Intelligent solutions combine maximum efficiency with excellent performance
ENGEL at Plástico Brasil and Plastimagen  Page 12

Modular safety
Newly developed modular safety guarding for flexible installation  Page 20

Putting thermoplastic composites into series production faster
ENGEL duo machine for composite research at NCC in Bristol  Page 24

Against the flow for increased competitiveness
Faurecia produces sophisticated black panels on ENGEL duo  Page 4
Welcome to K year!

"A world of pioneers" – K 2019 has taken up the cause of what today’s volatile conditions require: a world populated by companies that encounter new challenges with strong visions. At ENGEL, we have always distinguished ourselves by maintaining a balance between pioneering work and tradition. We see this as a guarantee to offer you assurance, even in a changing environment, and to give you the competitive advantages on which you as our customers can build your future.

In 2019, we will also be travelling around the globe with our products in order to be available to you locally. With exhibition stands at Plastimagen México and Plástico Brasil, we will be presenting our portfolio in Central and South America. At Koplas in Korea and Chinaplas in Guangzhou, we will be exhibiting our solutions for the manufacture of highly specialized LSR products for the automotive industry. Visitors to the fairs can experience the production of LED headlamp lenses made of liquid silicone rubber on a tie-bar-less ENGEL e-victory 310/120 injection molding machine live and see for themselves the advantages of tie-bar-less technology, which was presented for the first time at the K show 30 years ago.

The fact that plastic creates comfort and added value in our modern society is also demonstrated by our customers with their future-oriented applications and products. In this issue, you will learn, for example, how Faurecia has implemented efficient three-component injection molding for the center consoles of the new Audi Q8.

New times are dawning, especially for us in the plastics industry. Against the background of the much-cited megatrends, such as the circular economy, we are your reliable partner and trailblazer, providing you with comprehensive support in your pioneering work with innovative injection molding and automation solutions.
<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Against the flow for increased competitiveness</td>
<td>Faurecia produces sophisticated black panels on ENGEL duo</td>
</tr>
<tr>
<td>8</td>
<td>ENGEL worldwide. around the corner.</td>
<td>Fairs, events, projects</td>
</tr>
<tr>
<td>12</td>
<td>Intelligent solutions combine maximum efficiency with excellent performance</td>
<td>ENGEL at Plástico Brasil and Plastimagen</td>
</tr>
<tr>
<td>14</td>
<td>ENGEL opens second location in Mexico</td>
<td>Customer proximity in Monterrey region further strengthened</td>
</tr>
<tr>
<td>15</td>
<td>ENGEL trend.scaut in Shanghai with more than 300 participants</td>
<td>Automotive industry in Asia increasingly relying on new technologies</td>
</tr>
<tr>
<td>16</td>
<td>Plasticizing system optimized for processing long glass fiber materials</td>
<td>Better part properties thanks to fewer short fibers</td>
</tr>
<tr>
<td>20</td>
<td>Modular safety</td>
<td>Newly developed modular safety guarding for flexible installation</td>
</tr>
<tr>
<td>22</td>
<td>Chaotic superstars thanks to cold shock</td>
<td>Amorphous metals: ENGEL and Heraeus are pooling their expertise</td>
</tr>
<tr>
<td>24</td>
<td>Putting thermoplastic composites into series production faster</td>
<td>ENGEL duo machine for composite research at NCC in Bristol</td>
</tr>
<tr>
<td>26</td>
<td>&quot;ENGEL is a stroke of luck for us&quot;</td>
<td>Ukrainian processor Regula relies on tie-bar-less injection molding machines</td>
</tr>
</tbody>
</table>
The interior of the Audi Q8 is functional and at the same time elegant; pointing the way to the future. “Audi is particularly design-oriented,” says Jochen Klos, Injection Molding Manager at Faurecia Innenraumsysteme GmbH, headquartered in Hagenbach, southwest Germany, describing a especially demanding customer. Six interior parts are produced for the SUV Coupé at the Peine production plant. The center console clearly illustrates the high quality requirements. In order to be competitive, Faurecia, in collaboration with its injection molding machine manufacturing partner ENGEL, developed a production process beyond the mainstream.

The Black Panel component parts are produced on an ENGEL duo 700 combi injection molding machine with a rotary table in a three-component injection molding process. PC-ABS is processed for the carrier structure as are two PC types, one of them transparent, because the letter P, which symbolizes the “Parking” position in the switch display, is backlit. An articulated robot integrated into the production cell removes the parts from the mold and transfers them to quality control. Immediately after injection molding production, the surfaces of the center consoles are painted and the paint is precisely removed from the backlit P by laser engraving. The black high-gloss paint with a precisely...
defined matt content is a special development from Audi and a distinguishing feature for the automotive group.

The center console of the Audi Q8 is a filigree frame structure which houses the on-board computer, the gearshift system and a storage compartment in the cockpit. Production is demanding not only because of the three materials, which are processed simultaneously in one work step, but above all because the high-gloss lacquer requires an absolutely flat substrate. "Audi uses a strip light to test the component parts," explains Tobias Hüppe, the plant manager at the Peine site. "You can't fool the light. Even the finest weld lines or sink marks are detected and lead to rejects."

### Supplying hot pressurized water at 180 °C via the rotary table

"Polycarbonate is a particularly demanding material in terms of weld lines," as Jochen Klos confirms. In order to avoid visible weld lines, the Faurecia process developers opted for variothermal mold temperature control using pressurized water. However, sink marks caused by ribs and mounting elements on the B side of the carrier structure, with its thickness of just 2.5 mm, remained a challenge, as did washout in the transparent, backlit material, with the potential to impact light purity.

"These topics really caused us some headaches," as Klos reports. "Ultimately, we turned the conventional multi-component process on its head, so to speak," giving ENGEL, the mechanical engineering partner, a tricky task. "We had to route the entire media supply to the moving mold mounting platen through the rotary table," says Jochen Wallmüller, Automotive Sales Manager at ENGEL's Schwertberg headquarters in Austria. What is already state-of-the-art with high-temperature cables for applications in the automotive lighting sector has taken on a new dimension with Faurecia. "This is
the first time that we have also connected the pipes for variothermal mold temperature control, which transport 180 °C hot pressurized water, via the rotary table,” says Wallmüller. ENGEL has developed a rotary feedthrough specifically adapted to these requirements in order to reliably control the high temperatures and load changes between heating and cooling in the tightest of spaces. "The difference to conventional rotary feedthroughs lies in the sealing system," explains Klaus Hof, sales engineer at ENGEL Deutschland, who worked particularly closely with the Faurecia team on process development. "ENGEL has excellently supported us in solving the new engineering challenges and based on ENGEL's contribution we were able to take this extraordinary process into series production," says Jochen Klos. "We are achieving a scrap rate of less than 4 percent for three-component parts, which puts us ahead of the competition among black panel suppliers."

**Automation will further enhance part quality**

Two other factors contribute to this success: the needle shut-off mechanism and automation. In order to process three very different shot weights – the smallest being just 1.1 grams – in a single step, not only the three injection units must be tailored precisely to their respective tasks, but special attention must also be paid to the needle shut-off mechanism in the mold. A decision was made in favor of FLEXflow by the Italian supplier HRSflow. The needle shut-off mechanism with servo drive enables the stroke, speed and acceleration of the individual needles to be controlled independently of each other. Slow and precise opening and closing of the needle valve nozzles also helps to reduce the risk of surface defects.

"Our goal is a fully automated process," says Tobias Hüppe, giving an outlook on the further development of the manufacturing process. Today, we already have an articulated robot removing the injection molded parts from the mold and depositing them for visual quality inspection by an employee. The plan is to integrate a camera system and use AGVs (automated guided vehicles) to connect the injection molding cell with the painting system and the laser processing station. As Jochen Klos clarifies: "From the injection molding process to the final processing of the painted components and their packaging and delivery, nobody will have to handle the parts. Automation will enable us to further improve the surface quality and reduce the scrap rate."

Five ENGEL duo injection molding machines with clamping forces of 7000 and 5000 kN are in operation at the Faurecia plant in Peine producing a wide variety of black panel components for the Audi Q8 and Audi Q3. Further duo machines have been ordered, as Faurecia is manufacturing an increasing volume of interior parts using multi-component technology. And the numbers of variants are continuing to grow, leading to increasingly frequent setup processes. To avoid this impacting the cost effectiveness of the integrated manufacturing process, all the duo machines are equipped with magnetic rapid mold clamping systems as an enterprise standard.
Homogeneous design – that's the way forward
ENGEL is a strategic supplier for Faurecia. "The TCO, the Total Cost of Ownership, is crucial here", as Klos emphasizes. Faurecia’s Procurement department evaluates all machines, equipment and technologies on the basis of a matrix, which in turn is based on a large number of different facts and figures. In terms of products and technologies, these include performance and quality. In terms of the supplier, a global presence, services and innovative strength are vital. "And we definitely do not want over-engineering," completes Klos, adding an aspect that is personally important to him – second only to great innovative strength. "We do not want standard machines, but the opportunity to continuously expand our business. That is why ENGEL is the right partner for us. In the future, engineering expertise will be even more pivotal for our competitiveness than it is today."

Faurecia is systematically investigating which technologies will set the tone in the future. At the Méru location north of Paris, the automotive supplier has established its own competence center, focusing on the "Cockpit of the future", which employs more than 50 product developers. Autonomous driving and electric mobility are fundamentally changing the passenger car. The new challenges for interior designers include increasing connectivity and the desire for an increasingly individual, customized environment. "Buttons and switches will disappear. Homogeneous design – that’s the way forward," says Jochen Klos. For injection molding processes, this means even more integration, for example, from electronic features through to complete TFT displays. "In the future, there will be fewer parts to be assembled and therefore fewer gaps that still have to be covered today. The design becomes even simpler," says Klos. And it's not only the aesthetes who will be happy about this. The positive side effects are, on the one hand, that reducing the number of parts reduces interior noise and, on the other, that the number of work steps will be reduced saving even more energy and raw materials.
ENGEL worldwide. around the corner.

**Forward-looking solutions – for a special segment**

**LSR Symposium in Shanghai**

The manufacture of components from liquid silicone rubber (LSR) is an important area with very specific requirements. ENGEL regularly organizes LSR conferences for this reason, most recently in Shanghai. The participants received information from experts and were able to experience the production of sophisticated LSR parts: components for pharmaceutical aerosols were manufactured on an e-victory injection molding machine. The e-victory with its tie-bar-less clamping unit provides optimum conditions for processing low-viscosity liquid silicone rubber. Unimpeded access to the mold area enables particularly efficient automation solutions, after all, this is the only way to economically manufacture high-tech products from LSR for the mass market. A successful event – with lively discussions and new insights.

**Sophisticated composite processes in series production**

**JEC World 2019**

At this March's JEC World 2019 in Paris, France, ENGEL presents a broad range of composite lightweight construction technologies based on examples from the automotive industry, from the processing of organic sheets and unidirectional tapes in the ENGEL organomelt process, through in-situ polymerization, HP-RTM and flow molding with SMC. In the ENGEL organomelt process, thermoplastic fiber composite prepregs are formed and functionalized. For example, reinforcing ribs or assembly elements can be over-molded using a thermoplastic from the matrix material group. This not only enables a highly efficient manufacturing process, but also contributes to the circular economy. “The consistent thermoplastic approach facilitates subsequent component recycling,” says Christian Wolfsberger, Business Development Manager Composite Technologies at ENGEL. ENGEL offers fully integrated system solutions for the organomelt technology from a single source. The new process units include a tape stacking unit in pick-and-place technology developed by ENGEL, featuring optical image processing, and a consolidation unit for fiber stacks of different wall thicknesses developed jointly with Fill.

**IML not only for high-speed applications economically**

**Interplastica in Moscow**

At Interplastica, which was held the end of January in Moscow, Russia, ENGEL demonstrated how economical IML (in-mold labelling) concepts can also be implemented for small numbers with one-shot production of ready-for-sale decorated lids for food packaging. To do so, ENGEL combined an e-motion 220 injection molding machine equipped with a viper 20 linear robot with an IML uniLINE by TMA AUTOMATION. The robot removed the label from the IML cell, placed it in the mold of the injection molding machine, simultaneously removed the

"The consistent thermoplastic approach facilitates subsequent component recycling."

Christian Wolfsberger, ENGEL AUSTRIA
last molded finished part and transferred it back to the uniLINE for ejection. Thanks to its standardized system concept, the compact IML cell is particularly easy to integrate. Within a very short time, the injection molding machine can be converted for other tasks – with or without IML. “We are therefore also making IML attractive for non-high-speed applications,” stresses Olaf Kassek, Managing Director at OOO ENGEL in Moscow. “TMA’s automation solutions can be combined just as easily with ENGEL e-mac and servo-hydraulic ENGEL victory injection molding machines.” TMA AUTOMATION, based in Gdynia, Poland, is a new ENGEL partner specializing in the automation of IML and downstream processes in the general purpose sector.

“We are making IML attractive for non-high-speed applications.”
Olaf Kassek, ENGEL Russia

Efficient and sustainable at the same time
Arabplast in Dubai

Optimum efficiency, maximum performance and consistent quality: ENGEL demonstrated how tailor-made interaction between the injection molding machine, automation, and the mold can reconcile these demands cost-effectively and sustainably at the Arabplast fair in January in Dubai, United Arab Emirates. The focus was on innovative applications for the construction, logistics and packaging industries. It is these sectors in particular which benefit from the preparations for several million additional visitors expected at Expo 2020, the upcoming world exhibition in Dubai. “Demand is particularly high for solutions that lead to greater efficiency and further enhance sustainability,” reports Andreas Leitner, Sales Director Middle East at ENGEL. As an innovation-driven company with a high level of automation and expertise in system solutions, ENGEL is one of the preferred suppliers in this region. A deep understanding of local markets and individual customer requirements is a prerequisite for developing tailor-made injection molding solutions. To ensure close proximity to its customers worldwide, ENGEL is continuously expanding its sales and service network. In the Middle East, the service team in particular has recently been expanded. Dubai now also has its own service base.

Extremely compact integration
Plast Eurasia in Istanbul

Highly integrated, compact production cells minimize the system footprint and increase area productivity. These aspects really pay off in the cleanroom. ENGEL enhanced the stainless steel part sorting system for the cavity specific handling of small injection molding parts, so that the handling system now fits completely into the expanded safety gate of the injection molding machine. At Plast Eurasia in Istanbul this extremely compact solution was demonstrated using the production of needle holders for 1 ml safety syringes as an example. The precision parts were manufactured from polystyrene on an e-victory 170/80 injection molding machine equipped with a 16-cavity mold, taken off the mold by a viper 12 linear robot and transferred to the part sorting system. To be able to ensure batch traceability down to the individual cavity, the filigree parts were packed in cavity-specific bags. The 16 bags were hung in a cart directly below the part sorting system. To ensure fully automated cleanroom operation, two of these carts can be sequenced in series in the practical application, with a buffer system enabling a changeover during ongoing production.

“Demand is particularly high for solutions that further enhance sustainability.”
Andreas Leitner, ENGEL AUSTRIA
Augmented reality for even more efficiency and safety
Chinaplas in Guangzhou

ENGEL is focusing on optical applications for lighting systems at Chinaplas in Guangzhou, China, in May. Whether for vehicles, buildings or street lighting, LSR is gaining ground as a lens material. The reasons for this are the specific material properties and the very efficient processing in the injection molding process. Only an automated, rework-free process makes high-tech products made of LSR cost-effective. ENGEL is demonstrating what this can look like in practical terms at its trade fair stand with the manufacture of LED headlamp lenses on a tie-bar-less ENGEL e-victory 310/120 injection molding machine. ENGEL will be processing Dowell MS-1002 Moldable Silicone, a material developed specifically for use on injection molding machines. The curing speed has been optimized to obtain a smooth and very hard surface similar to thermoplastic. The high light transmission ensures a very good light yield. In addition, the high thermal stability ensures outstanding transparency. The surface, with its extremely filigreed structure, is molded with the highest reproducibility. The LED lenses leaving the production cell are ready for installation without the need for any secondary process. The MaxiMix G2 LSR metering equipment and the two-cavity cold runner mold were manufactured by ACH-Solution in Austria. An ENGEL viper 40 linear robot is used for part handling. A total shot weight of 16 grams is processed per cycle. The cycle time is around 50 seconds. Trade fair visitors can be guided through the individual work steps required to start the production cell with AR (Augmented Reality) glasses from AVR Tech Innovations. In the form of texts, animated objects or short video sequences, the glasses display helpful additional information. In the injection molding shop of the future, AR will support even more efficient work and reduces the risk of operating errors.

ENGEL honored as a showcase company
"Jobs through Innovation" initiative

Austrian companies that show excellent economic development thanks to innovative products or services, and offer their employees above-average working conditions were honored by the "Jobs through Innovation" initiative by FFG (Austrian Research Promotion Agency). One of the winners was ENGEL – which confirms the course taken by the injection molding machine manufacturer: "In Upper Austria, leading know-how meets well-trained, committed people. This is why we are continuing to invest heavily in our locations in the country and are continuously expanding our training and further education offerings," says Markus Richter, Chief Financial Officer of the ENGEL Group.

Great interest in innovative technologies
Medical Day in Shanghai

Looking back at the ENGEL Medical Day at the end of last year in Shanghai, a clear picture emerges: as quality awareness increases, the growth market of China is increasingly demanding innovative solutions
in the medical sector. "It’s about even higher precision and performance, automation and special technologies such as multi-component injection molding with silicone, which enables particularly high efficiency in the mass production of face masks," explains Kurt Hell, head of ENGEL’s Medical Business Unit in Asia. The speakers included MeHow innovative, one of the largest silicone processors in China based in Shenzhen. The more than 90 participating medical processors used the event to update their knowledge of the current engineering state of the art and to exchange experiences. Two live demonstrations ensured that practical aspects did not disappoint the attendees. Pipette tips for diagnostics were produced in a highly integrated and automated production cell as well as dialysis filter housings. The establishment of business units in Asia sees ENGEL continuously strengthening its local industry expertise. "Medical technology in particular requires exceptionally intensive cooperation," says Hell. "The processors responded to the fact that we have boosted our staff levels in this area. In addition to international companies, increasing numbers of Chinese medical technology companies are among our customers."

"It’s about even higher precision and performance, automation and special technologies such as multi-component injection molding with silicone."
Kurt Hell, ENGEL Asia

Space for an exchange
ENGEL CZ Forum in Czech Republic

The first ENGEL CZ Forum focused on news from the industry, current trends and a lively dialogue. Numerous representatives of well-known companies, including many from the automotive industry, were guests at the ENGEL subsidiary in Prague. The morning was devoted to ENGEL solutions for the smart factory and topics relating to service and spare parts, before interesting workshops were held directly at the machine and robot exhibits in the afternoon. In the scope of the event, ENGEL CZ opened a new, second training center for automation technology. "We now have even more capacity for customer training," says Petr Stibor, Regional President of the Eastern Europe Region, who was delighted with the overall positive results. "The event was very well received by our customers."

"An exchange of information helps us all move forward; that’s why we will be looking to hold this industry meeting regularly in the future."

Petr Stibor, ENGEL Eastern Europe

The road to the smart factory
Industry 4.0 open house in Italy

ENGEL and raw materials distributor Leonardi jointly invited customers to the Open House in Italy with Industry 4.0 as the main topic. The extensive program consisted of several keynote speakers and was supported with a medical application running on an e-victory injection molding machine. Numerous participants from more than 50 companies experienced firsthand the countless possibilities that digitalization and networking are unleashing, and are now ready for the next steps into the future.

"The event was very well received by our customers."

Preview

Plastico Brasil, São Paulo, Brazil, March 25th to 29th
Hannover Fair, Hannover, Germany, April 1st to 5th
Plastimagen, Mexico City, Mexico, April 2nd to 5th
China Plas, Guangzhou, China, May 21st to 24th
K 2019, Düsseldorf, Germany, October 16th to 23th
Intelligent solutions combine maximum efficiency with excellent performance

Demanding packaging applications will be the focus of attention at the ENGEL stands at both Plástico Brasil at the end of March in São Paulo and Plastimagen at the beginning of April in Mexico City. The ENGEL e-cap stands for maximum efficiency combined with the best-in-class product quality. At Plastimagen, the all-electric injection molding machine will be demonstrating its high performance under genuine production conditions. At the Plástico Brasil, an all-electric ENGEL e-motion 440/160 will be used to produce polypropylene ice cream cups using thin-wall technology and IML.

Plástico Brasil: Thin-wall with IML in 2.2 seconds

At Plástico Brasil, an e-motion 440/160 will be used to produce polypropylene ice cream cups using thin-wall technology in a 4-cavity mold with a total shot weight of 14.8 grams. Thanks to in-mold labelling (IML), the cups are ready-to-fill when they leave the integrated production cell. The cycle time is 2.2 seconds.

Two main factors are responsible for the high efficiency and economy of the production process. On the one hand, in-mold labelling makes it possible to change the decoration without interrupting production. Even with very small batch sizes, this guarantees the lowest unit costs. On the other hand, ENGEL has consistently geared its all-electric ENGEL e-motion injection molding machine for high-performance operation with injection speeds of more than 500 mm per second. The closed system for the toggle lever and spindle ensures optimum and clean lubrication of all moving machine components; the e-motion thus meets the strict purity requirements not only of the food industry, but also of the cosmetics, medical technology and pharmaceutical industries. ENGEL is implementing this exhibit together with partners. The mold is provided by SIMON. BECK automation is responsible for the IML automation. The labels come from Verstraete, and the polypropylene from Borealis.

30 years of ENGEL tie-bar-less technology

Compact manufacturing cells, efficient automation and fast set-up processes: with their fully usable plat-en areas and free access to the mold area, tie-bar-less injection molding machines fulfill the need for high efficiency and cost-effectiveness in production in a particularly good way.

To mark the start of the 30th anniversary of ENGEL tie-bar-less technology, the machine manufacturer is presenting a tie-bar-less victory 1060/220 injection molding machine at Plástico Brasil, on which technical parts are produced in a multi-cavity mold. With its tie-bar-less technology, ENGEL still has a unique selling feature today. Barrier-free access to the mold area makes it possible to fully utilize the mold mounting platens up to the edges. This means that large, bulky molds can be mounted on relatively small machines. This translates into an efficiency factor, especially when multi-cavity molds are used. Multi-cavity molds, although large, require relatively little clamping force for the precise molding of fairly small component surfaces. When a tie-bar-less injection machine is used the machine size is determined not by mold volume, but by the clamping force required for the molding process. Thanks to tie-bar-less technology, much smaller injection molding machines can be used for many applications; this keeps investment and operating costs low and using a smaller footprint for the cell on the production floor. Other advantages of tie-bar-less clamping units include improved ergonomics, mold set-up time savings and highly efficient automation concepts. The robots have maximum freedom of motion and unrestricted access to the mold area from the side, reducing the handling and mold opening times. In São Paulo ENGEL is demonstrating this with a viper linear robot.
MFI of below 1 g/10 min. high-strength HDPE materials are used with an highest possible number of good parts even when ensure the required plasticizing capacity and the ability of the e-cap injection molding machine. They are responsible for the outstanding process stabil- repeatability. High-performance servo direct drives of the injection molding machine's precision and they place higher requirements than ever in terms their light weighting minimum in terms of geometry, when selecting a cap machine. As caps have reached precision and process stability are decisive factors In addition to energy efficiency and productivity, time of 3.7 seconds for 28 mm PCO 1881 caps. CSD caps, cycle times vary depending on the cap type. At Plastimagen, the e-cap will achieve a cycle time of 3.7 seconds for 28 mm PCO 1881 caps. In addition to energy efficiency and productivity, precision and process stability are decisive factors when selecting a cap machine. As caps have reached their light weighting minimum in terms of geometry, they place higher requirements than ever in terms of the injection molding machine's precision and repeatability. High-performance servo direct drives are responsible for the outstanding process stabil- ity of the e-cap injection molding machine. They ensure the required plasticizing capacity and the highest possible number of good parts even when high-strength HDPE materials are used with an MFI of below 1 g/10 min.

Plastimagen: Minimum cycle times, maximum quality

Available with clamping forc- es from 1,100 to 4,200 kN, the ENGEL e-cap is the only cap machine on the market providing all-electric opera- tion in the high clamping force range. This makes it the most energy-efficient machine in its class at the same time. At Plastimagen, an e-cap 740/160 with 1,600 kN clamping force will be used to produce 28 mm PCO 1881 caps for carbon- ated soft drinks (CSD) in a 24-cavity mold by Austrian mold maker HTW. The processed material is a PEHD by Borealis at a shot weight of 2 grams per cavity. The peripheral units on display will include a dry air system by Eisbär. By precisely matching the injection molding machine, the material, the mold and the peripheral sys- tems from the outset, ENGEL can leverage efficiency potentials to a maximum and further reduce energy consumption. Therefore, the injection molding machine manufacturer delivers fully-integrated and automated manufacturing cells from a single source, worldwide. ENGEL has adapted the e-cap series specifically to the requirements of beverage cap production. The high-performance machine achieves particularly short cycle times for the individual cap types. At less than 2 seconds, the shortest cycle times are achieved in the manufacture of lightweight caps for still water. For CSD caps, cycle times vary depending on the cap type. At Plastimagen, the e-cap will achieve a cycle time of 3.7 seconds for 28 mm PCO 1881 caps.

Self-optimizing machine
inject 4.0 is another focus at the ENGEL stands in Mexico City and São Paulo. ENGEL already offers a range of established products and solutions for the digitalization and connectivity of manufacturing processes, and new ones are constantly being added. The modular approach of ENGEL’s inject 4.0 program makes it particularly easy for processors to take advantage of the new opportunities that industry 4.0 opens up. Even small-scale individual solutions promise considerable benefits. As an example, ENGEL will be presenting its iQ weight control assistance system. During the injection process, the software analyzes the pressure profile in real time and compares the measured values with a reference cycle. Individually for each shot, the injection profile, switchover point and the holding pres- sure profile are automatically adjusted to current conditions. In this way, fluctuations in environmental conditions and in raw materials are automatically recognized and machine process adjustments are made before even a single reject is produced.

Enhancing machine availability
The challenge in maintaining injection molding machines is to guarantee high avail- ability while at the same time reducing costs. And again inject 4.0 opens up new opportunities for this. e-connect.monitor makes it possible to check the condition of process-critical machine components during operation and reliably predict their remaining service life. In this way, unplanned downtimes can be avoided and the working life of the com- ponents fully utilized. Four modules are currently available, for plasticizing screws, ball screws in high-performance electric machines, fixed displacement pumps in servo-hydraulic injection molding machines and for hydraulic oil.

MES for newcomers and advanced users
At Plastimagen, ENGEL will also be presenting smart connectivity solutions for linking injection mold- ing machines and production cells within the enterprise. TIG authen- tig, the MES by ENGEL subsidiary TIG is tailored to the specific requirements of the injection mold- ing industry down to the last detail. It ensures transparency in order to utilize the total capacity of the machines or correlate productivity indicators and economic objectives. The new products that TIG will be presenting in Mexico include the TIG 2go dashboard solution, which is particularly suitable for entering the MES world, and the TIG big data high-performance analysis platform for networking machinery around the globe in a central cockpit.
ENGEL opens second location in Mexico

Together with customers and partners, ENGEL de Mexico opened a second location in Mexico at the end of February in San Pedro near Monterrey. "We are shortening the distance to our customers in the very important industrial region in the north of the country," emphasizes Peter Auinger, Managing Director of ENGEL in Mexico.

ENGEL de Mexico SA de CV is headquartered in Querétaro near Mexico City in the center of the country, where numerous companies in the plastics industry are also based. There are 800 km between the two industrial regions. "This is precisely why we decided to establish a permanent ENGEL team in the north," says Auinger. Two sales experts and four service technicians are the initial team. In addition to offices, they have at their disposal a large conference room with state-of-the-art presentation technology, which is also used for customer training courses. At the inauguration of the site, Peter Auinger demonstrated the new possibilities with a live broadcast to Querétaro. Via the ENGEL service tool e-connect.24, he switched to an injection molding machine in the technical center of the central Mexican branch. The CC300 control surface was transferred in real time to the monitor in San Pedro and the machine was remotely controlled from there.

"We're shortening the distance to our customers in the very important industrial region of northern Mexico."
Peter Auinger, Managing Director ENGEL de Mexico

Machine training directly on the machine

For training courses and workshops directly on the machine, ENGEL works together with a partner in the north of the country. In its technical center in Monterrey, this partner has machine capacities available for ENGEL customers.

"We are increasingly becoming a partner for our customers over the entire life cycle of our injection molding machines and system solutions," explains Auinger. "The demands placed on our consulting services are increasing, and we are working more and more closely with our customers. The geographic proximity becomes even more important." In the Monterrey region, the automotive industry in particular is strongly represented. In addition, ENGEL de Mexico has many customers in the packaging, telecommunications and consumer electronics industries.

Present in Mexico for more than 20 years

Injection molding machine manufacturer and system solutions provider ENGEL, headquartered in Austria, has had its own sales and service subsidiary in Mexico since 1996. In 2010, the premises were moved from Mexico City to Querétaro and significantly expanded. ENGEL has its own machine technology center and spare parts warehouse in central Mexico. All in all, ENGEL employs almost 70 people in Mexico.
For the first time, ENGEL trend.scaut took place parallel to FUMOTec, the international trade fair for automotive engineering and future mobility, at the Shanghai World Expo Exhibition & Convention Centre, attracting a particularly high level of attention to the conference. "Some trade fair visitors who had not known ENGEL and trend.scaut before quickly registered," reports Gero Willmeroth, President East Asia and Oceania of ENGEL based in Shanghai. The participants were mainly development and production managers as well as managing directors of both Chinese and international companies, and this also contributed to the huge success of the event. "We discussed new technologies and opportunities for the future on the basis of the specific requirements of local producers and were also able to reflect the topics in an international context." The keynote program was world-class with speakers including representatives of Volvo and Nobo (a member of the Great Wall Motor Company), Continental and Ecorea, as well as JSC Automotive, ExxonMobil, Sabic and ENGEL.

Increasingly relying on new technologies

As the first presentations made clear, the automotive market in Asia is continuing to develop at a particularly dynamic pace. "Over 100 vehicle brands are now competing in China," explained Dr Norbert Müller, head of the ENGEL Center for Lightweight Composite Technologies. The focus is on electric vehicles. Another development is that prominent Chinese suppliers are also placing their products in the premium segment. "This results in important opportunities for the market entry of new technologies," says Müller, summarizing both trends and using the example of innovative composite technologies in his presentation. Together with his team, Müller develops new, particularly cost-effective processes for large-scale composite lightweight construction, covering a broad range of technologies: from HP-RTM and SMC to the processing of thermoplastic semi-finished products such as organic sheets and tapes, through to innovative reactive technologies such as in-situ polymerization (T-RTM). "What is new is that composite manufacturers in Asia are also increasingly focusing on thermoplastic-based solutions," says Müller. "The possibility of functionalizing thermoplastic composite materials immediately after molding in the same mold using injection molding can secure decisive time advantages."

Focus on productivity and efficiency

The fact that high productivity and efficiency in the automotive industry are more decisive for competitiveness and success than in other sectors is not a new observation. In Asia in particular, however, the situation could be further aggravated, at the latest by 2020, when subsidies for electric vehicles are discontinued. In the keynote presentations and in the panel discussion, but also in additional smaller meetings, this topic came up time and time again. Various future scenarios were developed, but there is no general agreement among the experts. According to Jochen Siebert, the managing director of JSC Automotive, a management consultancy specializing in the Chinese automotive market, the industry is already undergoing a transformation process that could slow down the dynamic market development and lead to consolidation. Another scenario is that hybrid vehicles are growing faster than electric vehicles. Process integration and automation are becoming even more important as production efficiency pressure increases. "We are increasingly supplying multi-component machines to Asia," confirms Michael Fischer, Head of Business Development Technologies at ENGEL in Austria.
Plasticizing system optimized for processing long glass fiber materials

Long glass-fiber-reinforced polypropylene and polyamide are used in automotive lightweight construction especially where high impact toughness, very good crash behavior and low weight are required. However, care must be taken during injection molding, since not every screw is suitable for these materials. To maintain the fiber length reliably and obtain a uniform distribution of the fibers, ENGEL has developed a new plasticizing system for processing long glass-fiber-reinforced materials.
Plastics are filled with fibers in order to improve the properties of the composite material through the high strength and stiffness of the fibers. The addition of fibers significantly increases the mechanical characteristics, such as tensile strength, stiffness, impact strength, thermostability and wear resistance. Long glass-fiber-reinforced (LGF) materials with a fiber length of at least 10 mm are gaining ever increasing importance in automotive applications and have superior properties, in comparison to short glass-fiber-reinforced materials. However, if the plasticizing screw is not specifically designed for these materials, the long glass fibers may be reduced in length too much during recovery and the properties obtained may only correspond to those of short glass-fiber-reinforced materials.

Long glass fiber materials are available on the market in different qualities. The manufacturing process for rod-shaped pellets determines the quality. In pultrusion, a long glass fiber strand is pulled through a melt bath and then fed to a chopping system. The advantages of this process are good impregnation as well as a uniform distribution of the individual glass fiber filaments in the rod-shaped pellets, and therefore in the final part. Alternatively, the long glass fiber strand is only enveloped with polymer from the outside. Impregnation thus only takes place during processing.

A screw for different materials
ENGEL has the aim of developing a new plasticizing system that can be universally used for a wide range of long glass-fiber-reinforced materials. For processing long glass-fiber-reinforced rod-shaped pellets, ENGEL has so far offered a single-flight 3-zone screw with a special screw-on LGF mixing head. The LGF mixing head is designed to be pressure-neutral as a result of the relatively large flow cross-sections, allowing gentle plasticizing. Since the demand for injection molding machines for these applications is increasing, ENGEL decided to produce the screw and mixing head in one piece and to further optimize the screw geometry. The newly developed long glass fiber screw (LFS), in contrast to the standard screw, has a lengthened feed zone, a high channel depth in the feed and a longer compression zone, as well as a shorter metering zone and an optimized feed channel in the mixing head. The deeper channel in the feed zone prevents feeding problems and the associated recovery time fluctuations, since the rod-shaped pellets do not flow so easily into the screw as standard pellets. A highly effective flight welding gives the screw the necessary wear and corrosion resistance. The LFS is available with diameters from 80 to 170 mm.

![Graph showing fiber length distribution](image)

**Fig. 1** With the standard screw without LGF mixing head, the average fiber length is greatest, however with a low back pressure of 10 bar, fiber bundles are clearly visible. With the new LFS and 10 bar back pressure, the measured fiber lengths are somewhat higher than with the standard screw and 100 bar. Note: the distribution curve is a distribution of different fiber lengths and not a spot measurement.
Within the development project, ENGEL processed different PP-LGF grades, varying according to fiber content and viscosity, with the new LFS and with a standard screw, with and without LGF mixing head respectively, with constant process settings. In the series of trials, the ENGEL engineers assessed process parameters such as recovery time, melt temperature and torque, as well as the quality of the specimen parts produced. They investigated the specimen parts for optically identifiable fiber bundles, and determined the impact strength. In addition, individual strands were removed to determine the fiber length distribution. To compare the different screw concepts, the experts chose a process setting that would preserve the fibers as far as possible, with 0.2 m/s circumferential speed and 10 bar back pressure.

With the standard screw without LGF mixing head, with each long glass fiber material, the fiber bundles are visible with the naked eye, while the LGF mixing head breaks up these fiber bundles and the back pressure can consequently be reduced. The studies also show that increasing the back pressure shortens the fibers to a greater extent than the use of an LGF mixing head. Whereas with the standard screw, without LGF mixing head at 10 bar, fiber bundles are clearly visible for each long glassfiber material, these fiber bundles disappear when the back pressure is increased to 100 bar, provided that materials with high flow rate (PP matrix with MFR = 250 g/10 min at 230°C/2.16 kg) are used. If the material has low flow rate (PP matrix with MFR = 50 g/10 min. at 230°C/2.16 kg), the back pressure must be increased to 150 or 200 bar so that fiber bundles can no longer be identified. With the use of the new LFS, hardly any fiber bundles are identifiable at all at a backpressure of 50 bar, in the case of high-flow materials, while with low-flow materials isolated fiber bundles occur at only 100 bar (Fig. 1). These fiber bundles are only visible with naturally colored materials and are used as an indicator that the long glass fiber properties are retained.

Loading of the fibers in the melt
Besides the feed and compression zone, where unmelted material is still present, and projecting fibers can be easily broken, the loading of the fibers in the melt also results in shorter fibers in the area of the LGF mixing head. Fiber bundles can be further separated by the shear energy. The lower the viscosity, the easier is the impregnation and the lower is the fiber breakage (Fig. 2).

ENGEL plasticizing systems: development, production, and support from a single source
The demands on plasticizing units are continually on the rise based on a range of different factors – innovative additives, higher filler content, the trend towards lower weight and more efficient use of materials, more stringent dimensional tolerances and higher standards in terms of surface finish quality. "As an injection molding machine manufacturer, the challenge for us is to ensure that the pace at which new materials can be produced can continue to accelerate, and with quality standards keeping pace, despite the increasing load on the mechanical components," says Günther Klammer, Head of the Plasticizing Systems Division at ENGEL.

To comprehensively observe entire plasticizing unit and the interaction with other components within an injection molding machine, the team in the Plasticizing Systems Division has pooled a broad range of skills – from metallurgy and welding technology to rheology, plastics engineering, construction, NC programming, manufacturing technology and support. Experts are researching the complex physical and chemical influences in the plasticizing process while constantly working to optimize the company's own manufacturing practices. ENGEL combines a high vertical range of manufacturing with streamlined and resource-efficient production processes to guarantee not just consistently high quality, but fast delivery times as well.

To prepare for K 2019 trade show in Dusseldorf, Germany this October, ENGEL’s Plasticizing Systems Division has more new developments in the pipeline.

"New materials also have to be processed even faster and to even higher quality standards despite what are in part increasing stresses on mechanical components."  
Günther Klammer, Head of Plasticizing Systems Division at ENGEL
For determining the fiber length distribution, ENGEL collaborated with the Wood K plus competence center in Linz, Austria. Here, the fibers were separated out of the composite material without damage, and micrographs of the fiber structure were taken. After image processing and analysis, complete statistics of the fiber length distribution could be determined. With the aid of the determined fiber-length distribution, it can be seen that a low viscosity matrix material counteracts the fiber damage. The high-flow material has significantly longer fibers. Because of its greater channel depth in the feed zone, the new screw also provides higher recovery rates with lower fluctuations in recovery time. The rotational speed can therefore be reduced for the same cycle time (Fig. 3). The recovery behavior is more stable than with other designs.

The cooperation partner for determining the part properties and testing the parts by means of impact tests was Johannes Kepler University (JKU) in Linz. The impact energy necessary to penetrate the part was determined. The impact values of the specimen parts correlate with the average fiber length. The use of an LGF-mixing head made it possible to reduce the measured standard deviations, and consequently also the associated unreliability of the failure. ENGEL’s studies demonstrate the advantages of the new LFS. Due to the stable conveying behavior, recovery time fluctuations no longer occur. The screw ensures a higher recovery performance and low fiber length reduction together with good fiber distribution and dissipation. Taken together, that all means a significant improvement in the part properties.
A machine operator trips while walking through the production hall and falls against the safety guarding of a production cell. This scenario is simulated according to the EN ISO 14120 standard by a defined pendulum test with a 90 kg sandbag. Naturally the safety guarding has to withstand this test without being breached. This standard replaces the old EN 953. EN 953 merely prescribed a “certain mechanical strength” but did not define this further. The new standard on the other hand provides concrete information on the load capacity from the outside to the inside, and defines both the test procedures and the conformity criteria. This makes it possible to compare the information from different safety guarding manufacturers. In developing the new safety guarding, ENGEL set the goal of not only meeting the requirements of the new standard reliably but also improving flexibility for the user. As a provider of system solutions including injection molding machines and automation, ENGEL considers the free-standing safety guarding an essential component of the production cell. That is why the existing version of the safety guarding is now being replaced by an easy to install modular solution. With the modular structure, the new solution also meets ENGEL is improving employee safety in plastics processing with its newly developed safety guarding according to EN ISO 14120. Its modular concept supports straightforward configuration and installation. Thanks to the extensive selection of safety panels and functional elements such as control cabinets, cable ducts, and swivel and sliding doors, individual layouts can also be realized at reasonable cost.
future requirements arising from increasing process integration and automation.

**Consistent functional design**
The modular system is a flexible solution for the operation of individual injection molding machines with a conveyor and also for integrated and automated production cells. Individually adapted openings with a safety tunnel make it possible to safely remove or supply any parts in the production process. The standard viewing fields consist of polycarbonate panels to ensure good visibility of the automation process. Optionally, the fields are also available with wire mesh or a combination of wire mesh and polycarbonate.

ENGEL injection molding machines and robots have a consistent, functional design. In the course of adaptation to the new standard, the machine manufacturer has now also designed its own safety guarding. The experience accumulated by ENGEL over years with the previous version of the safety guarding was incorporated in development. Thus, the new guarding can be installed quickly and in many cases by just one person. Connection points are provided on the injection molding machines to reliably install the safety modules.

**Simplified maintenance and upkeep**
In addition to the protective safety function, the new design meets a variety of customer requirements. Even the standard version of the protective enclosure is easy to clean, since the ENGEL experts paid special attention to avoiding edges and cuts. In combination with a corresponding options package, the safety guarding therefore meets the requirements of medical device manufacturing in general and clean room production in particular.

The recommendations of the standard for coloring were followed exactly. Thus, the dark color of the grating surfaces in the wire mesh version prevents reflections from negatively affecting the view. Uprights and door frames can also be matched to the injection molding machine or the user’s corporate design in the wire mesh version.

Thanks to its modular structure, the safety guarding is easy to expand and adapt to new requirements. The electrical engineering was optimized as well. The electronics of the safety doors are no longer installed in the door frames, but in easily accessible door connection boxes. That simplifies maintenance and upkeep. Concealed system cable ducts on the walls of the safety guarding can be easily clipped in at the top and bottom as needed. A control cabinet with variable positioning simplifies the electrical installation. The safety guarding is easy to connect to the injection molding machine control unit with plug & play.

Having protective devices tested is not required. But ENGEL went beyond the requirements and did so voluntarily. The new safety guarding has been tested and approved by TÜV Austria (a technical testing organization). It is now the ENGEL standard.

ENGEL has equipped an initial system for composites processing in the automobile supplier industry with the new safety guarding.

The modular concept supports straightforward configuration and installation.
Components made of amorphous metals have special physical properties. Standard materials such as stainless steel or titanium are often unable to keep up. The better the material, manufacturing process and plant are coordinated, the higher the product quality. ENGEL and the Heraeus technology group are pooling their expertise in this area and creating new product qualities made of amorphous metals for mobility, aerospace, medical technology, industry, lifestyle and electronics – with a 70 percent shorter cycle time and 60 percent less energy consumption compared to previous solutions for injection molding of amorphous metals.

Continuous material development is fundamental for technological progress. Concrete, plastic, quartz glass, etc. – their invention has changed the world. Hand in hand with emerging and new manufacturing processes, new materials create new opportunities for pushing the limits of what is feasible.

The most recent examples include amorphous metals. Due to their non-oriented – amorphous – internal structure, they give the end product properties that are actually mutually exclusive, such as very high strength and hardness combined with high ductile properties. Their density is lower than that of other metals, which makes lighter component parts possible. The non-oriented, chaotic structure of these materials clears the way for countless new products. Fields of application include break-proof and lighter smartphone cases, sharper and highly durable scalpels and instruments for minimally invasive surgery, stable suspensions and wear-resistant drivetrain components in vehicles, jewelry and abrasion-resistant watch components. The challenge in processing amorphous metals is that the melt retains its amorphous structure during solidification. And this only happens with extremely high cooling rates typically of more than 1,000 K/s.

Heraeus, headquartered in Hanau, Germany, specializes in the production and processing of amorphous metals. The technology group is the only supplier in the world capable of comprehensively processing amorphous metals: melting and shaping, additive manufacturing, injection molding. The new AMLOY product range consists of zirconium-based alloys and copper-based materials. AMLOY is biocompatible in line with ISO 10993-5 and outperforms standard materials such as titanium, stainless steel and hardened stainless steel in terms of hardness, strength, elasticity, corrosion resistance and surface finish. Further benefits: AMLOY shrinks by less than 0.5 percent when cooled, allowing metal designers to work with far more precision than ever before. The hardness values of the material run through the entire material body; for other materials they usually decrease from the surface towards the interior. Thanks to this property, AMLOY is predestined for demanding applications and mechanically highly stressed components, such as gears, screw systems or drive shafts, which require high reliability, low wear, scratch resistance and reproducibility.

Copper, as an alloying component of AMLOY, enables low unit costs and opens up a wide range of
Another example of components subject to high mechanical stress is the screwdriver bits that Heraeus and ENGEL will be manufacturing from AMLOY at their stand at the Hanover Fair. Such as debinding to remove the plastic, and sintering are required. Shrinkage is massively higher in the MIM process, which significantly reduces reproducibility. This makes the injection molding of amorphous metals superior to conventional metal injection molding processes such as MIM and metal machining processes such as time-consuming CNC, which also generates a large amount of waste.

**Optimized for injection molding**

AMLOY is optimized for injection molding. ENGEL has specifically developed a new hydraulic injection molding machine – based on its tie-bar-less victory series – for this purpose; what primarily sets it apart from a conventional injection molding machine for plastics processing is the injection unit. Special attention was paid to the uniform heating of the AMLOY blanks. In the AMM (Amorphous Metal Molding) process, one or more fit-for-purpose components, are produced from blanks of 80 grams – with 60 and 100 grams expected in the near future – in a single step of just 60 to 120 seconds, depending on size and geometry. The components have an excellent surface fineness of 0.05 µm Ra, eliminating the need for manual reworking. End products such as visible parts in the jewelry industry or medical instruments that require a reflective surface can be processed further – polished, for example.

In injection molding, the amorphous metals are melted and injected in the liquid state into the mold where they solidify. MIM (Metal Injection Molding), on the other hand, processes metal/plastic powder. Further steps, such as debinding to remove the plastic, and sintering are required. Shrinkage is massively higher in the MIM process, which significantly reduces reproducibility. This makes the injection molding of amorphous metals superior to conventional metal injection molding processes such as MIM and metal machining processes such as time-consuming CNC, which also generates a large amount of waste.

**Total cycle times significantly reduced**

Even compared to previous solutions for injection molding of amorphous metals, the new development of Heraeus and ENGEL represents a huge leap in efficiency. The material composition and the fully automated production process, from melting to the dynamically controlled injection process, result in a cycle time that is up to 70 percent shorter than that of previous amorphous metal injection molding solutions. The required heating capacity is reduced by 40 to 60 percent. This significantly increases cost efficiency. The newly developed injection molding machine achieves very high injection speeds of 1,000 mm/s as standard. This makes it possible to achieve very low wall thicknesses and thus enables optimum use of the higher material strengths of AMLOY.

Simulation can save time and costs at an early stage, in the run-up to the manufacturing process. For example, Heraeus simulates the flow characteristics of amorphous metals during injection molding and analyses in advance whether the manufacturing process is suitable for the specific component and which optimizations can be made to the design of the component and injection mold.

All AMLOY materials and injection molding machines are offered license-free. ENGEL presented its first injection molding solution for processing amorphous metals as early as 2015. Heraeus has been researching and developing amorphous metals for about three years.
The automotive industry and aircraft construction business have traditionally been among the most important industrial sectors in the United Kingdom, where composite research and processing has established itself to an equally high degree. Catapult plays an important role in this. Comparable to the Fraunhofer Society in Germany, Catapult bundles top-level application-oriented research in the United Kingdom and supports the industry to profit more quickly from new technologies. “We act as a kind of catalyst,” says Paul Gallen, Sector Lead Automotive at NCC. The NCC is one of seven institutes which form the Catapult Network, each with its own particular focus.

Founded in 2012, the NCC is currently made up of 17,500 square meters with state-of-the-art manufacturing cells for a wide variety of composite technologies. More than 220 engineers and scientists employed there work closely with the University of Bristol, many other universities worldwide and above all with the industry. Companies – not only from the UK – use the capacities for their own development projects. “We are continuously comparing our roadmap with that of the automotive manufacturers,” says Gallen. “The increased use of thermoplastic materials in lightweight composite construction is high on both agendas.”

There are two main driving forces behind this development: “On the one hand, thermoplastic matrix materials enable efficient further processing of semi-finished products in an injection molding machine and functionalization with materials from the same material group in a fully integrated, automated process,” explains Christian Wolfsberger, Business Development Manager Composite Technologies at ENGEL’s headquarters in Schwertberg. “Process integration and automation are the prerequisites for achieving the unit costs required by the high-volume automotive industry. On the other hand, thermoplastic composites simplify the subsequent recycling of components, which is in line with the trend towards circular economy.”

The technological basis for the processing of thermoplastic fiber composites is expanding rapidly. A pioneering role is being taken by organo sheets, which are

Putting thermoplastic composites into series production faster

Composite lightweight construction based on thermoplastics promises more efficient manufacturing processes and the recycling of obsolete components. Until the innovative materials and processes are used on a large scale some challenges still need to be solved and more experience needs to be gained. The National Composites Centre (NCC) in Bristol, UK, has set both of these goals. An integrated manufacturing cell for overmolding fiber-reinforced semi-finished products from ENGEL is paving the way for mass production in both automotive and aerospace industries.

For composite research, ENGEL supplied a duo 1700 large-scale injection molding machine to the NCC in Bristol.
already being used in series production, particularly in the sporting goods industry. The first applications were recently launched in the automotive industry. “There is great potential,” emphasizes Graeme Herlihy, President Western Europe of ENGEL. “All OEMs and Tier 1 suppliers are working hard on this topic.”

Flexible adaptability
For many companies in the composites industry, the trend towards thermoplastic materials means they have to deal with completely new processes. It is also the first injection molding machine for the NCC. ENGEL supplied a duo 1700 large-scale machine including a Kuka articulated arm robot and an integrated infrared oven. “Many of the well-known automotive manufacturers and Tier suppliers have duo machines in their plants, and our partner institutes in the USA and Japan also work with this type of machine,” says Gallen about the crucial point of relying on ENGELs technology and knowhow. A second criterion was the flexibility offered by the ENGEL system solutions. The wide range of applications resulting from NCC research projects and company cooperation requires that the manufacturing cell can be adapted to new requirements, new materials and new technologies within a short time.

With a clamping force of 17,000 kN, the duo injection molding machine is suitable for large components. In order to have a practical approach to development, the demonstrator molds are based on the geometries of real car components. The sample parts have different sizes and complexities. So far, mainly organo sheets have been processed. These are heated in the infrared oven, inserted into the mold by the robot, formed there and then immediately overmolded with plastic. “The fact that the infrared oven is located above the clamping unit simplifies handling and reduces the cycle time,” reports Gallen.

Further developments focus on unidirectional (UD) fiber-reinforced tapes. With the help of these UD tapes, highly stressed areas in the component can be specifically reinforced in order to make even better use of the lightweight construction potential. “Today, the NCC is already a leader in the field of automated fiber positioning, so the transition to UD tapes is not too far away,” says Gallen. With three differently dimensioned tape stacking units, the NCC is well equipped to produce the stacks on site and process them further in an integrated step.

From product design to recycling
The NCC is an integrated factory, all processes can be developed and optimized in the overall context – from material development to simulation, design and processing to recycling. “The interfaces are particularly important when it comes to composites,” explains Sean Cooper, Principle Research Engineer at the NCC. “In no other area are material, design and processing steps so closely intertwined. If you change only one of these three factors, you end up with a completely different result.” It is also important for subsequent recycling to set the course during product and process development. NCC is working with industrial partners on initial projects to develop value-adding recycling concepts. “The aim, for example, is to give safety-relevant components made of long-fiber reinforced materials a second life as a bench or instrument panel based on materials reinforced with short fibers,” says Gallen.

NCC developers have carried out many series of tests right from the start with materials typical of the automotive industry, primarily from the PA family, as well as with the high-performance plastics PEEK and PPS, which are preferably used in aircraft construction. “Over the last two years, the aircraft industry has been working intensively on what thermoplastic composites can do for them,” reports Gallen. “The switch to thermoplastics often leads to a massively smaller CO2 footprint.” It all starts with high-volume applications, which also certainly exist in aircraft construction. Fastening elements such as brackets, for example, which currently consist of aluminum. “At the end of the day, composites always compete with steel or aluminum,” says Paul Gallen. “Composites can only be used if the parts are even lighter, the unit costs even lower and the production processes even more efficient. Our goal is to additionally obtain even better component properties.”

*“The industry we serve is still emerging: The production of composite components in large quantities,” says Paul Gallen (2nd from right) from the National Composites Centre (NCC) in Bristol. From left to right: Sean Cooper (NCC), Graeme Herlihy (ENGEL), Paul Gallen and Christian Wolfsberger (ENGEL).*
Regula manufactures particularly compact test equipment that enjoys an excellent reputation worldwide. Clients include law enforcement agencies in Europe, North and South America, the Middle East, Asia, Africa, Australia and New Zealand: foreign and interior ministries, police, border and customs services, banks and insurance companies. Regula did not have its own injection molding production until recently. However, the quality of the externally purchased housing parts did not meet the company’s requirements, prompting a decision to manufacture these parts in-house. The aim was to produce various small parts for housings by injection molding. “Because we have around 200 different devices in our product range, the batch sizes are fairly small,” as Alexej Tschistyj, Deputy Head of Development at Regula, reports. “This means a large number of injection molds that often have to be changed.”

**Setup in less than five minutes**

“As there are no tie bars in the way, victory injection molding machines save a great deal of time on frequent setup processes which increases machine availability,” as Olaf Kassek, Managing Director at Moscow-based OOO ENGEL explains. Unimpeded access to the mold area makes it possible to install the molds directly from the side. Employees do not have to bend over the tie bars during mounting, which also improves ergonomic
aspects. Another advantage of the ENGEL tie-bar-less technology is that the mold mounting platens can be used right up to the edge. “In this way, even large, bulky molds, such as multi-cavity molds or molds for multi-component injection molding, fit on comparatively small injection molding machines, which keeps investment and operating costs low and the system footprint compact,” says Kassek. This year 2019 marks the 30th anniversary of the tie-bar-less technology with which ENGEL still holds a unique selling feature.

In order to be able to react flexibly to new developments and customer requirements, Regula builds all the molding tools itself, using lightweight aluminum molds with manually changeable dies that can be produced in one to ten days. This reduces the development time for new devices from one, or even one and a half years, to four or five months. 18 to 25 different molds are required per tester model. If, for example, ABS is processed, the aluminum molds achieve a service life of up to 10,000 cycles.

**Maximum process consistency and reproducibility**

“Tie-bar-less injection molding machines by ENGEL are a real stroke of luck for us,” says Tschistyj. The Regula employees take less than five minutes to swap the interchangeable inserts. Even more important than manufacturing efficiency is the quality of the injection molded products, which has been Regula’s fundamental target from the very beginning. This is where the precise controllability of the injection molding process and the high process consistency of the hydraulic victory machines come into their own. “Thanks to the force divider flexlink, the moving platen in the tie-bar-less clamping unit follows the mold precisely during clamping force build-up and distributes the applied force uniformly over the entire clamping surface, resulting in extremely constant wall thicknesses,” explains Kassek. “The stable machine frame and the precise linear guidance of the moving platen allow for fast, low-friction movements and ensure high platen parallelism even during opening and closing of the mold.”

One important added bonus for Regula’s management is ENGEL’s service portfolio in Belarus with ENGEL’s own local service engineers. The short distances not only pay dividends when putting machines into operation and at the start of production. They also offer a great deal of assurance for ongoing production by minimizing the downtime for servicing, or for replacing spare parts. At Regula, the ENGEL victory is the machine of choice for the further expansion of Regula’s own injection molding production.
The world of ENGEL

As one of the world’s leading companies in the field of plastics machine manufacturing, we offer our customers integrated system solutions. This means: injection molding technology from a single source. Machine, automation, process, training and service are all perfectly integrated with ENGEL. And we always look to the future. Innovation and the latest technologies offer our customers a decisive competitive advantage. be the first.

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