Injection

The magazine from ENGEL for the plastics industry

April | 2016

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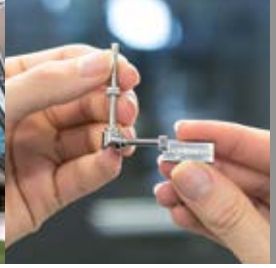
ENGEL
be the first



Dr. Peter Neumann
CEO ENGEL Holding

Warming up for K 2016

The K 2016 is already on the horizon. Many new developments have already completed their testing phase and are being further optimised, while preparations for the exhibition are approaching culmination. Networking is a general issue of focus in the industry, and Industry 4.0 is a dominant theme in the ENGEL exhibit programme for Düsseldorf. inject 4.0 – this is our answer to the challenges posed by the fourth industrial revolution.

Besides the K show, ENGEL has other areas of emphasis this year. We are working intensively to expand capacities at all our locations to enable us, in the future, to deliver the most individual solutions within a very short time. Despite all economic apprehension, things are going very well in our sales markets and we are confident that, under stable conditions, the 2017 business year will also provide further positive development. Injection moulding still has great potential, and the continued development of the machines – whether in the area of drive technology or control systems – has achieved such great improvements that many processors will inevitably have to replace their old machine parks to remain competitive.

Our worldwide presence – including production sites in Asia – guarantees for you, our customers, that machines with the same technology and quality can be provided locally, which is an outstanding advantage in view of the increasingly difficult challenges in global business. As a family-run company, ENGEL stands for continuity, with a stable and predictable ownership structure that guarantees long-term thinking so as to always keep our customers in view. Our focus remains on injection moulding solutions that provide you with even more benefits.

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ENGEL worldwide. **around the corner.**

Bridging development and practice
inject – the injection moulding forum

"inject – the injection moulding forum" from ENGEL AUSTRIA took place for the first time in March 2016 in Schwertberg, Austria. The purpose of the two-day event was to make the latest research findings more accessible to injection moulders and to promote the sharing of experiences among them. The following topics were covered at the premiere event: Plastification, material decomposition and its consequences, switching over correctly, monitoring and adjusting process parameters, interpreting injection pressure curves, cooling water quality and temperature control technology. The topics were discussed in presentations and short talks, with the objective being to provide attendees with food for thought and encourage them to exchange experiences and information. "Even in standard injection moulding processes, there is still plenty of potential for improvement, and with our developments, we are continuously trying to leverage this and make it accessible to injection moulders," emphasises Prof. Dr Georg Steinbichler, Senior Vice President Research and Development Technologies at ENGEL AUSTRIA and the head of the Institute of Polymer Injection Moulding and Process Automation at Johannes Kepler University in Linz. In 2017, "inject – the injection moulding forum" will take place on March 7th and 8th.

Inject – the injection moulding forum will take place annually.

"Access to latest research findings is crucial to injection moulders if they are to remain competitive in the long term."

Prof. Dr Georg Steinbichler, Senior Vice President Research and Development Technologies

Reliable quality with low unit costs
Medical conference in Tehran

More than 50 plastics processors gathered in Tehran in mid-February to learn about innovative manufacturing concepts, process technologies and strategies for reliable, and at the same time economical, cleanroom fabrication of medical technologies products. Together with its sales partner in Iran, Varzidehkar Co., and other suppliers, ENGEL hosted the conference. "We are very satisfied with the event," emphasises Christian Reisinger, Sales Director Middle East/Central Asia at ENGEL. "Many local processors took advantage of the opportunity to gather information and establish contacts. The need to catch up is very tangible in Iran." Beyond that, the rapid population growth and fundamentally good basic medical care system, are also contributing to the dynamic development in this industry. In Iran, ENGEL is seen as a technology leader and a preferred partner for long-term business relations. This good reputation results not only from the high quality of its products, but also from its strong local presence with numerous service technicians and close cooperation between the local sales team and the Business Unit at the company headquarters in Austria.

"The market has a strong focus on quality, and therefore the interest in European technology is quite high."

Christian Reisinger, Sales Director Middle East/Central Asia at ENGEL

The medical conference marks the beginning of a series of events ENGEL will be holding in Iran focusing on specialised applications.

inject 4.0 in focus internationally
From Mexico to China

Industry 4.0 is more than a buzzword, it is an important trend that is getting increasing attention among ENGEL's customers – not just in Europe. In early March, ENGEL presented its inject 4.0 strategy at the Plastimagen plastics trade show in Mexico City, and the topic also played a leading role at the ENGEL stand at Chinaplas in late April in Shanghai. "Industry 4.0, the fourth industrial revolution that we are currently experiencing, is both a

challenge and a chance," emphasizes Walter Jungwirth, Managing Director at ENGEL de Mexico in Querétaro. "Our goal is to master the challenges, together with our customers, in order to gain the maximum benefit from

"We view ourselves as a partner helping our customers to optimize their production processes in the sense of Industry 4.0."

Walter Jungwirth, Managing Director at ENGEL de Mexico

the new chances that are arising." ENGEL can draw on rich experience in this area, because in their own business, Industry 4.0 is already a long-established practice in many areas. The trust that processors worldwide place in the ENGEL solutions in this area is therefore very high right from the start. "Our modular inject 4.0 concept allows our customers to start, at any time, with a solution adapted to their individual requirements and

"At Chinaplas, many customers informed themselves about the new possibilities Industry 4.0 opens up."

Gero Willmeroth, Sales and Service President at ENGEL Machinery Shanghai

then gradually develop it further", says Gero Willmeroth, President Sales and Service at ENGEL Machinery Shanghai. "Optimising manufacturing processes starts with the individual machines and can reach all the way up to a global production network."

Center for Lightweight Composite Technologies expands capacity
Large ENGEL v-duo for St. Valentin

ENGEL is currently commissioning a 17,000 kN machine for operation at its Center for Lightweight Composite Technologies in St. Valentin, Austria. "We are expanding the capacity for our own development work, as well as for the projects of our customers," emphasises Peter Egger, Director of the Center for Lightweight

"The demand for components that combine very high performance with very low weight continues to increase."

Peter Egger, Director of the Center for Lightweight Composite Technologies

Composite Technologies. "With the ENGEL v-duo 700 that is already in operation and the new ENGEL v-duo 1700, we can now cover an even broader spectrum of thermoplastic and duroplastic fibre-reinforced composite applications." The new production cell with injection unit, integrated ENGEL easix multi-axis robot, and multi-component high-pressure metering system for reactive processing technology, is optimally equipped for very diverse composite technologies.

ENGEL is currently equipping its Center for Lightweight Composite Technologies in St. Valentin, Austria, with a second, even larger machine.

Ceremonial handover
ENGEL lends machine to TGM Vienna

The new all-electric and tie-bar-less ENGEL e-motion 50 TL injection moulding machine with integrated ENGEL e-pic robot has started work both in education and in research at the Laboratory for Plastics Technology (LKT) at the TGM Federal Institute of Technology in Vienna. The on-loan machine was handed over in a ceremony in the polytechnic's technology centre. Karl Reischer, Director of the TGM, and Klemens Reitinger, Head of the Department Plastics Technology, thanked ENGEL in the name of all students and professors for the outstanding collaboration with the company. Such a successful model of engineering education would not be possible without the support of the business sector.

From left: Alexander Revesz, CEO LKT, Karl Reischer, Director TGM, Klemens Reitinger, Head of Department Plastics Technology TGM, ENGEL CSO Dr Christoph Steger, Area Sales Manager Werner Sucharda and Vice President of Business Unit Franz Füreder from ENGEL and Prof. Dr Ernst Pöcksteiner, co-founder of the Society for the Advancement of Plastics Technology.

More output per square metre of production space
Plastics & Rubber Vietnam

At the beginning of March, at the Plastics & Rubber Vietnam in Ho-Chi-Minh-City, everything at the ENGEL stand revolved around efficiency. Noodle containers were produced on an ENGEL victory 500/160 tech injection moulding machine with an integrated ENGEL

Thanks to its tie-bar-less clamping unit, the ENGEL victory machine saves both investments and running costs.

viper 6 linear robot – with a particularly high level of floor space productivity, very low unit costs and top process consistency. The fact that the bulky noodle container mould – constructed by Donghae Plastic Company in Gyeonggi-do, South Korea – fits on a comparatively small injection moulding machine is due to a special design feature of the ENGEL victory machine: the tie-bar-less clamping unit.

Promote young scientists
ENGEL Polska supports polytechnics

n mid May, ENGEL is again organising a students' day at the Plastpol trade fair in Kielce, Poland. Like last year, the ENGEL Polska team will show students from various polytechnics in Poland around the exhibition stand, and demonstrate innovative technologies and pioneering applications on ENGEL injection moulding machines through presentations. More than 350 students

Lectures at universities are a firm component of ENGEL Polska's university project.

attended last year's event. The students' day at the plastics fair is part of ENGEL Polska's extensive collaboration with colleges and universities in the country. Other joint activities are university days during special events at ENGEL's subsidiary in Warsaw, the organisation of lectures at universities, and the establishment of work groups to advance regular exchange between universities, colleges and the industry. ENGEL provides machines to the technical schools of the universities and polytechnics on loan for certain projects.

"With our programme we grant students an early insight into the working world of the plastics industry and facilitate their later entry into professional life."

Piotr Nachilo, Managing Director of ENGEL Polska

23 years of collaboration
55th injection moulding machine for OMEGA

"There is a little bit of OMEGA in almost every car seat," explains Walter D. Olbert, managing director at OMEGA TECHNOLOGY PLASTIC with headquarters in Diepholz in Lower Saxony, Germany, while visiting the ENGEL facilities in St. Valentin, Austria. Together, the partners celebrated the delivery of the 55th injection moulding machine, an ENGEL duo 600 with an integrated ENGEL viper 40 robot, equipped for the production of components for car seats as well as for door locks. "The capacity of the machine was already booked out even before it was delivered to our factory," says Jürgen Exner, also managing director at OMEGA. In 1995, Walter D. Olbert took over the company in the course of a management buy-out and has led it on a track of continuing growth. Precision parts made of thermoplastics, complex sub-assemblies and plastic/metal composite components are its specialty. OMEGA often gets the bid when metal components are to be substituted with parts made of plastic.

OMEGA TECHNOLOGY PLASTIC in Diepholz keeps on growing.

The cooperation between Walter D. Olbert and ENGEL started even before the OMEGA company existed. "ENGEL is distinguished by its high quality, good service and innovative strength, but above all, we appreciate our strong foundation of trust," says Olbert. "We can speak openly, even about uncomfortable issues, and find good solutions for every challenge. ENGEL has already managed to make the impossible possible for us."

From right: Jürgen and Ulrike Exner, Walter D. and Ilona A. Olbert with Dr. Christoph Steger, Chief Sales Officer at ENGEL, Andreas Heckmann of ENGEL Deutschland sales, and Peter Mandlmayr of ENGEL AUSTRIA sales.

Besides ENGEL duo machines, tie-bar-less ENGEL victory and ENGEL e-victory machines are found in the plant. Most of them are equipped with an ENGEL linear robot. As demands on the complexity and quality of the components grow, automation and process integration become increasingly important. "We will soon implement the first two-component processes," says Exner. Already today, polyurethane sealant beads are applied immediately following the injection moulding process and contribute significantly to optimising water management in automobile doors. Components that are filled with PU foam or compact PU moulding compounds improve acoustics in the vehicle.

System solutions for the Gulf States
Saudi PPPP 2016 in Riyadh

Maximum output, consistent quality and constant machine availability: at the Saudi Plastics and Petrochem 2016 in Riyadh, Saudi Arabia, ENGEL demonstrated how these requirements can be combined with excellent profitability and energy efficiency through the perfect harmonisation of injection moulding machine, mould, automation, application technology and support. ENGEL's exhibits and demonstrations revolved around the manufacture of bottle caps, thin-walled packaging, pallets and fittings, as well as consumables for medical and laboratory use. "ENGEL is one of the most preferred plastics processing industry partners in the Gulf States, and our system solutions are responsible for a large percentage of this success," says Andreas Leitner, Sales Director Middle East at ENGEL. ENGEL works with system partners to enable it to develop the optimal solution for each individual situation, and three of those partners joined ENGEL in Riyadh, the mould makers Otto Hofstetter and ifw, and BECK automation. The partners possess many years of experience and have completed many projects in the Middle East together, particularly in the areas of caps and closures, thin-walled packaging, fittings and pallets.

The ENGEL e-cap injection moulding machine has established itself very well in the Middle East. In the United Arab Emirates all the well-known bottlers and bottle cap producers now use ENGEL technology.

Prize winner visits Austria
ENGEL Benelux Award

Leendert Vandenhove, a student in Industrial Science at the Diepenbeek Campus of the University of Leuven in Belgium won the ENGEL Benelux Award 2015. He impressed the jury of experts with his thesis on a new measuring method to determine chloroprene rubber (CR) in complex elastomer compounds. The award is endowed with a sum of money. Vandenhove and the five other nominees also visited Austria at the invitation of ENGEL. Apart from tours of ENGEL factories, they also visited ENGEL's partner company Haidlmair and Schöfer, and the Institute for Polymer Injection Moulding Technology and Process Automation at the Johannes Kepler University in Linz.
ENGEL Benelux established the award in 2014 to commemorate its 25th anniversary. The award honours the best theses in the field of plastics every year. It is open to students in the Netherlands, Belgium and Luxembourg. "In Benelux, we have excellent training and research facilities in the field of plastics manufacturing," says Kurt Callewaert, Managing Director of ENGEL Benelux B.V. with its seat in Houten, Netherlands. "With this award we help to make our region's level of performance better known."

Back (from left): Peter-Bas Schelling (Hogeschool Windesheim), award winner Leendert Vandenhove, Geert Heideman (Hogeschool Windesheim) and Tim Steensels (University of Leuven, Diepenbeek Campus); front (from left): Rene de Looff (ENGEL Benelux), Alexander Jordaens (University of Leuven), Stephanie Van Haecke (University of Leuven, Oostende Campus), Yannick Heijligen (Universiteit Hasselt) and Hilde Bonte (Education Polymer Processing, University of Leuven, Oostende Campus).

Preview

Technical Fair, Belgrade, Serbia, May 16th to 20th

Plastpol, Kielce, Poland, May 17th to 20th

ENGEL trend.scaut, Livonia, MI, USA, June 29th

Interplas, Joinville, Brasil, August 16th to 19th

K, Düsseldorf, Germany, October 19th to 26th

▼ *The two-day event offered not only specialised information, but also plenty of networking opportunities.*

▲ *Christoph Lhota and Heinz Rasinger from ENGEL, Dr. Edgar Vidal from Materion, Paul Hauck and Thomas Steipp from Liquidmetal Technologies and Steffen Mack, Materion (from left)*

More than 200 guests visit **Liquidmetal Forum in Stuttgart**

For two days, Liquidmetal was at the focus of the ENGEL Deutschland Technologieforum Stuttgart. In an exclusive event, ENGEL, together with its system partners Liquidmetal Technologies and Materion Corporation, presented the potential of the new materials and their efficient processing to its customers and interested visitors for the first time – with great success.

With more than 200 guests, the conference, which was initially scheduled as one-day event, far exceeded the expectations. Only about half of the companies represented were already customers of ENGEL. Besides plastics processors, many metal processors also took the opportunity to get to know the new technology.

Even the tiniest structures can be modelled efficiently using the Liquidmetal process.

Completely new material characteristics

The name Liquidmetal stands for a group of zirconium-based alloys that have been developed by Liquidmetal Technologies of Rancho Santa Margarita, California. As the exclusive engineering partner, ENGEL is the only supplier in the world offering machinery and system solutions for the injection moulding of these materials. A third partner is Materion, the material producer and distributor based in Mayfield Heights, Ohio. During the Forum event, the three partners jointly presented the new materials, injection moulding for processing them efficiently, and the potential they have for applications. Components made of Liquidmetal are extremely hard, but at the same time very elastic. They have low specific weight, are corrosion-resistant and biocompatible. The fact that the alloys can be processed in injection moulding is a further advantage compared to other metal materials, because this makes particularly efficient, highly automated and integrated processing methods possible. In only one step, injection moulding delivers fit-for-purpose components with very high quality surfaces. "These characteristics are fascinating for anyone who works with plastics or metals," says Heinz Rasinger, Vice President ENGEL teletronics. "Now it is all about the question of how we can make the best possible use of these characteristics."

Project planning starting for first applications

A Panel of Experts gave conference participants the opportunity to discuss their product ideas in a small, confidential circle of experts. "For some products, the discussions led to some very promising approaches," says Rasinger. "We will be starting the first projects shortly."

From medical technology to electronics, automotive to aerospace and even sports equipment, there will be a broad field of applications. "Liquidmetal offers great potential in particular for components subject to strong mechanical strain with high demands on component design and surface quality," emphasizes Christoph Lhota, Vice President ENGEL medical, thinking for example of the long and very delicate instruments for keyhole surgery. Further application examples that were discussed in Stuttgart include functional components for electrical devices and decoration elements for automotive interiors.

"What we are experiencing is an almost euphoric optimism."

Heinz Rasinger, ENGEL AUSTRIA

Investments in **the Austrian plants**

ENGEL creates room for further growth and new staff. At the company headquarters in Schwertberg, construction has been underway since the summer of last year. Parallel to that, work started on the expansion of the large-size machine plant in St. Valentin.

Before construction was even underway, the extent of the expansion of the headquarters in Schwertberg was increased. Instead of two, the new building on the south side of the site will now have three upper floors. The new building is connected with the technology centre that was completed in 2009, and provides an additional 10,000 square metres of floor space. Of these, more than 6,000 square metres are reserved for new offices to strengthen the sales and service teams. A new apprentice workshop will utilize approximately 1,300 square metres, and around 300 square metres will be used for day nursery facilities.

Greater integration of the apprentice workshop in production

The ENGEL apprentices will be the first to move into the new building. Installation of the machines for training will begin in July. The existing apprentice workshop at the company headquarters is already one of the most modern in the country and has received numerous awards. In time for the new training course starting in September, it will become even more attractive. ENGEL provides its staff with the best possible working conditions, which means ample daylight, ergonomic workstations and rooms with an open atmosphere. More than 150 young men and women are receiving training in eight technical professions at ENGEL in Austria. With a retention rate of 98 percent, the in-house professional training is an important factor in terms of securing skilled workers. The apprentice workshop is closely integrated into the production at the site. Machine components produced by apprentices will also be utilised in ongoing assembly processes. Because of the excellent results achieved in the past years, this training concept is being promoted even more strongly.

The apprentice workshop in Schwertberg serves as a model for the ENGEL Group's worldwide apprentice trainee programme. ENGEL also provides vocational training at its German site in Hagen, its component plant Kaplice in the Czech Republic, and its large-size machine plant in Shanghai, China.

The ENGEL Technology Centre, erected in 2009 in Schwertberg, is being expanded with a southern wing.

Day nursery facilities for ENGEL's children

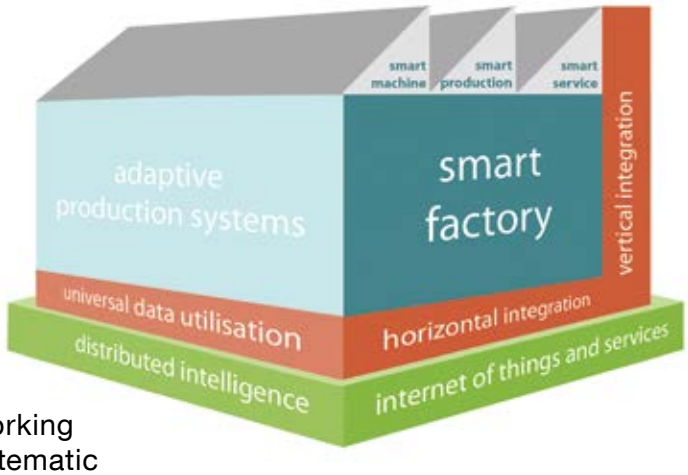
With its own childcare centre, ENGEL is making it even easier for staff to balance family and professional obligations. In advance of the opening in September, there are already 13 children registered for the day nursery, and interest continues to be high. In the future, two groups of up to 24 toddlers aged one to three will be cared for. The day nursery is equipped with its own kitchen and garden that will not only serve as a playground, but also provide space to grow vegetables for breakfast snacks.

More capacity for large-size machines

Parallel to the expansion of the company headquarters, ENGEL also started construction at its large-size machine facility in St Valentin, Austria. Two initial warehouse buildings will be completed by late summer. Also planned is the building of another production hall on the south side of the site, that will be connected to the existing halls, and expand the capacity for the manufacture of large-size machines.

In July, the occupants will start moving in. The first step will be to install the machines for the new apprentice workshop.

Check:
how smart do industries really manufacture?



The vision of Industry 4.0 turns into reality in the smart factory. With the help of the networking and integration of production systems, the systematic utilization of process and production data, and the use of adaptive production systems, the manufacturing processes continuously optimise themselves and secure producers a high level of competitiveness. Today, ENGEL is already offering the first solutions for all three fields – smart machines, smart production and smart services. inject 4.0 is ENGEL's answer to the challenge of optimum utilization of the opportunities of the fourth industrial revolution. Industry 4.0 is different for every undertaking, and there are also differences from industry to industry. Injection quizzed the heads of the business units of ENGEL AUSTRIA on where the specific opportunities and challenges lie, and what is already standard today.

Packaging Michael Feltes

For the packaging industry, Industry 4.0 primarily means two things: networking and integration. As a system provider, ENGEL delivers highly-integrated and automated manufacturing cells from a single source. ENGEL simplifies the control of complex processes with a standardised control logic from the injection moulding machine to the ENGEL viper and ENGEL easix robots. The aim is to control the complete manufacturing cell including the moulds, hot runners, IML automation and quality control systems, from the display of the injection moulding machine. ENGEL is working together with its partners on this. The pooling of all process data along the complete product creation process offers the opportunity to make the most of optimisation potentials and to exhaust the capabilities of all components in the manufacturing cell.

In future, the data on the condition of individual machine parts will also be collected automatically and evaluated systematically. Predictive and preventative maintenance will significantly increase the availability of the manufacturing cells and reduce maintenance costs. ENGEL already supports numerous customers in servicing via remote connection. Data transfer in real time enables quick diagnosis and troubleshooting and, in many cases, saves time-consuming and expensive on site servicing.

Process data at the point of sale is another contribution of Industry 4.0 to the packaging industry. In future, consumers will not only find information on the ingredients of foods and cosmetics in the supermarket, but also on how and from what materials the packaging was made.

"Predictive and preventative maintenance will increase machine availability significantly."

Teletronics – Heinz Rasinger

Regardless of whether we are talking about self-driving cars, the connected home, or fitness trackers by mobile phones or as wearables – for the teletronics industry, intelligent networking primarily means the added value that it generates for its customers with the help of increasingly smarter sensor technology. The connectivity of the modules supplies the data, which are collected, evaluated and made manageable either locally or via the cloud.
It is also, of course, about using the opportunities of the fourth industrial revolution to optimise own processes. The networking of injection moulding machines in a machine park via ENGEL e-factory is standard in many plants. The big, international companies are currently busy integrating their sites around the world into their MES. As a result they are able to monitor the utilisation, availability and output of machines in far-flung factories, from head office, and correlate global key production figures with business targets.
At a local level, intelligent assistance systems such as iQ weight control are moving into the machine parks at high speed. Apps are also very important in this industry as teletronics experts want to control not only the appliances in their own homes, but also the machines in their factories, by smartphone.

"Our customers want to control their injection moulding machines by smartphone."

Medical – Christoph Lhota

The top guiding principle in the medical technology industry has always been to have everything under control at all times, and to be able to prove which quality was delivered when and to whom. New solutions that make production more plannable, safer and more stable are attracting keen interest. The challenge lies in integrating them within the guidelines of GMP and ISO 13485 accepted by auditors.
In the field of smart production, the medical industry has advanced far down the road towards smart factory. An MES, like ENGEL e-factory, has been standard in most undertakings for many years. Through the smart machines approach of inject 4.0, for example, the manufacturing processes continuously optimise themselves with the help of iQ weight control, and necessitate new approaches in an environment of validated processes. ENGEL e-flomo has already made a name for itself. The electronic temperature-control water distribution system compensates for temperature fluctuations online in the mould, thereby improving process control. In no other industry are more ENGEL e-flomos in use.

"Solutions that make production more plannable, safer and more stable are attracting keen interest."

Automotive and technical moulding – Franz Füreder

Due to very high pressure to reduce costs and to innovate, as well as the trend towards small lot sizes in order to meet the ever more individualised wishes of customers, it is necessary to continuously optimise the manufacturing processes. In addition to this, a high proportion of parts are important for safety, therefore requiring exceptional care in traceability. In this regard, the networking of production systems and the systematic use of production data offer very high potential. The automotive industry is one of the pioneers in the utilization of this. What is new is that producers are now also focusing on the individual injection moulding machines. The ENGEL solutions of iQ weight control and iQ clamp control are often retrofit into existing injection moulding machines, always with the aim of improving process stability and product quality. iQ weight control, for example, detects fluctuations in the melt volume and automatically balances them out in the same shot.
The trend at technical moulding producers is similar. Manufacturers who produce very sophisticated, quality-sensitive parts are thoroughly investigating the possibilities offered by inject 4.0. Here, too, the goals are higher quality and full and continuous traceability, but also savings in raw materials.

"iQ solutions are often retrofit into existing injection moulding machines."

Entirely integrated: Following the trade fair, the production cell was shipped to HIB Trim Part Solutions in Bruchsal, Germany.

Efficiency up, Cycle Times down

Process integration and the corresponding automation solutions are important keys to better quality and lower piece costs. However, both trends tend to complicate the processes and require several control systems to communicate with each other in real time. Overall efficiency cannot be improved further unless peripheral controls are entirely integrated in the moulding machine control. Large multi-axis industrial robots, used in conjunction with injection moulding machines with high clamping forces, are no longer an exception from the rule.

At Fakuma 2015, decor elements with real wood veneer were produced on an ENGEL duo 650 combi M injection moulding machine using the ENGEL clearmelt process. A completely integrated ENGEL easix multi-axis robot placed the wood insert in the mould, removed the finished parts, and laid them on a conveyor belt. This was the first time ENGEL demonstrated its new large robot at a trade fair. Its 3,900 mm reach and its 240 kg load capacity, in the standard version, widen the application range of ENGEL multi-axis robots. Even injection moulding machines with clamping forces of up to 55,000 KN used, for example, in the production of 1,000 litre garbage bins, can be automated with multi-axis robots in an integrated solution.

Having their own robotics program is an important building block in ENGEL's strategy. As early as 1980, ENGEL began with the development and construction of linear robots and integrated them into the moulding machine control. Since 2011, ENGEL has also offered the ENGEL easix series of completely integrated multi-axis robots. The smaller models, available from the start, are based on a technology platform from Stäubli Robotics; for its new, larger models, ENGEL has secured Kuka as an added partner.

Simple Control for Complex Processes

The advantage of an integrated ENGEL solution comes from the fact that the injection moulding machine and the robots share the same control, and thus possess a parts data bank. The performance characteristics of a linear robot are also available to multi-axis robots. Complete integration is the prerequisite for simple and intuitive operator guidance. The operator can operate the robot using the familiar commands of the injection moulding machine. The other robot motion commands fit seamlessly into the graphical user interface of the machine control system. Even when additional peripherals are used, the CC300 controller continues to function as an overall control. The results are simplified control and control loops.

In order to enable rapid parameterization in even highly complex systems, the CC300 offers a variety of flowcharts, from the simple selection of ready-made standard processes, to the object-oriented graphical creation of sequences known in connection with linear robots. Among others, this includes manual mode, message and actual value displays, closing security and working space, as well as the use of standard and user masks for pre-programmed robot operations. An

ENGEL viper linear robots as well as ENGEL easix multi-axis robots are integral elements in the CC300 injection moulding machine control. Hand-held terminals are available for stand-alone operation.

additional advantage offered is an exit strategy in the form of a pre-programmed home run from any position. This function alone ensures that the industrial robot can be operated reliably and safely without in-depth training. In addition, the teach skills for linear robots are sufficient to parameterize a multi-axis robot. Further added value is offered by solutions that include an image processing system for simple presence tests prior and subsequent to the process, and robot guidance using the 2½D method. This provides the injection moulder with a single point of operation for the entire production cell even for complex automation tasks.

Zero Time Removal for Faster Processes

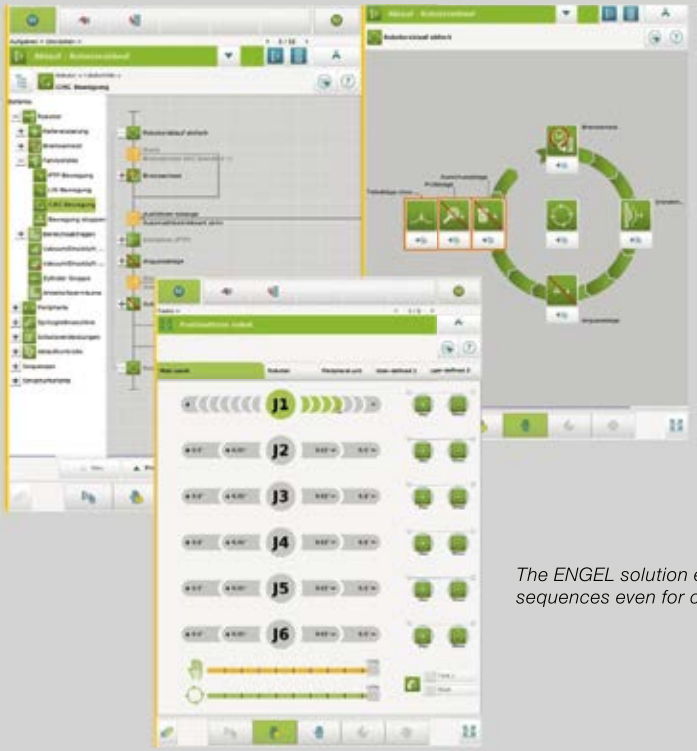
An essential advantage of this depth of integration is the fact that the robot does not communicate with the injection moulding machine, but, being an integral part of the system, accesses the same data base. This characteristic holds the key to optimizing production efficiency, since injection moulding machines and robots can automatically coordinate their motion sequence and control loops with each other.

Whereas robots in partly integrated solutions cannot be released until the mould is entirely open – and the machine has communicated this condition to the robot – the robot in the fully integrated ENGEL solution can start entering the moulding area during the opening motion of the moveable platen. So-called zero time removal shortens handling and eliminates the time required by conventional communication interfaces between machine and robot.

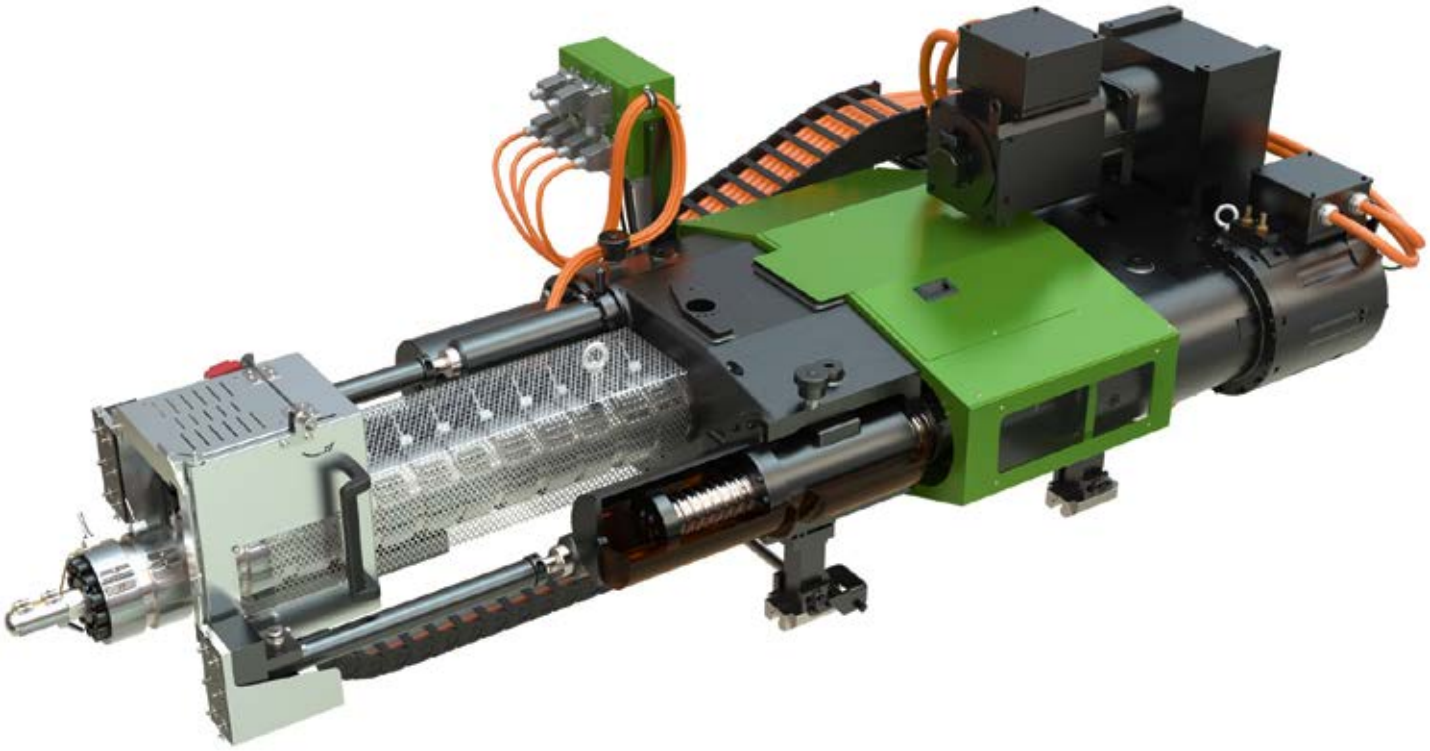
Fieldbus communication enables the motions of the injection moulding machine, mould and robot to be synchronized without additional equipment. This takes place, even for complex processing sequences, within the CC300 environment via the moulding machine display. The definition of blocked spaces is standard in the integrated solution.

New Scara robots complete product range

With its high system competence, ENGEL can offer powerful, multi-functional and easy-to-operate automation solutions. In order to adapt these solutions to maximize efficiency in particular applications, the company continues to expand its product range. Thus the ENGEL easix series has now been expanded to include a Scara version. Due to their high rate of picks per minute and comparatively low investment costs, these four-axis robots offer advantages for pick-and-place tasks, grip arm fitting or conveyor tracking.



The ENGEL solution enables object oriented graphical representation of flow sequences even for complex production processes.



ENGEL has geared itself for the thin wall trend. High-performance injection units with direct drives accelerate the screw to 800 mm/s in 30 ms.

Giving pressure greater weight

The wall thicknesses of injection-moulded parts are becoming thinner and thinner. This not only reduces material costs and cycle times, but also opens the door to new functionalities. To fill moulded parts with larger flow path/wall thickness ratios, powerful servo-electric injection units make injection pressures up to of 3500 bar available. With accelerations of more than 20 m/s² ENGEL's injection axis are among the fastest worldwide. However, it is often overlooked that the pressure also influences the flowability of the melt. This effect must be taken into account in the design of injection moulding machines.

Injection moulders still determine the flowability of a melt via melt index values based on data from the raw material supplier. These values indicate the melt's behaviour at very low shear rates that tend towards zero viscosity. In injection moulding, however, far higher shear rates occur, especially when the melt fills thin-walled parts or flows through gates with very small diameters, so that the information provided by the listed values is only of limited relevance for flowing behaviour under processing conditions. If the high injection pressures needed for thin-wall injection moulding are not considered in the assessment of flowability, this can lead to errors in simulating injection moulding processes and choosing the right injection moulding machine.

Process parameters influence flowability

Fundamentally, the viscosity of a melt is determined by the polymer's structure and its additives. The specific flowability set must always be viewed as a compromise between the properties required for the application and the processability.

During processing, the flowability of the melt is influenced by the process parameters. As a general rule, polymer melts demonstrate "shear-thinning" behaviour, in other words, the viscosity drops as the shear rate increases. A rise in the melting temperature causes the same effect, although the prevailing local temperature needed to transport the melt leads to higher viscosity. While the temperature dependency of flowability is well-documented for many polymers in the form of measurement graphs, there is, due to the complexity of the measuring procedure, very little data available for pressure dependency. Even simulation programs that offer the ability to include pressure-dependent viscosity in the calculations for the injection process can only rarely resort to pressure-dependent viscosity data.

Viscosity rises by more than 100 percent

The pressure-dependent viscosity can be calculated with the help of pressure coefficients and on the basis of known reference pressures. There are various equations available to describe the pressure coefficients, with the best reflection of practical experience being an equation based on a constant shear rate and a constant temperature. On the one hand, the viscosity's pressure dependency is measured using a high-pressure capillary rheometer at a constant shear rate, and on the other, conditions that come somewhat close to constant shear rates and temperatures prevail, at least in segments, during the injection process.

To demonstrate the influence of pressure on viscosity, the data of two plastics – an HDPE with an MFR of 11 g/10 min and a PP with an MFR of 30 g/10 min – are shown. If the pressure is increased from 50 to 1000 bar, the viscosity of the HDPE increases by approximately 92% at a shear rate of 50 s^{-1}. Although the influence of the pressure on the viscosity decreases as the shear rate increases, the viscosity still rises by 27% at a shear rate of 5000 s^{-1}.

The results for polypropylene are even more pronounced. At a shear rate of 50 s^{-1}, an increase in pressure from 50 to 1000 bar actually increases the viscosity by 122%, and at a shear rate of 5000 s^{-1}, the increase in viscosity is 89%. In comparison, a melt temperature increase of 20°C reduces the viscosity by only 16% at the same shear rate (see chart).

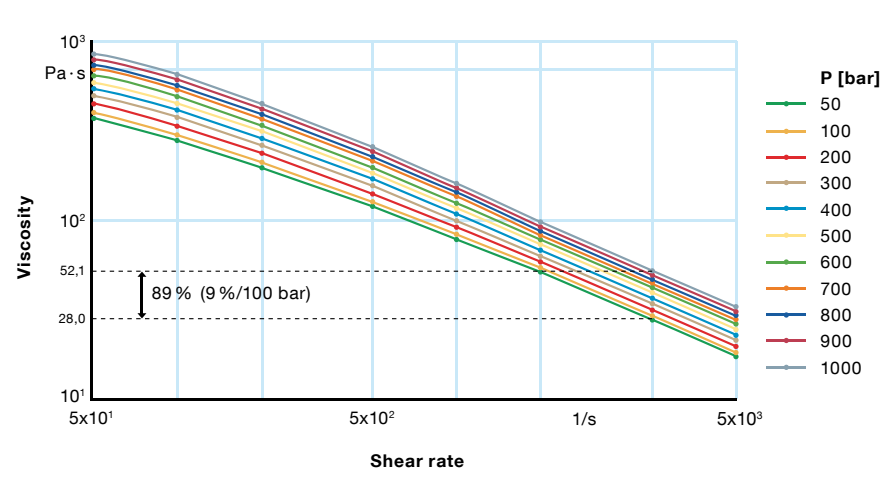
Specific adjustment of the clamping force

The effect that the pressure dependency of viscosity has on the clamping force is shown using a flat thin-walled part measuring 140 (L) x 70 (W) x 0.5 mm (H) in size as an example. A four-cavity mould was employed for the tests, and the reference data provided for the polypropylene material was consulted.

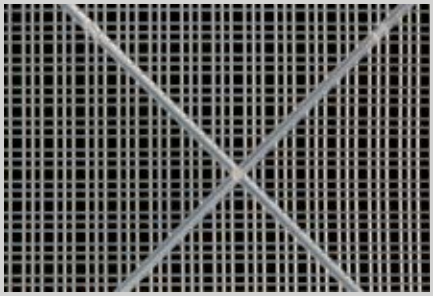
The mean velocity of the melt front was chosen so that a representative shear rate of 5000 s^{-1} would prevail in the cavity. When using a 30-mm screw, this is equivalent to an injection speed of about 115 mm/s. The filling time in this case is 0.26 s. When the viscosity's pressure dependency is ignored, the pressure required to fill the cavity is 810 bar in the gate area. Assuming a practical linear pressure drop until volumetric filling of the cavities, this results in a necessary clamping force of 1,590 N at a mean filling pressure of 405 bar over the planned surface of the moulding.

If, however, the pressure dependency is taken into consideration, the viscosity rises and the pressure needed for volumetric filling of the cavities rises from 810 to 1,340 bar. This means the clamping force needed rises from 1,590 kN to 2,630 kN.

The measurements and calculations were performed during a project at the Institute for Polymer Injection Moulding Technology and Process Automation at the Johannes Kepler University in Linz, Austria.



Viscosity of the polypropylene examined as a function of shear rate and pressure – at an increase in pressure from 50 to 1,000 bar and a shear rate of 5000 s^{-1}, the viscosity rises by 24.1 Pa s (86% or 9%/100 bar).



Numerous new applications – in the field of filter elements for example – require minimal wall thicknesses to achieve the desired functionality.

The headquarters of GW Plastics are located in Bethel, Vermont.

Out of the comfort zone – **into new markets**

Thanks to highly automated moulding cells, internal tooling capabilities and comprehensive material expertise, GW Silicones has secured competitive advantages for itself in the North American market. For the continuing expansion of its production capacity, the subsidiary of GW Plastics – with headquarters in Bethel, Vermont, USA – trusts tie-bar-less injection moulding machines from ENGEL. Because not only do they guarantee high efficiency, but they offer a great degree of flexibility as well.

Since it was founded in 2008, the silicone division of GW Plastics has grown considerably, expanding in 2012 to a newly constructed building with a large cleanroom in Royalton, which is only about three miles from Bethel. Since its inception, the machine park has been continuously expanded and the design and tool making facilities have been strengthened substantially. They have big plans. Mark Hammond, General Manager of GW Silicones, says: "Silicone has great potential and its use will continue to increase, particularly in medical technologies and health care. Again and again we see how product designers will call out for a TPE or TPU, but the product's end-use requirments will often drive them to silicone. The product developers are still more familiar with thermoplastic materials, but this comfort zone needs to be challenged. Silicone offers great benefits for many applications, and beyond that it opens up completely new markets and product opportunities."

"Flexibility is essential for us. ENGEL can help our customers achieve a competitive advanatage in the marketplace."

John J. Silvia, Vice President Manufacturing Engineering and Chief Safety Officer at GW Plastics

LSR wins the race

An example is in the production of a thin-walled fluid delivery device for surgical care that GW Silicones helped to develop and manufacture for a leading healthcare OEM. In the early product development stage, the OEM viewed materials costs as a critical factor. Initially, the OEM chose to go with TPU, because it was generally thought that liquid silcone rubber would be cost prohibitive. It was only after the product launch had to be postponed several times due to problems in the injection moulding process that the medical device company commissioned GW Silicones to develop a solution based on LSR. The TPU required extremely high injection pressures in order to reliably fill the thin walls, and the risk of rejects was correspondingly high. In addition, it required a large injection point and a hot runner, further reducing the material efficiency. Altogether, the result was a

process that was too slow, too unreliable, and in the end too cost-intensive.
"We have succeeded in meeting the high demands on quality and functionality for our customer while engineering in a very high level of production efficiency," says Hammond. The first tests, run with a single-cavity development mould designed by GW, proved LSR was a good choice. To the delight of their customer, the product is now being moulded in mass production, using high-cavitation tooling and offering competitive unit costs.
For GW, this is not an isolated example. GW Silicones' customers are primarily in the medical device and healthcare industries, and the production plant in Royalton is geared toward this clientele. Together, GW's two facilities in Bethel and Royalton integrate both silicone and thermoplastics expertise, and are progressively developing more multi-component and multi-material processes for their customers.

Compact production cells and great flexibility

Many current manufacturing trends in single- and multi-component processes, in both silicone and thermoplastics, are the result of the increasing cost pressure in medical technologies. At GW, this results in even higher demands on product quality, efficiency and flexibility, particularly when producing disposables in high cavitation tooling. These factors play a key role when choosing a new injection moulding machine and are the reason GW Plastics chooses the tie-bar-less ENGEL e-victory as one of the preferred machine designs. "The tie-bar-less design provides an enormous amount of flexibility," explains John J. Silvia, Vice President Manufacturing Engineering and Chief Safety Officer at GW Plastics. "Even with large moulds, we can keep the footprint of the manufacturing cell compact, and it is very easy to automate the process."
Currently, the largest moulds developed have 32 cavities, and the upward trend in higher mould cavitation is continuing. "There are only few companies in the USA that can construct moulds of this quality and size for high-precision and fully automated LSR processing," says Hammond. "That is our unique advantage."

Automation integrates further process steps

GW often purchases injection moulding machines and robots as an integrated package. "In silicone processing, the trend is moving towards fully automated production," says Hammond. The high level of automation at GW Silicones also includes the integration of upstream and downstream processes. For example, some products are printed and packaged directly at the machine immediately after the injection moulding.
For GW Plastics, automation and process integration have to do with more than just greater efficiency. The important thing is to achieve greater quality and process consistency and, ultimately, greater customer satisfaction.

James Moran, Business Unit Manager at ENGEL North America, Mark Hammond, General Manager of GW Silicones, Franz Pressl, Product Manager at ENGEL AUSTRIA, and David Girioni, President of Girioni Associates, ENGEL's sales representative agency in the Northeast (from left)

The tie-bar-less machine design speeds up the set-up processes.

Since it was founded, the silicone division of GW Plastics has grown considerably.

Visible and functional parts for household appliances, vehicles, medical equipment and the construction industry are the specialty of Eifler Kunststoff-Technik.

Smart technologies
for brilliant results

Vacuum cleaners and dishwashers do not have an easy life. They get pushed and kicked around, operated with greasy fingers and cleaned with strong detergents. Eifler Kunststoff-Technik takes on the challenge of fabricating extremely robust visible components for these appliances that are both functional and have a sophisticated optical finish, and yet can be produced at competitive unit costs. The key to success: reliable injection moulding technology, creative processes and a great passion for plastics.

The fact that Eifler Kunststoff-Technik (EKT) exists is due to the vision of its executive director Volker Scheffels. When its original parent company became insolvent in 2005, the fate of the plastics processor from Bielefeld, Germany, seemed to be sealed. Scheffels – who had a position at the company headquarters at the time – recognised how much potential the operation had to offer. His decision: to save the injection moulding business and run it as an independent company. He found an investor with Dieter Eifler, founder of the Eifler Group, and was able to win Miele as a major customer that would utilise the capacities to a large extent. Since then, the company has relocated to Bad Salzuflen and grown continually, attracting many new customers and tripling the staff. Currently, the third major expansion of their production facilities is being completed. In the autumn of last year, the company won the the prestigious German "Grand Prix of Medium-Sized Enterprises" business award.

The company also achieves exceptional technological accomplishments. "While the struggle for ever lower energy consumption has long been a dominating issue, today, design is also one of the most important distinguishing features in the household appliance market," explains Volker Scheffels. "Our daily challenge consists in combining high-quality optical design with top functionality, and yet still achieving very low unit costs." EKT has developed many processing technologies itself. For example, when it comes to high-quality and at the same time robust piano black surfaces, most state-of-the-art technologies are not economical and flexible enough. In-mould labeling is one of the specialties at EKT, but here it is combined with creative custom solutions as demonstrated by the example of vacuum cleaner control panels.

IML lays the foundation for fabricating small batch sizes efficiently and with short cycle times while realising surfaces that are both robust and of top quality. A cleanroom would normally be necessary for the high-gloss finish, but that would not be cost-effective. EKT therefore has their base film laminated with a protective film that is removed later.

The base film is usually colourless and transparent, because printing the film is also part of the expertise that EKT has achieved. The symbols for selecting the desired suction performance – for curtains, upholstery or carpet – are applied in white in an initial step. This

is followed by a transparent grey – for backlit warning symbols in day/night design – and finally black as the background. In contrast to conventional in-mould labeling, the unprinted side of the film adheres to the wall of the cavity while the melt bonds with the printed colour. "We must precisely tune the composition of the printing colour to fit the plastic granulate as well as the processing temperature and the geometry of the component. Only then can we prevent the colour from leaching around the injection point or becoming torn along ridges", explains Scheffels.
The films are brought into form mechanically, immediately before being back injected. A 3 mm rim is bent down at 90° so that the film cannot become loosened by the warm exhaust of the device. While most plastics processors that perform IML have their films thermally preformed by external suppliers, the production of the control panels at EKT starts with two-dimensional labels. "In this way we are much more efficient," emphasises Guido Bachmann, production manager at EKT. "We reduce the logistics effort and can stack the films in conventional storage facilities."
The preferred injection moulding machine model is the ENGEL victory with its tie-bar-less clamping unit. New machines are ordered with integrated robots. If ENGEL supplies both the injection moulding machine and the robot, the RC300 control unit for the ENGEL linear robot is fully integrated as a subsystem in the CC300 machine control unit. "In our experience, the integrated controls make it possible to program and operate even complex processes very easily," adds Bachmann. Process reliability and machine availability are key factors for EKT. The company in Bad Sulzuflen is the sole supplier for around 85 percent of its products.

EKT managing director Volker Scheffels, Christoph Hoelscher of ENGEL Deutschland and production manager Guido Bachmann (from left)

"The combination of functionality and optical finish will continue to keep us busy for quite some time," says Scheffels. The scratch-resistance of surface finishings is, for example, one issue. Hard-coating methods, as well as the ENGEL clearmelt technology with a polyurethane finish, are being discussed. In future, software solutions will also help leverage further potential for efficiency and quality. The installation of ENGEL e-factory is a first step. It makes it possible to network systems beyond the borders of a single location. EKT will be making use of these features in the near future, because it is establishing its first foreign production site in the Czech Republic, in the vicinity of a major customer. "Our goal is to be able to provide support for our employees in the Czech Republic from here in Bad Salzuflen," Scheffels explains. "Thus we are taking a first step towards Industry 4.0."
Just last summer, an 8,000 square meter plot of land was acquired next to the headquarters in Bad Salzuflen where two new production halls and a warehouse were erected in the course of the autumn and winter. Both investments have laid the foundation for managing the continually increasing order volume and growing customer base.

The melt is injected onto the printed side of the label.

EKT produces one million control panels a year in many variations.