogen-free, flame-retardant compound that combines good flame-retardant properties, light reflection and tracking resistance with high thermal conductivity. In the direction of flow, its thermal conductivity is 2.5 W/m·K. In flammability tests conducted in compliance with US standard UL 94, the easy-flowing material achieves the top classification of V-0 (0.75 mm). The high tracking resistance is demonstrated by its CTI A value of 600 V (Comparative Tracking Index, IEC 60112). Applications will include use in components for batteries in electric vehicles as well as plugs, heat sinks, heat exchangers and mounting plates for power electronics.

Teknor Apex has developed Creamid P Series PA 6 compounds that absorb nearly one-third less water at saturation than standard grades, providing 15-25% improved tensile properties in the conditioned state and exhibiting higher flow and better surface characteristics, even in highly glass-filled formulations. The Creamid P series is the newest product family of higher performance speciality polyamide compounds designed by Teknor Apex for structural components in metal replacement applications. The compounds are based on advanced formulation technology that Teknor Apex can apply to lower the moisture uptake of a broad range of PA 6- and 6/66-based compounds. These include grades with various types and loadings of reinforcements or fillers, as well as impact-modified

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IMAGE: HEXPOL TPE

Above: Hexpol TPE has developed materials for adhesion to polyketone substrates during multi-component injection moulding

toughened grades and other speciality compounds. Creamid P Series compounds can further employ an advanced heat stabilisation system that extends continuous use temperature.

At K2019 the company introduced the first two Creamid P compounds with 30% and 50% glass fibre content. Dry as moulded, these compounds exhibit about 80% reduction in water uptake after 24 hours as compared to standard PA6, and about 30% lower upon saturation. In the conditioned state these new grades, Creamid P2H7G6 and Creamid P3H2G10, exhibit higher tensile elastic modulus and strength at break (see Figure 1, p24).

"The improved tensile properties of Creamid P compounds enable them to meet the demands of certain structural applications where, traditionally, PA6 compounds did not perform due to high moisture uptake," says Markus Krippner, Director of New Business Development ETP. "In some cases they may provide a practical alternative to PA66 compounds as well."

In spiral flow tests, the new compounds exhibit higher flow than comparable grades of standard PA6 yet similar levels of mould shrinkage, enabling them to be processed with existing equipment and tooling.

The **RadiciGroup** High Performance Polymers Business Area has introduced Radilon NeXTreme, a polyamide capable of withstanding long-term exposure to high temperatures. "Radilon NeXTreme was initially developed for automotive applications, for which it is well suited as it features exceptional heat ageing resistance in air at 230°C," says Erico Spini, Global Marketing Manager. "After that, we developed a grade on the same polymer base for extrusion of technical filaments for industrial applications under very severe use conditions."

Two grades of Radilon NeXTreme are offered for the automotive sector: 35% glass fibre reinforced (RV350HHR 3800 BK) and 50% glass fibre filled (RV500HHR 3800 BK). Typical applications for these materials are air suction system components requiring considerable heat resistance.

The company also offers solutions using PA6.12 (Radilon DT) and PA6.10 (Radilon D) as replacements for PA12. This choice is dictated by the need to have materials capable of withstanding higher continuous use temperatures for some automotive segments than the traditional PA12 can handle. At K2019, RadiciGroup HPP introduced new materials specifically developed for air ducts, cooling system ducts, TOC and SCR hoses, and fuel line tubes, which are capable of passing tests in air and gasoline at continuous use temperatures of up to 120-130°C.

SABIC has launched Xenoy HTX resin, a polyester-based, high-heat technology that can enable the production of light, impact resistant and high performing structural automotive applications. The company says that Xenoy HTX resin is especially relevant for today's automakers, who need new polymer solutions for the production of structural components capable of withstanding higher temperatures, including those of e-coating lines operating above 180°C. Relevant applications include body-in-white components, structural reinforcements and battery protection systems for electric vehicles. Xenoy HTX resin is available in unfilled and glass-filled grades and offers significant weight savings compared to steel and aluminium. The new family of thermoplastic materials from SABIC also provides a drop-in alternative for PA66 compounds and alloys, which have had supply shortages and price fluctuations.

The first products of this new high-heat resin technology were introduced at K2019 and include unfilled Xenoy HTX 950, as well as two glass fibre reinforced grades, Xenoy HTX 975 and Xenoy HTX 575. The unfilled resin is modified to absorb significant energy and withstand plastic deformation in the event of a crash. SABIC is targeting the material for use as a lightweight metal replacement solution in new safety applications, including side rockers designed to offer protection for battery modules mounted to the floor of electric vehicles.

Hybrid honeycomb designs with Xenoy HTX can potentially save up to 60% of the weight normally associated with traditional all-metal based, multi-piece steel or extruded aluminium crash counter-measures, without compromising on dimensional stability, rigidity and mechanical strength. The glass-filled grades are particularly suitable for demanding body-in-white structures that must be capable of enduring e-coating cycles of 30 minutes at temperatures of 180-220°C. The grade can also be used to produce other structural parts subject-

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IMAGE: KRAIBURG TPE

Above: Thermoplastic elastomer hybrids (TEH) from Kraiburg TPE have a number of applications, including under-the-hood

ed to high service temperatures, including front-end modules, front brackets and under-the-hood components.

Hexpol TPE has developed materials for adhesion to polyketone substrates during multi-component injection moulding. The company says that the TPE compounds open new possibilities in application development and product design.

"The new compounds are another example of the high-performing materials we're delivering for the automotive industry," says Thomas Köppl, Group Product Manager. "We're giving our customers solutions to those hard to solve technical challenges. Those include for example materials with adhesion to diverse engineering thermoplastics for complex part geometries."

Polyketones have an elevated melting point (220-255°C) and are often used for high-performance applications in the automotive industry and technical components in mechanical engineering. In addition to good resistance to chemicals and hydrolysis, polyketones are characterised by their high wear resistance. The special TPE compounds expand the group's Dryflex 2K portfolio of adhesion grades. They do not require the use of a primer or adhesive to adhere to polyketone, which makes the production process more economical, faster and simpler.

The Dryflex B177 compounds are available in various degrees of hardness in the range of 40-70 Shore A. They also offer adhesion to a range of engineering thermoplastics such as PA, ABS or PMMA, and their related blends. (See also TPEs feature, p41.)

Kraiburg TPE has introduced a new technology platform for thermoplastic elastomer hybrids (TEHs), to close the performance gap between thermoplastic elastomers and conventional elastomer compounds. The TEH compounds are tailor-made to fit customers' specific applications. Combined with selected elastomers, the compounds provide the same features as elastomers while maintaining the workability of TPEs.

The company adds that TPE manufacturers have been trying to find ways of providing the performance of classic elastomers in their products. Although there have been a few successes with thermoplastic copolyester elastomers (TPCs) and thermoplastic polyamide elastomers (TPAs), it has not previously been possible to find a "universal super-TPE" that could match the properties of elastomers or rubbers.

"To close the performance gap between established TPEs and elastomers, particularly in relation to thermal resistance, we are therefore taking an approach that focuses rigorously on applications and customers," says Dirk Butschkau, Head of Business Development EMEA. "For example, we select the proportions of elastomers and thermoplastics in each compound on the basis of their specific compatibility and suitability for the required application temperature, chemical resistance and mechanical performance."

The result is a custom-engineered TEH compound with a completely crosslinked elastomer component – which in contrast to conventional elastomer mixtures can be processed just as economically for injection moulders of technical thermoplastics. The finishing that is usually necessary with most elastomers is not necessary and even sophisticated two-component applications with PP, PBT or PA can be implemented without bonding agents.

The new technology platform provides advanced TPE materials with a hardness range of 55-80 Shore A, with significantly improved performance based on different combinations of elastomers and thermoplastics. Along with good mechanical properties, the materials provide continuous operating temperatures up to 150°C and chemical resistance to oils, greases, lubricants and fuels. In addition, they remain completely recyclable, as the material is not crosslinked during the production of mouldings from TEH.

According to the company, the thermoplastic workability of TEH compounds may reduce the cycle time at comparable wall thicknesses by up to 80% in comparison with elastomers. This means they provide not only an extremely cost-effective alternative but also a wide range of possible new applications. The processing and characteristics profile are aimed particularly at parts of engine covers, oil sumps, fuel filler caps and oil caps, as well as cooling and/or temperature control units.

Additional examples are noise-absorbent and vibration-absorbent components in gearboxes, engines and pumps, and also includes connectors, screwed cable glands and fasteners. The initial successes include an application that is used in the lubrication circuit of a 2 litre diesel engine, in permanent contact with the engine oil and exposed to considerable amounts of diesel and blow-by gases during driving with a cold engine.

Following an extensive development phase and various basic research investigations, Kraiburg TPE says that it sees tremendous potential for further expansion of this new technology, which has only recently been introduced in the market. "We are currently testing the use of butyl rubbers to improve barrier properties and we're following various approaches to achieve softer TEH ratings below 50 Shore A," says Butschkau. "The wide choice of thermoplastics also includes plastics such as PE, PBZ, PET, TPO and TPU to influence certain material properties in specific ways."

Tisan, based in Turkey, produces ETP compounds based on PA6, PA66, PPS and PPA for automotive and other applications. The company says the automotive market is in a transition phase to meet new sustainability demands. In addition, "Under-the-hood conditions have become more challenging and automotive suppliers are looking for highly durable components with thermoplastics," it says.

The company produces its Tislamid line of polyamides with standard and customised formulations for customer requirements, with enhanced properties from toughness to heat resistance. Tislamid 30D03 K02 K06 R02, a 30% glass fibre reinforced, hydrolysis and heat stabilised PA66 material, is an example for applications in engine components.

Tisan says: "The type and grade of thermoplastics depend on the specific application and the thickness of the part. For example, a small difference in the application or design of the end product can make PPS and PPA compounds better solutions."

Tisan has developed PPS materials branded Hyperpol SP with high temperature resistance, chemical resistance, dimensional stability, good electrical properties and inherent flame retardant properties. Hyperpol AP is the trademark for PPA compounds developed by Tisan which have high physical, thermal and electrical properties. These products are stronger, stiffer and have higher thermal resistance than PA66. Chemical fatigue and creep resistance are other significant properties of PPA. Hyperbol AP 30D03 K02 K06 R02 is a PPA compound with glass fibre reinforcement and is heat stabilised for use under the hood.

Tisan also offers blend solutions to its customers. Tisblend AI K06 R02, for example, is a PA/ABS blend that has high hydrolysis resistance for use in oil tank covers.

Plastics additives manufacturer **Songwon** has developed Songxtend 2721, which improves long-term heat stability, to enable recycled polypropylene to be reused and high durability achieved in automotive interior and exterior applications.

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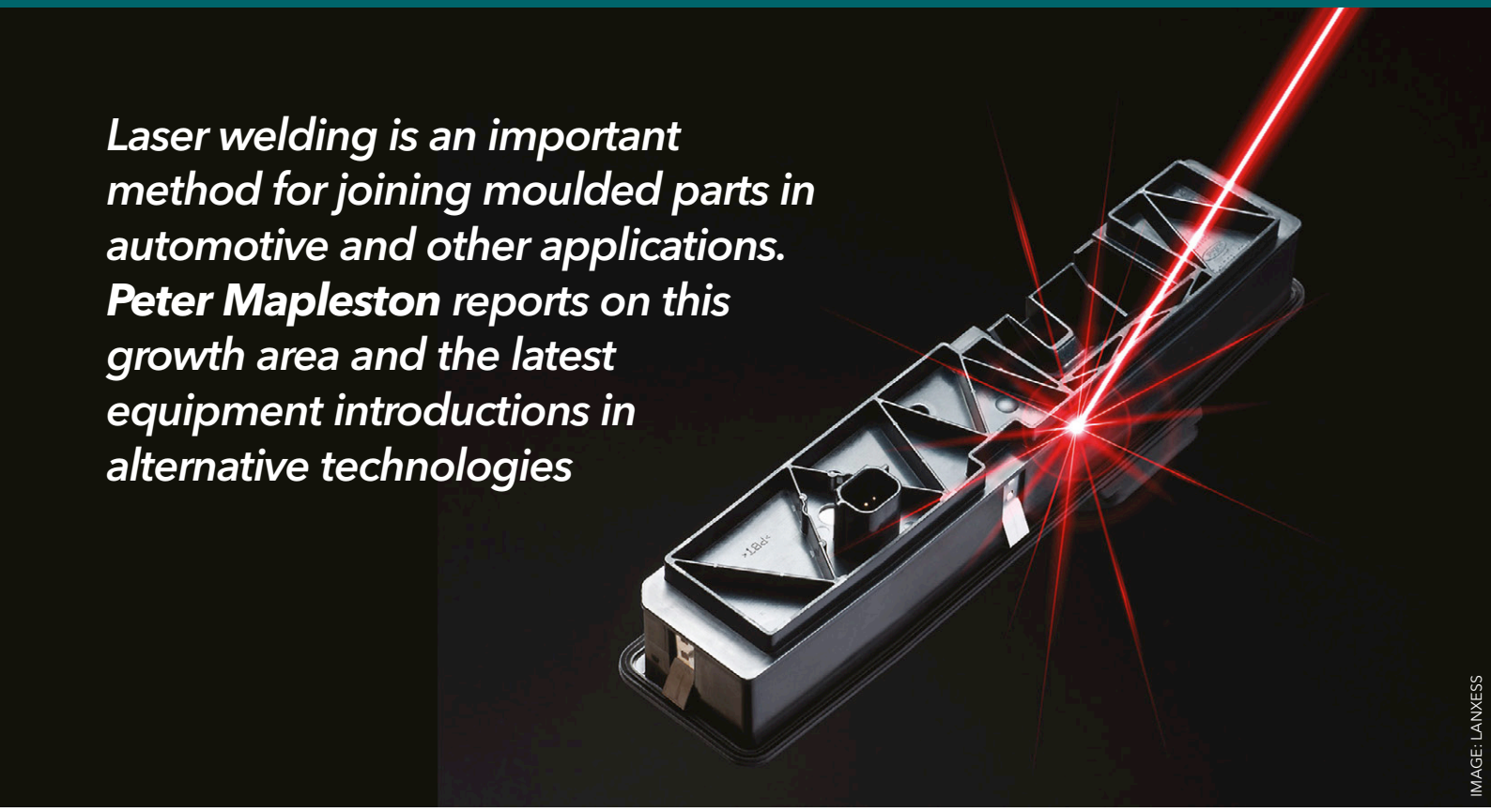

IMAGE: LANXESS

Laser welding is an important method for joining moulded parts in automotive and other applications. Peter Mapleston reports on this growth area and the latest equipment introductions in alternative technologies

Join together: options for welding moulded parts

From applications in hot and oily environments under the car hood, to clinical conditions in care facilities, laser welding is an increasingly attractive option for joining plastics parts together quickly, efficiently, and permanently. In this feature article, *Injection World* looks at what is out there now, using laser welding and other joining technologies.

Laser welding began as a process that could only be used where at least one of the materials used for the parts being joined was translucent or optically clear (to allow the laser beam to pass through it to reach the join) – hence its popularity for headlamp assembly. But as it has matured, plastics producers have developed grades that, while transparent to laser light frequencies, are opaque to the human eye.

Covestro, one of the leading global producers of polycarbonate, points to the advantages of laser welding for various automobile components: not only headlights and taillights, where the technology is well established, but also items such as battery cases used in electric vehicles (EVs).

Batteries used in EVs need to keep cool to function properly and retain their life span. One cooling process, known as fluid cooling, requires airtight seals to keep fluids contained and avoid spills. While several joining methods can be used to weld plastic battery packaging components, those like laser welding that do not require external agents (welding rods, for example) tend to be more cost-efficient.

In the US, Covestro has worked with **Leister Technologies** to develop process and material solutions for laser welding fluid-cooled battery modules used in various types of EVs, from passenger cars to buses and trucks. Battery cases injection moulded in an opaque flame-retardant Bayblend PC/ABS blend can be laser-welded shut. Flame-retardant plastics are preferred and often required for battery enclosures as they can help prevent or delay the spread of fires.

"Using Bayblend FR3010, we developed effective and reliable laser welding solutions for production-ready battery modules that can withstand battery abuse testing," says Terry Davis, principal engineer, Covestro. Bayblend FR3010 has high impact strength, chemical and hydrolysis resistance, thermal stability, and a good balance of high distortion temperature under load and physical performance.

For production of such modules, Leister offers

Main image: Lanxess has added three new products to its selection of laser-transparent Durethan PA and Pocan PBT materials

IMAGE: COVESTRO

Right: Covestro worked with Leister Technologies in a laser welding application for fluid-cooled battery modules used in EVs

the Novolas workstation laser welding system (WS-AT), which it describes as an all-inclusive, ready-to-use, Class 1 solution that can be customised for many component-assembly applications.

Lanxess has also been upping its game in materials suitable for laser welding, including EV batteries, and also smaller applications. It says that as miniaturisation of E&E components continues, the potential for use of laser transmission welding is growing, since laser welding allows complex geometries to be produced in a cost-efficient and resource-friendly manner.

Last year, the company added three new products to its selection of LT (laser-transparent) Durethan polyamides and Pocan polybutylene terephthalates (PBT). Claudia Dähling, an expert in technical plastics at the company, says potential applications include components for EV drives and driver assistance systems as well as devices for the Internet of Things.

Pocan B3233XHRLT is a 30% glass fibre-reinforced PBT that performs well in hot and humid environments, as demonstrated in the SAE/ USCAR-2 Rev. 6 long-term tests of the American Society of Automotive Engineers. "Materials like these are almost unprecedented on the market because standard additives for hydrolysis stabilisation generally cause the laser transparency of PBT to deteriorate significantly," Dähling says.

Most flame retardants also diminish the laser transparency of thermoplastics, Dähling adds. "With Durethan BKV30FN04LT, we can offer a corresponding compound based on PA6," she says. It uses a halogen-free flame-retardant package that gives the compound a UL 94 V-0 rating. It leaves hardly any deposits in the tool and provides a high tracking resistance of 600V (CTI A, Comparative Tracking Index, IEC 60112), making it well suited for components for high-voltage batteries and plugs.

Pocan TP150-002 is a 30% glass fibre-reinforced PBT compound exhibiting a laser transmission (980nm) of 13%, which Dähling says is around double the transparency of most other laser-transparent PBT product types.

In May, **PolyOne** launched into the Asian market a new Bergamid laser weldable PA66 compound for use in automotive parts, consumer goods and medical devices. The company says the new addition to its Bergamid portfolio has controlled laser transmission rates, multiple colour choices and can have customised performance options, allowing manufacturers to produce high performance parts with durable welds and smooth surfaces.

"Laser welding is technically advanced, and its success depends on the weldability, transmission rates, softening point, absorption agents, and colour compatibility of the materials used," said Flight Xu, General Manager of Specialty Engineered Materials Asia for PolyOne. "Our new Bergamid grades allow high welding strength and a smooth surface resulting in an unparalleled finished product."

PolyOne says it also offer services including part design, material compatibility evaluation, and laser welding process selection to support manufacturers using its new materials.

Akro-Plastic is another materials supplier with a range aimed at laser-weldable parts. It offers polyamide compounds based on PA6, 66 and 612, unreinforced and reinforced with up to 60% glass fibres, black or coloured and even impact modified. It even has a long fibre reinforced grade, Akromid C28 LGF 40 6 XTC LT schwarz (7176), a PA66/6 with 40% reinforcement, aimed at housing applications in the automotive sector.

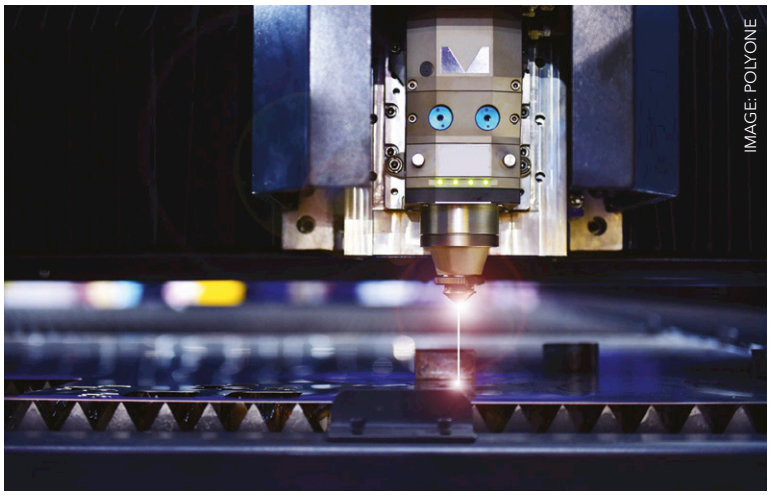

IMAGE: POLYONE

Below: PolyOne has launched a laser weldable PA66 compound in Asia

More medical options

Apart from automotive, medical is also an important area where laser welding has important advantages. At last year's Medical Design & Manufacturing West show in Anaheim, US, **Clariant** introduced Mevopur-branded materials incorporating additives to

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optimise laser welding for medical applications. It says laser welding has important advantages over alternatives in applications such as drug-delivery devices, diagnostic products, and dialysis systems. For example, surfaces do not require pre-treatment and the risk of creating potential leachables from solvent residues or adhesive is eliminated. In addition, high-speed joining of even complex geometries is possible with minimal stress in the joints. Welded components can survive repeated sterilisation, if necessary.

In the run-up to this year's show, Clariant Healthcare Polymer Solutions announced the availability of more Mevopur compounds as well as masterbatches for laser welding. It says these are supported by formulation expertise that can help medical-device manufacturers take a Quality by Design (QbD) approach to laser-welding of plastic components.

Included in Clariant's latest Mevopur offering are laser-weldable transparent grades of ABS. The new compounds feature transparent colours for both the laser transmitting and absorbing components.

Laser-welding offers numerous advantages in medical and diagnostic applications in terms of speed and reliability, according to Steve Duckworth, Global Head of Marketing & Business Development. But he also points out that if the combination of polymer, colorants, part design and processing techniques are not considered in the earliest stages of product development, weld consistency can suffer, and the risk of product failure may become unacceptable.

Colour choices play a critical role in the ability of one part to transmit laser energy, and the other to absorb laser energy and melt at the bond line. In many applications, colour decisions are taken only in the later stages of the development cycle by the marketing team or others not involved in the functional design process. When laser welding is involved, this introduces considerable and unnecessary risk and complexity.

"Traditional approaches to coloration may not work," explains Duckworth "For example having a visually opaque black or very dark colour that typically uses carbon black would not perform in

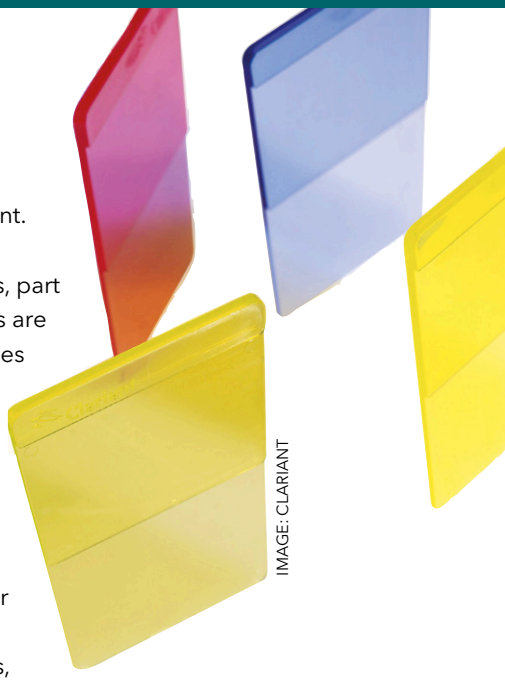

IMAGE: CLARIANT

Above: Bright transparent colours can be combined with laser-welding functionality in Clariant's Mevopur ABS compounds

the laser-transmitting component. Neither would a white component, where a typical pigment used is titanium dioxide. We can give different colour options in a wide range of polymers including polypropylene, ABS, polycarbonate, PC/ABS blends and more. In collaboration with laser equipment suppliers, we've developed analytical techniques that can be used to screen different solutions to find the best one."

Laser all-clear

Just as laser welding requires that one of the two plastics parts must be transparent to laser frequencies so that the light can reach the join and heat it up, so it follows that the process won't work if both components are laser transparent. Solutions that enable the joining of parts that are both transparent are increasing in number, not only from materials suppliers, but also welding equipment makers.

Emerson, which owns welding equipment specialist Branson, recently collaborated with **Sono-Tek** to develop a new variant of the process. It combines Branson simultaneous through-transmission infrared laser welding technology and an ultrasonic spray deposition technology from Sono-Tek.

The Sono-Tek technology deposits a laser-absorbing material in the form of microparticles of a dye or carbon black suspended in a low boiling point liquid. The laser heats up these particles, which in turn heat up the plastic to the point that it softens and so enables bonding under pressure.

Spraying is carried out using an ultrasonic horn that atomizes the dye and deposits it in patterns that can be as narrow as 0.5 mm and with thicknesses measured in nanometres. The carrier fluid is flashed before the welding process begins.

Hugh McNair, laser applications and systems manager for assembly technologies at Emerson, says that because the spray deposition process is so precise, the need to precisely focus the laser energy is possibly not as great as when welding plastics that are inherently laser-absorbent, since clear-on-clear welding only occurs where the laser-absorbing dye has been deposited.

Branson says the technology is invaluable for medical devices that demand optically clear flow paths, simplifying everything from automated blood cell counts in capillary-sized fluid paths, to providing visual validation to a technician that a micro-dose of a powerful therapy is being properly administered to a patient. The process can also make high-quality transparent lenses, fluid-handling devices and other components for consumer products.

The Branson/Sono-Tek development is tied to the Clearweld process invented back in 1998 by TWI, the UK-based industrial research and development organisation that specializes in materials joining. The Clearweld process is covered by a number of worldwide patents now owned by or licensed to **Gentex**. Companies buying material from Gentex or from its licensed supplier, Crysta-Lyn Chemical, have rights to use the process.

"We have been developing our optically clear to optically clear plastic welding process for over five years," says Tom Hoover, Senior Medical Business Development Manager, Americas, at Branson Ultrasonics Corp. "There are multiple methods to apply laser absorbing dies, with ultrasonic spray deposition currently being the most accurate. We worked with Gentex, then Crysta-Lyn, to formulate the best absorber particle composition, size and carrier fluid. Part of our development time was for cytotoxicity and biocompatibility approvals. Our technology breakthrough is in terms of the scale and accuracy that we can deliver."

Expanding capability

Another welding equipment company increasingly involved in laser welding is **Dukane**, already a worldwide leader in plastics welding. Last year, it bought Blackhawk Technology Group, a laser welding equipment company headquartered in Oregon, US. According to Dukane, Blackhawk is a "systems, services, and contract manufacturer for laser plastic welding," with a focus on end-to-end service, from basic material tests to full process development and contract manufacturing.

Mike Johnston, Dukane President & CEO, says his company's LaserlinQ technology's ability to enable welding of clear-to-clear (2-micron) components without the need for additives has grown the demand for its own laser technology. He says customers are now requesting laser technology for 1-micron opaque to coloured weld

Below: Joining automotive taillights with the LPKF PowerWeld 3D 8000 laser system

IMAGE: LPKF

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IMAGE: FORWARD TECHNOLOGY

Above: HD2X-OSW servo spin welder from Forward Technology

applications. "This increasing demand makes acquiring Blackhawk a perfect fit for Dukane."

The possibilities offered by laser plastics welding for a wide range of applications were demonstrated by **LPKF** at K 2019 last October. The company says its machines make it possible to join very small and large components safely and reliably, with weld seams that are only a few tenths of a millimetre wide for small parts and significantly wider for larger parts. The company demonstrated application examples ranging from medical technology to automotive and consumer applications.

LPKF had a new machine at the show, the InlineWeld 2000, which enables round or non-rotatable workpieces to be joined. It also presented the universally applicable, standardised LPKF InlineWeld 6600 laser system. This system is used in particular when efficiency and cost minimisation are priorities, but quality must be ensured at all times. The LPKF PowerWeld 3D 8000 laser system is available for large, three-dimensional components such as automotive taillights.

All laser systems combine established process technology with integrated quality assurance and extensive interface options. The LPKF software takes over the CAD data, calculates the optimum welding contours, and transfers the information directly to the machine controller, making setup of the machine very quick and easy.

LPKF says its software package offers a complete solution for laser plastic welding: from creating the weld contour to controlling and monitoring the welding system. Three process elements define the software concept of LPKF's laser plastic welding systems. First, the automatic generation of the weld seam contours based on the CAD data, and the transfer to the machine; then the implementation via the machine control for the final welding process. The software guides the user through the entire work-flow.

Away from lasers, **Forward Technology**, which makes various types of welding equipment, introduced a new dual-axis servo spin welder in April. This is designed for applications where high rotational power is needed, together with high vertical and rotational precision.

The HD2X-OSW servo spin welder has what the company says is an industry-leading 24-in (61-cm) stroke, allowing for simple push-button recipe changes when switching between tall and short tools, without the need for manual adjustment of the head's vertical position. Rotational tolerance accuracy between the two parts to be welded is ± 0.1-deg; finished vertical weld tolerance is 50 microns.

The unit provides a press force of 600lb (2.7kN), which Forward Technology says gives process engineers plenty of head room when designing spin weld applications, including those with difficult-to-weld materials and large diameters.

Brett Raisanen, General Manager of Forward Technology, says the unit's dual-servo system allows precise control of welding depth and enables synchronisation of vertical and rotational movement to optimize the weld process.

The company's DLVW-4848-LX vibration welder now has an enhanced drive for additional analytical options. The unit uses synchronised heads to provide substantial amounts of weld force and is capable of welding individual parts up to around 122x122mm, or multiple smaller parts. Servo drive technology is said to provide much improved process control while substantially increasing the available power.

The DLVW-4848-LX is particularly suited for welding of large automotive parts such as intake manifolds, instrument panels, and engine covers. For the fast-growing plastics pallet industry, it is offered as an alternative to hot plate systems, offering significant cycle time reductions.

Forward Technology is part of the Crest Group, which specialises in ultrasonic technologies. Other producers of welding equipment in the group include Rinco Ultrasonics (Switzerland), KLN Ultraschall (Germany), and Mecasonic (France).

Sonotronic had three new ultrasonic welding products at K 2019: an Ecoflex iSonic welding cabin in a reworked design, new USG iSonic ultrasonic generators offering rapid, digital control of the welding process, and the DNP iSonic handheld welding device, equipped with a quick-change function for the oscillating units and sonotrode cooling.

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An expansion of applications for thermoplastic elastomers is supported by their advantages in haptics, weight reduction and processing. ***Peter Mapleston*** *looks at what's new in TPEs*

TPEs come to the aid of health and sustainability

IMAGE: ENGEL/HAIDLMAIR

Main image: Haidlmair and Engel have collaborated on a mould solution for the production of TPE components of reusable masks

Producers of thermoplastic elastomers (TPEs) continue to work on new developments that meet specific market needs. Among the highlights is a renewed emphasis on grades for over-moulding onto thermoplastics of various types, to provide hard/soft combinations in an increasing variety of consumer and technical applications. Thermoplastic polyurethanes (TPUs) are being processed in new ways. One major TPE supplier has developed innovative technology to enable parts that are light and strong. And numerous technology suppliers, whether it be in materials, moulds or injection moulding machinery, are pulling out the stops to create new solutions to combat Covid-19.

TPEs have a long history of use in over-moulding applications with harder thermoplastics. Elizabeth Ponte, Senior Product Marketing Manager, **Teknor Apex Company**, says that, until now, the classic example of an over-moulding application for TPEs has been the toothbrush, with its cushioning TPE grip over a rigid substrate. "The key attraction of this and other products with TPE grips and handles is ergonomics, combined with the stylish appeal of a two-tone finished part. But many new over-moulding applications require more from TPEs than a soft touch and good looks."

In automotive applications, over-moulding is used increasingly for parts consolidation, which reduces production steps, part weight and costs, she says. One example she cites is an under-hood housing with an over-moulded TPE gasket. "Beyond the capability of adhesion to a rigid plastic, the TPE must provide low compression set for retaining its sealing function, plus resistance to high temperature and automotive fluids. In food storage containers whose rigid lids have over-moulded TPE seals, the TPE must be suitable for food contact and resistant to heat and hot water. And in over-moulded medical devices, the TPE component must be ISO-10993-5 compliant, have FDA-compliant ingredients, and be resistant to drugs and other fluids encountered in clinical settings."

Ponte goes on: "The expanding functionality required of TPEs for over-moulding has accelerated the demand for custom TPE compounds, each of which meets specific application requirements and strongly adheres to a specific rigid substrate. While standard styrenic and vulcanizate TPEs generally adhere to polyolefins like PP and PE, they exhibit poor adhesion to polar engineering resins such as PC, ABS, nylons, polystyrenes, acrylics,

IMAGE: TEKNOR APEX

Left: Food storage containers are an important and growing over-moulding application for TPEs

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Right: PolyOne reSound OM bio-derived TPEs have up to 50% bio-renewable content, derived from sugarcane

IMAGE: POLYONE

copolyesters, acetals, PBT, and ASA."

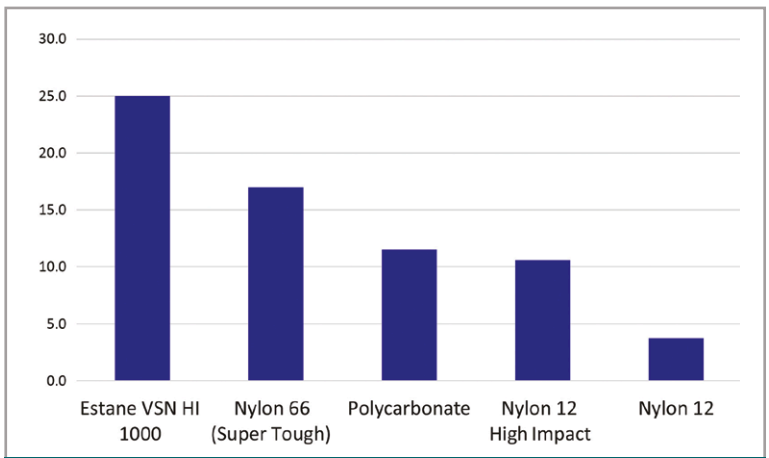
Teknor Apex has developed a wide range of TPEs whose chemistries have been modified to adhere to these substrates. Typically, each substrate requires a different TPE chemistry for adhesion. Grades are supplied under the Monprene OM brand, the Medalist brand for medical applications, and the Sarlink brand for the automotive industry.

"Each product line is designed to comply with regulations and specifications unique to that industry," says Ponte. "A new Medalist series, for example, exhibits strong adhesion to PC and PC alloys and provides enhanced resistance to lotions and disinfectants encountered in wearable medical devices."

Lubrizol has recently extended its Estane VSN portfolio of TPUs for eyewear. It says the lightweight product range has shown unique properties when applied via over-moulding in safety, sports or fashion glasses, as well as in other consumer-related applications. "Specifically, it is working as a solution for customers facing adhesion problems brought about by having to bond soft/hard materials such as polycarbonate, nylon or metal," the company says. Very high gloss colour without coating can be achieved, and bonding to coatings requires no primer.

The highly impact-resistant grades provide high aesthetic quality; for example in children's eyewear frames that use different colours or glitter, says Lubrizol. The materials also show high resistance to abrasion and chemicals used in skincare products. Most recent developments include a softer grade used for flexible and soft-touch eyewear parts such as temples and nose pads.

PolyOne is also emphasizing over-moulding, with its recently-launched reSound TPEs. These are the latest addition to its "sustainable solutions" portfolio, using between 40 and 50% bio-renewable content derived from sugarcane. They have hardness levels and performance comparable with standard TPEs.



Notched impact strength of an Estane VSN grade of TPU from Lubrizol compared with various engineering thermoplastics (numbers in ft-lbf/in)

Jim Mattey, global marketing director, Specialty Engineered Materials at PolyOne, says the new materials meet the needs of OEMs, particularly those offering consumer products, who want to incorporate environmentally responsible materials in their designs while still meeting functional requirements.

The product portfolio consists of four over-moulding grades compatible with PP, and one suited for moulding over ABS. "All grades are formulated for durability, delivering property retention and UV resistance comparable to traditional TPEs," says PolyOne.

In addition, the new grades feature easy colourability, a major requirement for applications such as cosmetics packaging, personal care products, and consumer electronics. With an opaque natural colour, all reSound OM materials can either use traditional TPE colorants or be paired with sustainable colorants from PolyOne. Further supporting sustainability, when manufacturing with reSound OM, production scrap material can be reused.

Hexpol TPE is another TPE supplier expanding its portfolio of bio-based TPE compounds, as well as grades containing recycled content. It launched its Dryflex Circular range at K2019. Kirsty Wood, Development Technologist and Sustainability Lead at the company's UK site, says: "Consumers are more aware than ever of what happens to plastic products once they've finished using them, whether that's recycling, incineration, landfill or even marine littering."

The Dryflex Circular range is structured into different series based on the recyclate source,

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helping give clarity about material origins. Currently there are series based on either post-industrial recyclate (PIR) or post-consumer recyclate (PCR), as defined by ISO 14021.

The recyclate source for the Dryflex PIR grades includes material diverted from the waste stream during the manufacturing of consumer, construction and household applications including baby products. The recyclate source for the Dryflex PCR grades includes recycled PP from end of life vehicles, including automotive interior and exterior applications.

Dryflex Circular TPEs are available in a range of hardnesses from 40 Shore A, with recycled content up to around 80% by weight. Hexpol says the compounds are produced under the ISO 9001 and ISO 14001 standards and all compounds are RoHS, REACH and SVHC compliant.

The Dryflex PCR grades are currently only available in black. They are targeted at automotive exteriors such as mud flaps, side-steps and wheel-arch liners. These grades can also be used for outdoor equipment such as lawnmower wheels or safety barriers. The Dryflex PIR grades are available in a natural colour, providing additional design possibilities. They are targeted at consumer goods, sports equipment, footwear, household and automotive applications.

Kraiburg TPE has taken another route towards increased sustainability. It announced last year that it had launched what it calls the world's first weight-saving TPEs. Rather than using a foaming mechanism to reduce material density, these grades incorporate hollow glass beads. The company is now offering three new product lines for automotive vehicle construction, power tools and various other application areas.

Expandable materials require strict process control procedures to achieve an even surface quality without surface waviness, the company notes. This is one reason why it has implemented a new TPE technology using 3M Glass Bubbles for materials with very low densities – between 0.7 and 0.9 g/cm³ – that allow the production of thin-walled mouldings with high quality surfaces that can withstand high mechanical loads. Compression-set values are described as excellent.

The microscopically small hollow glass bubbles are made of chemically stable borosilicate glass. Kraiburg TPE says they spread evenly in the TPE matrix and help increase the dimensional stability. Production waste can be recycled directly.

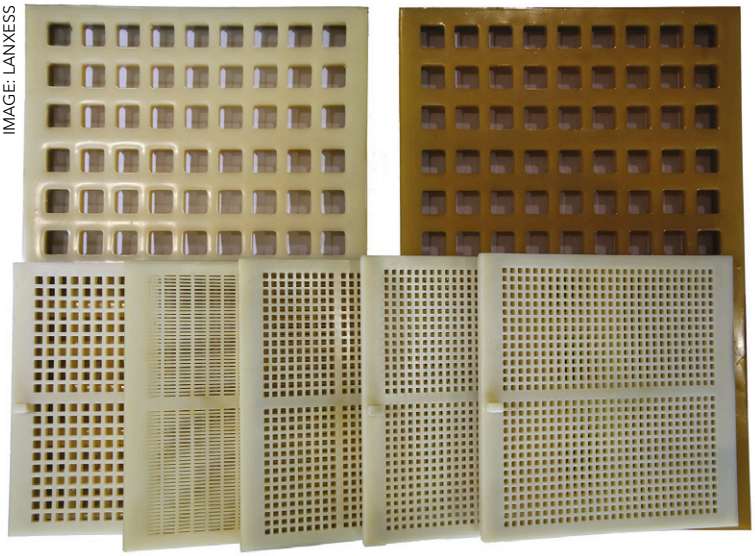
Thermolast K LW/UV (lightweight plus UV resistance) grades are specifically for exterior vehicle components; Thermolast K LW/CS/UV (with increased compression set) grades adhere to polypropylene, making them particularly suitable for various sealing applications; Thermolast K LW/PA (lightweight plus adhesion to polyamides), which are rated HB under UL94, are suitable for power tools, among other things.

"3M Glass Bubbles have been tried and tested

IMAGE: ZYLOG ELASTOCOMP

Left: Car mat in Zylog's new Neoflex 8150-02 is 1.8m long

IMAGE: LANXESS



Above: Innovative processing of cast polyurethanes: new mining screens are manufactured by Autox for the first time by injection moulding from the prepolymer Adiprene LF

as weight-saving fillers in various 'hard' thermoplastics, but our new lightweight technology is using them in TPEs for the first time," says Martina Hetterich, Project Manager Advance Development at Kraiburg TPE.

Zylog ElastoComp, India's oldest TPE compounder, has also been working on lightweighting for automotive. It has developed a range of high-flow compounds for injection moulding of large and flexible parts. It says it is responding to demand for higher productivity and simpler tools than are required when using more viscous TPEs, which it says hinder the development of large aesthetic parts because of the problems they give with flow marks, streaks, flash, and shiny patches on visible surfaces.

Neoflex 8150-02, a styrenic TPE, has a flow rate of over 1,500g/10 min at 190°C (10kg). "Working closely with a processor and OEM, we formulated this high flow material, which allowed processing a 6ft [1.83m] long part, free from aesthetic issues, at lower pressure and shorter cycle time," says Zylog director Aschak Damani. "The criticality of the formulation is to ensure homogeneity of the compound, optimised die swell and no phase separation during injection moulding."

Damani adds that the formulation is designed to enable post-moulding operations such as welding and bonding, while complying with automotive OEM requirements of low odour, low fogging, weatherability, chemical and heat resistance and light weighting. Its density is 0.89 g/cm^3.

The range includes grades for various applications, including over-moulded instrument panels, door trims, consoles, parcel shelves, boot mats, boot trims, large exterior step mats and underbody shields.

Last year, **Lanxess** announced that its Adiprene C930 castable urethane low free-MDI prepolymer (originally developed by Chemtura, acquired by Lanxess in 2017) had been proven as an appropriate material for injection moulding as well. Korean company Autox developed a production process that allows cast polyurethane to be injection moulded. "This innovation brings a new perspective to the cast polyurethane world as it combines the processing advantages of injection moulding along with the properties of cast urethane," says Lanxess. Autox produces a new vibrating screen for the mining industry which is made from this material.

Compared with the casting process, injection moulding has a notably higher production output rate. Cost efficiency is also influenced by lower labour costs. Lanxess says the current production time of an injection moulded mesh screen is 5 min, while the pour casting process will normally take 35 min. "Adiprene LF (Low Free) prepolymer delivers improved industrial hygiene, along with ease of processing," Lanxess adds. "It offers a perfect fit with the injection moulding process, as the viscosity is lower than of a conventional prepolymer."

Lanxess says Autox's new development means complex shaped parts are easier to mould as the pressure needed for the injection allows the flow to get into the part details. "The injection process answers one of the main concerns of the industry: waste management, as it also allows for better quality consistency, leading to less trimmings but also less waste from reduced scrap," the company says.

The Adiprene C930 mining screen offers "outstanding" abrasion resistance and rebounding properties, improving the lifetime and screening efficiency of the part. Results of this caprolactone-based technology have been supported by field testing, which has shown that the lifetime of the screen can be up to three times longer than the market high-quality reference.

Lanxess says it and Autox, which normally specialises in rubber spare parts for construction equipment, are confident that other applications can also benefit from this development.

A third major TPU producer, **Covestro**, announced in early May that it will co-operate with independent compounder Teknor Apex on compounding materials based on Covestro's Desmopan polymers. Thorsten Dreier, the new global head of the TPU business at Covestro, says the two companies together "want to develop customised products to grow together with our existing and new customers." ›

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The new products will be marketed under the name Desmoflex, a name first used for TPU blends co-developed by Covestro's previous parent Bayer and German compounder PTS Plastic-Technologie-Service, which Teknor Apex acquired in 2016.

Covestro points out that TPUs can be made with various properties, ranging from soft to hard and from elastic to stiff, depending on customer requirements. All products have in common a high abrasion and wear resistance as well as chemical and weather resistance.

The Covid-19 pandemic has prompted many manufacturing companies to divert operations to assist in various ways to combat the spread of the disease. Numerous companies involved in TPE production and processing have quickly turned to join the effort to produce masks for operatives on the front line, and for the public at large.

Mould maker **Haidlmair** recently developed and implemented a new mould solution for the production of integral-hinge TPE components of reusable masks in what injection machine making partner **Engel** says was record time. The mask design was invented by German company Providee. The mould solution is now being used by plastics processing companies worldwide.

The masks provide protection for the mouth and nose for use in daily life and in certain work situations, for example in the construction industry. They can be cleaned and disinfected and different filter materials can be inserted. In countries that have exempted face masks from medical device legislation due to the Covid-19 pandemic, these masks can be produced and marketed by companies from a wide range of industries. "This solution allows us to help companies change their production at short notice in order to actively participate in the fight against the further spread of Covid-19," says Christoph Steger, CSO of Engel.

IMAGE: ENGEL/HAIDLMAIR

Above: A reusable mask design by Providee features integral-hinge TPE components

Lubrizol has donated Estane TPUs in support of efforts by **Nike** to develop full-face shields and powered, air-purifying respirator (PAPR) lenses for front-line medical staff in hospitals across several US cities. Lubrizol's innovation team quickly evaluated materials, provided insights to optimise performance and re-structured its production and supply chain to produce the necessary material.

Kraiburg TPE says some of its materials, used in many everyday applications such as toothbrushes, razors, and automotive components, have also become indispensable in numerous areas of systemic importance. "Currently, our TPEs are used in medical applications such as valves, connections and tubes for ventilators, face masks, respirators, as well as simple buttons and elastic straps," it says.

"Specialty Thermolast M and K compounds are needed here," the company says. "The Thermolast M medical compounds in particular are characterised by a high degree of purity, which is guaranteed through a constant production process, permanently assigned production units and numerous quality assurance tests."

Kraiburg TPE recently decided to increase its production capacities for these materials and to give top priority to their production. The company says stocks of the relevant raw materials have been increased to ensure constantly smooth and stable production capacity.

The company cites its customer, **BaS Kunststoffverarbeitung** in Eslarn, Germany, as one company that has decided to use at least some production capacity in the fight against Covid-19. "Instead of components for the automotive and electrical industry, the company is now producing reusable face masks/respirators for welfare and social-service institutions and medical offices," it says. "It was the company's close collaboration with Kraiburg TPE in the project, among other things,

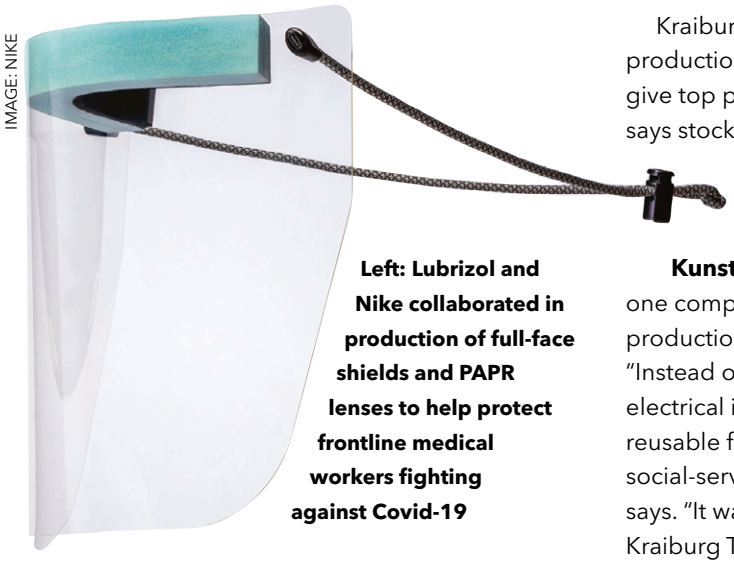

IMAGE: NIKE

Left: Lubrizol and Nike collaborated in production of full-face shields and PAPR lenses to help protect frontline medical workers fighting against Covid-19

Right TPE from Francesco Franceschetti Elastomeri is used by Negri Bossi to mould this face mask

that made this possible."

After BaS had designed a 3D model, Rietsch Werkzeug- und Formenbau produced the mould required to manufacture the masks. With Kraiburg TPE able to promptly deliver the compounds needed to produce the masks, it took only a few days for the first sample to come off the conveyor belt. At the time of writing this article, BaS was able to produce 1,500 masks with breathing apparatus filters every day.

A special feature of this mask system is its modular design, which combines a cleanable half-mask and an exchangeable filter. The plastic mask is easy to clean – in a dishwasher, for example – and can be reused with a new filter afterwards. "The mask is very easy to clean and has a pleasantly soft surface that allows it to fit snugly onto the face," says Matthias Schmidt, Sales Manager Medical at Kraiburg TPE. "This is one of many different face-mask applications that have recently been implemented using our TPEs."

Since early April, injection moulding machine maker **Negri Bossi** has been using two machines at its plant in Cologno Monzese, Italy, to produce masks using TPE. The company can make up to 500 masks per hour. The mould was built, again in record time, by Esistampi, near Ancona on Italy's east coast. The TPE comes from **Francesco Franceschetti Elastomeri**.

The masks are the result of a project carried out entirely by Negri Bossi. They can be reused thanks to the interchangeability of the filtering fabric. They can also be upgraded, with the optional insertion of an exhalation valve filter. The transparent masks are easily sanitized in boiling water and soap.

Below: Coloured transparent medical TPE is new from Hexpol

Hexpol TPE has added more transparent grades to its Mediprene portfolio of TPEs for medical applications. New customised coloured grades are based on the Mediprene Transparent TPE Series, ranging in hardness from 30 to 90 Shore A.

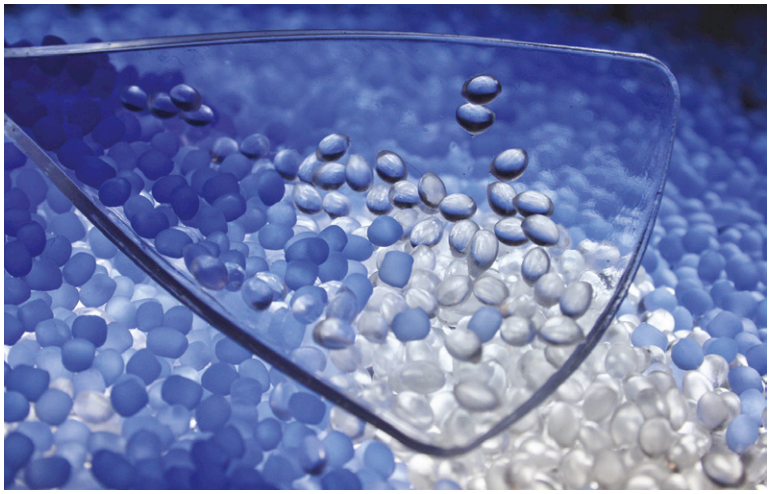

IMAGE: HEXPOL

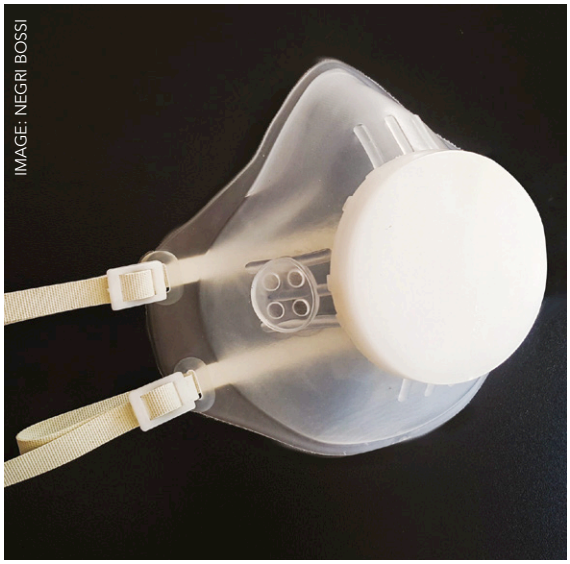

IMAGE: NEGRI BOSSI

"Colour in medical applications could identify products with different uses or sizes, disguise potential discoloration after radiation sterilisation or simply be a design opportunity supporting branding and identity," Hexpol says. "Transparency and the ability to see through the product, on the other hand, is an important feature for many applications such as face masks and tubes."

The Mediprene Transparent TPE series compounds and customised coloured materials use raw materials that are food contact compliant (FDA 21CFR and Commission Regulation (EU) No 10/2011) and have a proven level of biocompatibility. For example, the styrenic block copolymer has passed USP Class VI; the paraffinic oil is a medicinal white oil, complying with the European Pharmacopoeia for liquid paraffin and USP for mineral oils; the PP has passed the USP Class VI tests and meets the requirements in the EP Monograph 3.1.3 Polyolefins; any colour masterbatch used is made from raw materials that have passed USP Class VI or corresponding parts of ISO 10993.

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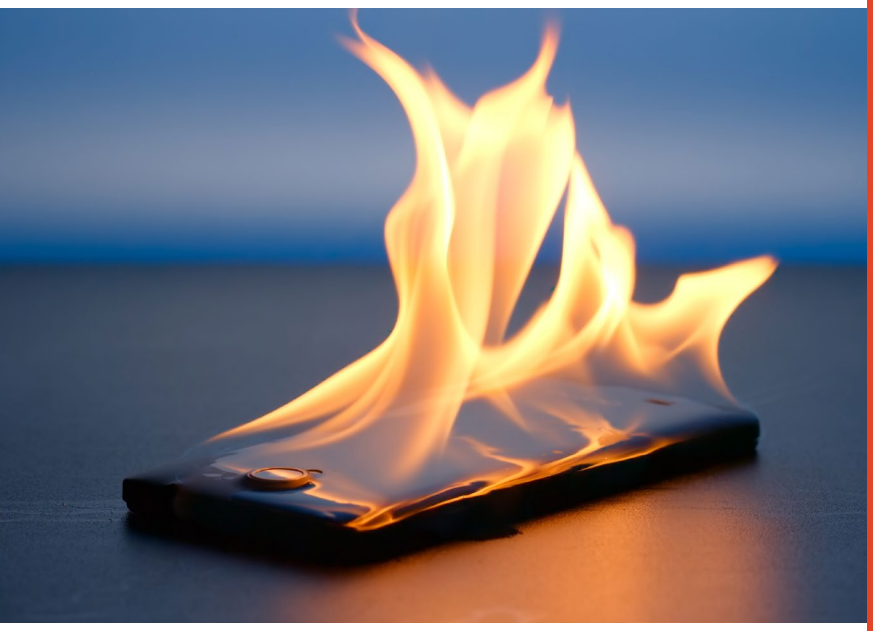

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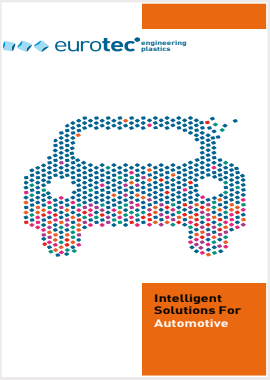

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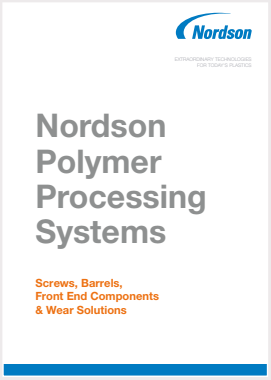

The plasticising components offered by Nordson for injection moulding include bi-metallic barrels, screws and FECs, as well as barrel coatings and wear solutions. Find out more in this brochure.

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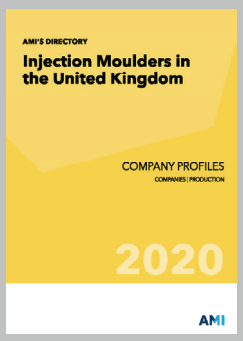
Injection Moulders in the United Kingdom



A complete and up-to-date picture of the injection moulding industry in the United Kingdom. Find out the polymers processed, the products manufactured and the number and size of machines operated by 904 injection moulding sites in the United Kingdom.

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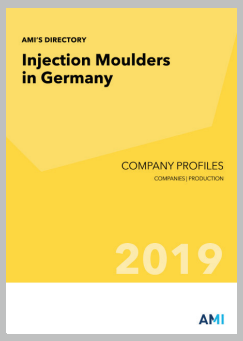
Injection Moulders in Germany



Germany is the leading country for injection moulding in Europe. Gain access to this market with profiles of 2162 injection moulding sites in Germany. Access in-depth contact and production data equipped with extensive search capabilities. Alternatively, the pdf version supplies basic company profiles.

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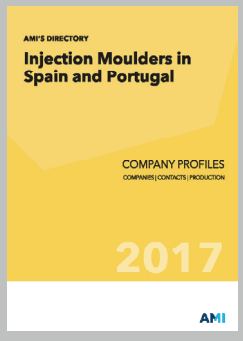

A unique insight into the production of 1011 injection moulders in the Iberian peninsula. This directory gives you access to managerial contacts and production information on 790 manufacturing sites in Spain and 221 in Portugal serving a number of markets such as medical, automotive, electronics as well as food and non-food packaging.

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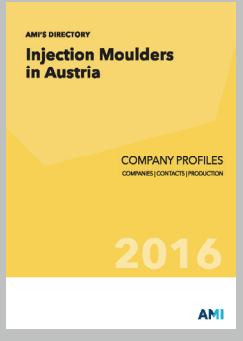
Injection Moulders in Austria



This directory identifies 189 injection moulders in Austria serving the electronic and electrical markets as well as other industry segments. The data is available in pdf format or as a database which enables you to search companies by polymers processed, markets served or number and make of machines operated.

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The 4th edition of Plastics Regulations provides advice on a range of compliance issues at one event. The event takes place on 2-4 November 2020 in Cologne, Germany. The conference provides an ideal environment for regulatory updates.

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To see our full line-up of more than 50 plastics industry events over the next 12 months, please visit www.ami.international/events

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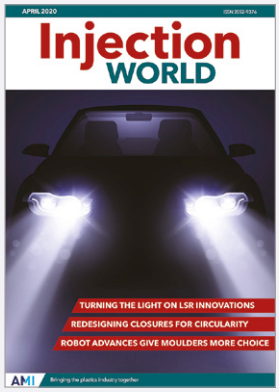

Injection World
April 2020
The April issue of Injection World looks at the growth in applications for liquid silicone rubber moulding as suppliers introduce innovations. Plus features on robots and caps/ closures.

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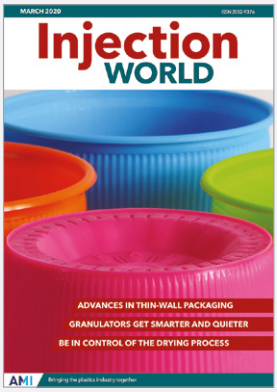

Injection World
March 2020
The March edition of Injection World magazine looks at the latest mould and machinery developments for thin wall moulding. Plus the latest introductions in granulation and material drying technology.

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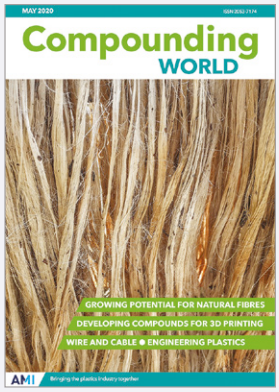

Compounding World
May 2020
The May 2020 edition of Compounding World looks at the latest developments in natural fibres that are helping deliver high performance bio-compounds. Other features cover the burgeoning 3D printing materials sector, engineering plastics and wire and cable compounds.

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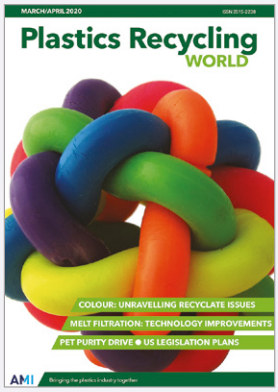

Plastics Recycling World
March/April 2020
The March/April edition of Plastics Recycling World looks at the challenges of effective colouring, plus the latest developments in melt filtration and PET recycling. It also updates on US recycling legislation moves.

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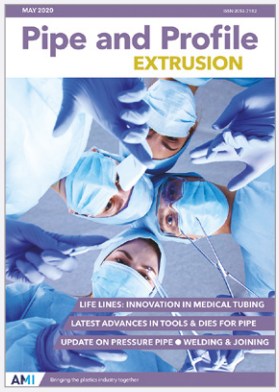

Pipe and Profile
May 2020
The May edition of Pipe and Profile Extrusion magazine examines some of the latest developments in the medical tubing sector. It also looks at innovations in pressure pipes, pipe dies and pipe joining technology.

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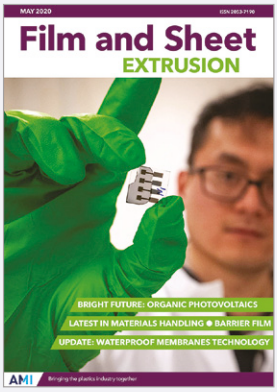

Film and Sheet
May 2020
The May issue of Film and Sheet Extrusion features new developments in materials handling and looks at innovations and opportunities in waterproof membranes, barrier film and organic solar cells.

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Compounding WORLD
Film and Sheet EXTRUSION
Pipe and Profile EXTRUSION
Injection WORLD
Plastics Recycling WORLD

GLOBAL EXHIBITION GUIDE

2020	**3-6 August**	Chinaplas, Shanghai, China **CANCELLED**	www.chinaplasonline.com
	8-10 September	Feiplar, Sao Paulo, Brazil	www.feiplar.com.br
	9-11 September	Plastics, Printing & Packaging, Dar-es-Salaam, Tanzania	www.expogr.com/tanzania/pppexpo
	9-13 September	Taipei Plas, Tapei, Taiwan	www.taipeiplas.com.tw
	29 Sep-1 Oct	Interplas, Birmingham, UK **POSTPONED**	www.interplasuk.com
	6-9 October	Plastpol, Kielce, Poland **NEW DATE**	www.targikielce.pl
	6-10 October	IPF Japan, Tokyo, Japan	www.ipfjapan.jp
	7-8 October	Compounding World Expo Europe, Essen, Germany **NEW DATE**	www.compoundingworldexpo.com/eu/
	13-17 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de
	4-5 November	Compounding World Expo USA, Cleveland, USA	www.compoundingworldexpo.com/na/
	10-13 November	Plastimagen, Mexico City	www.plastimagen.com.mx
	23-26 November	All4Pack, Paris, France	www.all4pack.com
	1-5 December	Equiplast, Barcelona, Spain **NEW DATE**	www.equiplast.com
	5-8 December	Plast Eurasia, Istanbul, Turkey	www.plasteurasia.com/en
2021	**9-12 January**	Arabplast 2021, Dubai, UAE	www.arabplast.info
	25 Feb-3 March	Interpack, Dusseldorf, Germany **NEW DATE**	www.interpack.com
	13-16 April	Chinaplas 2021, Shenzhen, China	www.chinaplasonline.com
	4-7 May	Plast 2021, Milan, Italy	www.plastonline.org/en
	17-21 May	NPE 2021	www.npe.org

AMI CONFERENCES

14-16 September	Polymer Sourcing & Distribution, Hamburg, Germany
16-17 September	Plastics Recycling Technology, Vienna, Austria
16 September	Tooling for Composites, Bristol, UK
29-30 September	Single-Serve Capsules, Berlin, Germany
30 September-1 October	Performance Polyamides, Dusseldorf, Germany
7-8 October	Polymer Foam, Hamburg, Germany
8-9 October	Composites in Rail, Berlin, Germany

For information on all these events and other conferences on film, sheet, pipe and packaging applications, see

www.ami.international

PLASTICS RECYCLING WORLD EXPO

POLYMER TESTING WORLD EXPO

7 - 8 October, 2020

ESSEN, GERMANY

PLASTICS EXTRUSION WORLD EXPO

COMPOUNDING WORLD EXPO

4 - 5 November, 2020

CLEVELAND, OHIO

www.ami.international/exhibitions