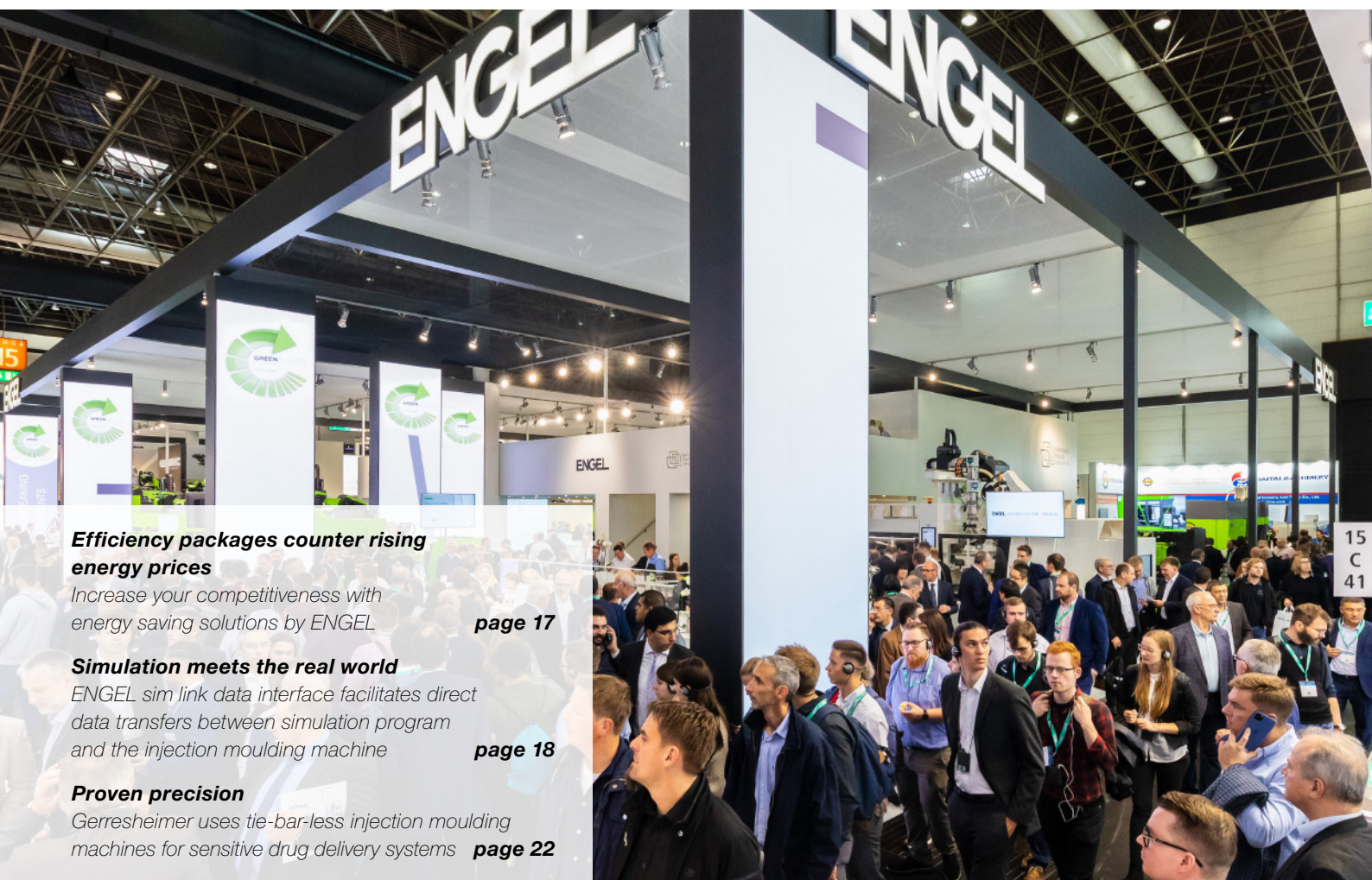


Injection



October | 2022

The magazine from ENGEL for the plastics industry



Efficiency packages counter rising energy prices

Increase your competitiveness with energy saving solutions by ENGEL

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Simulation meets the real world

ENGEL sim link data interface facilitates direct data transfers between simulation program and the injection moulding machine

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Proven precision

Gerresheimer uses tie-bar-less injection moulding machines for sensitive drug delivery systems

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Be the first. Together.

Welcome to ENGEL at the K show 2022

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ENGEL
be the first

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Dr Stefan Engleder
CEO, ENGEL Holding

Be the first ...

... means helping our customers – and that means you – to be pioneers in their fields. This is what motivates us at ENGEL day after day, and something we are excited to demonstrate to you once again at this year's K show. In line with this, the theme of our entire presentation at the show will also be our invitation to you: "Be the first!" – use our ENGEL solutions to be the leader in your field!

We have taken things a step further since the last K show three years ago. Neither the pandemic nor economic uncertainties were able to stop our research and development activities (page 12). One focus at our stand is on energy efficiency. After all, besides having an injection moulding machine with efficient drives, there are other tweaks for reducing energy consumption in injection moulding (page 17).

We have not just optimised our portfolio of solutions, but also our own processes. Our Sustainability Report summarises what we do as a company to keep the footprint of both our plants and our products small (page 8). For us, purpose has much to do with responsibility. We accept responsibility for our employees, for society and for the environment. For us, sustainable action is an obligation, a motivation and an essential part of being the first.

*Yours,
Stefan Engleder*

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Publisher: **ENGEL AUSTRIA GmbH** | Ludwig-Engel-Strasse 1, A-4311 Schwertberg, Austria, www.engelglobal.com
Editorial team: Susanne Zinckgraf, ENGEL | Ute Panzer, ENGEL (responsible editor)
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ENGEL worldwide. **Where you are.**

Pioneering spirit 25 years of ENGEL in India

Together with customers and partners, ENGEL INDIA celebrated its 25th anniversary – following a one-year delay due to the Covid pandemic. In 1996, ENGEL established a sales and service subsidiary in Mumbai. Starting with only 5 employees at that time, the team now counts 24. Early this year the subsidiary moved into new modern premises, which shows ENGEL's commitment to this important and dynamically growing market. Apart from the automotive industry, in which ENGEL has been strongly represented from the outset, the medical, packaging and technical moulding



Early this year, ENGEL India moved into new, modern premises in Mumbai. Other offices are located in Chennai, Delhi and Pune.

sectors open up a great deal of potential. In addition to the Mumbai location, there are now three sales and service offices, in Chennai, Delhi and Pune. ENGEL is strongly committed to training young technicians in India. Based on a program launched at ENGEL Austria, the subsidiary started an 18-month graduate trainee program this year. There is also a female trainee among the participants being trained to become a service technician. ENGEL is one of the pioneers in India with providing in-house training programs and promoting women in technical professions.

En route to the circular economy ENGEL joins R-Cycle



ENGEL joined the R-Cycle Community. The objective of this cross-company initiative is to introduce digital product passports for plastics products. All information relevant to recycling is recorded as early as the product manufacturing stage so that, for example, waste sorting plants can identify recyclable plastics more accurately and deliver single grade fractions for recycling. In this way, it is possible to recycle plastics on a par or even with added value. "You can only ensure the desired product properties if you know what you are processing." The product passport makes it possible to track the life cycle of materials and plastic parts," emphasises Dr. Gerhard Dimmler, CTO of the ENGEL Group.

Award for Peter Neumann Plastics Hall of Fame



Dr. Peter Neumann, CEO of the ENGEL Group up to 2016 has been inducted into the "Plastics Hall of Fame". The U.S. Plastics Industry Association (PLASTICS) has

presented this award since 1972, as an accolade for individuals who have made an outstanding contribution to the growth and success of the plastics industry. Commenting on the election of Peter Neumann, the association said: "Peter Neumann steered ENGEL through a period of rapid global growth. The company expanded fast in the 1990s. With Neumann as the CEO, sales revenues grew from 76 million to 1.36 billion euros." This is the second induction into the Plastics Hall of Fame for ENGEL. Peter Neumann's predecessor Georg Schwarz was given this honour in 2009.

Amazing potential ENGEL founds subsidiary in Morocco

ENGEL has strengthened its market presence in North Africa by establishing its own sales and service subsidiary in Morocco. Morocco, Tunisia, and Algeria offer a dynamic environment for injection moulding production with Morocco in particular showing stable growth and remarkable potential. "Morocco has established a significant production industry in the past ten years. The automotive sector in particular has grown noticeably", says Romain Reyre, the Managing Director of the new ENGEL



"We are building on a long-established market position in North Africa."

Romain Reyre,
ENGEL Maghreb

Maghreb Sarl in Tangier, who is also the Managing Director of ENGEL France. Right from the outset, ENGEL has been able to participate very successfully in this positive development. The opening of the Maghreb subsidiary is an important step towards further strengthening the proximity to our customers in this region. Numerous customers and partners took part in the official inauguration ceremony mid-June in Tangier.



Together with customers and partners, ENGEL inaugurated the new sales and service subsidiary in Tangier.

Successful partnerships ENGEL hands over state-of-the-art equipment to technical school



Official handover: ENGEL CTO Gerhard Dimmler (left) and Director Franz Reithuber.

A good balance between education and business awareness is key to facing the current challenges on the labour market. The HTL (Higher Technical Collage) Steyr and ENGEL have maintained a successful partnership for many years. In order to optimally prepare the students for their future jobs, ENGEL is providing the technical college with a new all-electric injection moulding machine and a new robot. "The great support we get from companies has made us one of the most modern higher technical colleges in Austria," says Director Franz Reithuber at the handover ceremony. "Thanks to this generous donation by ENGEL, we can promote practically-oriented learning in a more effective way. The best way to express our thanks is to return well-trained professionals to the company when they complete their training." Around 70 percent of ENGEL employees in Engineering are HTL graduates, and many employees in Development also have HTL training.

Anniversary in Prague 30 years of ENGEL CZ

ENGEL was the first Austrian machine manufacturer to establish a subsidiary in the Czech Republic. This was 30 years ago. In the presence of more than 200 guests – including customers, partners and representatives of the Austrian Embassy – ENGEL CZ, headquartered in Prague, celebrated this anniversary in the magnificent art nouveau Municipal House in Prague. All team members were invited to

Precise and cost effective elastomer injection moulding ENGEL at DKT IRC in Nuremberg

High prices for raw materials and energy are making life difficult for processors. At DKT IRC 2022 in Nuremberg, ENGEL presented three exhibits showing innovative solutions for the competitive production of seals, O-rings, and precision parts made of elastomers despite the current challenges. The exhibits included the flexseal series, a machine model especially designed for the production of seals, and a tie-bar-less, all-electric ENGEL e-motion TL perfectly suited for moulding very small precision parts. The showcase production of diaphragms on an e-victory demonstrated how tie-bar-less design can help to increase overall efficiency and to reduce unit costs. Conserving energy and resources was an important topic across all three exhibits. Beyond the machines' drive technology, it is digitalisation that helps to leverage the machines' full potential. ENGEL also used iQ weight control at DKT IRC. Visitors to the fair were able to watch the smart assistance systems live on the CC300 control panels of the injection moulding machines.



Leveraging the opportunities that digitalisation offers LIT Factory Symposium



Promoting the wider use of digital products: Dr. Gerhard Dimmler at the LIT Factory.

In his keynote at the LIT Factory Symposium 2022, ENGEL CTO Dr. Gerhard Dimmler highlighted the contribution that digitalisation can make to a sustainable plastics industry. From smart assistance to horizontal networking of companies along the value chain, the injection moulding industry can turn to a wide range of digital products and solutions that help to reduce the carbon footprint. In this context, the LIT Factory itself is the perfect example of a horizontal platform for cross-company, interdisciplinary collaboration. In the networked teaching, learning and research factory, more than 25 companies collaborate on new solutions for smart plastics processing, digital transformation and the recycling and up-cycling of plastics. They cover the entire value chain from raw material production to recycling.



Petr Stibor, President Europe East, (left) with Dr. Stefan Engleder, CEO of the ENGEL Group.

ENGEL worldwide. **Where you are.**

Focus on sustainability New technology centre at St. Valentin



The training room offers seating for eight participants – but it is also the perfect environment for a remote learning session.

ENGEL has opened a new technology centre at the large machine plant in St. Valentin. ENGEL offers a great number of large injection moulding machines on show for a wide range of applications. Customers can benefit from the opportunity to test ENGEL products and technologies in an environment that is close to real life production. The focus of this extended offering is on energy efficiency, digitalisation and the circular economy. ENGEL invested more than 14 million euros in the new technology centre. With a total floor space of 3400 square metres, the capacity of the technology centre at the location has more than doubled. The machinery is divided into four sections. The Applications Technology Centre for the large dual-platen duo series machines produced at the location, the Machine Technology Centre of the Technology Centre for Lightweight Composites, and the Packaging Centre are available to ENGEL customers for demonstrations, trials and joint developments. ENGEL uses a fourth area for its own development work. The opening of the technology centre at St. Valentin sees ENGEL conclude the largest investment programme in the history of the company. Over the last few years, ENGEL has invested more than 375 million euros into the expansion and modernisation of production plants around the world.

More than 10,000 guests Open house in St. Valentin

More than 10,000 guests came to the open house day at the ENGEL large machine plant in St. Valentin. Over the last two years the factory has grown visibly, which made the local people even more interested to see the plant. The new state-of-the-art office building, the spacious machine technology centre and the expanded production areas impressed the visitors. One very popular item on the agenda was the factory tour. Around 100 team members showed at 25 stations what makes the large machine plant so special. Machines and technologies focusing on the topics of sustainability and recycling were received with particularly great interest. Musical entertainment and a varied children's programme kept visitors in a good mood throughout the day. ENGEL is an important employer in St. Valentin and the surrounding area. Some 1,300 of the 3,700 Austrian workforce are employed at the large machine plant.



e-learning programme set for expansion ENGEL training and KIMW

A firm understanding of injection moulding machines, robots and the interaction of individual process steps means getting more out of injection moulding production – whether this be in the form of more productivity, more stable processes or enhanced product quality. ENGEL training supports customers with a comprehensive programme of further education and training options. For ENGEL, collaboration with partners in this area is critical. "We are expanding our training programme for



"e-learning allows us to tailor our training options more precisely to the specific needs and requirements of customers."

Kathrin Neunteufel-Steyer, ENGEL training

customers through cooperation agreements and helping participants to see the bigger picture and learn about other relevant areas of plastics processing," as Kathrin Neunteufel-Steyer, head of ENGEL training, emphasises. Kunststoff-Institut (the Plastics Institute Lüdenscheid (KIMW)) is a long-standing partner with whom ENGEL is now further intensifying its cooperation. A new programme of online training is being developed collaboratively.



New **ENGEL Packaging Centre**

Rising energy prices, establishing a circular economy and changing consumer needs pose serious challenges for manufacturers of plastic packaging. ENGEL has established a new Packaging Centre to support customers in this demanding industry by finding ways to increase the performance of production cells and ensure their competitiveness.

"Cycle time and energy efficiency are key performance indicators in the packaging industry. And ENGEL is industry leader worldwide in both sectors", says Christoph Lhota, Vice President of Business Unit Packaging at ENGEL. "This is precisely what we are demonstrating at the new Packaging Centre". Production cells for a wide variety of packaging applications are available at two locations – Schwertberg and St. Valentin. They include all-electric e-cap high-performance machines for manufacturing caps and flip-top lids, e-speed machines for thin-walled containers and pails, and duo speed machines for large containers. In addition, all-electric e-mac injection moulding machines can be used at the technology centre. After all, this series is also increasingly seeing use in packaging applications in the mid-performance segment, frequently for processing recycled material.

Energy efficiency as a central topic

Energy efficiency, the circular economy and digitalisation are the central topics which the new ENGEL Packaging Centre addresses. All of the injection moulding machines are equipped with smart assistance systems from the ENGEL inject 4.0 programme. For example, with iQ weight control, which detects fluctuations in the shot volume and material viscosity and automatically compensates for them in the same cycle. The latest series of tests have shown that the software achieves notable quality improvements in high-performance applications with very short cycle times. iQ flow control, which controls the temperature differences in the individual cooling circuits to maintain the set value, is a further example. "The

and automation solutions developed both in-house and by partners.

Premiere: rPP for foods

Some 300 customers and partners of ENGEL accepted the invitation to the Packaging Centre opening ceremony. There were keynotes, panel discussions and live machine exhibits at both locations. The speakers included technology and material suppliers as well as packaging producers. Prof. Edward Kosior from Nextek reported

key to high energy efficiency is that all components of a production cell work together perfectly. We make sure that the production cell meets the individual requirements", says Lhota. ENGEL offers the best drive technology for each packaging application with a wide range of machines. ENGEL cus-



We invite our customers to make use of the new facility and to test our injection moulding machines at the new Packaging Centre.

Christoph Lhota, Vice President, ENGEL packaging

tomers can bring their own moulds, and also their own materials, to the new Packaging Centre for a hands-on performance test including cycle time and energy efficiency analyses. On top of this, ENGEL provides many moulds from the various product groups. This offering is rounded off by a wide range of peripheral systems

on the opportunities food packaging production opened up by rPP. To fit this keynote, ENGEL staged a world premiere, presenting injection moulding of PP, recycled following post-consumer collection, in food grade quality for the first time. The opening of the Packaging Centre established a landmark en route to a circular economy. ■



More on ENGEL packaging:





From left to right: Stefan Engleder, Martin Weger and Klaus Fellner

Green is **more than a colour**

"We believe that a world with sustainable plastics is not only possible, it is also necessary," says Stefan Engleder, CEO of ENGEL, in the context of the ENGEL sustainability report which was published in June. During the TechTalk, he, Martin Weger, Vice President Global Quality and Environment, and Klaus Fellner, Team Lead Circular Economy, talked about the wide ranging sustainability activities of the ENGEL Group.

Injection: Mr. Engleder, "Green is more than a colour" is the title of the sustainability report that ENGEL published in the summer. ENGEL is not legally required to publish a sustainability report. How did you reach this decision?

STEFAN ENGLEDER: We decided to produce a sustainability report because it provides us and our customers with a certified and internationally acknowledged compendium. The report provides the answers to all the questions relating to sustainability

activities at ENGEL. This also helps to evaluate supplier relationships from these points of view.

Is there a particular customer segment where there is a particularly high demand for information?

STEFAN ENGLEDER: We have seen huge demand from the automotive sector in this context, often linked to specific requirements. But the sustainability report is intended to offer added value for all of our customers. Sustainability has become an important

factor of competition. And we want our customers to be able to use this to their advantage.

Mr. Weger, what exactly are the customers asking for?

MARTIN WEGER: Strictly speaking, the questions come from the consumers. These days end-consumers want to understand how the plastic products they are using were manufactured. It is important to look at the entire supply chain. If a product is produced on energy-efficient machines, but the

machine manufacturer sources its steel from companies that heavily pollute the environment, then the product cannot be classified as sustainable.

How can that be ruled out?

MARTIN WEGER: Processors are approaching this issue by, for example, developing questionnaires that we as suppliers complete. Sustainability rankings are also becoming more important for buying decisions.

ENGEL is ranked by EcoVadis, for example.

MARTIN WEGER: Exactly. EcoVadis is the world's largest provider of sustainability rankings. EcoVadis's rankings include data from more than 90,000 evaluated companies. We have just had an audit and are excited about

receiving the results to discover the areas in which we could take another step forward.

Where is ENGEL in the current ranking?

STEFAN ENGLEDER: We are in the top eight percent across all industries. Without having explicitly pointed this out so far, we have always been very much sustainability-oriented at ENGEL. As a family business, this is one of our core values; we see it as a matter of course. That's why we have achieved very good results in the ranking right from the start, even without putting up additional efforts.

This is where the circle to the sustainability report closes.

Stefan Engleder: The sustainability report is the basis for everything; it lays down the path for our sustainability strategy. On top of this, it reveals potentials; after all, we are looking to improve step by step. This progress is then, in turn, reflected in rankings such as EcoVadis.

In which area is ENGEL particularly advanced according to EcoVadis?

MARTIN WEGER: In the environment area. We are ranking in the top group in this category with only one percent of the participating companies. All told, we have a silver status in the EcoVadis ranking.

What activities have lead to this very good ranking?

MARTIN WEGER: The criteria cover many aspects, from environmental protection measures through to certifications and our carbon footprint. For example, we have now certified all our locations worldwide in line with ISO 14001 and ISO 9001.

Can you give us some examples of environmental protection campaigns?

MARTIN WEGER: Water is a very interesting topic. It shows the detail that EcoVadis puts into its audits. At the Schwertberg plant, we take cooling water from the River Aist, which flows directly alongside the plant. We use a closed circuit that makes losses and

contamination impossible. Another aspect is the fact that we have established recycling circuits for our waste materials, for metal chips, for example. STEFAN ENGLEDER: Green electricity is another very important topic for us. At the Austrian plants, we use one hundred percent green electricity. We generate some of this ourselves with our own photovoltaic systems. We are currently upgrading all our plants and our subsidiaries with PV systems, and we use geothermal energy in China.

Green power counts directly towards the carbon footprint. What does ENGEL's energy consumption look like?

STEFAN ENGLEDER: Energy efficiency is a very important topic at ENGEL, in two respects: for one thing, we offer our customers some of the most energy-efficient solutions on the market. And for another, we are constantly reducing our own internal energy consumption, by using state-of-the-art machines and production cells.

Where is the focus in further reducing the carbon footprint?

MARTIN WEGER: Essentially, it's about reducing our gas consumption even further. It accounts for 80 percent of our remaining direct emissions. To achieve this, we are evaluating various measures, for example, the expansion of photovoltaic systems, but also the use of biomass or geothermal energy, which Mr. Engleder already mentioned. We manufacture on three continents and, reflecting the local conditions, the steps taken at the locations often look different.



We are ranked in the top group in the environment category; it includes just one percent of all the companies audited. All told, we have a silver status in the EcoVadis ranking.

Martin Weger

Processing of recycled plastics makes a very large contribution towards reducing the carbon footprint.

Klaus Fellner

Go to the ENGEL Sustainability Report



Our vision is an absolutely sustainable, and at the same time profitable, plastics industry.

Stefan Engleder



Apart from supplier evaluation. To what extent do customers benefit from the steps taken? Mr. Fellner, we just talked about the energy consumption of ENGEL products.

KLAUS FELLNER: Many processors assume that they have used up all their options if they use an energy-efficient injection moulding machine. Having said this, mould temperature control is responsible for nearly 40 percent of the total energy consumption of a production cell. And this is precisely why ENGEL has been focusing on mould temperature control for more than ten years and has established a separate product programme for this.

Are there other tweaks that injection moulders can use to improve their carbon footprint?

STEFAN ENGLEDER: Of course. Efficient drive technology and smart assistance systems help to run the machine in the optimum operating state. This also reduces energy consumption and at the same time rejects, which indirectly contributes to the carbon balance.

At this point we also need to talk about processing recycled materials, for which ENGEL offers many solutions.

KLAUS FELLNER: Processing of recycled plastics makes a very large contribution towards reducing the carbon footprint. It is important to keep the bar low for entry into recycled material processing. Recycled material can be processed on any injection moulding machine by ENGEL.

So, where do the challenges in processing recycled material lie?

KLAUS FELLNER: Our goal is for recycled material to be used for a far wider range of applications. The focus on premium applications is crucial to replace the downcycling of products, which is still prevalent today, with recycling or even upcycling. Smart assistance systems contribute towards this, as do new processing technologies.

ENGEL is operating in many countries around the globe. What regional differences are there in the assessment of sustainability and the customer requirements?

MARTIN WEGER: The trend towards greater sustainability started in Europe, but other regions are now following as well. In North America, for example, legislation in many areas mandates the use of sustainable, energy-efficient solutions. And customers in Asia are also asking us about our carbon footprint. European supply chain legislation ensures that companies are moving in the same direction globally.

From a global perspective, the conditions are different. Especially when it comes to recycling. European companies certainly have an advantage here due to the good infrastructure with plastics collection systems. To what extent can we as a plastics machine manufacturer contribute towards establishing closed material cycles worldwide?

KLAUS FELLNER: Regional differences are definitely a major challenge. This is why we are establishing our own recycling experts in the USA and China as a first step. This strengthens our local recycling expertise and empowers us to bring our machines and technologies for processing recycled material more precisely in line with local requirements.

Depending on the region, costs are also an issue.

KLAUS FELLNER: Yes, sustainability has to make economic sense, in many regions even more so than here in Europe. Just look at direct processing of plastic flakes, which we are presenting at the K show, for example. The two-stage process saves a complete work step – that of repelletising. This massively reduces the energy consumption and therefore also significantly reduces the costs of recycling.

What possibilities are there to make a contribution via environmental initiatives?

KLAUS FELLNER: Environmental initiatives make a huge contribution. They bundle the expertise of many individual companies, achieving a greater impact and

attracting more attention by doing so. One example is the Alliance to End Plastic Waste, which ENGEL has joined. Among other things, the Alliance is working to establish collection systems in regions where a great deal of plastic still ends up in the environment and the sea.

STEFAN ENGLEDER: And let's not forget the projects right on our doorstep! We collaborate closely with universities to promote the circular economy and upcycling. For example, we partner with the Johannes Kepler University in Linz or the Institute for Waste Management at the University of Leoben. But, although we have made good progress in Central Europe, we still have a lot to do.

Mr. Engleder, what does your sustainability vision look like?

STEFAN ENGLEDER: Our vision is an absolutely sustainable, and at the same time profitable, plastics industry. Consumers around the world need to be able to rely on the fact that they are using plastic products in their everyday lives that are manufactured in a way that conserves resources and whose supply or value chains are ethically sound. This is how we can ensure prosperity, especially for the generations to come. ■

Be the first. Together.

Welcome to ENGEL at the K show 2022

ENGEL helps its customers to be the first when it comes to saving resources in plastics processing and securing competitive advantages by doing so. The focus is on digitalisation, the circular economy and energy efficiency. Explore at the K show 2022: hall 15 – stand C58 – and at the Circular Economy Forum in the outdoor exhibition area between halls 11 and 16.

ENGEL automotive: Improved cost efficiency in structural foam moulding

Structural foam moulding is more popular than ever. It saves raw material, energy and weight, supporting the objective of producing and using plastic parts in a more sustainable way by doing so. At K 2022, ENGEL is presenting a new type of system technology for plastics processors who produce parts in parallel on several production cells using the structural foam moulding process. Where each injection moulding machine previously required its own gas supply, ENGEL now offers the e-foam XL multi, a central units for supplying several injection moulding machines with highly compressed nitrogen for structural foam moulding. Only the plasticising and control technology is still decentralised on the individual machines. This new solution sees ENGEL significantly reduce the capital

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19 – 26 October
Hall 15 | Booth C58



outlay for structural foam moulding and make a major contribution to reducing unit costs. The new modular ENGEL e-foam XL multi systems, based on Trexel's MuCell technology, are offered exclusively by ENGEL. At its trade fair stand, ENGEL is demonstrating the huge potential of structural foam moulding technology on an ENGEL duo 1000 injection moulding machine.

ENGEL teletronics: recycled material for high-end visible parts

To be able to move forward with the circular economy, it is essential to use pretreated plastic waste in a far wider range of applications. Visible components with premium surfaces have posed a particularly great challenge here thus far. In order to achieve these surfaces directly in the injection moulding without secondary operations, a high proportion of virgin material is usually required, if recycled material can be added at all.



Featuring smart assistance software, the all-electric e-mac injection moulding machine automatically compensates for fluctuations in the raw material to ensure consistently high part quality. 100 percent of the rABS used to produce the premium electronics boxes is sourced from post-consumer waste collection.



At the K show 2022, ENGEL is collaborating with Roctool to demonstrate a new approach. TV boxes with a high-gloss finish are being produced on an e-mac 465/160 injection moulding machine. They are made from 100 percent rABS sourced from post-consumer waste collection. The cavity is laser engraved to create an innovative pattern on the top side of the boxes, and there are fixtures for installing fans and connectors on the side surfaces. The ultra-thin design – the wall thickness is 1.2 mm – additionally saves material. The key to the premium surface quality of this recycled component is the interaction between forward-looking machine and mould technologies. The all-electric e-mac relies on mould temperature control, based on Roctool induction technology, to enable outstanding moulding precision and the highest surface quality. New energy-efficient, compact and air-cooled Roctool generators are being used at the K show. The smart assistance systems from ENGEL's inject 4.0 portfolio used in the e-mac machine make a further contribution to high quality in the processing of recycled materials. The smart assistance systems include iQ weight control, which detects fluctuations in the raw material and automatically adjusts the injection profile, the switchover point and the holding pressure to reflect the current conditions in the same cycle. The application presented at the K show demonstrates the huge potential for the circular economy for manufacturers of household appliances, white goods, consumer electronics and telecommunications products. The proportion of virgin material can

be significantly reduced, to zero in the best case. Already today, many manufacturers are taking back end-of-life devices to recycle them and feed them back into production. Thanks to this combination of Roctool induction technology and smart digital assistance systems by ENGEL, even demanding housing parts with a very thin and complex geometry can now be produced from 100 percent post-consumer recycled material in a cost effective and sustainable way. Other system partners involved in the project's success include Moldetipo, Standex, Lavergne and INCOE.

ENGEL packaging: Processing rPET in thin wall injection moulding

In cooperation with partners ALPLA Group, Brink and IPB Printing, ENGEL is presenting a quantum leap for the packaging industry at K 2022. For the first time, thin-walled containers made of PET can be produced in a single injection moulding process

step. Featuring a wall thickness of 0.32, the transparent, round 125-ml containers are representative of a whole genus of packaging, especially in the food industry. Thanks to integrated in-mould labelling, the containers are ready-for-filling as soon as they leave the production cell. The special feature in this application is the material. The thin-walled containers are produced directly from recycled PET (rPET) in a single processing step. Up to now it has only been possible to process PET in thick-walled parts such as bottle preforms in injection moulding. The final shape of the packaging was formed in a second process step – by blow moulding for example.

Bottle-to-cup and cup-to-bottle is the target

Under the European Plastics Pact, the intent is for all plastic packaging to contain 30 percent recycled material and to be 100 percent recycling capable by 2025. The typical materials for packing foods in thin-thin-walled containers are polyolefins or polystyrene. But experts estimate that it will be impossible to achieve the stated objectives with these materials. And the recycling flows lack the approval of the European food authority, EFSA. rPET offers a solution. PET offers the benefit of a close recycling loop already being in place. To date, PET is the only packaging material which can be processed as a recycled material on an industrial scale to create food packaging. This innovation sees the partner companies pave the way for removing the need to downcycle packaging products other than bottles. This would substantially extend the range of uses for PET and rPET. In addition to the bottle-to-bottle cycle, this also means that the establishment of bottle-to-cup or even a cup-to-bottle recycling is conceivable.

Injecting at 1400 mm per second

An e-speed 280/50 injection moulding machine is the heart of the production cell. ENGEL specifically developed this hybrid machine



Thanks to the new high-performance injection unit, thin-walled containers made of PET and rPET can be produced on the ENGEL e-speed. Thin-wall rPET containers are moulded live at the K show.

with its electrical clamping unit and hydraulic injection unit for the high performance requirements of thin-wall injection moulding. At K 2022, ENGEL has once again boosted the power of this machine series. The new high-performance injection unit achieves injection speeds up 1400 mm per second at a maximum injection pressure of up to 2600 bar when processing small shot weights with an extreme wall-thickness to flow path ratio. This makes it the most dynamic injection unit on the market worldwide. To process rPET, ENGEL combines the new injection unit with a plasticising unit specifically designed for processing recycled material. During plasticising and injection, the viscosity of the PET is configured for thin-wall injection moulding. The new ENGEL e-speed supports the processing of arbitrary recycled materials up to one-hundred percent rPET.

ENGEL medical: Maximum output on the smallest footprint

Small footprint and energy efficiency are becoming more important features when it comes to injection moulding machines. ENGEL is establishing new records in both aspects at K 2022. On a minimal footprint, an all-electric high-performance machine is producing two-component sample vessels for medical diagnostics under cleanroom conditions. At the heart of the production cell, is an all-electric ENGEL e-motion 160 combi M injection moulding machine, and again this is a first. The combi M design was previously only available for large machines, ENGEL is, for the first time, presenting an injection moulding machine with just 160 tonnes clamping force and a horizontal indexing table in Düsseldorf. In the combi M design, the indexing table divides the mould closing area in the centre to operate two moulds in parallel. This makes combi M technology useful both for integrating two-component injection moulding and for doubling the output, if two identical moulds are



Extremely compact: combi M technology reduces the production cell's footprint. Under cleanroom conditions, ENGEL is moulding two-component sample vessels for medical diagnostics at its stand at K 2022.

mounted. The combi M machines are equipped with two injection units. One unit is located on the stationary platen, the second on the moving platen.

Machine footprint reduced

The diagnostics components are two-component parts. The core with cylindrical cavities is injected in the first step using dyed PC. Then the indexing table rotates in order to seal the cylinders with transparent PC on one side with lenticular covers in a second step. The two moulds, with 32 cavities each, come from Hack Formenbau. combi M horizontal rotary table technology saves floor space, especially where multiple-cavity moulds are used. A comparable 32-cavity mould with a vertical rotary table would have needed a machine with at least 280 tonnes clamp force. In this application, horizontal rotary table technology reduces the machine's footprint by more than 20 percent. On top of this, the smaller machine consumes less energy.

ENGEL technical moulding Improved cost effectiveness

The production of stackable logistics boxes and crates poses huge challenges. Continuous efforts have been made to increase production efficiency and reduce unit costs. But this must not impact on product quality. After all, the crates need to bear heavy loads and be stable when stacked high. And consistent weight is equally important as tare values are specified in many cases. One important parameter for improving productivity and cost efficiency simultaneously is the cycle time. Large, multiple-use containers

with a shot weight of 2000 grams are being produced in HDPE in less than 25 seconds at the ENGEL stand – some 30 percent faster than was previously possible. Thanks to the perfect combination of injection moulding machine, digital solutions, automation and mould, ENGEL in collaboration with HAIDLMAIR, are setting a new standard.

High-speed machine with small footprint

An ENGEL duo 8310/700 speed injection moulding machine is the core of the production cell. The duo speed series was developed by ENGEL to meet the requirements for extremely cost effective manufacturing of storage and transport containers as well as pails. In the range of large tonnage machines this series combines outstanding productivity and efficiency on a small cell footprint. ENGEL now offers a dual-platen machine for a segment previously reserved to toggle-lever machine. The advantage of this design is, that it is shorter than a toggle-lever machine with a comparable clamping force, while providing a larger opening stroke. ENGEL duo speed injection moulding machines achieve dry cycle times of less than two seconds and ensure excellent repeatability. The robust components make it run smoothly. The newly developed high-speed injection unit reaches an injection speed which is twice as high as that of the standard injection unit. As a result, the duo



The duo speed series, tailored to packaging and logistics applications, is based on more than 25 years of experience with large dual-platen machines. The manufacture of large logistics products is under extreme cost pressure. The cycle time in the injection moulding process is a critical factor when it comes to unit costs.

speed machines can keep pace with the trend towards even thinner wall thicknesses with long flow paths.

Faster injection of large shot volumes

HAIDLMAIR technologies make a further contribution towards the very short cycle times. The high-performance mould features a 6x FDU Midi SLS type hot runner system by HAIDLMAIR subsidiary FDU Hotrunner. This is an innovative wide-slot nozzle which, compared to conventional needle valve systems, allows large shot volumes to be injected into the cavity far faster without generating high friction energy. Additionally, hybrid inserts ensure optimum cooling and excellent heat transfer. Sensors on the inside of the mould – for measuring the internal pressure, analysing the material flow and determining the crystallisation effect – contribute towards a high level of stability.

ENGEL elast:
Production of LSR precision parts
At the K show 2022, ENGEL and NEXUS Elastomer Systems are presenting an innovative solution



for the production of umbrella valves made of LSR. The high-end production cell combines maximum output with maximum quality consistency to improve cost effectiveness. Umbrella valves are used in a wide range of applications. The precision of the parts is safety-relevant. To fully leverage the quality and efficiency potential, the production cell combines an e-victory injection moulding machine and smart digital assistance systems with NEXUS's innovative mould and plasticising technology. The cell is running a 64-cavity mould, fully automated with an ENGEL easix articulated robot and an integrated vision system.

Consistent quality with iQ

Featuring tie-bar-less servo-hydraulic clamping and electric injection units, the e-victory is the perfect machine for precision applications with LSR. The design features of this machine support low-flash, rework-free processing of LSR. The excellent accessibility and the space available in the mould area are unique. Where multiple-cavity moulds are used, smaller machines than the mould size would normally dictate can be used in many cases.

Networked via OPC UA

The ServoMix X20 LSR dosing system is connected with the injection moulding machine via OPC UA and MES authentig by TIG. This ensures full process data monitoring and complete traceability down to the level of the individual cavities. This is the first time that ENGEL shows an injection

The optimum holding pressure time is often lower than the holding pressure time set manually. Consequently, the cycle time is reduced.



A large number of cavities, combined with maximum precision and compact automation, take the mass production of umbrella valves made of LSR to a new level of efficiency. LSR umbrella valves are safety-relevant and functional components in many applications. The requirement for the injection moulding process is "zero defects".

moulding machine and an LSR dosing unit connected via OPC UA Euromap 82.3 standard live at a show. The exhibit shows that connecting and networking equipment makes production processes faster, more transparent and reliable.

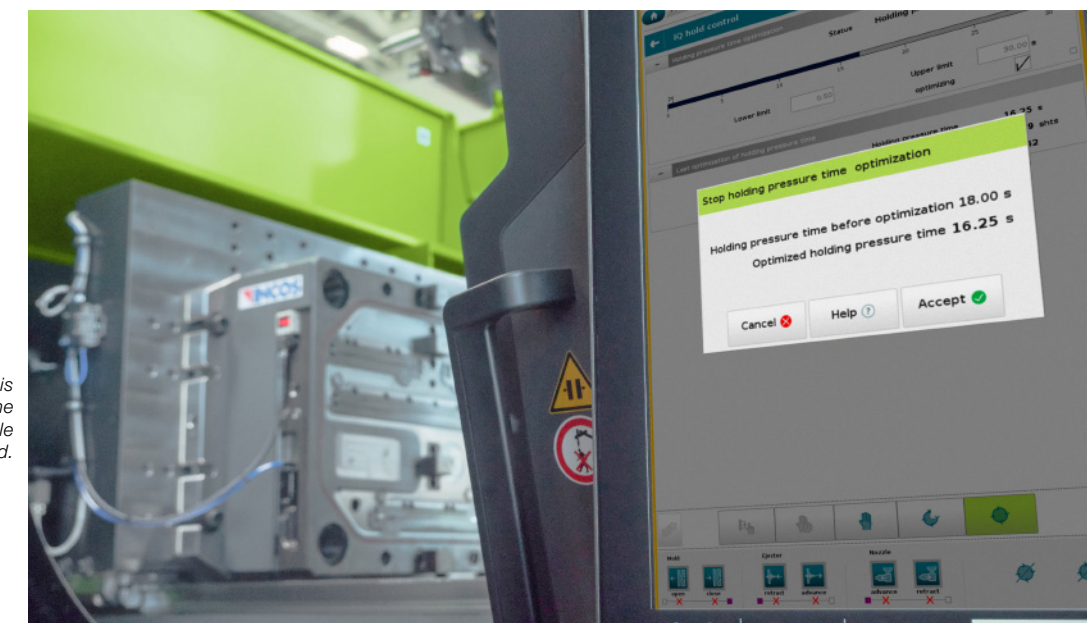
ENGEL inject 4.0: New smart assistant for nominal values shortens sample validation process

ENGEL is introducing a new member of the iQ product family at K 2022. The new smart assistant for nominal values goes by the name of iQ hold control; it automatically determines the optimum holding pressure time to help process technicians achieve time savings. The holding pressure time is one of the quality-driving parameters. This is why it is individually configured after mould set-up and typically determined empirically. Determining what is known as the sealing point not only takes a lot of time, it also consumes a lot of raw material, since several parts first need to be moulded and analysed in the quality lab. The new holding pressure assistant by ENGEL takes this responsibility off production personnel's shoulders, saving both time and raw material. The holding pressure time is calculated based on mould breathing and screw position. iQ hold control analyses both values and suggests the optimum holding pressure time via the

machine control unit after just a few cycles. The hold pressure time is determined objectively, meaning that even less experienced process technicians can adjust the process parameters. The efficiency of the cell is increased as well, if the automatically calculated holding pressure time is lower than the manually set value. Consequently, the cycle time is reduced. And the energy consumption is decreased. Visitors to the K show can experience iQ hold control in action. Connectors for automotive electronics are being produced on an e-mac. The machine features all available smart assistance systems. The smart assistance systems can be activated and deactivated individually to allow show visitors to experience the feature live. This makes it easy to see, how the individual iQ solutions translate to benefits in plastics production.

ENGEL Automation Technology: viper 4 saves space and energy

The new viper 4 sees ENGEL extend its series of linear robots and take a



new approach. The use of low-voltage drive technology significantly boosts energy efficiency. This innovation is another contribution towards a neutral eco balance in plastics production. Now available in eight sizes – for nominal load-bearing capacities between 3 and 120 kg, the ENGEL linear robots can be customised to any automation task in injection moulding operation. The new viper 4 is primarily used for picking and placing small moulded parts. It is designed for load carrying capacities of 3 kg downstream of the swivel axis and for use on machines with a clamping force of up to 2200 kN. In simple pick-and-place applications, the viper 4 achieves a dry cycle time of 5.5 seconds, with a picking time of less than 1 second.

Energy saver switch for vacuum

The special thing about the new viper 4 is its extremely low energy consumption. In a standard cycle of 6 seconds with full strokes and the maximum possible dynamics, the energy consumption is 200 Wh an hour. This means that the small robot only consumes the same amount of energy as a conventional CAD desktop workplace. The viper 4 relies on



Mit dem neuen viper 4 ergänzt ENGEL seine Linearroboterbaureihe nach unten.

48-V drive technology and only needs a 230-V AC single-phase power supply. And, for the first time, all vacuum circuits feature an energy-saving function as standard. The vacuum is controlled by a flow program to reflect requirements. Depending on the application, this reduces the energy required for the vacuum circuits by up to 80 percent.

ENGEL Service Level Agreement makes maintenance easy

The more complex the production cells, the more confusing the service offerings can become. ENGEL puts an end to this. We made it our target to make things easier for our customers. We bundle essential and useful services in a single contract at a fixed rate. ENGEL assesses the specific requirements together with the customer and takes into account individual preferences when setting up a Service Level Agreement. Each Service Level Agreement is tailor-made for the client. The contract components can include, for

example: remote maintenance tools such as e-connect.24 and e-connect. expert view for fast online support, tools for condition-based preventive maintenance from the e-connect. monitor program, the protect plant protection package, agreements on the availability and response times of service technicians, and training for operating and maintenance personnel.

Your maintenance roadmap

The Service Level Agreement is a kind of roadmap that guides you through maintenance and service intervals. The contract helps processors keep track of events, plan ahead of time, not miss any actions, and put their own resources to better use. Availability and performance of your equipment as well as part quality will increase. According to analyses by ENGEL, up to 20 percent higher OEE can be achieved. ■



ENGEL at K 2022



After-sales service requires individual solutions just as much as project planning for machines and production cells.

ENGEL at K 2022

Efficiency packages counter rising energy prices

Rapid increases in energy prices see plastics processing companies face huge challenges; after all, it is typically difficult to pass these costs on to the customer. The key to safeguarding competitiveness is saving energy. ENGEL is offering tailor-made efficiency packages to help customers reduce energy consumption.

With its great expertise in systems solutions, ENGEL does not focus on the injection moulding machine alone when optimising energy consumption. The new efficiency packages include matching temperature control solutions and smart assistance systems. This means that energy savings of up to 67 percent are possible, given a hydraulic injection moulding machine with a fixed displacement pump.

Efficiency factor no. 1: The injection moulding machine

When selecting a new injection moulding machine, the focus is on the drive technology. In collaboration with the processor, ENGEL analyses the requirements to find the best possible balance between energy consumption and machine output for the product to be manufactured. The overall efficiency is decisive. To avoid energy losses, ENGEL relies on servodrive technology

and consistent insulation of the barrel, among other factors. From servo-hydraulic, through hybrid, to all-electric, injection moulding machines by ENGEL are some of the most efficient on the market in their size and performance classes.

ecograph plus and ecobalance are important integral parts of all efficiency packages; after all, transparency is the platform on which energy efficiency can be optimised. The Plus version of ecograph measures the energy consumption of all plant components – including the peripheral units and hot runners – and displays them in an easy-to-read overview. Based on these values, ecobalance distributes the total power defined for the machine or production cell in question across the injection moulding cycle in line with demand. This means that energy peaks and the risk of penalties can be avoided.

Efficiency factor no. 2: Temperature control

Mould temperature control is responsible for almost 40 percent of the total energy consumption of a production cell. This makes it by far the greatest energy

consumer in injection moulding. In the efficiency packages, all injection moulding machines are equipped with e-flomo and e-temp for this reason.

The maintenance-free e-flomo temperature control water manifold systems monitor the flow rate, pressure, temperature and temperature difference, helping to avoid errors and ensure consistently high part quality. e-temp type temperature control units are fully integrated into the CC300 controller of the injection moulding machine via OPC UA. In this way, the speed of the temperature control water pumps is automatically adapted to match the actual demand, and this has a direct effect on the energy balance.

Efficiency factor no. 3: Digitalisation

Smart assistance systems help processors leverage the full potential of the injection moulding machine. iQ flow control is the smart assistance system, which ENGEL specifically developed to optimise the temperature control processes and has integrated as an essential part of its efficiency packages. Based on the measured values determined by e-flomo, the software actively controls either the flow rate or the temperature difference in the individual circuits. This means that the thermal conditions in the mould remain constant even if there are fluctuations in the system. The result is very high repeatability and minimum cooling water and energy consumption. ■



Saving energy with ENGEL





Production of interior door components clearly shows how valuable sim link is.

Simulation meets the real world

The new sim link data interface links simulation and the real-world process. The aim is to provide plastics processors with even better support throughout the product lifecycle – from product development and mould design to serial production. The example of a family mould for the manufacture of automotive components clearly demonstrates how sim link speeds up sample validation for injection moulds and the optimisation of the injection moulding processes while increasing productivity.

A wealth of information is generated even before mould configuration for a newly developed injection moulded product. CFD simulation is used, for example, to identify possible injection points, check the filling behaviour of cavities, set boundary conditions for the injection moulding process and optimise mould cooling. Where the results of the simulation are satisfactory, mould production can begin, followed by pilot sampling, optimisation of the machine settings and finally series production. During sampling, however, it is often the case that cavities need to be re-worked to achieve the required product quality. This can drive up project costs significantly and lengthen time-to-market for the new product.

The possible causes of the additional overhead include the fact that many process parameters defined in the simulation are not transferred to the production process, or that the selected injection moulding machine, for example, cannot adopt the volume flow from the simulation. But why is this the case? The main problem is that the values generated by the

simulation process need to be converted in a time-consuming process and that the simulation fails to consider the machine's limits. Conversely, simulation technicians are given virtually no feedback on the quality of the configuration data record supplied with the mould or the quality of simulation. With sim link, ENGEL is aiming to break through this data barrier. The data interface makes it possible to adapt the findings and parameters gained through simulation prior to mould production for a specific machine, and then transfer them to the injection moulding machine's control unit

as an initial set of proposed settings, while – on the other hand – feeding the physical process data back to the simulation. The aim of this is to progressively enhance the quality of the simulation. In this way, simulation technicians and production technicians can use each other's expertise and findings, and learn from one another.

The more realistic the simulation, the greater the benefit

The accuracy of simulation is largely dependent on modelling and the quality of the material data and input parameters. The more realistic the simulation, the better the results and the greater the benefits of simulation. sim link therefore works equally well as a postprocessor (exporting initial settings for the injection moulding

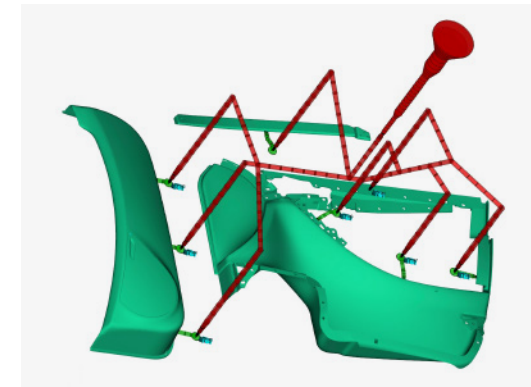


Figure 1: The simulation model was set up in the Moldflow simulation program by Autodesk.

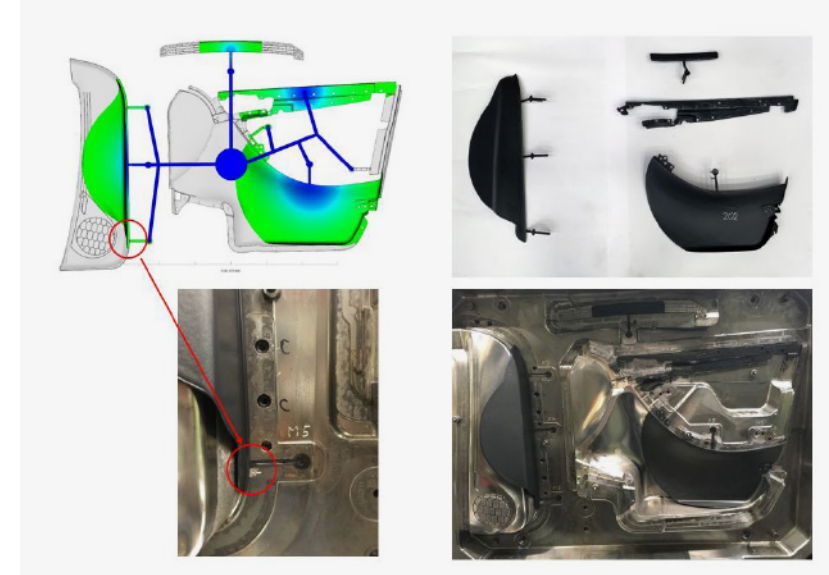


Figure 2: In the simulation, care was taken to ensure that for all needle shut-off nozzles, the flow fronts for the respective cavity and the needle shut-off nozzle to be opened meet at the gate in order to avoid weld lines.

machine) and a pre-processor (importing production data). sim link aims to adapt the simulation for a machine and generate an initial set of proposed settings from simulation for an injection moulded product while steadily enhancing the quality of simulation via feedback from production. Currently sim link features three functions: modification, export and import. The modification function adapts the simulation profile to the physical dynamics of the selected machine, significantly improving the simulation quality by doing so. This means that both the machine dynamics and the machine limits can be taken into account as early as in the simulation, and that the quality can be significantly improved. Modification makes it possible to gauge whether a product can actually be manufactured on the selected injection moulding machine.

The export function automatically creates a parts data set from the simulation and transfers it directly to the control unit of the selected ENGEL injection moulding machine. In the process, the simulation settings are automatically converted so that they can be correctly interpreted by the control unit. In this way, the processor can transfer their settings from the simulation to the machine at the push of a button, and get started with production in a more efficient way. The import function transfers physical parameters and measured value signals from the production machine back to the simulation program, and automatically converts them for the simulation. Using this feedback, the simulation technician can verify the quality of the simulation, compare pressure profiles and build up more expertise.

Data security was a key consideration in the development of sim link. Sensitive data such as CAD files and information on complete simulation projects remain on the user's local systems and are not transferred to the ENGEL systems.

Avoiding costly reworking of finished moulds

In partnership with Oerlikon HRSflow and Borealis, ENGEL has put sim link through extensive practical tests. An automotive family mould with three cavities and one hot runner cascade, and eight servo-electrically controlled nozzles, was used to demonstrate the full potential. The parts were the interior trim for a car door, a map pocket and a stiffening element to be produced from polypropylene with 7% mineral additive.

The settings for producing of the parts were to be determined and optimised via simulation. The focus of the optimisation was a constant flow front velocity across all three cavities and optimum switching points for the servo-electric nozzles of the hot runner. In this family mould with cavities of varying sizes, the biggest challenge was to coordinate the cascading of the hot runner nozzles to the flow front position.



sim link hands on

"It is very important for the production specialists to meet up with the simulation engineers. Each iteration costs valuable time and money," says Gianluca Cappella, who is responsible for mould making at Intercable in Italy. By using sim link, the manufacturer of fastening systems and technical mouldings for the automotive and electronics industries can significantly reduce the number of iterations during pilot sampling and improve the quality of the simulation. This reduces the risk of delays in the start of production and keeps project costs within budget.

The simulation model was set up in Moldflow by Autodesk. It contained the cavities, the entire hot runner volume, the servo-electric needle shut-off nozzles and the machine nozzle, including some of the space in front of the screw (**figure 1**). Mold cooling was also included in the modelling and simulated.

First, a machine-independent simulation was performed using a relative injection profile. The injection speed was defined as a percentage volume flow by reference to the cavity filling level. As a result, the melt-front velocity at any point in the cavity is independent of the melt compression in the system. The aim for process setting was to maintain a constant flow front velocity throughout the filling process. The switching points for the individual hot runner nozzles were defined on the basis of the flow front position in the filling process. The specification was that the flow front in the cavity would meet the flow front from the nozzle at the respective gate. Machine-independent simulation made this easy. The opening times for individual nozzles are fully decoupled from one another, and also from the compression in the system. This showed that, by choosing machine-independent simulation, even a complex system can be optimised very quickly and with few iterations in the simulation.

Continuous process optimisation through simulation

In the machine-independent simulation, all initial settings were determined and adapted for the chosen injection moulding machine – an ENGEL duo

12060/1700 – using the sim link "Modification" function. To optimise the process further on the basis of the specific production machine, the machine-dependent settings obtained were simulated again. Since the result with the machine-dependent and therefore very realistic parameters was highly satisfactory, an initial data set was generated for sampling and automatically transferred to the CC300 control unit of the production machine using the "Export" function. The needle opening settings were configured manually based on the values obtained from the simulation. When starting up the injection moulding machine, the actual switchover point was retroactively set to match the simulation. sim link exports a reliable value so that parameter inaccuracies in the material data or barrel temperatures cannot result in overmoulding of the cavities. Good parts were produced from the outset. Further optimisation was not necessary.

Simulation technicians and production technicians learn from one another. The simulation quality is successively enhanced.

In the simulation, care was taken to ensure that for all needle shut-off nozzles, the flow fronts for the respective cavity and the needle shut-off nozzle to be opened meet at the gate in order to avoid weld lines. It was found that the initial simulation data matched the real production in a very accurate way (**Figure 2**). Similarly, on switchover from the speed-controlled injection phase to the pressure-controlled holding pressure phase, the level of concordance between the simulation and actual production was very high.

Learning from feedback for follow-up projects

To provide the simulation technician with feedback on the usability of the setting parameters determined in the simulation, the parts data and measurement results used in the real process were transferred back from the machine to the simulation program using the sim link "Import" function. Since sim link automatically edits and imports actual data from production, the simulation technician can start on the post-simulation and compare the simulation with the actual data at the push of a button. There is no need for time-consuming manual entry of values and profiles. And sources of error can be avoided. Of particular value is the fact that the actual machine behaviour is transferred to the simulation program with the actual profiles, including oscillation of the injection pressure during switchover

until the required holding pressure is reached.

The simulated flow-front velocity corresponds very well with the actual injection parameters (**figure 3**). When comparing the pressure profiles for the specific injection pressure, it is apparent that the prediction of the simulation returns a far lower peak value than the profile measured in the production process in spite of realistic process parameters (**figure 4**). A close look at the material parameters showed that the pressure dependency of the viscosity was not measured. In the cross-WLF model, which is generally used, the pressure dependency is described by the parameter D3. In this case, $D3 = 0$. Better congruence between the measured and the simulated pressure profiles was quickly achieved by adjusting the parameter using empirical values.

Feedback from production helps the simulation technician develop a better feel for the materials used in production and for the quality of the associated process parameters. In this way, the quality of the simulation is enhanced for other applications. For example, more accurate pressure predictions can be made for follow-up projects. Comparing the cavity pressure profiles can also provide additional information on aspects such as the quality of the material parameters stored in the simulation database. The cavity pressure profile has a major influence on shrinkage and distortion of the moulded part in question. Accordingly, the aim is to predict the mould cavity pressure profile as accurately as possible via simulation. ■

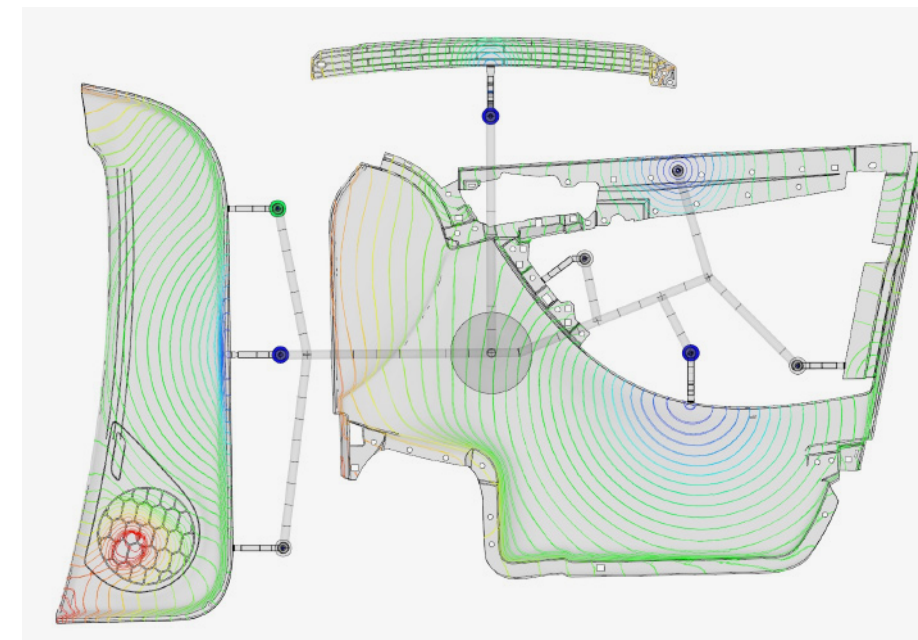


Figure 3: The simulated flow-front velocity corresponds very well with the actual injection parameters.



More details on
ENGEL sim link

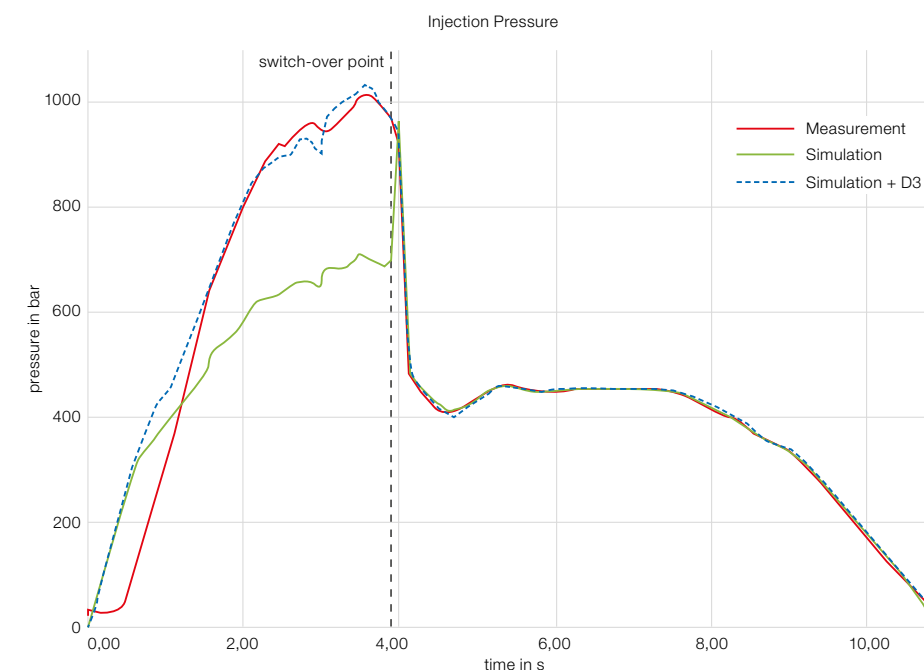


Figure 4: When comparing the pressure profiles for the specific injection pressure, it is apparent that the prediction of the simulation returns a lower peak value than the profile measured in the production process in spite of realistic process parameters. A close look at the material parameters showed that the pressure dependency of the viscosity was not measured.

Summary

ENGEL sim link is a versatile tool that directly transfers the simulation engineer's expertise to the production. Even before production with a mould starts, it is possible to check whether the injection moulding machine selected for production is actually suitable for the product in question. Modifying of simulation parameters to match the selected injection moulding machine makes it possible to use more complex injection profiles and realistically assess cycle times. Feedback from production helps to improve the quality of simulation, avoiding costly mould reworking.

The benefits:

- sim link enables a closed-loop process through simulation and production, including a digital twin.
- The simulation quality is continuously enhanced.
- The improved simulation quality reduces the number of optimisation loops in the mould design.
- The time-to-market is reduced.
- sim link is compatible with ENGEL

- injection moulding machines which use the CC200 and CC300 control unit generations.
- sim link works with Moldflow by Autodesk and Cadmould by Simcon.

Proven **precision**

Every year, Gerresheimer produces well over one hundred million inhalers in various designs for a range of pharmaceutical companies. Comprising many complex injection moulded parts, the inhalers are produced at Pfreimd, a town 40 minutes north of Regensburg by car. e-victory injection moulding machines from ENGEL are the company's guarantee of high efficiency. The decision-makers at Gerresheimer, however, had to work hard to convince their own staff of the merits of tie-bar-less injection moulding machines.

"Dimensional accuracy and process stability are our top priorities," as Peter Felber, Global Senior Director Operational Excellence at Gerresheimer, clarifies during a tour of the production plant. A high degree of dimensional accuracy is important for automated assembly, and especially to make sure that our products work reliably. The lives of patients with certain illnesses can depend on this reliability. Inhalers produced by Gerresheimer deliver medicines to counter asthma, COPD and cystic fibrosis, to give some examples.

ENGEL e-victory 740/180 injection moulding machines are used to produce what are known as drive tubes and other components for these inhalers. These cylindrical parts of PBT constitute various assembly and functional elements and enclose the drug cartridge in the fully assembled inhaler. Thanks to this new generation of inhalers, Gerresheimer customers are switching to an environmentally friendly and reusable system of exchangeable drug cartridges. To this end, several functionally relevant injection moulded parts needed to be redesigned. As a system solution

At ENGEL, the entire team gets behind the project from day one. This is what sets our partnership apart.

Peter Felber, Gerresheimer

provider, Gerresheimer supports an international client base at every stage, from product development and industrialisation to production, assembly under GMP and FDA conditions, functional testing, packaging and logistics.

Tie-bar-less clamping unit keeps production cells compact

After injection moulding, the drive tubes are automatically demoulded, stacked on trays and transferred to an intermediate storage facility. Since the high-bay warehouse is also part of the cleanroom, complicated packaging of parts is not necessary: The parts are quickly available for assembly whenever required. The special thing about the Pfreimd plant is that all cleanroom production areas – which together span over 20,000 square metres – are interconnected. This eliminates the need for staff to perform any infeeding or discharging procedures during work.

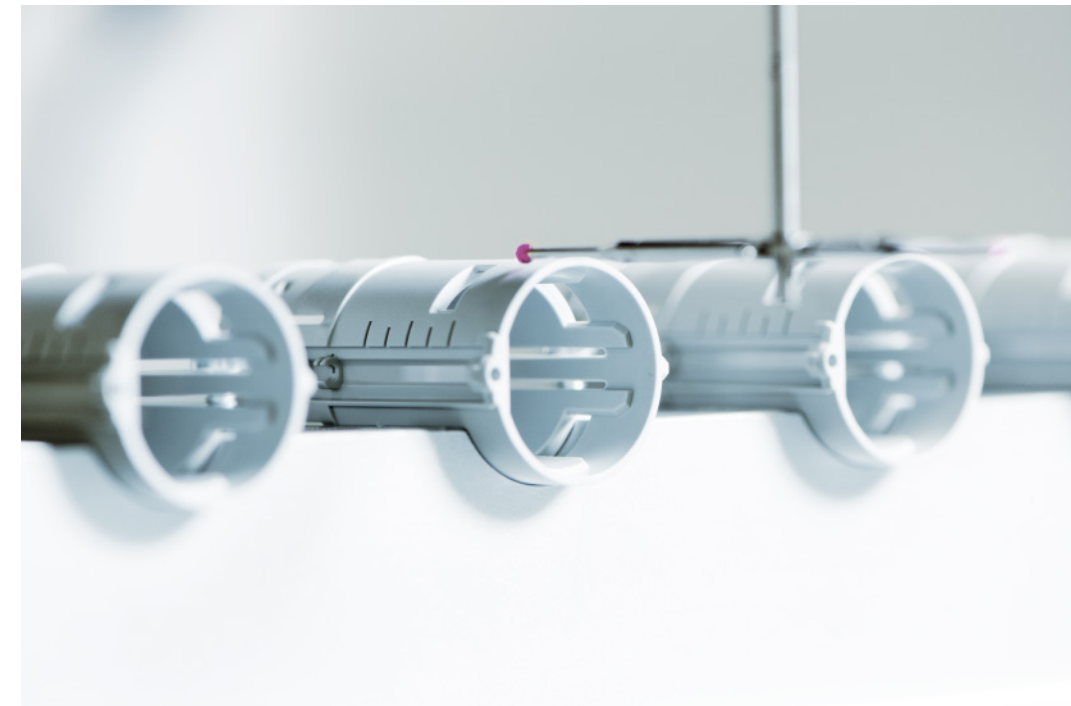
"It is important to ensure production space is utilised to the full in a cleanroom," emphasises Felber. To increase the amount of productive space, therefore, Gerresheimer is increasingly relying on heavily utilised multi-cavity moulds; and this generally calls for appropriately large injection moulding machines. With their tie-bar-less clamping units, e-victory machines really come into their own here. Because there are no tie bars in the way, the mould mounting platens can be fully used up to their very edges. This means that large moulds fit onto relatively small injection moulding machines, which enables a much more effective use of limited space.

This is also an advantage when using multi-cavity moulds or moulding products with complex part geometry that require sliders or core pulls. In both cases, the clamping force required to mould the parts is lower than the installed clamping force of a tie-bar machine with tie-bar spacing large enough to mount this kind of mould. "Using a tie-bar machine we would need a higher clamping force class for multi-cavity moulds," says Helmut Neuper, expert in injection moulding technology at Gerresheimer. "Tie-bar-less technology helps us to use smaller machines with lower energy consumption."

Tie-bar-less machines also facilitate side-entry of robots for part take-off which leads to a lower height of the system compared to machines with tie-bars. This facilitates the use of standard robots, even on production floors with low ceilings.

Consistent dynamic platen parallelism

Gerresheimer operates more than 30 tie-bar-less injection moulding machines, and plans to use this type in many forthcoming projects. However, reaching this point has been a long road. "At first, there were definite



The changeover to a reusable system also meant a new design for the drive tube, which holds the drug cartridge inside the inhaler.



Barrier-free access to the clamping unit makes manual work on the mould particularly simple.

reservations over tie-bar-less clamping units within our ranks," confirms Neuper. "What about platen parallelism when opening and closing a mould? Is it even possible to produce precision parts without tie-bars? Does tie-bar-less technology mean that moulds wear out faster? These were all questions for our experts." Seeking answers, the process owners contacted ENGEL in 2016. Not to order a tie-bar-less machine for production, but to measure the dynamic platen parallelism of the tie-bar-less clamping unit. Gerresheimer spent a whole year testing an e-victory machine, putting it through its paces. For this purpose, an XD laser measuring device was attached to the top of the mould and the distance to the moving platen was recorded. Multiple measurements were taken over the entire injection moulding cycle, at different opening stages of the mould and at different mould temperatures. "The results convinced us," says Neuper. The first e-victory injection moulding machine for regular production operation was installed at Pfreimd in 2017, but Gerresheimer continued with the measuring. Commissioning was accompanied by an initial series

of tests on the new e-victory machine. Measurements were performed shortly before the machine was delivered at the ENGEL plant in Schwertberg, and just after installation in Pfreimd. A final dynamic parallelism test was carried out in 2019. The results: after two and a half years of production operation, the platen parallelism had not deteriorated. "Thanks to thorough testing, we were able to demonstrate that the guidance accuracy on tie-bar-less machines is at least as good as it is on machines with tie-bars," Felber concludes.

Full flexibility, short project times

Since tie-bar-less injection moulding machines from ENGEL have solid frames, the clamping unit is ideally supported and does not bend, even if the moulds are very heavy. With additional bearings available for the moving mould half, as used by Gerresheimer, the mould weight can be increased virtually without limits. The central bending elements ensure that even where clamping force is applied, the moving platen follows the mould exactly and adapts to the parallelism of the two mould halves.

A third design feature of the tie-bar-less clamping unit is force dividers, which distribute clamping force

Using a tie-bar machine we would need a higher clamping force class for multi-cavity moulds.

Helmut Neuper, Gerresheimer

evenly over the entire mould mounting surface. A third design feature of the tie-bar-less clamping unit is force dividers, which distribute the clamping force evenly over the entire mould mounting surface. These ensure consistently high part quality with no flash, even where multi-cavity moulds are used.

That said, the clamping unit is not the only reason for the consistently high quality of drive tubes. "Polybutylene terephthalate is difficult to process," says Neuper. In a targeted process, ENGEL adapted the plasticising units of e-victory injection moulding machines to the requirements of PBT and fitted the screws with a matching shear mixing head.

"We expect a great deal of flexibility from our suppliers," says Felber. "For us, the mould determines the machine, not the other way around." Short project durations pose a particular challenge, as mould design and project planning for injection moulding machines are generally simultaneous processes. To avoid losing time and money, the processor and machine manufacturer need to work hand in hand.

Connectivity defines new requirements

Gerresheimer's strategy is maximum flexibility for special solutions based on a largely standardised machine – a strategy that ENGEL optimally supports. When called for by the situation, as Mario Oppelt of ENGEL Deutschland confirms, even suspending the articulated robot upside down can be an option. "There simply wasn't enough space for the linear robot we originally planned for." "At ENGEL, the whole team gets behind a project from day one. That's what sets our partnership apart and enables fast decision-making," says Peter Felber. The two partners have big plans for the future. Gerresheimer is backing its Formula D programme to lead the company into a digital future. "In years to come, connectivity and greater use of process data from injection moulding machines will play a very central role," says Felber. "We know that ENGEL is in a good place when it comes to digitalisation, and can pursue that path with us, both here in Pfreimd and at our other sites around the world." ■

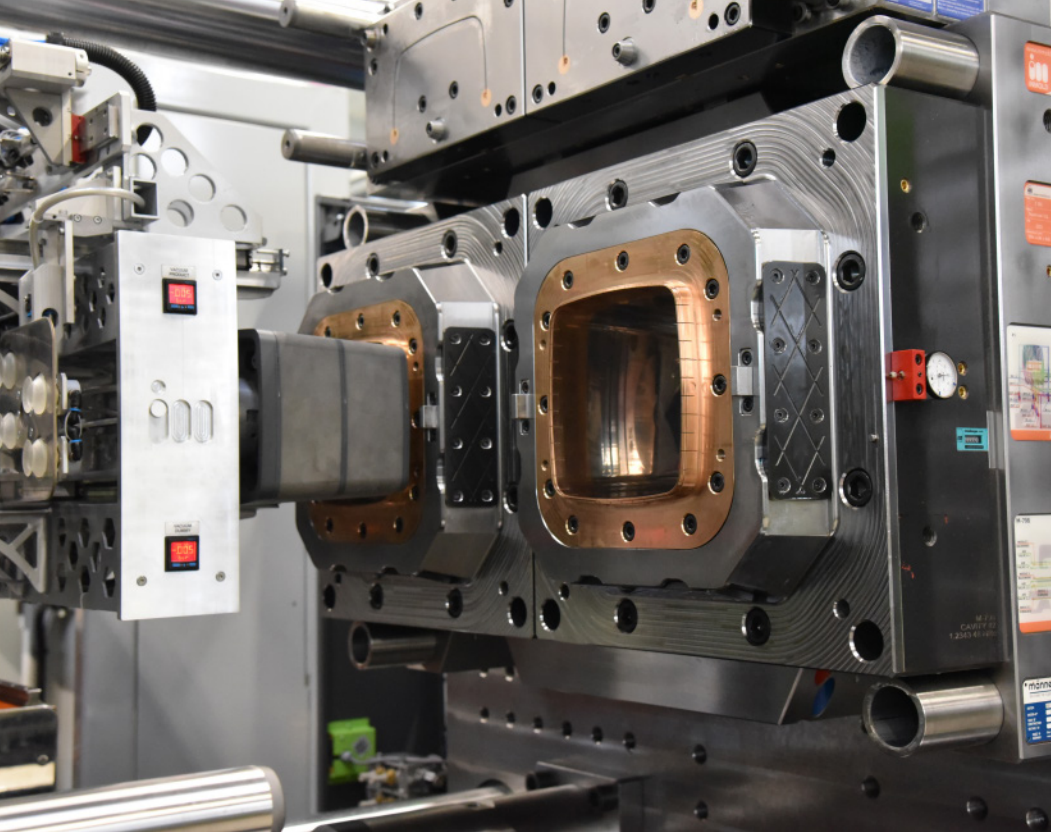
All logistical processes are performed by robots and driverless transport systems. The high-bay warehouse is connected to the 20,000-square-metre cleanroom.



30 years
of ENGEL
tie-bar-less
technology



Putting the tie-bar-less clamping unit through its paces: Franz Pressl and Markus Malleck from ENGEL AUSTRIA, Helmut Neuper and Peter Felber from Gerresheimer and Mario Oppelt from ENGEL Deutschland (from left to right).



Hygiene and cleanliness in production can be achieved effectively using machines from the e-motion series.



The ENGEL e-motion 550 at Ilsen accommodates moulds with a total weight of up to 7.3 tonnes.



The technical requirements for the 5.5-litre pail are extensive. Thin-wall injection moulding helps optimise resin consumption.



From left to right: Udo Pape, Adrian Schnell, Stefan Witt, Phillip Schnell and Christoph Lhota.

Pail production goes **all-electric**

Gerhard Ilsen in Hövelhof has lifted the lid on all-electric production. The production of lids for the 5.5 litre pail with tamper-evident closure on an all-electric ENGEL e-motion 280 started three years ago. The injection moulding machine series provides excellent process stability and is highly energy efficient. Ilsen has now taken this to the next level: all-electric production of the matching pails.

"The e-motion 280 has been running without interruption since series production started back in 2019," as Adrian Schnell, Managing Director of Ilsen, points out. This all-electric machine is used to mould a lid for a 5.5-litre pail. For three years, Adrian Schnell had been in continuous contact with Udo Pape, Sales Manager, and Stefan Witt, Packaging Specialist and Packaging Machine Sales – both from the ENGEL Hanover location. It had always been the plan to produce the pail on an all-electric machine as well, which seemed only logical. To do this, the company has now invested in an e-motion 550. In Adrian Schnell's view, the machine had a number of other arguments in its favour besides trouble-free operations with the lid production machine. All main movements of the e-motion are servo-electrically driven; this enables parallel motion and ensures extremely high dynamics. Short cycle times, fast injection and cooling are important cost factors, especially - but not only - in the packaging industry. They have a big influence on the profitability of a produced part. "Downtime causes additional costs. That is something, that we as machine manufacturer absolutely

need to help prevent", as Christoph Lhota, head of the Packaging Business Unit at ENGEL, emphasises.

Boosting productivity and delivery capability

The company had already gained good experience operating the CC300 machine control unit. Once the mould setting data and machine parameters for a part are stored on the control unit, the data is used for reliable repeatability of the process. Data backup combined with very short set-up times ensure a high level of operator convenience. "We just start up the machine, and it runs", as Adrian Schnell confirms. For the operator, this means a productivity

boost, and for the end users, delivery capability they can rely on.

Energy benefits and a clean production environment

Despite the pandemic, demand for this classic product in Ilsen's versatile portfolio remains unabated, as Adrian Schnell assured us. The classic 5.5-litre pail is typically used for packaging salads, sauces and convenience foods. The product is made of polypropylene and achieves material savings through an optimised process; this is particularly beneficial in the current scenario where materials are scarce and prices on the rise. At the same time, the technical requirements for producing a pail are far tougher than you might originally think from looking at the product. To achieve cost effectiveness, pails are being produced with thinner and thinner walls. Even so, stability cannot be

ignored. Even when filled to the brim and stacked on top of each other on a pallet, the containers need to retain their shape.

"In addition to the energy benefits achieved by integrating the new ENGEL machine into the process, this also makes a significant contribution to reducing CO₂ emissions", as Udo Pape points out. These advantages would not be achieved using machines that have hydraulic drives only. The customer reports that it has been able to save some 30 percent on energy in series production since starting up the e-motion 280 compared to the hybrid machine. The current assumption is that the e-motion 550 will achieve similar values.

As Stefan Witt adds, "What people tend to forget in the overall appraisal of the pros and cons of all-electric injection moulding machines is the fact that the producer has less oil and oil mist in production. You can save on maintenance of machine, hoses and accumulators." Hygiene and cleanliness are further arguments for switching to an all-electric injection moulding process when manufacturing food packaging. The encapsulated and completely

"We start-up the machine, and it runs."

Adrian Schnell, Ilsen

sealed toggle lever on the e-motion machine makes an essential contribution to the overall cleanliness of the machine. "Cleanliness is a topic that is becoming increasingly important for our customers", as Adrian Schnell reports. "But it's also far more pleasant for our employees because the machine is very quiet during operation."

In the run-up to the investment, tests were carried out at the ENGEL technology centre; the series production mould was transported to Schwertberg for this purpose. "We had agreed that the tests would be performed on the model as specified in the quotation – that is, on an e-motion with a clamp force of 550 tonnes", as Adrian Schnell recalls. Stefan Witt explains the objective of these tests. "The focus was on investigating the feasibility of this product on an all-electric machine. Ultimately, we were able to achieve meaningful results in this test." "After all," Witt continues, "the point for us is not just to sell our technology, but to help the customer achieve their technical and business targets."

Five years of planning certainty

"Another reason to purchase was the protect plus service package", Adrian Schnell adds, talking about his decision to invest after the successful production tests. This gives Ilsen five years of planning certainty;

after all, on top of 24x7 service, this also covers all costs of spare parts, the fitters and their travel expenses. To ensure this, the customer signed a maintenance agreement including e-connect.24 support. e-connect.24 provides immediate expert remote maintenance of every ENGEL injection moulding machine. If service is needed, or a machine is down, the customer can post a service request. The ENGEL support can start troubleshooting immediately.

So far, Ilsen has had a very good experience with both the e-motion 280 and the e-motion 550. Adrian Schnell also appreciates the close cooperation with ENGEL. The current business environment makes it important to watch energy efficiency closely. The company is planning to install a photovoltaic system, and Adrian Schnell is open to invest in more all-electric machines. "If you look at this investment in the context of renewable energy, this makes even more sense. It is really motivating." ■

Save energy costs with all-electric machines:



From plastic flakes to pallet

A new ENGEL technology means that a whole process step can be eliminated in the processing of recycled material because the recycled material is processed in the injection moulding process without the need for pelletising. AVK Plastics BV uses this technology to manufacture new pallets from recycled material. This technical innovation boosts efficiency in production and saves valuable energy. The reason for this is that 60 tonnes of post-consumer material are processed every day at the Dutch location in Balk; an achievement that is made possible by process optimisation. The demand for pallets which use "second life cycle" plastics is currently very high; and this is what prompted the capital outlay for new ENGEL duo 1500 and ENGEL duo 2300 machines featuring the innovative two-stage process.

"The demand for plastic pallets is high because the classic supply chains for wooden pallets have been massively disrupted by the war in Ukraine," as Vally Hoogland, Technical Operations Manager at AVK explains. It was decades ago that the company in the Netherlands established its strategic role on the recycled materials processing market. "Back then, we were looking to offer attractively priced alternatives by substituting existing products such as pallets and manhole covers. Today, the increased demand is driven by the pandemic and supply chain problems on the one hand and, of course, by the vision of sustainability and customers' elevated requirements in terms of hygiene on the other," says Vally Hoogland describing the current situation.

AVK currently deploys five ENGEL injection moulding machines which process the full range of recycled materials. Three dual-platen machines from the ENGEL duo series are running conventional injection moulding technology, where plasticising and injection occur in a single process step. The two latest injection moulding machines were delivered as a duo in the truest sense of the word and are based on the dual platen machine solution of the

The compact design of the machine was an important aspect for us. It frees up space for additional machine capacity at our location.

Vally Hoogland, AVK

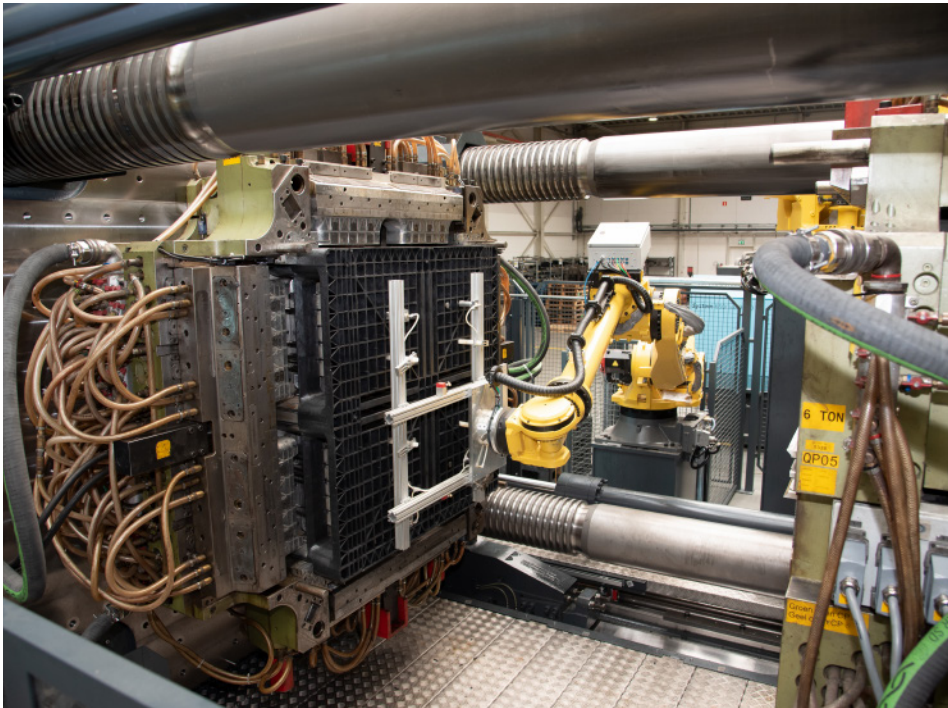
same name: an ENGEL duo 1500 and an ENGEL duo 2300, extended to include a technical innovation from ENGEL, the new two-stage process. This technology's highlight is already quite clear from the name. Plasticising and injection are broken down into two independent but finely tuned process steps. In this way, an entire time-consuming and energy-intensive process step can be omitted.

Compact machine design thanks to two-stage process

The first process step involves plasticising material from post-consumer processing, which is supplied in the form of flakes. "The screw has a diameter of 135 mm, and it plasticises continuously," as Patrick Grüner, Business Development Manager Technical Moulding at ENGEL's Schwertberg site explains, "and the pistons are designed for a maximum shot weight of 30 kilograms at a stroke volume of up to 40 litres. The melt is injected into the cavity in the second stage of the ENGEL duo injection moulding machine with a specially designed piston unit. Compared to the standard ENGEL machines, this technology can be housed in an even more compact machine design. This is why the new duo machine is also several metres shorter compared with the classic model

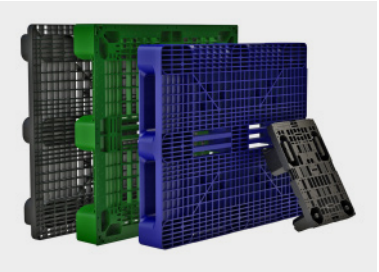
from the same series. "This was also an important aspect for us," explains Vally Hoogland, "because it frees up space for additional machine capacity at our location.

AVK exclusively processes recycled material. Vally Hoogland: "It's a blend of polyolefins that are partly obtained from post-consumer sources and partly from industrial waste." AVK collaborates with companies that are specialised in the collection of waste for recycling and deliver to the processor in bales. The material is then washed and the metal separated. A float-sink process is used to separate the plastic content; it relies on different specific densities to separate the different raw materials. In downstream processing, AVK exclusively uses the portion that floats on the liquid medium due to its lower density. "With recycled material in particular, we draw on our years of experience to create the optimum mixing ratio of the different polyolefins," says Vally Hoogland, outlining AVK's expertise, which forms the basis for injection moulding of plastic pallets with defined properties, such as dimensional stability or load-bearing capacity. This is because the mixing ratio has a considerable influence on the melt/volumetric flow rate. Virgin



ENGEL duo 1500: 25 kilogram shot weight. Plasticising takes place continuously during the cycle, while the cavity is fed by a piston unit.

The pallets are made entirely from post-consumer material.



Comparing sizes: The new ENGEL duo 2300 with the two-stage process is several metres shorter than a conventional model from the same series right at the end of the production floor. This is also an important purchasing criterion for AVK.



material has a very constant value, while recycled material varies a lot." AVK has these properties analysed in advance in a test lab to determine the proportion of impurities. If the material is not compliant, additional material is added until it meets the desired properties. This mixing takes place on site at AVK. Vally Hoogland can report from many years of experience that recycled material quality has continually improved over the years. However, it is important to understand that the material will never be single grade. It is not uncommon to find some disruptive materials in it, such as small stones or wood residues. "At the end of the day, the material package has to be right, because it has a considerable influence on the injection moulding cycle." The shot weights for the ENGEL duo injection moulding machines featuring the integrated two-stage process are 28 kilograms in each case. These two machines now use stack moulds on which pallet halves are injected. The upper and lower parts are then simply clicked together. "Today, we use four moulds with this design to produce closed pallet models," says Vally Hoogland, explaining the technical background.

Working with recycled material since the 1980s

AVK's first contact with recycled materials was back in the 1980s, when the Netherlands started to substitute cast-iron manhole covers. Plastic was increasingly being used as a material for road construction. At first, the manhole covers were produced from polyurethane to ensure lockable access to pipes. It was price considerations that prompted the company switch to recycled material. "At the time, this was new ground for us, because there

weren't really many products made of recycled material at that time," as Vally Hoogland recalls. Later on, the company switched to polyamide as a recycled material. AVK developed its own material blend for this purpose in order to ensure the best properties for the product.

In 2003, the first customer enquiry for producing pallets reached the company. The order was processed using what was already a familiar and proven material as the basis at that time: recycled material. The business share accounted for by pallet production has grown steadily ever since. This has resulted in a

We recognise the value of this new technology and see a great deal of potential.

Vally Hoogland, AVK

portfolio with a large number of standard pallets of different dimensions, load carrying capacities and features. AVK even develops and manufactures custom pallets in-house.

Close collaboration between ENGEL and AVK in development

"There was very close cooperation between our development engineers and AVK during the development of the two-stage process," says Dr Thomas Köpplmayr, who was involved in the development project in the ENGEL Plasticising Systems and Recycling Development department. And this development project was a win-win situation for AVK, as Vally Hoogland confirms from the customer's point view: "For us, ENGEL was the only partner with whom we could have implemented a project like this." AVK brought all its acquired skills to the table in the project, more specifically, knowledge of the technical requirement for continuous plasticising. "Both project partners contributed their know-how, which made it possible to build the newly configured piston machines on the basis of dual-platen technology," says Patrick Grüner. In particular, operations-specific details of the post-consumer material to be processed were very important to ENGEL, while AVK was keen to implement plastic flake processing in a way that lent itself to series production. In the "hot phase" of the project, joint project meetings were held every week to discuss the technical challenges. "The hot phase was in the period of Covid restrictions at the time," as Bas de Bruin, account manager at ENGEL Benelux, recalls. Contact with AVK was first established back in 2007, and the first ENGEL injection moulding machines were then delivered in 2015 with modified

equipment as predecessors to the injection moulding machines with the integrated two-stage process. "We really put the time we invested to good use in developing the new two-stage process," and, as Vally Hoogland goes on to say: "We are aware of the added value that this new technology means for us and see a huge amount of potential for our production and for further cooperation with ENGEL."

Greater acceptance of post-consumer products

AVK is strongly in favour of "end-of-life-care". Vally Hoogland hopes to see "far greater acceptance of post-consumer products" on the markets in future. Plastic is an excellent material, he says. But you need to dispose of it reliably at the end of its service life to avoid it entering the environment. "If there is a completely closed recycling loop at some point, I can think of a whole bunch of products where recycled materials will be valuable input materials for an additional value-added stage." Especially considering the fact, from AVK's point of view as a processor, that oil also needs to be factored into the bottom line as a raw material in the recycling process; after all, starting with the crude oil that is extracted and transported, you first need to create the basis for a plastic at the refinery in what is a very energy-intensive process. Vally Hoogland is certain of one thing: "If you make an honest assessment of the data in this analysis, recycled plastic has a significantly better CO₂ footprint compared with virgin material".

Lower energy consumption than conventional process

The capital expenditure has paid dividends for AVK in many ways, especially

in terms of power consumption. This is because there is an issue specific to the production plant resulting from the existing infrastructure: restrictions in terms of the power supply from the local energy provider. The two-stage process has significantly reduced the connected loads of the machines compared to standard models. "We have been through strong growth in the past few years and the energy demand has grown to match. If we had connected two conventional injection moulding machines, we would have had to have the energy supplier install a new power supply, and this would have entailed high costs," as Vally Hoogland confirms. "We don't need either high pressure for pallet production nor the high plasticising capacity that accompanies it. The special machines can make do with a significantly smaller screw which is powered by smaller drives." In figures, this translates to 585 amperes as opposed to 900 amperes. On top of this, the functional approach of plasticising with the piston unit is more energy-efficient because the process is continuous instead of first starting plasticising and then stopping it again when the process is finished. "There are no more current peaks as

there is enough time to plasticise the high shot weights during cycle time." This means that the machine combines various benefits: the coordinated plasticising capacity on the one hand and a matched shot volume on the other. "This is a decisive advantage of the two-stage process because these two parameters can be adjusted individually," says Patrick Grüner. In contrast, both parameters need to be adjusted at the same time on a standard machine and as functions of each other.

Any overall comparison also needs to factor in the ability to eliminate an entire plasticising step. For example, there is no need to produce regrainulate by additionally melting the material. It takes twice as much energy to produce the product – no less than 0.45 kWh per kilogram of material. But with flakes, the material is processed directly, that means, it is only melted once.

The next evolutionary stage: processing agglomerates

"The next stage of development will be the use of materials that are more difficult to process, recovered from recycled film material," says Vally Hoogland, outlining the technical challenges for the near future. A similar process is already being presented

Two-stage process live at K 2022

ENGEL is presenting the new two-stage process for the first time live at the K 2022 trade fair. Logistics load carriers with rollers, also known as dolly pallets, are being produced at the ENGEL stand at the Circular Economy Forum in the open air area between halls 11 and 16.



in collaboration between AVK and ENGEL at the K show in Düsseldorf. This machine is additionally being equipped with filtration and degassing to enable the processing of recycled materials with a lower degree of purity. Plastics with a higher melt point, or impurities such as wood, aluminium and paper can then be filtered out of the recycled materials and gaseous impurities from detergent residues or printing inks removed. Instead of the piston unit, a second screw is being used here to feed the melt into the cavity. ENGEL is already working on a digital solution to support the two-stage process, as Thomas Köpplmayr reveals. iQ weight control will then be used to ensure a constant moulded part weight in combination with a controlled and immediately adjustable injection volume. ■



From left to right: Vally Hoogland (AVK), Dr. Thomas Köpplmayr, Bas de Bruin and Patrick Grüner (ENGEL).



More details on the two-stage process:

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