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international edition

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Plastix recycles nets and ropes, carries polyolefins „from rope to rope“ and turns them into consumer products:

PP and PE-HD in circuit

How digital twins save **Gealan** time and money. Why **FKT** diffusion welds large mold inserts. Where plastics score against **wood and cork**. How **Nifco** is accelerating 2K injection molding. How **Akro-Plastic** compounds LFTs. And how **V Frames** injection molds e-bike frames with FIT.



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Leaps in efficiency and recycling

Dear reader

new technologies for greater efficiency in processes and innovations for the reprocessing, refining and application of plastics are the focus of this issue.

Classical processes for the production of near-contour tempering channels in injection moulds are limited to certain installation spaces. FKT in Triptis overcomes this with seamless diffusion welding: page 6. Sicht-Pack Hagner has been processing PET recyclables for a long time. Now the film manufacturer has invested 12 million euros in a reprocessing line to further increase the use of recycled material: page 12. Within just a few years, the start-up Psilkon from Motten has made a name for itself as an LSR injection moulder – and for medical products: page 16. V Frames has developed an all-plastic frame for a low-entry e-bike. More about the “Wave Frame” and the recycling strategy on page 26. Plastics have conquered important areas of application from wood - in construction and logistics. On the substitution of the renewable raw material: page 34.

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Markus Lüling

Markus Lüling, Editor-in-chief

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In Europe's largest competence centre for diffusion bonding at PVA Loet- und Werkstofftechnik, components with a useful volume of up to 900 x 1,000 x 450 mm³ can be joined.



Photo: PVA LWT

Giving diffusion welding a leg up

How FKT is opening up new dimensions with the seamless joining of large-format tool inserts

“We have already hit the bull's eye with our first tests,” says developer and designer Christian Kolbe, pleased with the latest successes of an alternative joining technology in toolmaking at FKT Formenbau und Kunststofftechnik GmbH, Triptis. While classic technologies for realising near-contour tempering channels in the injection mould reach their technical limits above a certain size, the use of diffusion bonding at FKT is proving to be a key technology for large-format mould inserts. In a research partnership, FKT has explored the potential and already implemented the added value in customer solutions. FKT Managing Directors Udo Staps and Christian Kolbe report.

Text: Dipl.-Ing. (FH) Sabine Rahner, Editor K-PROFI

The advantages of close-contour temperature control of the injection mould are well known. The effective and uniform heat dissipation during injection moulding, which is made possible by this, results in reduced cycle times with high-quality component surfaces

at the same time. Complex temperature control channel structures can be realised using segmented mould inserts, which are connected by soldering or screwing techniques after the channels have been inserted. Additive manufacturing technologies are an alternative. Both methods hit their limits as soon as the tool inserts reach a certain size. In the case of additive processes, the limitations are due to the space required for the system and the complex powder management. Screwing large segments, on the other hand, fails due to the insufficient tightness and rigidity of the entire tool or the limited space for the screws. Soldered seams, on the other hand, can form an intermediate layer that differs from the base material and influences the thermal and mechanical behaviour.

“The question for us was: what can we do with larger tool dimensions? How do we join large mould inserts into which we have previously inserted cooling channels?”, says FKT Managing Director Udo Staps, describing the background to his company's participation in the DiffMold research project. The goal of this ZIM project

(Central Innovation Programme for SMEs), which was funded by the BMWi and concluded at the end of 2020, was to develop diffusion-welded mould inserts for medium-sized and large injection moulds. Other partners in the two-year project were the non-profit KIMW Forschungs-GmbH, Luedenscheid, the Guenter-Koehler-Institut fuer Fuegetechnik und Werkstoffpruefung GmbH (ifw), Jena, and PVA Loet- und Werkstofftechnik GmbH, Wettenberg.

Joining zones with shoulders, bevels and free-form surfaces are the special feature

In diffusion welding, the joining partners are brought together in an inert gas atmosphere or vacuum under mechanical pressure and at temperatures below the melting point. The joining surfaces are joined by solid-state diffusion without visible seams. "The material within the joining zone corresponds 100 per cent to that of the base material. Therefore, the achievable strengths are also within the range of the materials used," explains Christian Kolbe. This joining technology is already several decades old and has also been used by hot runner manufacturers for some time. What is the advancement of the DiffMold project? "In the established applications, such as mould cores and hot runner manifold plates, it is a question of smaller dimensions on the one hand and flat joining surfaces meeting here on the other. This is indeed state of the art



Managing Director Udo Staps: "We achieve stable inserts for contour-following tempering in medium-sized and large moulds with diffusion welding."

and probably also in use at other mould-makers," Christian Kolbe classifies. "The special feature that we have worked out with our project partners is the possibility of also being able to join large-format free-form surfaces as well as realising downright jumps between different joining planes."

FKT has worked out this presumed unique selling point step by step. "We first implemented the technology on flat components for which we could not find a solution with

conventional tempering and were extremely satisfied. Among them was a lattice component with many ejectors, which is still running without restrictions at the customer's today." In this case, FKT milled temperature control channels in one plate and connected it with another plate to form a two-plate system. "From these initial experiences, we were already able to derive design guidelines: How flat must the surface be, what must the surface be like, and the like." The next steps were also still rather simple



Developer Christian Kolbe: "For us, diffusion welding is a key technology for complex tasks – parallel and complementary to additive manufacturing."

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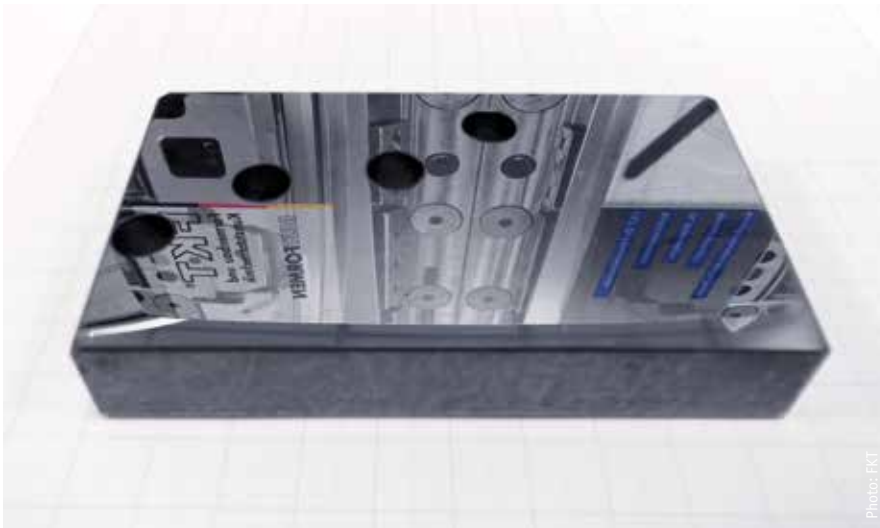
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Diffusion-welded insert made of two parts with cooling holes and angled shoulders in the joining zone (top: underside), on whose mirror-smooth surface (bottom) the joining seam is not visible.



components. However, FKT expanded into a second level, as in the case of a replacement insert for an injection-moulded cover. Here, the tempering channel was milled into two superimposed plates and joined to form a multi-plate system: "With exchangeable inserts, the interfaces for temperature control and screw-on points are a challenge, which makes conventional cooling difficult. That's why we went to two levels. However, the aim is to use as few sensible parting planes as possible and thus to have to join as few components as possible, among other things to keep the effort and complexity within limits. For this reason, too, the construction from many individual sheets is out of the question for us."

The next stage of development was particularly exciting. Here, the project team developed a demonstrator tool for a fan in order to test diffusion welding for freeform surfaces using this complex three-dimensional

structure. "As long as the route via a multi-plate system works, this is obviously to be preferred. The solution must make sense both technically and economically. The multi-plate system is not suitable for components with larger aspect ratios, i.e. weld seam depth to weld seam width, but above all for components with free-form contour surfaces, such as a cone geometry or a fan wheel with multiple curved surfaces and large separation jumps. Joining free-form surfaces also becomes interesting for shell-shaped or flat components with numerous demoulding conditions. In the simplest case, I am thinking of ejectors, sliders or pressure and temperature sensors. These are components that require a corresponding amount of space. The more of these functionalities have to be accommodated, the more difficult it becomes to integrate the temperature control. With conventional methods like drilling, I can no longer get to the contour."

Know-how lies in adjusting the angles of attack and contact forces

The demonstrator tool was based on a series tool from FKT for a fan wheel made of PP GF40 with a diameter of 600 mm. Its master mould was redesigned for the tests. During the design revision by FKT, the interfaces for temperature control, number and cross-section of the temperature control circuits as well as sprue distributors had to be retained. The project coordinator KIMW took on simulation tasks regarding the rheological and thermal optimisation of the fan wheel tool. A simulation model from ifw Jena assisted in the design of the tool inserts, which meet via free-form surfaces due to the contour-following tempering channels. "Within the framework of the simulation carried out by ifw, we were able to sound out the limits of the angles of attack of joining surfaces." To understand: diffusion welding systems apply the pressing forces via a punch uniaxially, i.e. only in one direction. Two surfaces brought perpendicular to each other would not join because the contact pressure from the side is missing. "The fact that we now know these limits and know what measures to take in case of jumps or steps in the contour in order to avoid later stress peaks in the tool insert is a unique selling point for us as a toolmaker," Christian Kolbe is pleased to say.

The larger the joining surface, the higher the pressing forces required. "In some places, free space must be created, i.e. the pressing area must be reduced so that the pressing forces of the system are sufficient in total. With such large components, the contact pressure forces have to be sounded out precisely in order to ensure reliable welding. On the one hand, the joining surface must be tight, and on the other hand, the components must not be deformed in the process." For this process engineering know-how, the designer refers to ifw Jena: "We have the toolmaking know-how, i.e. how we position the parts in relation to each other, how we machine and finish the surfaces so that a safe welding process can take place. The knowledge of the process itself and the plant technology lies with ifw and PVA, who have the extensive

material-specific and technological experience. This is because the parameters – i.e. temperature, pressure forces, shielding gas and duration of the welding process – vary greatly depending on the tool steel.”

Large installation space makes it possible

The maximum possible installation space dimensions of the diffusion welding system from PVA available at ifw are 500x300x250 mm³. As soon as the overall structure takes up more space, as was the case with the fan project with a diameter of 600 mm, FKT calls on the services of PVA Loet- und Werkstofftechnik GmbH (PVA LWT). The subsidiary of system manufacturer PVA Tepla AG has two of the largest diffusion welding systems available for services in Europe and in May 2021 opened what it claims is Europe's largest competence centre for diffusion welding. Components with up to 900 x 1,000 x 450 mm³ useful volume at application temperatures of up to 1,300 °C can be realised here.

“When we joined the components for the fan mould, we were very impressed in light of this size. During the joining process, there is definitely compression due to the high pressing forces,” reports Christian Kolbe. The service provider ensures the tightness of the joining surface by means of a helium leakage test. FKT then processes the components further. FKT tested the finished tool in direct comparison to series production in its technical centre: same 6,500 kN injection moulding machine, same process parameters, same plastic. The result was not only convincing in terms of strength and tightness of the inserts, which are exposed to high pressures during injection moulding. In addition, a thermographic image showed a more homogeneous temperature distribution of the injection-moulded fan blades, which therefore exhibited significantly less distortion and thus higher concentricity. In addition, the cycle time was reduced by a full ten per cent.

Invisible and highly stress-resistant joining seam

FKT has gained a wealth of experience with DiffMold and – where possible and in consultation with the customer – incorporates this into current series orders. Not only main contour elements but also partial contours were realised by means of diffusion-welded segmented mould inserts. “That adds up to a large number,” says Udo Staps with satisfaction. Now it is a matter of spreading the added value of the technology. “In contrast to the early days of additive processes, we have to do much less convincing here than expected,” says Christian Kolbe. “We can already advise our customers with sufficient arguments and know when diffusion-welded inserts, with their higher production effort, prove to be technically and economically viable.”

One of the main advantages is certainly that the joining seam does not differ from the base material. Accordingly, the injection moulding tests showed that the original separation does not show on the injection moulded part. “We achieve an absolutely homogeneous surface,” emphasises Christian Kolbe. Keyword surface: “We have managed to join ground, finely milled as well as eroded surfaces, although diffusion welding already makes high demands on the surface quality. We can adapt the design of the contact forces to the roughness of the surface.” FKT's task in DiffMold was to determine the boundary conditions to be able to use diffusion welding for

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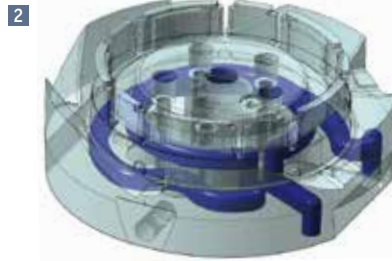
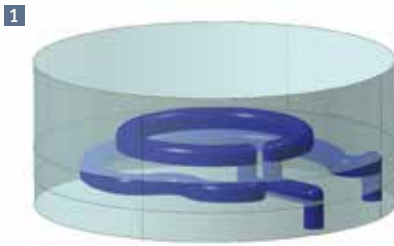


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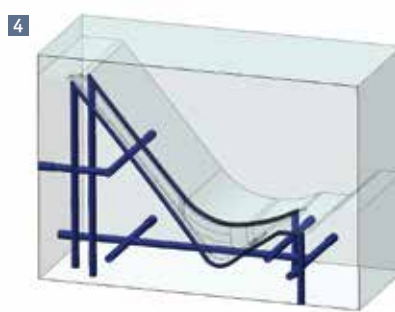
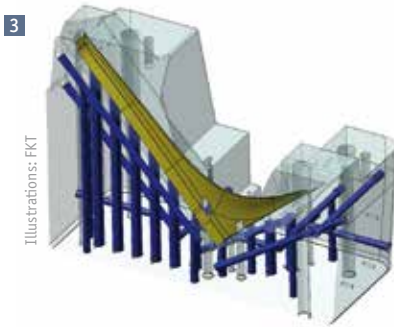




Unit joined to form a multi-plate system after milling the tempering channel in two planes: blank after diffusion welding **1** and finished insert **2**.

Numerous riser holes in a conventionally drilled tempering system impair the strength of the mould insert **3**.

More stable mould inserts without fissuring: the contour-following tempering channels can be inserted into the diffusion-welded raw body **4** in a hybrid solution (milling and joining) in accordance with the process **5**.



medium-sized and large injection moulds. Therefore, FKT tested the tool steels used in its own mould and tool construction.

Robust and durable large injection moulds

And what is the added value of diffusion-welded mould inserts with contour-following cooling channels for the user in concrete terms? "Since there is no fissuring of the mould insert due to feeder and connecting holes in the tempering system, we achieve significantly higher strength. This is a huge advantage because the inserts are subjected to high transverse and bending forces during injection moulding. By introducing as few holes as possible, we can minimise notch stresses and increase the longevity and availability of these cost-intensive mould components." At the same time, there is more space for additional mould functions for demoulding or sensor technology. Avoiding blind channels or other fluidic dead spaces results in lower pressure losses, the flow rate of the temperature control medium can be increased and thus heat can be dissipated more efficiently. This in turn improves the quality of the injection

moulded parts. And so the circle is completed. "This is a win-win situation that benefits both the mould maker, who has to provide the warranty, and the injection moulder, who gets the added value in production via the longer service life and the improvement in cycle time," Udo Staps is convinced.

FKT does not view the application as being limited to contour-following temperature control alone. "It is just as conceivable to join two different metals, for example, to

combine a thermally conductive material in the substrate with a wear-resistant upper material to form a component with multi-material properties," knows Christian Kolbe. Copper, with a thermal conductivity many times higher than steel, could contribute to significantly more efficient heat dissipation.

FKT Managing Director Udo Staps is pleased about the expansion of the spectrum in his tool shop: "With diffusion welding, we can implement a very stable insert design for medium-sized and large tools. Here we are talking about dimensions that exceed 250 mm or 500 mm in cubic terms. In the smaller range, we are using laser beam melting technology. We recently retrofitted our lasercusing system with a 1,000-watt laser." With the use of diffusion welding, customers have another technology at their disposal to be able to select the technically and economically best possible solution for contour-following temperature control even in (moderately) large injection moulds. **■**



High design freedom: diffusion-welded tool insert with contour-following cooling with multiple curved surfaces and large separation jumps.

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SILICONE AT ITS BEST



With a new reprocessing line, Sicht-Pack Hagner sorts PET flakes, producing some of its own input goods for film products.

Laser sorter decides on good material

PET film manufacturer Sicht-Pack Hagner invests in its own recycling plant

“We've been processing recycled material for a long time, but now we're also reprocessing it ourselves,” says Frank Bartels, authorised signatory at Sicht-Pack Hagner GmbH from Dornstetten-Hallwangen in the northern Black Forest. The PET-only processor produces about 65,000 tonnes of high-quality film for the packaging industry every year – and the use of recycled material is constantly increasing. For quality control and safety, the plastics processor has now expanded its machinery with a EUR 12 million reprocessing line and thus produces part of its incoming goods itself.

Text: Dipl.-Ing. (FH) Karin Regel, Editor K-PROFI

In order to be able to set up the new modern sorting and processing line, Sicht-Pack Hagner has reconfigured its factory premises somewhat. “The silos in which the delivered PET flakes are stored before processing should be as close as possible to the building. That's why we changed the entire material logistics,” explains Jochen Held, authorised signatory and technical manager at Sicht-Pack Hagner.

First, existing silos on the factory site were moved to make room for new ones. The eight new silos specifically for PET flakes were then installed on the space thus gained. This is where the purchased flakes from the bottle fraction are now stored. “We process the bottle fraction because this is the purest recycling material currently available on the market. It is best suited for the production of food contact films,” says Frank Bartels, describing the incoming goods for the reprocessing plant.

He notes, however, that it is currently only available in limited quantities. Besides the desirability of the bottle fraction, one reason for the lack of availability is the absence of the 0.5-litre bottles in the returns. This bottle size is the classic container for events, which have been completely cancelled for over a year due to the world-wide pandemic. In the future, he would like to be able to process PET film products from the yellow bag in addition to the bottle fraction. “There is a whole lot of valuable raw material lying dormant here, for which, however, there are no ideal processing options as yet,” is his assessment.



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The silos for the incoming PET are located close to the building and are equipped with vibrating floors to avoid clumping of the flakes obtained from bottles.



Five slitters implement the customer's specification in the slitting centre and produce the desired end products or reels.



PET rolls leave the plant in Dornstetten-Hallwangen as finished packaging films for food products.

Core component: High-speed laser

In addition to their proximity to the processing plant, the PET silos have another special feature: they are equipped with vibrating floors to prevent lumping and to facilitate conveying. In the process, the PET flakes first pass through two sorting stations: In the first – the core of the plant – up to 3 t/h of flakes arrive via a vacuum conveyor. Here they are distributed to three shafts. As the flakes fall through, they are exposed to a high-energy laser beam. Its energy stimulates outer electrons in PET molecules to jump to a higher shell. As soon as the energy stops, they fall back to their original position and emit energy that can be measured. Each atom or molecule has its own spectral imprint, so this method can be used to eject foreign materials. The ejection is done via air jets.

“We then convey the first-reject material to shaft four of the sorting station to increase the yield. Naturally, you always get some good material when you “jet out”,” Jochen Held explains and emphasises that, in contrast to conventional sorting methods that work with UV or NIR light, this process can also identify black plastic particles and produce very pure fractions with up to 99 % good material.

Quality is the key in film production

Quality assurance was the main criterion for Sicht-Pack Hagner to invest in its own sorting and reprocessing plant. “We are known for the high quality of our film products – and it has to stay that way,” says authorised signatory Frank Bartels. The company has been using recycled material for a long time, but bought-in and always only reggranulates. “No matter how good the input fraction of flakes is, fluctuations cannot be avoided. This is different with reggranulates. They have a defined property profile and are comparable to virgin material.”

Quality control works even better when it takes place in-house. Thanks to the new, in-house reprocessing plant, the PET film manufacturer now works directly with flakes, without the additional step of re-granulation. This saves energy and means one less thermal treatment for the polymer, which in turn benefits quality. And this is how it works at Sicht-Pack Hagner now: First, the sorted flakes are preheated batch by batch in a warm gas stream before being transferred to an SSP reactor from Starlinger. Vacuum ensures that surface moisture dissipates and that the desired further crystallisation takes place.

To support this, gas flows periodically through the material bed during the vacuum treatment and transports volatile components out of the process chamber. The so-called De-Con technology of the reactor is essential for the production of food-grade PET flakes and is partly responsible for the fact that the entire process at Sicht-Pack Hagner has already received EFSA approval. The reactor is designed for around 2 t/h of material but is only operated at 1.5 t/h when an IV value increase is targeted. "In the reactor, an IV value increase of 0.04 dl/g/h is possible," according to Jochen Held's experience. For production, the PET film manufacturer needs input material with IV values between 0.7 and 0.82 dl/g, depending on the product; the input material usually has an IV value below 0.7.

The quality of the incoming goods is crucial

After the reactor, the flakes undergo extensive quality control. This includes surface moisture measurement, IV value analysis, L,a*b colour determination and the Siropad. Siropad is a new procedure developed by Gut GmbH from Walheim for the fast and large-scale fine analysis of plastic flakes, granulates

and pellets. The method serves as a substitute for the PET flakes roasting sample. It is a near-infrared measuring system for detecting the composition of plastic samples from production or a recycling process and is suitable for all non-black plastic flakes, granulates and pellets up to approx. 100 g. The maximum analysis time is less than 15 minutes. Only after this quality control and the "go ahead" do the processed flakes go into one of the five film extrusion lines with a maximum total capacity of 100,000 t/a.

"We operate all extrusion lines as triple-layer lines. This serves either to produce three-layer products or to increase the output of the entire line for mono-products. In this way, we work both flexibly and efficiently," says Frank Bartels, describing the procedure for the extrusion of PET films. In this context, he confirms the trend in the industry towards more mono-film products, as these are, after all, easier to recycle. "Cheese packaging has shown the way. Protection also works with monofoil products. We already supply a considerable tonnage to the sausage manufacturing industry, which sold more than 20 million individual packs in the first half of this year. Compared to the same period last

year, the mono share has multiplied. We are convinced that this trend will continue for other products as well."

Customised, wide range of films

The company from the northern Black Forest produces its films for a wide circle of customers, 50 % of whom come from Germany and 50 % from other European countries. Sicht-Pack Hagner primarily serves customers from the medical, pharmaceutical and food industries. The product range includes rigid films for thermoforming applications in thicknesses up to 1,000 µm and widths up to 1,350 mm as well as laminating films. The latter are produced on the three in-house laminating lines, on which the PET films produced are bonded to PE, PA or O-PET films with the use of a two-component, solvent-free adhesive. The lamination serves either to protect the carrier material or to achieve certain material properties such as sealability or peelability as well as an increased gas barrier. Last but not least, the films arrive at the slitting centre, where five slitters convert the customer's specification and produce the desired end-product sizes or roll goods. ■

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With the reusable respiratory mask made of silicone, the company also has its own developments to show.



The two tiny openings with a diameter of 1 mm are created in post-processing by laser.



Getting off to a flying start on challenging terrain

How the LSR start-up Psilkon is establishing itself in the medical technology market

Within just a few years, the start-up Psilkon in Motten has made a name for itself as an LSR injection moulder – and in the demanding medical products segment, of all places. The eight-member team around managing directors Philipp Metz and Patrick Buberl views its strengths both in the rapid development of parts up to series production readiness and in a deep understanding of processes for reliable production. Based on its success, the company is now taking the next big step.

Text: Dipl.-Chem. Toralf Gabler, Editor K-PROFI

Production with three LSR injection moulding machines in the rented hall looks modest only at first glance. Here, series of millions are produced for well-known medical technology and car manufacturers. And the technology is extraordinary because the company's founders have relied on high-tech from the very beginning. "If possible, we always want the latest technology available," says Patrick Buberl, "otherwise we invest twice when there are higher demands later on."

In hindsight, this perspective has paid off, even if the path was not necessarily mapped out in this way. After all, it started rather by chance when Patrick Buberl took over the continuation of a deceased relative's

company earlier than planned in 2016. HN Maschinenhandel in Neustadt an der Weinstraße specialises in the production of equipment for punching various materials such as leather, foam and plastics. As these are mainly customised machines, special seals were always needed in small quantities. "There were long delivery times for these, and the prices were very high," Buberl sums up. And so in 2017, he decided to start supplying himself using an LSR injection moulding machine. This was no coincidence, as Patrick Buberl and Philipp Metz, who had joined the company in the meantime, had previously worked together in leading positions at a large LSR processor and thus already had the necessary knowledge and skills.

Passion and know-how for medical technology

"Back then, word quickly got around in the market," Metz reports, "and the initial interested parties from the medical technology sector came with specific requests for silicone parts." This was the trigger for the decision to found a separate company for LSR processing. "We come from medical technology and have the passion as well as the know-how for it," says Buberl. "If anything, we're going to put our money where our mouth is – that was our motto." And so Psilkon got off the ground in October 2017.

The first project was a sophisticated seal for epidural syringes. The syringe manufacturer kept getting complaints because the product was at the same level as it was 15 years ago. "In addition to meeting all medical requirements, the seal in the syringe body must not only seal reliably but also be smooth-running with a defined resistance so that there are no complications when injecting into the spinal column," Metz explains the challenge.



The new seal was developed completely in-house. After the design on the screen, a sample part made of plastic was created on the 3D printer, which in turn was used to create a vacuum casting mould. This was then used to cast functional prototypes in silicone. "The properties of such prototypes are very similar to an injection-moulded component," Philipp Metz points out. "And up to this point, no investment in steel is necessary. Only when the prototype meets all the set requirements are the injection moulds created." Just three months after the start of development, the pilot series was running on the injection moulding machine.

Prototypes in a few days

"This is our standard procedure for putting a prototype on the customer's table within two or three working days," explains sales manager Pascal Kümmert. Sometimes customers lack in-depth silicone know-how because the parts are often only additional seals. And so they are often produced according to predefined drawings, which is not always the best way. "We scrutinise

Tapping and evaluating the process data from start to finish ensures process understanding and stability.

The laminar flow box can be used under class 7 cleanroom conditions.

the use of the seal and on this basis also work out suggestions on how to implement it cost-effectively," says Kümmert. This is very much appreciated by the customers, he says, but only works if one is involved from the very first step. Here it pays off that the sales manager also has extensive experience in LSR processing and medical technology. "He is always involved in the development and can guide our customers closely," emphasises Patrick Buberl.

With a reusable respiratory protection mask made of silicone, the company already has its own developments to show. Only six weeks passed from the idea to the series tool. The mask, called "PROVID", is approved as a class 1 medical device and is sold through the company's own webshop. The exchangeable filters are manufactured by the punching specialists of the sister company HN.

First hurdles successfully overcome

"To enter the medical field, we needed the relevant certifications as quickly as possible," Philipp Metz makes clear. Once again, the company founders were fortunate in that they were already active in this segment and therefore knew what was important. "We completed certification according to DIN EN ISO 13485 just six months after founding the company, which cleared the way to other large customers. And they then approached us."





Pascal Kümmert: "We are not only looking for large orders but see our know-how especially in development."

But right away, with the shortage of silicone in 2018, there was another hurdle for the young company to overcome. "We had just really started when they suddenly said there was no more material," Patrick Buberl recalls. "Without our strong connection to the silicone manufacturers, it would have been difficult. It was helpful that we have known and appreciated each other as business partners for years."

A partnership approach is also important to Psilkon with its customers. "Of course, clients expect a certain standard," says Pascal Kümmert, "but if you honestly say that, as a young company, we still need a little support, you will get it. Conversely, the silicone experts are not afraid to say openly what is technically not possible or where something could be changed in the product that has "always been done that way" by the customer. "Such ideas are gladly accepted," is the sales manager's experience. Even if a project doesn't come to fruition, one or the other of the people we talked to later remembers the critical approach and comes back to Psilkon for that very reason.

Approach through trust

In the beginning, there was sometimes a wait-and-see attitude towards the new company. "You might exchange contact details, but then you would first observe how the new player was doing," Kümmert recalls. "After a year it became a little easier. There were enquiries to get a feel for how we work and how we are positioned in terms of price. And in the meantime, even publicly listed companies from the medical technology sector come to us with very specific enquiries, which then lead to projects."

At the beginning, they were also frequently confronted with the issue of whether they could ensure long-term production, which is especially important for medical products, adds Philipp Metz. "Of course, we couldn't give anyone a guarantee," he says, "but our expertise and philosophy, as well as already existing well-known reference customers, were often convincing in the end." He adds that HN

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Philipp Metz: "Psilkon is now on a solid foundation."

Maschinenhandel as a parent company with a very good equity ratio was also helpful in gaining the trust of potential customers. "In the meantime, Psilkon itself has a solid foundation," emphasises Metz.

A visible expression of this is the machinery that has grown in a short while. A second Arburg LSR injection moulding machine was quickly added to expand capacity. At the end of last year, an LSR injection moulding machine from Fanuc went into operation. A second of this type will follow as early as this year.

The stated focus continues to be parts for the medical segment, which accounts for about 80 % of the current annual turnover of around EUR 700,000 (2020). But products for the automotive, electrical and food industries are also manufactured in Motten. Here, the development is moving away from being a pure component manufacturer to post-processed parts as well as complete assemblies. For the automotive market, the company is currently working on a corresponding certification.

Enhancement by sister company

"This is where our sister company HN comes in handy again because they have a lot of know-how for plants for automation, lamination or assembly," says Philipp Metz. For example, a silicone foam mat with a laminated surface is being produced for an automotive customer. While the foam is being purchased, HN has the expertise for punching and laminating. "Such products are not part of our core competencies. But we also manufacture seals for this customer, and he approached us with the request," explains Metz.

Two tiny openings are lasered into the end piece, which is only 1 mm wide, of a tiny silicone part used in eye operations. In addition, there are special surface coatings. This is how Psilkon reworked the seal for a disposable medical filter. The seal is permanently cast together with the filter in a single unit. Because parts of the casting compound stuck to it, until now the seal also had to be disposed of after one use. Thanks to a special coating, they can now be used several times. At the moment, one still often works in cooperation with partners. "But we are already developing such key facts with the perspective of bringing the technologies for this in-house in the next few years," Philipp Metz makes clear. He sees the advantage of having the supply chain, including all verifications, in one's own hands. "But this can only be done step by step because the production quantities must also be there for the corresponding investments."

With versatility, Psilkon wants to increase the advantage over pure injection moulders. One of the injection moulding machines is already equipped with a laminar flow box and achieves class 7 cleanroom conditions. Another topic that is being worked on intensively is 2-component injection moulding with LSR and thermoplastic. While the company is currently working with supplied inserts, it plans to start thermoplastic injection moulding at the beginning of next year. Then the epidural syringes will also be produced completely at Psilkon, including subsequent assembly.

Start also with small series

Last year, more than 9 million silicone parts were produced in Motten, and this year it is expected to reach up to 16 million. "However, we are not only looking for large orders," emphasises Sales Manager Pascal Kümmert, "but rather we see our know-how especially in development." Even in small series, he says, there is always a chance that the part will later run in larger numbers or that the customer will also come with large series because of the good service. Kümmert cites the development of catheter valves as an example, where the initial development involved a few hundred parts. "Then came larger quantities, and after the end of this year we are talking about 20 million per year."

"That's why we realise everything from batch size one to many millions," says Patrick Buberl. In order to be flexible here, Psilkon relies on different-sized master moulds equipped with appropriate cold runner systems, which are fitted with interchangeable inserts for the respective products. At present, the master moulds have 2, 4, 8 and 16 cold runners; for the new machine, moulds with 32 and 64 cold runners are planned. This way, series can be easily scaled up. "Making additional mould inserts means much less effort than building a new larger mould," explains Buberl. "It also simplifies the changeover from one product to another. We only have to change the mould inserts instead of the entire mould."

Interesting market in India

By the way, the catheter valves are also supplied to India. "We know the Indian market from our previous activities and are active there with a sales representative," says Philipp Metz. Customers there highly appreciate European quality and reliability, so that they are even willing to spend a little more than having the valves produced locally themselves. "That's why we became active in India shortly after the company was founded and now generate around 30 per cent of our medical sales there." At the end of the year, Psilkon plans to set up a subsidiary with a warehouse on the subcontinent. "But we don't want to produce in India," emphasises the managing director.

Stable processes are the be-all and end-all

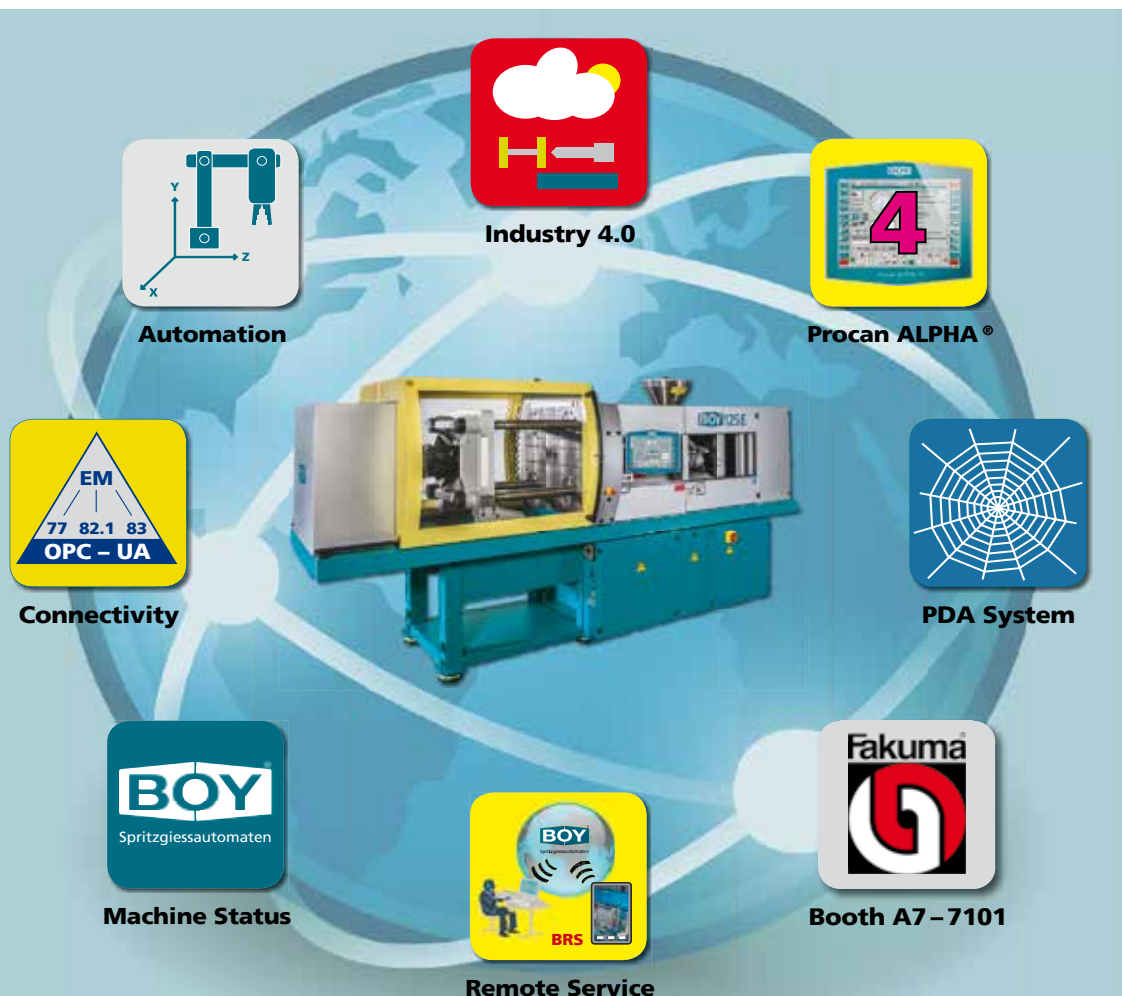
It is not only in the injection moulding of micro parts and components with filigree wall thicknesses or structures that stable processes are relied on in Motten. "We don't want to detect problems only when a defective product is at the customer's, but already during production," Patrick Buberl

explains the approach. "That's why we digitised everything from the very beginning to make the processes transparent."

"Just as we want to be active at the very beginning of component development, we also start here at the process origin," explains Philipp Metz. "Figuratively speaking, we can already see what kind of component will come out in the end when we look into the two silicone barrels." The recording of the process parameters begins with the dosing and the mixing ratio of the two LSR components and continues via the dosing of the colour right into the mould. In this way, it is possible to intervene immediately in the event of deviations, even before a series of parts is produced incorrectly. Metz sees a plus here in the Servomix metering systems of the Austrian technology partner Nexus Elastomer Systems, among others. The pressure is measured not only at the starting point of the material on the machine, but already at the beginning of the conveyor line so that the pressure can be readjusted in time. "As a result, we don't carry any errors from the beginning of the process onwards, but we eject them straight away."



Patrick Buberl: "If possible, we always want the latest technology available."



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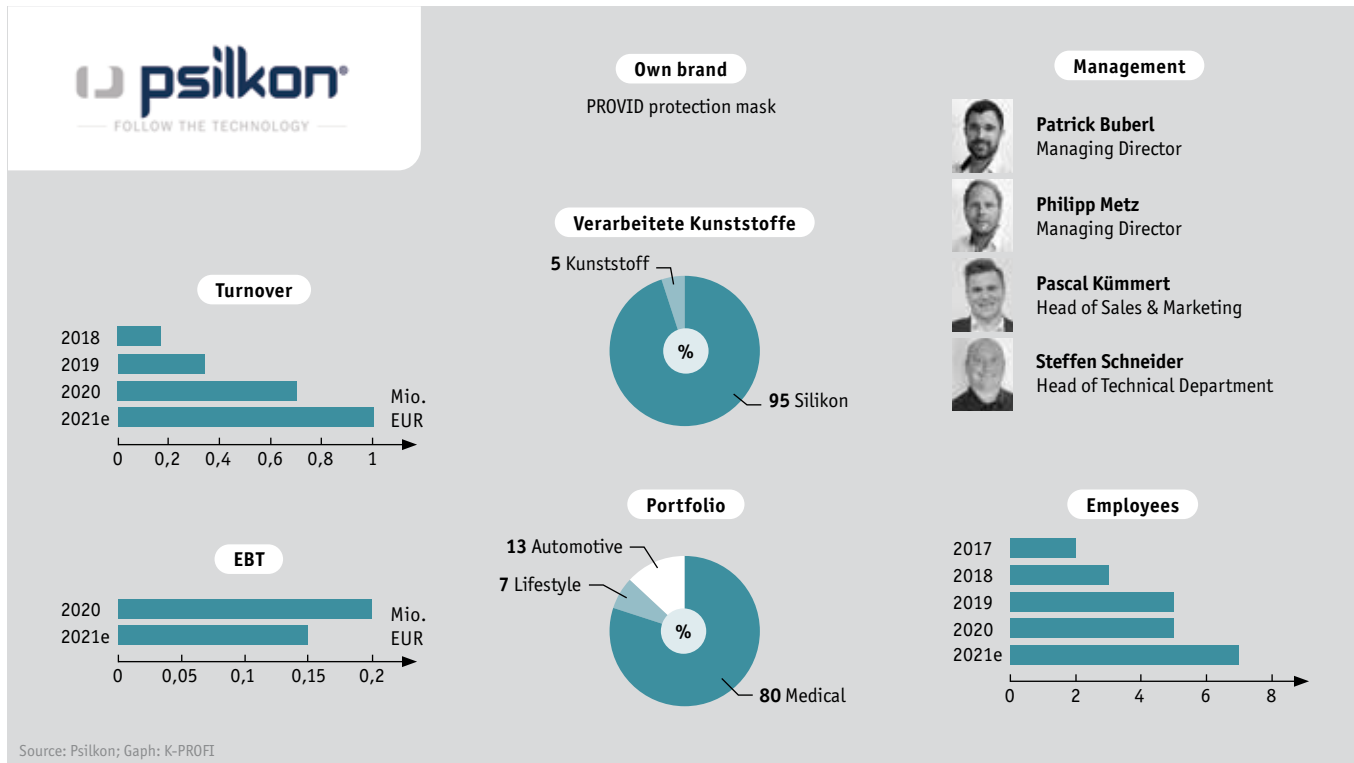
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With the cold runner control via the tablet, each individual needle can also be controlled during the running process. "This allows us to react in nuances without having to stop the machine. Effects of readjustments are also immediately visible due to the constant parameter query – from dosing to pressure monitoring in each individual cavity," Metz explains the advantage.

Advantages through process reliability

The Managing Director says: "When you enter the medical technology sector, you have to be convinced that you can hold your own in the market and offer progress. And for us, this lies in tapping and evaluating process data from the beginning of the process to the end. We see our special know-how in

this affinity for technology." There is more behind this than pure enthusiasm for technology. For example, the process reliability that has been achieved has made it possible to dispense with a 100 % inspection of the parts in Motten. "We only examine random samples, but we don't have any deviations," says Patrick Buberl, referring to an O-ring series that is currently running. And even with a batch size in the millions, the complaint rate is zero. Nevertheless, they now want to prove this once again with a temporarily installed camera system via an optical complete inspection. "The work and investments we made upfront will definitely pay off in the end," Buberl is convinced. At night, for example, the stable processes enable unmanned production.



The third LSR injection moulding machine, which has been producing at Psilkon since the end of 2020, will be followed by a fourth system this year.



The syringe stopper removal system was created in collaboration with its sister company HN.

Psilkon strives for perfection not only in the actual injection moulding process. In the beginning, the plugs for the epidural syringes were simply collected as dropped parts in a box. In the process, individual parts sometimes popped out or became contaminated in some other way. "Even if it was only a few parts that were then no longer usable, we didn't want to settle for that," Philipp Metz reports. So a removal system was developed that removes all parts and deposits them cleanly, also sorting them by cavity if necessary. The removal system was developed and built together with the

handling specialists at HN Maschinenhandel & Vermietung GmbH. This also resulted in a system for the automatic separation of O-rings and vent overflows after demoulding. "There, with metalworkers, electricians and programmers, we provide exactly the know-how that we need for the construction of such plants," the managing director makes clear.

New building with start-up campus

On the strength of the road successfully travelled, Psilkon is now ready to take the next big step in the young company's history. When the fourth injection moulding machine goes into operation at the end of the year, the space in the rented production hall will almost be exhausted. Therefore, a plot of land is now to be acquired where production will be rebuilt with the experience gained so far. "We can now build the shell around the process as we imagine it," Philipp Metz is pleased to say. Among other things, complete digitalisation, automatic removal of the components, post-processing and assembly are envisioned. "Everything that was previously not possible in-house for lack of space will be found there," says Metz, looking ahead.

Initially, a hall with 1,200 m² of production space plus offices is planned. The site also offers space for up to a tripling of the production area. As an additional highlight, a start-up campus is to be created. "We come from this background ourselves and know what challenges have to be overcome at the beginning. That's why we like to accompany such developments," Patrick Buberl explains this plan.

And Psilkon also wants to retain its own start-up character despite the expansion. For example, at lunchtime, they sometimes have a barbecue in the courtyard together with the entire staff. "Our open company culture has also proven itself in the pandemic," reports the managing director. The whole set-up was designed from the beginning so that work could be done from the outside without any problems. "We didn't have to change anything for the move to the home office."

The new company premises include spacious retreats and feel-good oases for the employees. "The best solutions are usually not found in the hundredth scheduled office meeting, but in casual conversation in pleasant surroundings," Buberl is convinced. "And sometimes such solutions come from someone who has nothing to do with the project at all but brings an outside perspective."

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Fakuma 2021 gets underway on schedule

Europe's largest plastics trade fair of the year is about to take place at Lake Constance

As of the editorial deadline in mid-September 2021, the online exhibitor directory lists a total of 1,469 exhibitors from 44 countries, including 1,039 from Germany, Austria and Switzerland. This means that the trade fair venue in Friedrichshafen is once again fully booked. On the exhibitor side, Fakuma from 12 to 16 October 2021 will feature the usual breadth of themes. Thus, it is likely to offer by far the largest range of exhibits at the European plastics trade fairs in 2021. K-PROFI spoke with Bettina Schall, managing director of the organising trade fair company Schall.



Photo: Schall

K-PROFI: Ms. Schall, the year 2020 had to run entirely without trade fairs. How did you get through the difficult year as a private provider?

Bettina Schall: In 2020, like many other private companies, stand builders, transport services, hotels, restaurants, caterers and other businesses, we naturally had to accept severe losses. But that's in the past now, we're looking ahead, especially to the trade fair autumn of 2021, when we're looking forward to Motek/Bondexpo, Fakuma and Blechexpo/Schweisstec with our exhibitors. We've always remained in close contact with our exhibitors over all these months, never slackened our efforts to prepare for the next presence trade fair, and now the time has come. We're looking forward to it! Fakuma will take place in a very secure setting. We're carefully laying the groundwork for the smooth running of the trade fair and the successful exchange of information between our customers – with the hygiene concept at the Friedrichshafen Exhibition Centre, which has been completely coordinated with the authorities and implemented on the basis of the generally valid Corona Ordinance of the State of Baden-Württemberg.

K-PROFI: What expectations do you now associate with Fakuma 2021?

Bettina Schall: We're pleased that manufacturers and users, suppliers and customers will once again be able to exchange ideas in person and engage in practical discussions. Everyone involved is picking up the thread of direct communication again, which we had to let go of at the beginning of 2020. The presence trade fair in the B-to-B sector is now the indispensable business platform par excellence, and Fakuma 2021 will be this again in the customary manner.

K-PROFI: What special features can visitors expect in terms of content this year?

Bettina Schall: Clearly the topics of sustainability, climate protection, environmental protection, resource conservation and recycling will be at the top of the agenda in many areas this autumn and will be dealt with intensively. New materials for 3D printing, for increasingly individualised manufacturing and for lightweight construction are also top topics. These are not special features in terms of content, but logical, current developments in the plastics industry. That will be exciting!

K-PROFI: What makes the Fakuma particularly attractive for visitors from other European countries?

Bettina Schall: The Fakuma in Friedrichshafen at the attractive border triangle of Germany, Austria and Switzerland on Lake Constance is easily accessible from Italy, France and other neighbouring countries as well. Moreover, the trade fair combines practical relevance with a high level of professional competence. The community of plastics manufacturers and processors has been meeting here for years. Above all, the Fakuma's theme and status are attractive: It is the world's leading trade event in the field of injection moulding. Trade visitors receive answers to important and current questions regarding production efficiency here. The trade fair is regarded as an industry and technology barometer for the fields of extrusion technology, thermoforming and 3D printing, and is the first port of call for new developments in all aspects of materials, machines, peripherals, processes and simulation in plastics processing. ■

Differentiated hygiene concept

Ticket sales for Fakuma will be conducted exclusively online, and on-site access control will be completely contact-free. The hygiene regulations which will apply to exhibitors and visitors had not yet been determined in detail at the time of going to press. It is advisable to inform oneself about the currently valid regulations on the websites of the organiser and Messe Friedrichshafen: www.fakuma-messe.de; www.messe-fn.de



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Three times FIT with PA-CF40

What V Frames expects from the first recyclable e-bike frame



View into the open fluid injection mould
with numerous sliders and the insertion option
for the handlebar axle sleeve on a 17,000 kN
Engel duo machine.

All-plastic bicycle frames have already put a few inventors on the map. An Austrian-German team has taken on the multifaceted challenges of a low-entry e-bike. On the road until mid-2020 under the Velosione brand, the pioneers from V Frames in Saalfeld, Thuringia, have proven the feasibility of their self-developed “wave frame” made of semi-aromatic PA-CF40 and made it ready for series production using fluid injection technology – with recycling potential and a CO₂ advantage over aluminium. Despite the long service life of an e-bike, the makers are already thinking about multiple product life cycles for the plastic of the frame.

Text: Dipl.-Ing. Markus Lüling, Editor-in-chief K-PROFI

V Frames has designed a low-entry bicycle without a top tube, a so-called “wave frame”. “An e-bike frame, and a deep-entry frame at that, is one of the most challenging bicycle frames to design in terms of riding characteristics due to the lack of a top tube,” notes Dr Umut Cakmak, which is why it was a fundamental decision to manufacture the frame using fluid injection technology (FIT). “Some people have tried to make bicycle frames using injection moulding, but ribbed constructions did not provide the required stiffness. To achieve the primary required torsional stiffness, a closed tube geometry is needed. Our designed deep-entry frame achieves at least the values of a comparable wave frame made of aluminium in all load cases,” explains the co-founder and shareholder of V Frames, CEO of the engineering office Plastic Innovation, Ottensheim/Austria, and PostDoc at the Institute of Polymer Product Engineering at the Johannes Kepler University in Linz.

The common ISO test standards for bicycles are focused on fatigue and not on stiffness or – even more important for the development process – on driving characteristics. “We used experimental investigations to determine the links between mechanical characteristic values and properties of driving dynamics,” explains Dr Umut Cakmak. “The values from the defined load cases served us as a benchmark because we also had to achieve the lateral stiffness values, which are not specified in the norms and standards, in order to also create the connections from design and manufacturing to driving dynamics. For this, we came up with our own standards and load cases, which will help us considerably in future projects regarding component design.”

Intensive simulation and structural analysis

“Achieving our goal of implementing a deep-entry frame using injection moulding was anything but a no-brainer,” says Christian Wolfsberger, co-partner of the engineering firm for product development Plastic Innovation and Business Development Manager Lightweight Composites at the injection moulding machine manufacturer Engel: “At Plastic Innovation, we worked out the idea down to the last detail. We went straight for a deep entry model because it was clear to us that if we managed to successfully implement this frame model, then we could also realise any other model. It all started when we came up with a procedural concept for manufacturing. In the concept phase, we had to make sure that the product with several fluid volume flows was also feasible in terms of process technology. Then we worked our way up step by step with regard to the requirements for the structural properties, stretched real aluminium frames on the test bench and measured the deformation values when force was applied.

Thus, we had a benchmark. In intensive cooperation with Coleo Design, Cologne, some sketches and then a CAD model were created. During the design phase, special attention was paid to the technical feasibility and the subsequent process engineering implementation, also because at that time we were not aware of any other component in which three fluid volume flows push the plastic core out of the component at the same time. The volume flows must be separately controllable and must not influence each other. We are talking here about large volumes that are pressed out of the component. To ensure that the frames also have the desired quality and that we don't go blindly into a mould, we have designed and optimised the component according to the load by means of intensive filling and structure simulations.”

For the filling simulations, the engineers rely on Moldex-3D. “It is very important that the fluid injection with the residual wall thickness and fibre alignment to be achieved can also be realistically mapped in the filling simulation. Both the cavity formation and the fibre alignment are crucial for the subsequent structure simulation,” says Dr Umut Cakmak. The analyses of the filling simulation include the injection process, the holding pressure and cooling phases. Critical weld lines, air pockets and defects in the fluid injection phase can be identified. These faults are eliminated by optimising the frame design, then simulated and analysed again until the bicycle frame is process-optimised. “We work with the designers from a very early stage in the design process and think about the plastic-appropriate design and the associated tooling technology right from the design stage. We had to design according to the material and the process in order to exploit the full potential of the material. The mechanical design includes the load cases of the standards as well as axial and lateral static loads, which provide conclusions about the driving dynamic performance. The loads of these requirement profiles were mapped and optimised in several structural analysis loops. Validation experiments were conducted concurrently to improve the material models of the simulations. From the design freeze onwards, we have to ensure to the customer that the product has exactly the properties that meet the requirements.”

High-performance material with recycled carbon fibres

During the development phase, the team tested several matrix materials – each with different reinforcing fibres in varying degrees of filling. Together with the compounder Akro-Plastic, the experts determined that a semi-aromatic polyamide with 40 wt.% carbon fibre reinforcement (CF) was optimal. Michael Rieck, Business



The e-bike with the Wave frame from V Frames in use.

Photo: Engel Austria



Photo: K-PROFI/Schneider

Dr Umut Cakmak, CEO at Plastic Innovation as well as PostDoc at Johannes Kepler University Linz, sees the wave frame without top tube as the most difficult geometry possible for bicycle frames.

Development Manager at Akro-Plastic: "Compared to a high reinforcement with 60 wt.% glass fibre in the polyamide, carbon fibres save 20 % in density and bring 70 % more stiffness."

Akro-Plastic already relies on a reclaimed carbon fibre in the Akroloy ICF product range used here to produce the base material. "We reprocess a continuous fibre product that has not previously come into contact with resin or thermoplastic, thus deriving the carbon fibre for our compound," explains Michael Rieck. "Although CF-reinforced material is more demanding to process, it is well suited for fluid injection technology," he reports, "we have been working very intensively on FIT. One of our pilot plants in Niederzissen can handle these applications. This made continuous material adjustments possible on the one hand, and targeted optimisations for the FIT process on the other."

Industrial implementation at injection moulding processor Isoco

The technical realisation takes place at Isoco Plastics Technology in Saalfeld-Schmiedefeld, which is a shareholder of the bicycle frame manufacturer V Frames. Managing Director Michael Müller took over Isoco from insolvency in 2013. Today, the company produces small load carriers, returnable containers and pallets made of recycled polyolefins on the one hand, and other injection moulded parts and moulded parts made of reinforced plastics on the other hand in two plants at the same location. The injection moulding machinery includes clamping forces between 400 and 23,000 kN.

"Highly filled fibre-reinforced thermoplastics are something new for us, but then again they are not. Here at the site, 700 employees used to produce hand laminates for caravans," Michael Müller looks back on the history since 1960. "We come from injection moulding, and we are competing not to make an old standard in injection moulding, but to pursue new projects again and again. We started with the boxes. These products with high recycled content were a real challenge, but we started very successfully with them. Today we process 10,000 tonnes of polyolefin recyclate per year into boxes and pallets."

For the production of bicycle frames, Isoco has invested in a large Engel duo injection moulding machine with a clamping force of 17,000 kN and a high-quality plasticising screw for processing highly reinforced materials. In addition, for smaller bicycle frames there is an exchangeable cylinder so that the shot weights can be reduced. Add-on parts for the frames, such as the battery compartment cover, are produced in another plant in Erfurt.

Triple FIT application on the PA-CF40

A total of three channels are placed as permanent cavities in the closed frame – on the one hand under the battery compartment in the down tube, and on the other hand in the two brackets that form the seat and chain stays in the rear triangle. For this purpose, after filling the mould and an initial cooling of the edge layer, fluid is forced into the interior of the moulded part at three points via injectors, while



Photo: K-PROFI/Schneider

Michael Müller is managing director of Isoco and V Frames.

core pulls open so-called secondary cavities at the fluid channel end to accommodate the still plastic core. The fluid volume flows are controlled separately from each other. At the end of the fluid process, the fluid pressure inside the component is briefly maintained, quasi as holding pressure in the entire cavity interior. The process is therefore very low in shrinkage and distortion, and the components do not have any sink marks.

The finished plastic bicycle frame weighs 3.2 kg. Of the almost 4.5 kg shot weight, the three fluid volume flows displace 1.2 kg into the secondary cavity. As an alternative to the so-called blow-out process into a secondary cavity, the so-called mass push-back process is also being examined for future projects. In this process variation, the plastic core is pressed back through the hot runner into the screw antechamber of the injection unit instead of into a secondary cavity. The material that is pushed out can then be injected again during the next shot. In the eyes of those in charge, extensive know-how in the entire process chain of filling and structure simulation, design, mould construction, process engineering and material behaviour is decisive for the good result.

QA through close tolerance band monitoring

Particularly important is the reproducibility of the process with identical properties from moulded part to moulded part. To this end, those in charge are currently defining the process window more narrowly. "Because we have optimised the process and therefore many parameters, we can produce the frame in 100 seconds cycle time with constant quality." A 100 % inspection of all moulded parts produced has proven to be unnecessary. Dr Umut Cakmak: "We set up a DoE (Design of Experiment) with all relevant parameters and determined correlations of machine parameters to component properties." Christian Wolfsberger: "This means that it is sufficient to have the process parameters monitored in the machine control system for tolerance band transgressions. In the sampling, we determine how tightly we set the quality parameters to be sure." Of course, V Frames relies on complete traceability through parameter-based documentation.

"We are now going into series production and setting up a small testing laboratory," Michael Müller reports, "all in all, we will



Christian Wolfsberger co-developed the Wave frame for e-bikes and is Business Development Manager Lightweight Composites at Engel.

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Photo: K-PROFI/Schneider

Freshly demoulded frames, still with the secondary cavities filled by the fluid injection technique.

President Europe Central at Engel: "V Frames is a project where an innovative idea coupled with the team's ability to implement and the economic efficiency of the concept have resulted in a totally innovative product." Christopher Vitz, also a member of the advisory board of the Open Hybrid Lab Factory in Wolfsburg, is full of respect for the achievement: "Anyone who consistently commits to an idea and tackles an innovative manufacturing process has to tackle a very broad field. The people at V Frames have brought in university know-how, engaged calculation expertise and implemented everything brilliantly. Nevertheless, we are only at the beginning of a large potential business area that can really make a difference in a user industry. A good product with a good ecological balance, with recycling potential and with the potential to do something positive for society. We'll be hearing a lot about this in the next few years," he says with conviction – and makes a statement for his employer: "If we at Engel have the chance to get involved in such projects, we're happy to take it."

determine which mechanical tests are to be carried out on each part and how many. Currently, we are producing 500 frames each for two months, then 3,000 per month. The theoretical capacity is 1 million pieces per year on our machine."

Strong support from the machine manufacturer

As an injection moulding machine manufacturer, Engel has accompanied and supported the project for years. Christopher Vitz,



Photo: K-PROFI/Schneider

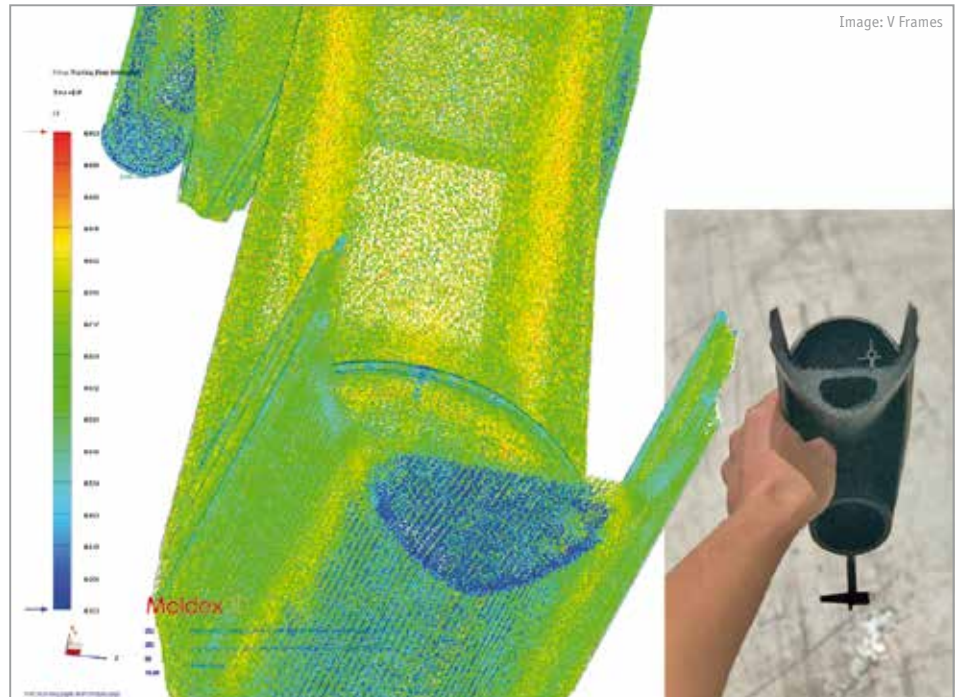
The large injection moulding machines at Isoco mainly produce load carriers, folding boxes and plastic pallets. A 17,000 kN model also produces bicycle frames.

Plastic frames for just-in-time assembly

The final assembly of high-quality e-bikes mainly takes place in Germany and the Netherlands, which is why just-in-time production is definitely possible in Saalfeld, explains Michael Müller. "From Asia, we always have the sea route in between." Michael Müller describes the investment costs for tools as a major barrier to market entry. "We only achieve amortisation through the production of frames. Our concept is interesting for customers who are interested in large quantities of about 6,000 or more. A single tool can produce around 300,000 frames per year. But hardly any individual bicycle manufacturer needs such quantities. Nevertheless, we could already serve a very large market through this one machine."

Several projects and geometries in the pipeline

The Isoco Bikes division will start selling the first commercially available production bike with a Wave frame in the autumn. V Frames, meanwhile, has other bike frames



in development for various OEMs. "Concrete projects include a children's bike and several other models. Currently, seven tools are in the design stage," Michael Müller reported.

The filling simulations with Moldex-3D realistically depicted the achievable residual wall thicknesses and fibre alignments during fluid injection.

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Michael Rieck, Business Development Manager at Akro-Plastic, is convinced of the potential of CF compounds for the bicycle industry.



As Area Sales Manager at Engel, Matthias Hölscher looks after customers in Thuringia, including Isoco and V Frames.



As Engel's service technician, Florian Rammer accompanies current trials by V Frames on fluid injection technology with recyclates.



Christopher Vitz, President Europe Central at Engel, praises the team effort at V Frames.



The residual wall thickness and the fibre orientation are essential quality parameters and criteria for compliance with the load specifications determined in the structural analysis.



For example, Norway's Buddy Electric is among the first to start selling e-bikes with carbon composite injection moulded frames. The proprietary design of the frame "Made in Germany" comes from Eker Design and Buddy Electric.

"Buddy Electric is not our first customer, we have other orders and moulds in development and production, but these are still subject to various NDAs. In the coming months we will announce more OEM frames," says Michael Müller. Buddy Electric from Norway has more than 20 years of experience with electric vehicles and had already developed a first e-bike in 1993. It was only in 2017 that Buddy successfully resumed the product and has since advanced to become one of the largest e-bike manufacturers in Norway. The Buddy sX1 should be available in the first quarter of 2022. Sooner or later, Michael Müller wants to expand the clamping force range at Isoco to 35,000 kN – not only for the growing business with large containers and large pallets but also to be able to injection mould plastic frames for cargo bikes, for example.

Multiple product life cycles in sight

Back to the current model: how does V Frames intend to organise an orderly and quantitatively satisfactory return of frames for a consumer product that is used for a longer period of time? Michael Müller: "We assume that the buyer of an e-bike registers with the manufacturer to document his warranty claims. This keeps a relationship from the manufacturer to the user." At the end of the life cycle, the frame of the e-bike should



This X1 carbon frame for Norwegian brand Buddy Electric is also to be produced in around 100 seconds cycle time.

become the frame of a CityBike, the frame of the CityBike a few years later should become the frame of a children's bike, and the frame of the children's bike should then become the frame of a running bike. "This way we can create multiple product life cycles over a very long time."

The very day after K-PROFI's summer visit, V Frames launched a new round of attempts

to process production recycle from frame production into new frames – and not just with admixtures, but with 100 % recycle. ■

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Where and why plastics score over wood

Wood grows almost everywhere and is easy to work with. That is why it has been one of the most important materials in the building industry for thousands of years. One of its disadvantages is its susceptibility to weathering. For this reason, plastics have conquered important fields of outdoor applications today. And the logistics industry is also increasingly replacing wooden pallets with plastic ones because of their greater durability. In part five of the series on the occasion of the anniversary “100 years of plastics”, the K-PROFI editorial team looks into the substitution of the renewable raw material.

Text: Dipl.-Ing. Karin Regel, Dipl.-Ing. (FH) Sabine Rahner and Dipl.-Chem. Toralf Gabler, Editors K-PROFI

“Once in a while a drop of oil for the hinges, but otherwise no maintenance is necessary for a window with a PVC profile frame,” reports Dr Norbert Berndtsen from his more than 25 years of work as division manager for PVC profiles at the former Hüls Troisdorf AG. PVC windows have long since established themselves worldwide and have clearly pushed back conventional wooden or aluminium windows. Today, almost 60 % of all windows in Germany are made of PVC, wooden

windows only account for about 15 %. In Europe, too, PVC windows have high market shares, as a study by the Frankfurt-based Verband Fenster + Fassade (VFF) shows. “Country-specific figures vary slightly and are, for example, 39 % in Italy, while they reach 70 % in Poland,” says VFF managing director Frank Lange. Scandinavian countries such as Denmark are an exception, where the wooden window with a market share of 47 % is still clearly superior to the plastic window with 28 %.

High design freedom with vinyl

A lot has happened since the first vinyl window was created in 1954 in cooperation with Dynamit AG. In particular, the manufacturing process has been made more efficient and cost-effective. Here, a breakthrough was made not only by more efficient extrusion lines but also by welding machines that reduced the production process to half the time it used to take. Today, the manufacturing costs for vinyl windows are at about the same level as the costs for wooden or aluminium windows. However, vinyl windows have advantages that the other materials do not have. They are easy to shape and can therefore be adapted to individual wishes and designs. Even unusual designs



Wooden railway sleepers are susceptible to weathering.

FFU railway sleepers are installed on the Hohenzollern Bridge in Cologne, among others.

such as round arches or muntins, different colours and opening shapes can be realised without any problems. They are very energy-efficient and, above all, virtually maintenance-free and durable. “Today, a window is only removed if it no longer suits the property for visual reasons or if better thermal insulation is required,” Dr Berndtsen continues. But even here, a standard has been reached today that can hardly be improved.

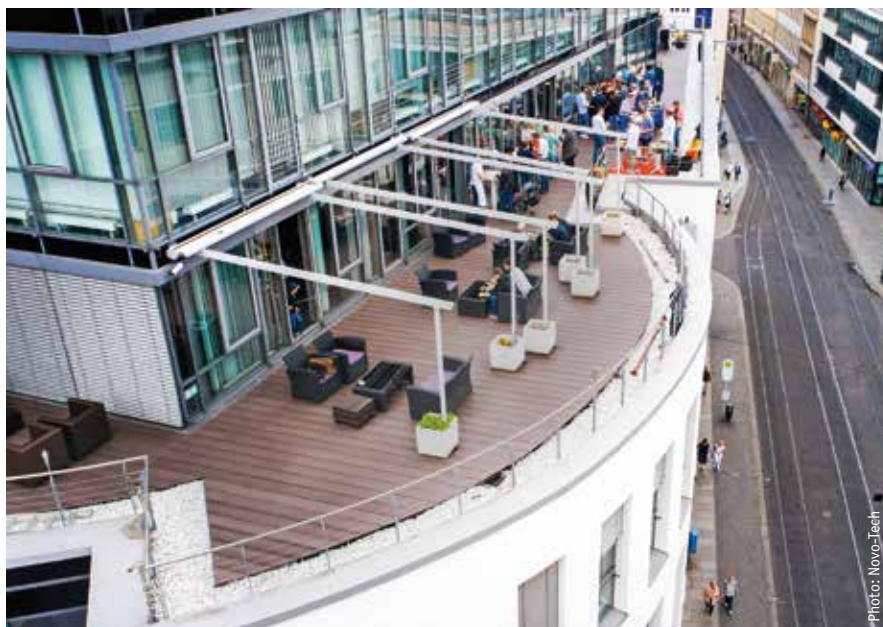
Old windows in the material cycle

If a plastic window is actually removed, it can be recycled today. A lot has happened in the past few years in terms of recycling. At the beginning of the 1990s, PVC was criticised and classified as problematic. In order to set a clear signal here, the German plastic window system providers joined forces in 2002 to form the recycling initiative Rewindo and since then have been making an important contribution to resource and energy efficiency in the sense of the Circular Economy. With growing success, Rewindo GmbH, headquartered in Bonn and now with 55 collection points supplementing the collection system, organises the recycling of PVC windows, doors and roller shutters throughout Germany. The regranulates are returned to the production cycle. Thus, in 2019, over 35,500 t of PVC regranulate were created from old windows and a further 65,000 t of production waste were recycled. After all, plastic windows can be kept in the cycle because they are created from thermoplastic raw materials that can be melted down again and reused, which is not possible with wood. Another advantage of plastic windows.

Combination of wood and plastic

In addition to window and door profiles, there are other applications in construction where plastic solutions replace or complement conventional wood solutions. These include fence elements, wall panels, flooring and decking. Here, too, plastic solutions score with their advantages of low to no maintenance, individual design options and weather resistance, which is a big plus, especially for outdoor applications.

“Our decking boards last about three times as long as comparable boards made of wood,” explains Holger Sasse, managing director of Novo-Tech GmbH from Aschersleben, who relies on a combination of wood and plastic with his innovative company. Such combinations are becoming more and more popular



Plastic solutions in the construction industry at a glance: Window profiles made of PVC and decking boards made of a wood-plastic composite.

in the construction industry. After the USA, so-called wood-plastic composites are also a material in Europe that is gaining more and more market share and has long since established itself, especially in outdoor applications such as decking. Typical materials frequently consist of 50 % wood fibres and 50 % plastic, with both polyolefins and PVC being used. Holger Sasse and his company go one step further and produce a polymer-bound wood-based material that contains a very high proportion of natural fibres. Here, around 70 % sawdust, i.e. by-products from wood processing, and around 30 % HDPE and additives are used as input materials. This is the basis for decking boards that are now available in 1,000 different assortments and designs.

Sustainable tropical wood alternative

“With our decking boards, we offer an environmentally friendly alternative to the well-known boards made of the tropical wood Bankirai and we are very happy about the high popularity,” reports the managing director, who founded his company in 2005 and today already produces and processes 30,000 t/a of granulate. The planks look almost like wood and can be processed like it, but wind and weather can hardly harm them. “Our planks last between 20 and 30 years, whereas wooden planks usually breakdown after 7 to 10 years and have to be replaced,” Holger Sasse continues, explaining that the issue of environmental

protection and sustainability is so close to his heart that he has just founded a second company, Novo-Tech Circular. “We offer a cradle-to-cradle solution for our products. We collect products that are no longer usable from the customer free of charge and return them to the cycle.” In doing so, Holger Sasse wants to make his contribution to

One of the advantages of PVC window profiles is that they can be recycled. Rewindo has built a Germany-wide network and today already returns 35,000 t/a to the cycle.



the Circular Economy and help improve the tarnished image of plastics. After all, he says, plastic is a great material that has only come under criticism, among other things, “because we are too stupid to handle it properly.”

Deutsche Bahn’s (the largest German railway company) rail network covers approximately 33,400 kilometres. Around 120 million sleepers are used to fasten the rails and thus to secure the track gauge in railway operations. Today, sleepers made of prestressed concrete dominate. However, the former standard material wood is also still used. On bridges, wooden sleepers act as a damping buffer between the rail and the bridge structure, reducing noise and the load on the bridge through lower vibrations and dead weight. Where the bedding thickness is limited, e.g. in tunnels or on bridges, the lower height is an advantage compared to concrete sleepers. In the construction of turnout systems, where sleepers with individual lengths are required, wood wins points because it is easy to work with.

The big disadvantage of wood is that it is susceptible to cracks due to mechanical stress and moisture, and it can also rot due to weather influences. Waterproofing with coal tar oil, which is hazardous to health and the environment, increases the lifespan of wooden sleepers to around 20 to 25 years, but then turns them into hazardous waste. And since a failure at their preferred locations, such as tunnels, bridges and points, would have a considerable impact on rail traffic, plastic sleepers have been gaining acceptance as a more reliable alternative for some years now. Such sleepers can be found, for example, on the Laberviadukt, a 319 m long steel bridge on the Nuremberg-Regensburg railway line, in turnout systems at the Würzburg, Leverkusen and Vienna railway stations, on the Hurdener Bridge over Lake Zurich in Switzerland or in the track systems of the Paris Metro and Vienna Underground.

Japan pioneer in plastic sleepers

A pioneer in this field is the Japanese company Sekisui Chemical Co. Ltd, which is now building its first European plant for the production of synthetic railway sleepers in Roermond, the Netherlands. K-PROFI spoke to Clemens Bretschneider, Manager Railway Products at Sekisui Chemical GmbH, one of the nine Sekisui companies in Europe, about the background, advantages and potential of synthetic railway sleepers.

“In order to increase the availability of its rail network, the Japanese railway company JNR approached Sekisui in 1978 to find out whether the so-called synthetic wood FFU was suitable for substituting



Photo: Novo-Tech

The wide range of products that Novo-Tech manufactures from the polymer-bonded wood-based material also includes wall panels for outdoor use.



Photo: Sekisui

The FFU railway sleepers consist of glass fibre bundles foamed with PUR.

existing hardwood sleepers,” reports Bretschneider. The continuous fibre-reinforced polyurethane FFU (Fibre Reinforced Foamed Urethane) was originally developed for basins in sewage treatment plants because of its high chemical resistance.

In 1980, JNR started a first field trial with FFU sleepers on a bridge and in a tunnel. “This use of plastic materials in structural safety-relevant areas was an absolutely new territory at the time,” Bretschneider emphasises, “because there was no experience yet on the fatigue phenomena over decades.” And with depreciation periods of at least 25 years, the service life of railway sleepers was set quite high. After five years, some of the sleepers were removed and subjected to a test by the Railway Technical Research Institute (RTRI). “The result was very positive,” says Clemens Bretschneider, “the important technical parameters such as E-modulus and softening were almost unchanged and there were no cracks or even fractures.” As a result, there was approval by the JNR in 1985, and FFU sleepers became the standard



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product for railway tracks in Japan, where there are particularly high demands on availability. Even the Japanese high-speed train Shinkansen runs partly on tracks with such sleepers.

In an ongoing process, sleepers from the trial projects are examined every five years. "So far, always with the result that the values remain the same or deviate only minimally," the product manager knows. The first plastic sleepers are still doing their job reliably after more than 40 years. After the regular inspection in 2011, the RTRI confirmed a service life of at least another 20 years. "This means we are now already at a service life of 50 plus x years," Bretschneider is pleased to say.

Flexible glass-fibre PUR system

The FFU sleepers are manufactured using the pultrusion process. In this process, glass fibre bundles are foam-coated with the PUR reaction mixture. After the reaction is complete, the strand is cut to length. The material system is very flexible, because by varying the components, the density as well as other technical characteristic values such as E-modulus or pull-out forces of the sleeper screws can be adapted to special requirements. "Laminations are also possible," explains Clemens Bretschneider, "so that, for example, a core from the standard quality can be wrapped with a stiffer material."

The range of applications is also very broad in terms of ambient temperatures. "We have done tests in Finland at temperatures as low as -65 °C," reports the product manager. "According to the Finnish railway operator, the FFU material does better than wood here." Thanks to the now-widespread use in Japan, experience has been gained in a wide range of climatic zones. It is advantageous that the foamed material has an insulating effect so that heat does not penetrate into the inside of the sleeper, which keeps it stable. "As a result, there is no critical lane narrowing when the train passes over."

The glass fibres also mean that the thermal linear expansion of the material is minimal. "In relation to the track width of 1,435 mm, the maximum expansion at a temperature difference of 30 K is only 0.5 mm," Bretschneider quantifies this important parameter. This is an advantage over railway sleepers made of recycled plastic, for example.

Recycling solutions already established

Since the first FFU sleepers will reach the end of their expected service life in ten years at the earliest, recycling is not yet a dominant issue, but the Japanese have already worked out solutions for it. "In manufacturing in Japan, we recycle one hundred per cent of the production waste," reports Clemens Bretschneider. These are shredded and pressed into shape with PUR. "Such sleepers then no longer have the technical characteristic values as the initial product," says the product manager, "but can be used for subordinate railway lines." In this way, retired FFU sleepers could also be recycled later.

But used sleepers can also be recycled directly. For this, only the drill holes of the fastening screws would have to be rehabilitated, and then there would be nothing to prevent further use. "This is also common practice in railway operations for concrete sleepers," Bretschneider knows. "The sleepers are then no longer used on main lines, but for secondary tracks, for example."



Photo: Sekisui

Clemens Bretschneider: „Our potential is in the hotspots where you can't replace wood with concrete.“

Production to start soon in Europe

In Germany, the first tests were carried out at the Technical University of Munich in 2008, and one year later the Federal Railway Authority (EBA) granted approval for testing. In 2011, the first FFU sleepers were installed in the Deutsche Bahn track network. In 2017, general approval was granted by the EBA as well as internal approval by Deutsche Bahn. "Since then, Deutsche Bahn has been using FFU sleepers on a larger scale in areas where wood was previously still used," reports Clemens Bretschneider.

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Photo: EPAL

60 years of the Europool pallet: according to EPAL, 2 billion rotations of the standardised wooden pallet take place annually in the global movement of goods.

Lighter, more stable, more sustainable, more hygienic and more economical

But while wooden pallets for DIY furniture are enjoying growing popularity, the logistics industry is partly saying goodbye to the classic. Take Transoflex Express GmbH, for example: the logistics provider for the pharmaceutical, cosmetics, consumer electronics and other sensitive goods sectors switched from Euro pallets to plastic hygiene pallets in national long-distance transport in 2019 after a two-year test phase. "Because the hygiene pallets last significantly longer, they are more environmentally friendly than the traditional wooden pallets, and the investment will reduce our costs in the medium term," says CEO Wolfgang Albeck, explaining the move to the load carriers called H1 pallets with identical dimensions. The previous wooden Euro pallets had to be replaced at Transoflex after an average of eight rotations due to damage. In contrast, the durability of the plastic version, which weighs only 18 kg, is five to six times longer. With a full semi-trailer, this means a weight saving of more than 200 kg. According to Wolfgang Albeck, there is another important aspect, especially when transporting medicines: "The H1 pallet not only keeps its weight but also its appearance and cleanliness. Wooden pallets, on the other hand, become dark and contaminated in use." Pharmaceutical customers would increasingly refuse to accept these pallets. "Too heavy, too dirty, too quickly broken" is therefore the conclusion at Transoflex for the classic wooden Euro pallet. The logistics provider also sees the introduction of plastic hygiene pallets in regular transport as a climate-friendly initiative.

Patented half pallet with one-third PCR

The counterpart to the Euro pallet used in food retailing on an exchange basis is called the Düsseldorf pallet. This pallet is used for store deliveries, is only half the size of the Euro pallet (600 x 800 mm) and, like its big sister, can be approached by a forklift truck from all four sides. A change is also on the horizon for

The expert does not consider a comprehensive replacement of concrete sleepers to be realistic. Deutsche Bahn installs about 2 to 3 million concrete sleepers per year. In terms of price, plastic sleepers could not keep up. "But there are still enough hotspots where wood cannot be replaced by concrete. That's where we see our potential."

Currently, Sekisui manufactures the sleepers only in Japan. The new plant in Roermond, where production will start in 2023, should increase availability for the European market and significantly shorten delivery times. Initial capacity is planned at around 100,000 standard sleepers per year.

Everything shipshape with plastic

Eleven boards, nine blocks and 78 nails: this year the Europool pallet, or Europallet as it is colloquially known, celebrates its 60th anniversary. On 1 July 1961, European railways introduced the exchangeable wooden load carriers to facilitate freight transport and agreed on the basic dimensions of 800 x 1,200 x 144 mm. The universal transport platform begins its triumphal march. 30 years later, the European Pallet Association e.V., EPAL for short, is founded. It organises and controls the pool, which today comprises more than 600 million Euro pallets,

and issues licences to producers and repairers. According to EPAL, there are 2 billion rotations of the Euro pallet every year. 17 types of wood are approved for the production of the solid wood carriers standardised according to EN 13698-1. In Germany, domestic birch, pine or spruce is usually used. Depending on the moisture content of the wood, they weigh between 20 and 24 kg. Its load-bearing capacity is 1,000 kg (point load) and up to 2,000 kg with a full-surface load. The Euro pallet is considered indispensable in the worldwide movement of goods and has even advanced to become a popular raw material in the do-it-yourself scene.

Easy to repair and recyclable: Aldi relies on the Düsseldorf plastic half pallets developed by Walther Faltssysteme throughout the company.



Photo: Aldi



Just as big as the classic Euro pallet, but lighter, stronger and cleaner: the H1 pallet is replacing the traditional wooden pallet as a load carrier in long-distance transport at Transflex because it is more sustainable, hygienic and economical.

K-PROFI 3-4/2021, directly available at: www.k-profi.de/heft/210410). Dominik Lemken, authorised signatory at Walther Faltsysteme, knows that reliably functioning plastic load carriers are needed to ensure that automated storage in high-bay warehouses runs smoothly. Metal brackets on the runners of wooden pallets are often bent when the forks are hit. The new KDP, therefore, has exchangeable runners made of glass fibre-reinforced PP as well as TPE inserts on the underside of the pallet deck for corresponding slip resistance against the forklift tines.

The KDP was launched in autumn 2020 at the discount sister stores Aldi Süd and Aldi Nord, where it is gradually replacing the classic wooden pallet. Unlike the Düsseldorf wooden pallets, there is no exchange principle with the KDP. Instead, the KDPs are made available to suppliers via a pooling system operated by Polymer Logistics. After

these half pallets: as a durable and intelligent alternative to the Düsseldorf wooden pallet, Walther Faltsysteme GmbH, Kevelaer, developed the patented plastic Düsseldorf pallet (KDP), which won the pro-K award

in 2019. The 6.5 kg light model made of PP with more than a third PCR content is manufactured by Formex Plastik from Kevelaer on two 11,000 kN injection moulding machines (see the portrait on Walther Faltsysteme in

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Photo: Auer

each rotation, empty pallets are checked for damage and cleaned by the service provider. As a result, the pallets meet higher hygiene standards, according to Aldi. Another advantage: integrated RFID chips and barcode labels (IML) allow each pallet to be recorded with location accuracy. “The pooling service provider can track at any time how

many pallets are in the depots, at the supplier and at the retailer. This also results in less pallet shrinkage,” explains Arne Ringkowski, Teamlead Return Logistics at Aldi Nord. Düsseldorf pallets made of wood are usually no longer usable after a few rotations and repairing them is usually uneconomical. “The KDP can be repaired without much effort due

In its new, third production hall, Auer Packaging exclusively manufactures large-format products, including plastic pallets in Euro and DIN format.

to its modular design. Defective runners are simply replaced. Discarded elements are recyclable and are fed into a recycling process,” says Arne Ringkowski.



Photo: Werit

Currently, there is no universal industry solution for the food retail sector. For several years now, the Schwarz Group (Lidl and Kaufland) has been using the so-called Heilbronn half pallet made of plastic. And as a one-to-one solution to the larger Euro pallet, the Schwarz subsidiary PreZero developed the Neckarsulm Euro pallet. Dimensions and requirements such as entry height, closed runners, block widths and deck heights conform to the standardised Euro pallet. Conveyor technology does not have to be adapted. PreTurn, a brand of PreZero, markets the 20 kg Euro pallet made of PE-HD and equipped with RFID transponders as Pallet 4.0 for European logistics. The Heilbronn half pallet and the Neckarsulm Euro pallet are also offered and operated by PreTurn in a closed Europe-wide pallet pool cycle.

Werit integrated PE-HD injection moulding machines, welding machines, milling equipment as well as systems for quality control into its autonomous production cells for Euro H1 hygienic pallets.

Autonomous pallet production in XXL format

For more than 20 years, the Werit Group, headquartered in Altenkirchen, Germany, has been a certified manufacturer of Euro H1 hygiene pallets, which are considered leading load carriers for all hygiene-sensitive food, chemical or pharmaceutical applications. With certification by GS1 Germany, these returnable load carriers are also exchangeable in the open pool, at least throughout Europe. The load capacity here is 5,000 kg statically and 1,250 kg dynamically, i.e. when transported by forklift or pallet truck. Werit manufactures the pallets at its Buchholz site on autonomous production cells. The production lines for the Euro H1 hygiene pallets made of PE-HD integrate injection moulding machines, welding machines (for welding the three runners), a milling machine and quality control systems. In addition, the Werit pallet portfolio also includes half pallets (800 x 600 mm) as well as industrial pallets (1,200 x 1,000 mm) made of PE-HD virgin or regenerated material in various designs.

Two injection moulding machines with a clamping force of 45,000 kN are the eye-catcher in the new production hall at Auer Packaging in Amerang, occupying the entire width of the new building and producing pallets as well as large load carriers. Auer Packaging commissioned its third production hall in the first pandemic year of 2020 and exclusively manufactures large-format products there, such as plastic pallets in Euro and DIN format as well as big boxes and large load carriers. The additional 9,000 m² of production space houses 15 injection moulding machines, including the two 45,000 kN models. Lightweight pallets, cleanroom pallets, hygienic pallets and medium pallets are the names of the four different pallet variants that Auer has in its range, specially designed for heavy loads, transportable by machine and adapted to Euro or ISO formats.

Wooden pallets for vaccine transport

Currently, a shortage of raw materials and rising wood prices are causing a significant increase in the price of Euro pallets. While the price for a new wooden pallet was still below eight euros at the beginning of the year, it climbed above the ten-euro mark in April 2021. In addition to the aspects explained in detail above, the plastic pallet is

also becoming increasingly attractive from this point of view. But for some applications, it reaches its limits. For example, the plastic pallet must surrender at low temperatures, as is currently required for the transport of Covid 19 vaccines. Their temperature resistance usually ranges from -30 °C to 40 °C, and even up to 90 °C for short periods. At temperatures that are too low, plastic pallets could lose their elasticity and tend to break. Low temperatures of -70 °C or more, on the other hand, do not affect the stability and load-bearing capacity of EPAL Euro pallets, EPAL is pleased to report. ■

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Glass: www.k-profi.world/issue/210106

Ceramics: www.k-profi.world/issue/210226

Leather: www.k-profi.world/issue/210240



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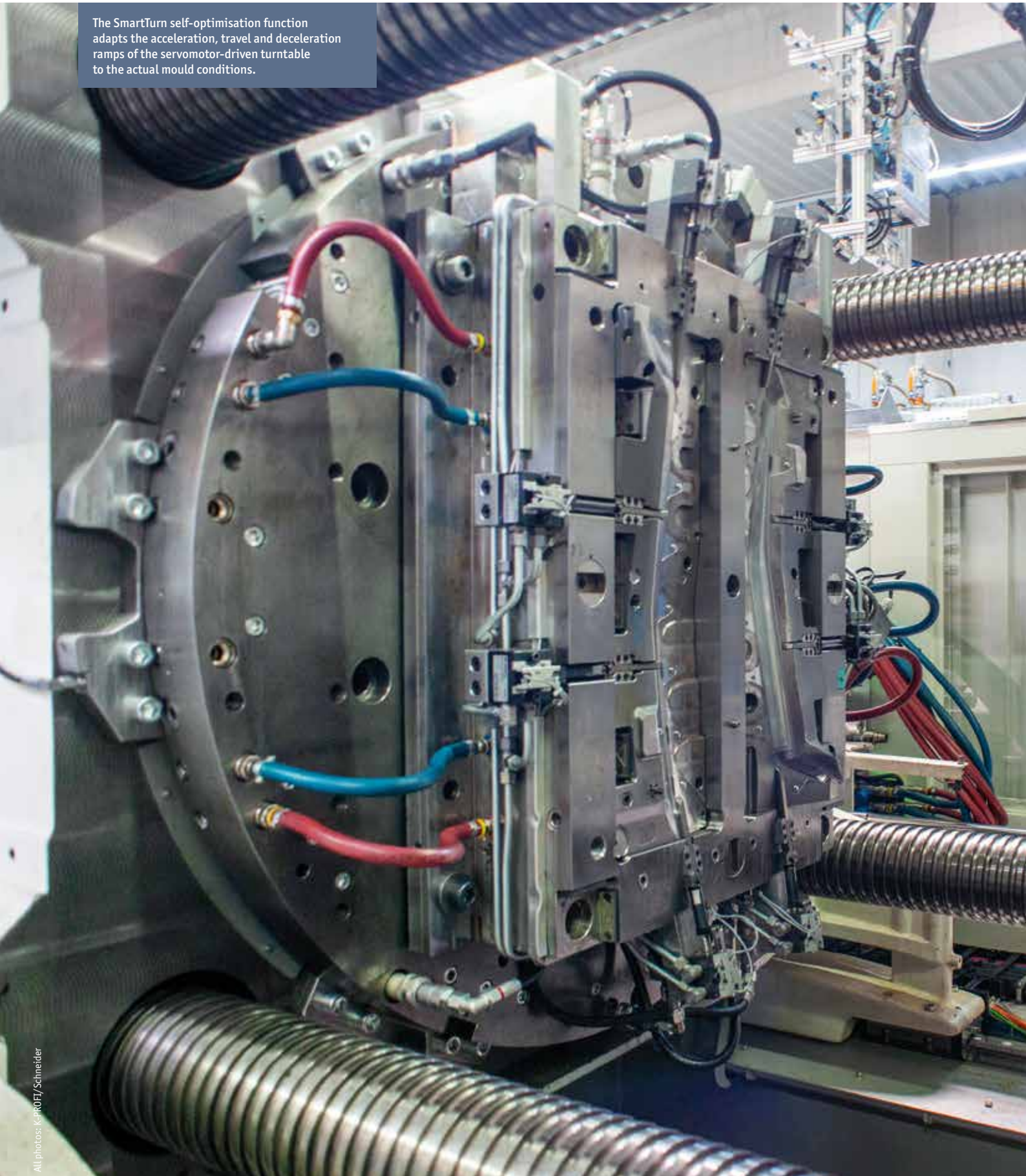
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The SmartTurn self-optimisation function adapts the acceleration, travel and deceleration ramps of the servomotor-driven turntable to the actual mould conditions.





Injection-side mould half of the 2C decor strip with insert-holding slides for holding the preformed decor foil.

An Assistant for the Optimum Turn

How Nifco Germany increases efficiency in 2K injection moulding with a new function

“We are constantly working on making our processes as efficient as possible,” says Claus Haban, plant manager of Nifco Germany GmbH, Weissenburg, highlighting the never-ending improvement process as an automotive supplier. Every saving contributes to success. And every (further) step counts. Digital tools for process optimisation are becoming increasingly established in injection moulding production. Nifco has now tested a new software function for rotary table applications in the field for machine supplier KraussMaffei. Claus Haban and his team report on initial experiences and the potential for the production of multi-component parts.

Text: Dipl.-Ing. (FH) Sabine Rahner, Editor K-PROFI

Since 2014, the plant that emerged from Kunststofftechnik Weissenburg GmbH & Co KG (KTW) has been part of the Japanese Nifco Group and now operates jointly with the former Kunststofftechnik Schmidt GmbH & Co KG from Solingen as Nifco Germany GmbH. In contrast to the North Rhine-Westphalian site, which concentrates solely on interior components for the automotive industry, the Bavarian site in Weissenburg supplies OEMs with complete assemblies for both the interior and the exterior as a Tier 1. The two locations are closely linked and form an independent group within the group, which has also been supported by a US location in Toccoa/Georgia since 2016. Nifco stands for Nippon Industrial Fastener Corporation and refers to the origin of the Japanese parent company: the manufacture

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of fastening elements. "Our product range is completely different from that. Our components are much larger than in the Asian Nifco plants," explains Plant Manager Claus Haban.

Two-thirds of the 29 injection moulding machines in Weissenburg produce interior components, besides kinematic components mainly finished visible parts, either with IML, IMD or high-gloss decor directly from the injection moulding. In addition, two painting lines open up a wide range of colour and paint variants as well as chrome (VI) substitute coatings. ZSB (assembly) parts up to complete instrument panel modules are produced in the in-house assembly department. Exterior applications from Weissenburg include complex air ducts with mounted air flap control and large parts such as underbody panels or wheel arch covers, which are produced on the largest injection moulding machine with a clamping force of 23,000 kN. While weight aspects are increasingly important for exterior applications, which Nifco Germany addresses with physical foam injection

moulding (Mucell), among other things, the increase in functionalities challenges the developers in the interior area. "Light is a big issue for all OEMs. We rarely produce a decorative component without a light component. No matter whether it's an instrument panel or door trim, ambient lighting is usually involved," Claus Haban knows.

Decor, light and function for the interior

"There are highly interesting developments in this area, including projectors that bring



Plant Manager Claus Haban: "We are open to any new technology. We adapt to the market."



The media feed via a hose chain instead of a rotary feed-through with movable seals prevents leaks.

snowfall or sunshine into the interior. But where the journey ultimately takes us is up to the customer. We are open to any new technology," says Haban. To this end, Nifco Germany operates its own development centre for component and process development at the Weissenburg site. "For our product range, the worldwide development takes place here in Weissenburg. We develop everything from





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Combination of IML and 2K injection moulding: For the decorative strip, a foil insert is first overmoulded with crystal-clear PC and then with ABS/PC.



the component to the tool to the finished ZSB and pass on our experience both to the Solingen site and to Nifco KTW America in the USA." Claus Haban considers globalisation to be one of the greatest challenges. To supply OEMs in the USA directly, Nifco Germany launched its first plant abroad in Georgia in 2016. It produces interior and exterior parts for BMW's X models, among others, and since 2018 also components for Daimler. Claus Haban accompanied the start-up of this local branch for three years before coming to Weissenburg: "The location in the USA is very well utilised. We are currently expanding production capacities there." In the beginning, the plant in Georgia was equipped with 22 injection moulding machines from KraussMaffei, including Mucell technology for weight-saving underbody panels.

The blue-and-white injection moulding machines also dominate the scene in the three production halls in Weissenburg, which have a wide range of clamping forces from 800 to 23,000 kN. In addition to six older machines from other manufacturers, 23 injection moulding machines are made in Munich. With the exception of two 13,000 kN machines equipped with Mucell technology, the machinery focuses primarily on surface technologies such as Variotherm injection moulding for high-gloss components as well as IML and IMD processes for foil decoration, which according to Claus Haban is growing strongly. In 2015, the first rotary table injection moulding machine moved in, a KM1300 with Mucell equipment, followed by a GXL 651-3000/750 with rotary table, two of which have been in the hall since mid-2020 for capacity reasons. However, with a

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After six months of development, KraussMaffei has tested the SmartTurn optimization option not only in field tests at selected customers but also in-house on five different rotary platen and insert machines. The function is currently offered for injection moulding machines with rotary tables or indexing units in the GX series, and there are plans to extend it to other series. Andreas Handschke, Technology Manager Multi-Component & Foaming at KraussMaffei, explains how it works.

K-PROFI: Mr Handschke, why does one need an option to optimise the turntable movement, why doesn't the turning unit move optimally by default?

Andreas Handschke: As a machine manufacturer, we don't know which tool the customer will use later, we don't know the weight, the dimensions and therefore we don't know the

moment of inertia. But this is the decisive criterion for how fast the motor can be started up. So that the user does not have to suffer a total failure sooner or later when trying to exhaust the cycle time without having an eye on a possible motor overload, we have taken precautions and initially assume that the heaviest possible tool is set up. Of course, with the consequence that the turntable then rotates too slowly in comparison if the customer uses lighter tools.

How have you solved this dilemma so far?

We released the parameters after consultation, of course not without appropriate written assurance. Users justifiably asked for automatic detection. This gave us the idea of using the intelligent MC6 control to detect the optimum turning movement for the individual application.

And how does the control recognise the optimum?

As soon as the user selects self-optimisation in the control, the inverter starts to rotate gradually faster than the presetting for the maximum permitted tool weight. Since the turntable is usually in reversing mode for a pre-moulded and a finished moulded part, i.e. it rotates backwards and forwards by 180 degrees, an optimisation loop of the inverter includes a counterclockwise and a clockwise rotation. The MC6 control communicates with the inverter to detect the gap to the optimum from the recorded parameters per cycle.

In just a few cycles, SmartTurn works its way towards the optimum using intelligent algorithms and adapts the acceleration, travel and deceleration ramps to the actual tool conditions. A safety buffer avoids overloading the motor and machine in continuous operation.

Nifco was able to save more than one second of cycle time in the tested application. Does the function bring further advantages? In general, the lighter the tool, the more interesting this feature becomes and the greater the potential it offers. In addition to cycle time reduction, we also achieve motor protection with SmartTurn. To this end, the function not only optimises the turning speed but above all adjusts acceleration and deceleration based on the motor's characteristic curve.



Andreas Handschke, Technology Manager Multicomponent & Foaming at KraussMaffei



Production cell for the decorative strip: 2C injection moulding machine GXL 651-3000/750 with rotary table and six-axis robot for film and part handling.

Nifco Germany operates a total of 29 injection moulding machines in Weissenburg, here in the forefront, physical foam injection moulding (Mucell) on a 13,000 kN system.

small difference in the MC6 machine control system: SmartTurn is the name of a new software feature that optimises the movement of the turntable (for more information on how it works, see the interview on page 46) and is to prove its practicality in field tests at Nifco.

New developments on the test bench

"Nifco is always one of the first contacts when it comes to field tests. We maintain an intensive partnership and mutually benefit from synergy effects," reports Frank Burkhardt from KraussMaffei's sales department. Nifco already supported the machine builder with earlier new developments, as Maintenance Manager Christopher Emmerling knows: "We had the all-electric PX machine here for testing, as well as the APC machine function and later APC plus." Since this function for process monitoring and stabilisation has been available, Nifco equips every new acquisition with it. "We use the function on all machines equipped with it."

Being open to new things is the credo in Weissenburg. Therefore, the willingness to test the new SmartTurn feature in the field was not a question. Since the end of the first quarter of 2021, Nifco has even been using the new assistant in series production. The IML-2K series application is a decorative strip that is part of a ZSB interior component with a lighting module and is



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When it comes to continuous improvements, the focus is on Coordinator Christian Stark.



Joachim Schinke, head of the injection moulding department, inspects the 2K/IML decorative strip, which is challenging in terms of gap dimensions and surface.

manufactured for a compact class passenger car of an internationally operating German OEM. To accommodate the large mould, which weighs over 4 t, the 6,500 kN machine has the tie bar dimensions of an 8,000 kN version – hence the designation GXL 651. The clamping surface of the mould is 1,000 mm x 800 mm, and the rotary table moves its 1,350 kg ejector side into the correct injection position with high precision and dynamism cycle after cycle.

With each cycle, a six-axis robot mounted on the console inserts a preformed foil insert into the mould cavity, which is overmoulded in the first step with a crystal-clear polycarbonate for the image of the light window. After rotating the mould by 180 degrees, the pre-moulded part is completed with the second component, a black ABS/PC, to form the finished part. The robot removes the component and inserts a new decorative film in the same step. One cycle takes about one

minute. And this could now be further improved by the new control assistant. Christian Stark, Continuous Improvement Coordinator, knows the details. He is the focus of attention when it comes to optimisation at Nifco Germany, and he is where all activities for continuous improvement converge. He summarises his experience with SmartTurn without further ado: “We were able to reduce our cycle time by more than 2 per cent. We had expected much less. SmartTurn is a



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great thing and easy to use. The function is simply activated via the display of the machine control. Then the optimisation runs for a few cycles and the result shows up immediately in the actual value cycles."

Saves time with the same energy consumption

The team is very satisfied with the results. On average, the turning time for this application was reduced from 3.84 s to 2.73 s, i.e. by 1.11 s or almost 30 %, and the total cycle time was even reduced by 1.29 s – with identical energy consumption. "We are certified according to the environmental standard ISO 14001 and the energy standard ISO 50001. The fact that the optimisation is possible without additional energy expenditure was therefore particularly important for us," confirms Maintenance Manager Christopher Emmerling and adds: "The average power consumption of the motor is somewhat higher with optimisation, but due to the shorter running time, the specific energy requirement in kWh/kg is even slightly lower than the original value."

Claus Haban illustrates how valuable the savings are: "Even if the saving had been only half a per cent, the function would still pay off for us. In any case, we achieve higher utilisation of the machine. A two per cent saving on a 60-second component means that I can produce around 8,000 more components a year." Such further developments to increase efficiency are immensely important, especially for automotive suppliers and in view of the continuously demanded price reductions. "Depending on the project and OEM, savings are requested in the third year at the latest. And then there are only two options: Either I optimise the technical side or my processes."

Nifco makes use of energy-saving potentials

The certified environmental and energy management systems also come with corresponding specifications and targets. "We have to look everywhere in the company to see where we can save in order to pass the audits," reports Christopher Emmerling. In the past, a number of energy optimisations were implemented. Nifco Germany has encased the plasticising units of all injection moulding machines with full cylinder insulation. "These heating jackets are very good. They save us around 30 per cent of

the energy used to heat the cylinders. And because virtually no more heat is emitted to the outside, they help prevent accidents." In addition, the hydraulic drive concepts of the machines were optimised and constant pumps were replaced by frequency-controlled servo drives. "Depending on the machine size, we save up to 25 per cent energy." Nifco Germany sees further potential in automation, as Christian Stark knows: "KraussMaffei offers an eco-mode for the six-axis robots. The programmed speed is often too fast. The Eco-Mode calculates the required speed so that the robot is above the machine in time. This saves us around ten per cent energy." The site is currently converting its lighting concept to LED technology and expects to save 43,000 euros this year alone.

... and plans to expand digitalisation

"Our next improvements are in the digital area. On the one hand, we are planning to use the RedBox from KraussMaffei for a remote connection to give service access, and on the other hand, a BlueBox to be able to manage data centrally. In addition, we will have the first machine equipped with the Smartcube from KraussMaffei and test it in the next few weeks," announces Maintenance Manager Christopher Emmerling. Since the beginning of 2021, every new injection moulding machine

Maintenance Manager Christopher Emmerling:
"The optimised process requires no additional energy and is easy on the motor."



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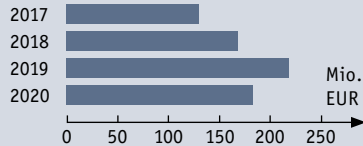
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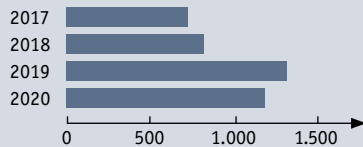
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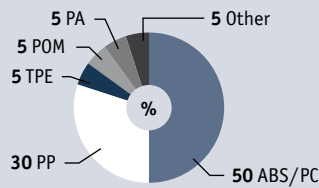
Turnover



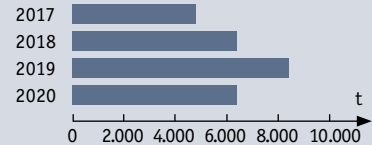
Employees



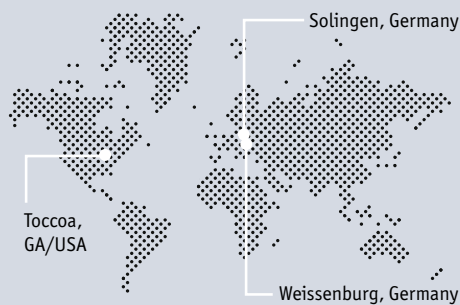
Processed plastics



Processing quantity



Locations



History

- 1997 **Foundation** of KTW Kunststofftechnik GmbH
- 2014 **Name change** to Nifco KTW GmbH
- 2015 **US site** by foundation of Nifco KTW America Corp.
- 2019 **Merger** of Nifco KTW and Nifco KTS to form Nifco Germany GmbH
- 2021 **Serbian site** by foundation of Nifco-Germany d.o.o.

Source: Nifco; Graph: K-PROFI

from KraussMaffei has included this standardised hardware solution for the operation of digital products, which is already equipped for the 5G mobile communications standard; older machines can be retrofitted via interfaces. With the Smartcube, all data streams are recorded, analysed and stored in real-time on-site at the machine.



Frank Burkhardt, sales KraussMaffei: "Nifco is always one of the first contacts when it comes to field tests."

"Smartcube is a high-performance IPC through which we can offer various digital solutions and service models. Among other things, this goes in the direction of predictive maintenance, process analysis, detection of anomalies on the component, for example, in order to guide the operator in a targeted manner towards correction possibilities," explains Frank Burkhardt. Claus Haban is also convinced that it is precisely the independent detection of deviations in the production process that makes a further increase in quality possible. Such tools for condition and process monitoring in injection moulding are becoming increasingly established in practice.

How is Nifco Germany coping with the overall challenges surrounding the pandemic and the switch to electromobility? "Since our business is 100% oriented towards the automotive sector and the latter is always subject to very large fluctuations, our company policy is strategically geared towards this. We were able to absorb the slump satisfactorily," admits Plant Manager Claus Haban. The range of parts has hardly changed. "We recognise the shift away from the combustion engine not by the parts themselves, but by how the call-off quantities shift." For the location in Weissenburg, the signs are pointing to growth. "Our order books are



Simply tick the box: Christian Stark shows how SmartTurn self-optimisation can be activated in the control software.

overflowing at the moment. We will have to expand here. But we are also aiming for further globalisation." ■

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Input goods for Plastix are post-consumer ropes and fishing nets, which are collected in the ports and thus cannot contribute to marine litter in the first place.



Designer furniture from the sea

How a Danish recycler reprocesses PP and PE-HD and even recycles them “from rope to rope”.

Some designer furniture, scooters, kayaks or toys made of plastic are meanwhile available in 100 % recycled material. And sometimes this recycled material has a very special origin: it comes from the sea. According to estimates, between 3 and 15 million tonnes of waste end up here every year. 11 per cent of this marine litter comes from maritime companies or industries, or up to 1.6 million tonnes. Examples are fishing nets and ropes. Facts enough for two people from outside the industry to found Plastix A/S in Lemvig/Denmark and ensure that this waste is no longer produced in the first place. In an interview with K-PROFI, Fenella Metz, Business Development and Project Manager, explains how the company started, where it stands today and what the special challenge is when reprocessing fishing nets and ropes.

Text: Dipl.-Ing. (FH) Karin Regel, Editor K-PROFI

With a strong determination to curb marine litter, Hans Axel Kristensen and Ole Raft founded the Danish company Plastix in 2012. „After a feasibility study, we started from scratch and focused very intensively on recycling fibres from ropes and nets. No one had done this before, so we had to take care of everything - from sourcing the

material to processing it and setting up a distribution network for the end product,” says Fenella Metz, describing the not always easy path. It worked: Today Plastix employs 43 people, operates an Erema plant for reprocessing the waste with a maximum capacity of 11,000 t/a and sells its recyclates to companies such as Scancom, among others, who also want to contribute to curbing marine litter.

Imperfect is the new perfect

Scancom International A/S from Korsør, another Danish company and a leading supplier of outdoor furniture, developed the „DuraOcean“ chair. It was launched in 2020 and took the market „by storm“, as Patrick Moeller Hoestgaard, Communication Manager at Scancom, explains. The seat shell is made of 3.5 kg OceanIX rPPC - the PP recycled from ropes by Plastix. FSC-certified eucalyptus wood from Brazil was used for the chair legs. Shortly after its launch, the chair was named best new product at Solex, the major outdoor trade fair in the UK. For Scancom, the chair is another product in the portfolio that fits with the company's commitment to „act in the right way“, both innovatively as well as sustainably and ethically. By 2025, they plan to bring more injection-moulded chairs made from recycled material to market, depending on material availability and customer interest.



Foto: Plastik



Foto: Plastik



Photo: Plastix

Only when the residual materials have been separated, shredded and washed in the purest possible way in terms of type and colour are they transferred to the re-granulation line.

Scancom also already uses recycled materials and mixtures of sawdust and plastic recyclate, as well as scrap aluminium, to manufacture tables. Other products are to follow. Patrick Moeller Hoestgaard says: „Quality is of course very important in the production of sustainable furniture, so we put a lot of research and development work into these products. Small errors, such as minimal colour deviations, give our products their character, freely according to the motto „imperfect is the new perfect“.

Understanding the incoming goods

In order to be able to supply customers with recycled materials at all, Plastix first needs incoming goods and has to process them. „Our goal is to ensure that used and defective nets and ropes neither end up in the sea nor in landfills. As a rule, the fishermen

bring the defective products back to the port and we make sure that they can be collected separately here,“ Fenella Metz explains the approach. Collection containers from recycling companies have been around for a long time, but Plastix first had to establish itself as a buyer and good customer. „In the beginning, old motors and bicycles were also delivered to us, but now people know us.“ Plastix still receives slightly varying incoming goods from its suppliers, with different degrees of sorting and different foreign content, which are remunerated accordingly, but overall the delivery works well.

Then the nets and ropes now make their way through the company. This first means sorting by type and - if possible - by colour. „Often fishing nets are green, but there are other colours for these as well as for ropes, which we try to separate from each other.“ In addition, nets are mostly made from PE-HD, while ropes are made from a mixture of PP and PE. „Unfortunately, there are no

Plastix has put a lot of work into its own classification of post-consumer goods in terms of diameter, colour, number of strands, interlacing and material.



Photo: Plastix

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In Denmark, an Intarema 1512 TE, consisting of a preconditioning unit with a diameter of 1,500 mm and a short single-screw extruder with a screw diameter of 120 mm, takes care of the production of the regranulates.



automated processes for sorting so far, so a lot is done by hand at our company," Fenella Metz expresses a challenge.

While nets are rather uniform in terms of the raw materials used, the difficulty with ropes is that they are very different and it is not uncommon for two or even more ropes of different, incompatible polymers to have been twisted together. „We, therefore, contacted the rope manufacturers and drew their attention to the recycling issue. It makes a lot of things easier if as many manufacturers as possible use the same raw materials and the same method of production," the Business Development and Project Manager explains further and is pleased that a change in thinking is taking place. More and more rope manufacturers have already made their formulations more recycling-friendly. In order to be able to sort the different ropes as accurately as possible, Plastix has developed its own identification code. „In our laboratory, we have taken a close look at a great many ropes and can now assign them on the basis of diameter, colour, number of strands, interlacing and material, making in-house sorting much easier."

First sort, then shred

At Plastix, the first step in the reprocessing operation is sorting, which is quite different from what happens in many post-consumer plants. There, the first step is shredding in order to separate the resulting flakes or shreds, for example via NIR sorting. „In our case, the shredding process produces small, sometimes very fine fibres that can no longer be separated from each other, so we sort them first and throw the single-type fractions into the shredder," says Fenella Metz, describing the next special feature of the reprocessing method. Before the shredder,

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Photo: Plastix

PE-HD, PP as well as mixed regranulates are produced from the post-consumer fishing nets and ropes.

The better the incoming goods are sorted, the more individually the regranulates can be produced.



Photo: Plastix

there is a metal separator and afterwards the washing station. „Of course, the washing water is recirculated at our plant; after all, the issue of sustainability is very close to our hearts here as well.“ From the washing and drying system, the fibres finally reach the plant of the Austrian company Erema from Ansfelden.

Plastix opted for an Intarema 1512 TE system. This consists of the preconditioning unit (formerly known as the cutter compactor) with a diameter of 1,500 mm and a short single-screw extruder with a screw diameter of 120 mm. In the preconditioning unit, the fibres that have already been shredded are now very finely shredded and heated and dried by friction. This results

in material compaction, which is absolutely desirable in order to convey as many fibre residues as possible into the tangentially flanged extruder.

With Intarema, Erema introduced the new „Counter Current“ technology to the market a few years ago, in which the material in the preconditioning unit rotates in the opposite direction to the running direction of the extruder. Erema explains: „A simple effect with a big impact. The relative speed of the material in the feed zone, i.e. in the transition from the cutter compactor to the extruder, increases to such an extent that the extruder screw acts like a sharp cutting edge that literally „mills out“ the plastic. The result: the extruder takes up more





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material in less time. Thanks to the improved material intake, plastic can also be processed with high throughput even at lower temperatures.“ The process benefits productivity, flexibility and operational reliability. The system installed at Plastix, for example, achieves a throughput of 700 kg/h.

The process described produces different recyclate types based on both r-PP and r-PE-HD in the colours natural, yellow, green, mint, blue and black, sometimes mixed with virgin material according to customer specifications. While the PP grades are generally suitable for both injection moulding and extrusion and less so for blow moulding processes, the PE-HD grades are suitable for extrusion and blow moulding and some are also suitable for injection moulding.

From vision to reality

When founding their company Plastix in 2012, the two owners were obviously already aware of the problem of marine littering, but that there would be such specific rules and plans across the EU as are now coming into force was a vision at the time. It is true that transitional rules apply to fishing nets, in contrast to disposable articles, which have been banned since 3 July this year, but there are clear guidelines for these as well. To curb pollution from lost plastic fishing nets, the EU plans to record all fishing nets sold from 2022 onwards and match them with the old nets collected at or in the sea. At the end of December 2024, minimum quantities are even to be introduced that must be collected by coastal states for recycling.

„For us, these are positive signals,“ says Fenella Metz, „on the one hand, these regulations prove that we are on the right track. On the other hand, they support us in our efforts to close the material cycle again. This way, actors are forced to bring post-consumer goods back on land.“ Material flows, appreciation and further business growth are thus ensured, she said. Already, more and more customers are buying the regranulates from Denmark and thus making their contribution to the circular economy.

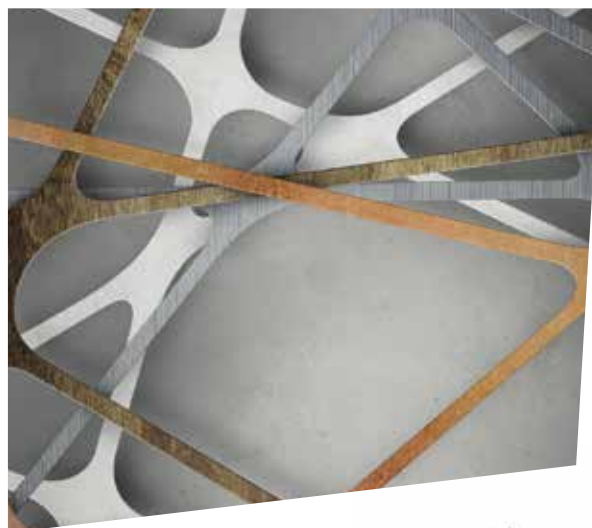


Photo: Scancom

Danish furniture manufacturer Scancom offers chic chairs made of Plastix regranulates for outdoor use.

With Epsotech Denmark in Tistrup, there is even a first customer who buys the regranulates in order to produce new ropes from them and thereby close the material cycle. „From rope to rope“ is the slogan of the specialist for the production of technologically sophisticated monofilaments made of PE and PP, who is very positive about the material quality of the recycled goods: „Comparable to new goods, but with a better story.“

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Photo: Jannik Hammes

A giant step towards food-grade recyclate

Why Borealis and Tomra are investing in a pilot plant at Zimmermann with a capacity of several thousand tonnes per year



Red, green, blue, yellow, white, and transparent bales are neatly sorted by colour and stacked in the yard of Zimmermann Recycling&Transporte GmbH in Lahnstein. Here, the post-consumer plastic waste pressed into bales is processed into high-quality recyclates in a unique, three-stage process. "Sorting is the first important step on the way to high-quality recyclates," knows Andreas Leitner, Director Circular Economy Solutions of the Borealis Group from Vienna. Together with Jürgen Priesters, Senior Vice President Circular Economy at Tomra Sorting GmbH from Mühlheim-Kärlich, he presented the pilot plant installed in Lahnstein, its special features and the partners' future plans to journalists. K-PROFI was there for you.

Text: Dipl.-Ing. (FH) Karin Regel, Editor K-PROFI



Andreas Leitner from Borealis gives a tour of the site in Lahnstein and makes it clear how important pre-sorting is for the subsequent regranulate quality.

Advanced Mechanical Recycling is what the three partner companies Borealis, Tomra and Zimmermann call the process for which they have set up a pilot plant at Zimmermann's site in Lahnstein. "Our goal is to significantly improve the recyclate qualities, not only in terms of mechanical properties, but above all in terms of qualitative parameters such as purity, odour and colour," explains Andreas Leitner. Only then could the recycled materials be returned to high-quality applications and in the long term also to food applications.

The latter is the supreme discipline of all recycling processes and still a lofty and as of yet unachieved goal. "However, we are certain that with the hitherto unique plant we have taken a giant step towards making recyclates suitable for food applications," emphasises Andreas Leitner, not without pride. First brand owners who have tested the materials confirm this, he says.

All good things come in threes

The raw material manufacturer Borealis has also been active in plastics recycling for about eight years. Not least through the takeovers of MTM in Niedergera and Ecoplast in Wildon, Austria, the company has "entered a different world", but has already accumulated a great

Jürgen Priesters from Tomra presents the elaborate washing plant, which is operated exclusively with hot water for high efficiency.



deal of know-how with the companies that are established and well known in the industry. "Plastics are valuable raw materials even after they have been used by the consumer, and it is important to reuse them for both ecological and economic reasons," Andreas Leitner is absolutely convinced.

The second in the group is the certified waste management company Zimmermann, for which recycling and reuse of waste and residual materials is very close to the heart. According to the company motto "Recycle instead of landfill", the waste management company uses efficient processing methods to make the various types of waste, which also includes post-consumer waste from the yellow bag, available to the economic cycle again.

Partner number three is the sorting experts from Tomra in Mühlheim-Kärlich. Almost everyone has met the company at some time or other, after all, around 75% of all bottle deposit machines in supermarkets come from Tomra. The worldwide group with its headquarters in Norway and more than 4,000 employees generates about 50 % of its revenue from deposit machines. Another important pillar is waste and metal sorting systems that use NIR technology. "Technically, it is already possible today to separate all types of plastic from each other, to recognise colours and also the MFR range. For example, a white PE-HD shampoo bottle can be separated from a white margarine tub," explains Jürgen Priesters from Tomra, who describes himself with a smile as having been working "in waste" for 33 years.

He is very pleased that there is now finally a coming together between companies along the value chain. "Recycling can only work when design and technology come together and there is a common solution." And that is exactly what the three partners want to prove. Also important in this interaction are the buyers of the recyclates, brand owners such as Henkel and Procter & Gamble, for example, with whom there are already intensive relationships.

Three steps to a high-quality recyclate

"We are convinced that the pilot plant in Lahnstein is currently the most cutting-edge of its kind," says Jürgen Priesters of Tomra. "With our process, which we are still optimising and will soon expand to include a compounding unit in the processing stage, we produce recyclates from post-consumer plastics in a quality that has never been achieved before," adds Andreas Leitner. Here, both films and solid plastic household waste can be processed and produced into recyclates with high degrees of purity, high product resistance and low colour deviations. As "Borcycle M recycled polyolefins", Borealis uses the raw materials itself or sells them as an alternative to virgin material in the consumer goods sector or for automotive applications. "Our declared goal is to soon operate large-scale plants of this kind for our own recycling activities and to sell the products to interested companies," Andreas Leitner casts a glance into the future.

The motto "all good things come in threes" applies not only to the partners but also to the pilot plant – and twice. The waste from the yellow bag and household waste goes through the three steps of sorting, washing and finally producing regenerates and recomponds according to customer specifications. The first step, pre-sorting, is again divided into three steps: sorting by plastic type, then by colour and finally by MFI range.

Zimmermann takes care of the pre-sorting step: the plastic materials from the yellow bag or household waste are first sorted by plastic type. Then the plastic type is sorted by colour and object and pressed into bales again. These bales are then stored finely stacked in the yard until further processing. If, for example, there are enough pre-sorted red bales, they are processed further. The partner companies are convinced that good sorting and further processing “in batches” allow them to produce the highest-quality regenerates.

Elaborate cleaning determines quality

In detail, the path of the bales pre-sorted according to material and colour in the pilot plant is as follows: The bale is opened, the plastic packaging runs on the conveyor belt through a metal separator into the wet mill and is crushed. The flakes then enter the washing system, which was supplied entirely by Krones. They start in the prewash tank, where all the surface dirt is removed.

“We work exclusively with hot water in the entire washing plant, since this ensures the degree of purity we require”, explains Jürgen



The preparation process begins after pre-sorting in the washing plant, which consists of pre-washing and main washing.

Priesters during a tour of the hall. “Of course, we circulate the water and even treat our tap water before we use it, to really make sure that we can wash under ideal conditions,” Jürgen Priesters explains further. For each

tonne of plastic, about 1,500 litres of fresh-water are needed in all steps. “We do need significantly more water in the individual process steps, but we run this almost completely through a filtered cycle.”

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High-quality flake fractions from only one raw material and with as uniform a colour as possible are the result of the pilot plant.

Hot washing is followed by rinsing before the flakes “fly” into a large air classifier for drying and the fines are sieved off via a screen. After washing and drying, the flakes pass through two NIR sorters, of course from Tomra. “Although we achieve a purity of over 99 per cent in the first sorter, we still run the flakes through a second sorter to increase the certainty that 99.9 per cent of the flakes contain only the desired raw material,” Jürgen Priesters continues. The NIR sorters work at an enormous speed. They detect thousands of particles per second and eject wrong pieces accurately via air nozzles.

Finally, the material is packed in a big bag station to be transferred to the superclean plant. “Our superclean plant works independently. All you have to do here is hook in the big bag and set the desired time X and temperature Y,” Jürgen Priesters clarifies the simplicity. This unit uses a vacuum process to ensure that all odours escape. Contrary to popular belief that unpleasant odours pose the problem, it is rather the odorous and perfumed substances from washing and care products that are now undesirable. “Fragrances diffuse into some plastic packaging during use and ensure that the regenerates are difficult to sell. That is why it is essential to remove them,” says Andreas Leitner, explaining the important process step.



In what is currently the last process step, in the superclean plant, adhering odours are removed from the flake fractions.

Economic efficiency is important, but not the only decisive factor

The principle described above is used in Lahnstein to produce mostly PE/PP regenerates, 100% of which are further processed directly by Borealis. PS flakes and PET flakes, in which not only smaller converters are interested, are delivered directly by Tomra as demonstration quantities. In addition to the ecological aspects of such a plant, it must of course also be profitable.

Jürgen Priesters explains: “We usually buy the incoming goods pre-sorted and currently pay about 250 euros for a tonne of PP and about 400 euros for a tonne of PE-HD; PET is sometimes more expensive, depending on the quality. The market is currently very volatile due to interruptions in the supply chains.” Due to the reprocessing process described above, the material can subsequently be sold at prices comparable to virgin material, sometimes at even higher prices, as recycled material is currently in high demand.

“Should the enacted plastic tax for all materials that are not recycled of 800 euros per tonne be passed on to the companies, our regenerates will, of course, become more interesting and more in demand,” Jürgen Priesters is convinced. “In addition, the planned CO₂ tax will have an impact. We are sure that the future belongs to our plant design. After all, mechanical recycling has a much better CO₂ footprint than chemical recycling, because the chemical integrity of the plastic is not changed. At the same time, thanks to the sophisticated process, we achieve a constant, good quality that can replace virgin material and thus close the loops.” ■

www.borealisgroup.com, www.tomra.com
www.zimmermann-recycling.com

From the washing plant, the flakes are transferred to Tomra's two sorters, where the last foreign particles are reliably detected and removed.



Further postponements in Asia

The trade fair calendar remains in motion

After the first waves of the Corona pandemic, some trade fairs have taken place again. In view of the renewed increase in the number of infections, more organisers of Asian trade fairs

have postponed their events from autumn 2021 to spring 2022 or even deeper into 2022 – most recently in Indonesia and Vietnam.

Trade Fair	Location, Country	Fair runtime	Homepage
Fakuma 2021	Friedrichshafen, Germany	12.10. - 16.10.2021	www.fakuma-messe.de
InterPlas Thailand 2021	Bangkok, Thailand	01.11. - 04.11.2021	www.interplastthailand.com
Plastics Recycling Show Europe	Amsterdam, The Netherlands	04.11. - 05.11.2021	www.prseventeuropa.com
ArabPlast 2021	Dubai, UAE	15.11. - 18.11.2021	www.arabplast.info
Formnext 2021	Frankfurt/Main, Germany	16.11. - 19.11.2021	www.formnext.de
Plast Eurasia 2021	Istanbul, Turkey	01.12. - 04.12.2021	www.plasteurasia.com
Interplastica 2022	Moscow, Russia	25.01. - 28.01.2022	www.interplastica.de
T-Plas 2021	Bangkok, Thailand	09.02. - 12.02.2022	www.tplas.com
Plast India 2022	New-Delhi, India	17.02. - 21.02.2022	www.plastindia.org
JEC World 2022	Paris, France	08.03. - 10.03.2022	www.jec-world.events
Plastimagen 2022	Mexico City, Mexico	08.03. - 11.03.2022	www.plastimagen.com.mx/en
ICE/CCE/InPrint	Munich, Germany	15.03. - 17.03.2022	www.ice-x.com
Swiss Plastics Expo 2022	Lucerne, Switzerland	15.03. - 17.03.2022	www.swissplastics-expo.ch
Injection Molding Expo	Detroit, MI, USA	16.03. - 17.03.2022	www.injectionmoldingexpo.com
Plast Expo Nordic 2022	Helsinki, Finland	16.03. - 17.03.2022	pfsptec.messukeskus.com
France Innovation Plasturgie	Lyon, France	05.04. - 08.04.2022	www.f-i-p.com
Chinaplas	Shanghai, China	25.04. - 28.04.2022	www.chinaplasonline.com
GreenPlast	Milan, Italy	03.05. - 06.05.2022	www.greenplast.org
HanoiPlas	Hanoi, Vietnam	18.05. - 21.05.2022	www.chanchao.com.tw/hanoiplas
Argenplas	Buenos Aires, Argentina	06.06. - 09.06.2022	www.argenplas.com.ar
Plastics Live	Coventry, UK	05.07. - 06.07.2022	www.plasticslive.co.uk
Indoplas 2021	Jakarta, Indonesia	31.08. - 03.09.2022	www.indoprintpackplas.com
Vietnamplas 2021	Ho Chi Minh City, Vietnam	21.09. - 24.09.2022	www.chanchao.com.tw/vietnamplas
Colombiaplas	Bogota, Colombia	26.09. - 30.09.2022	www.colombiaplast.org
K2022	Dusseldorf, Germany	16.10. - 23.10.2022	www.k-online.com



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Digital twin tools save time and money

How a continuous data flow generates advantages and minimises sources for errors at the window profile manufacturer Gealan



All photos: Gealan

Drawing board, flip chart, Excel tables and paper printouts, possibly with corrections in different colours, are a thing of the past at Gealan Fenster-Systeme GmbH from Oberkotzau. Tablets have found their way into toolmaking, enable an unhindered and continuous flow of data and thus simplify processes and workflows enormously. In addition, digitalisation in the PVC window profile manufacturer's own toolmaking department generates significant potential savings despite initial investment costs. What exactly these are, what digitalisation means in concrete terms and how the employees have reacted to the changeover, Norbert Gruner, head of the toolmaking department, and Kevin Schmelzer, group manager, tell K-PROFI.

Text: Dipl.-Ing. (FH) Karin Regel, Editor K-PROFI

Things are going well at the plastics processor Gealan, which produces PVC profile systems for windows and doors. In the first five months of this year, the profile manufacturer was able to further increase its company

sales and reports around 35 % more revenue compared to 2020. The year 2020 already ended with a plus of 6 million euros to 245 million euros. And all this despite the Corona crisis and the continuing tense market

Norbert Gruner (left) and Kevin Schmelzer have been involved in the digitalisation project from the very beginning and are not only pleased with the successful implementation, but also with the potential for expansion.

situation with regard to material prices and availability. "We are on course for growth," says Norbert Gruner, head of the toolmaking division, with satisfaction, and attributes this to Gealan's regional expansion, but above all to always innovative profile systems as well as numerous sensibly complementary products around the window. These include, for example, the Gealan-Clarie ventilation product family and the retrofittable Gealan-Sense burglary protection.

The Gealan Group, which has been part of the globally active Veka Group since 2014, has its headquarters in Oberkotzau in Upper Franconia. The second location in Germany in Tanna in Thuringia is the central production and logistics site. In addition, there are further production sites in Lithuania, Poland and Romania as well as commercial agencies and service locations in a total of ten European countries. With 1,400 employees, the company processed around 70,000 tonnes of plastic in 2020. Further growth is clearly the goal, which is reflected, among other things, in the willingness to invest, which for the year 2021 is 16 million euros. Last year, EUR 15 million were already invested. Around 10 million of this went to the two locations in Oberkotzau and Tanna. At the latter, investments were made in new offices, a canteen, and an apprentice workshop. Recently, a new recycling plant was installed there, which replaces the former manual cleaning and sorting of scrap profiles. In Oberkotzau, the money was used, among other things, to digitalise the tool shop.

Huge advantages through digitalisation

Gealan uses between 800 and 900 active tools to manufacture its large product portfolio of different profile systems. "Every year we manufacture about 50 new tools.

Of these, two-thirds are tools for new products and one-third are replacement tools for existing geometries. For main geometries, we sometimes build the 25th follow-on tool," Norbert Gruner explains the demand in the in-house toolmaking department.

For Gealan, in-house toolmaking is not only a way to keep know-how in-house, but also a clear time and cost factor. After all, even a tool made in-house can cost up to 120,000 EUR. Of these costs, it is not uncommon for a share of about one third to be accounted for by the running-in and adjustment of the tool in the production line.

This also makes the savings potential clear: Real money can be saved if the costs for the toolmaking itself can be reduced if successive tools become cheaper and if the running-in on the production line becomes easier. All factors could be positively influenced by end-to-end digitalisation. "Even though the process of digitisation is not yet completely finished, we can already draw an absolutely positive conclusion," says Kevin Schmelzer, who admits that during the not always easy initial phase of the changeover, he definitely asked himself whether it was the right way to go. After all, it was "open-heart surgery", i.e. during ongoing operations, and the "point of no return" was quickly reached. "It wasn't easy, there was an incredible number of things to consider and balance, but today I'm sure it was the right decision," says Norbert Gruner, who also has high praise for his approximately 70 employees. "With very few exceptions, all employees were fully on board right from the start and embraced and supported digitalisation." Smiling, he adds: "By now, even the doubters are convinced."



The running-in of a profile tool in the plant is much faster and more cost-efficient thanks to the new software solution.

System supplier supports conversion process

It all started with a competition organised by RWTH Aachen University, in which the toolmaker of the year is chosen every year. "In 2017, we came fourth among Germany's internal toolmakers with more than 50 employees," recalls Kevin Schmelzer, who has been with Gealan since he started his apprenticeship in 2006. "The fourth place has



Innovations

Thermoforming of UV-varnish coated materials and curing in one process



For high-quality decorative parts, when thermoplastic films or sheets with special coatings for special properties such as scratch resistance are used. Therefore these coatings have to be molded without any damage first and afterwards activated by UV light. The temperatures during activation of coating haven't to be a negative influence on shaping. For this reason, GEISS has developed a system for processing uncoated or coated thin-walled films or thick plates based on the current thermoforming machine series, in order to produce both the thermoplastic component and, if necessary, the UV curing in one cycle.



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both validated and spurred us on in equal measure." The initial spark for the conversion of the tool shop to "digital" was laid and began in 2019.

After deciding on Solidworks' system as a complete solution (CAD: Solidworks Professional, CAM: Cam-Works Premium, Backbone: Solidworks PDM, Flow Simulation: Solidworks Flow Simulation), which also has the advantage that the parent company Veka uses the same system, the process got underway. The paperless and continuous data flow was implemented. "With Solidworks, we particularly liked the work in the preparation of the project. Selected employees from all areas were invited to pilot workshops in Nuremberg, where the new software could be tested live. Afterwards, Solidworks proved on our components that the systems are able to fulfil all requirements accordingly. During the introduction of the system, we were supported by a project manager who acted as an interface between us and the relevant departments at the software provider. This was a very good solution due to the scope and complexity of the project," Kevin Schmelzer praises the system supplier. He says it was also advantageous that it was possible to buy a certain contingent of



Both profile extrusion and logistics take place at the Tanna site. Since May, the site has had its own recycling plant (below), which automatically sorts shredded scrap profiles in order to return them to production.

user licences. "With the multi-user licences, we are independent, and every employee can simply log into the system."

Uniform concept instead of isolated solutions

"Of course, we already had digital processes in our toolmaking department before the universal digitalisation, but not in every work step and in each case as an isolated solution," says Norbert Gruner, naming one

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of the major changes after the conversion phase. For example, the design department had long worked with a CAD/CAM system and created 3D models, but there was no feedback with downstream work steps such as the programming departments for wire cutting and milling.

Now everything is different. There is one consistent system for everyone. All departments work live on the same data model. As a result, the data model corresponds to the actual status on the steel until the completion of the run-in process. For visualisation and documentation, among other things, 25 tablets were purchased, of which the management team each uses its own and the other employees use one of the shift tablets. "Of course, we were able to store in the system who has which access rights and how release processes have to take place," explains Kevin Schmelzer. In addition, each machine was equipped with a tablet holder, and large screens were also installed in all departments, as the drawings, which are up to DIN A0 in size, can hardly be displayed on a small tablet. "One of the great advantages of the new solution is that every change to a planned tool is stored and every employee can see the same status. This minimises duplicate work and sources of error enormously," emphasises Norbert Gruner. Nothing gets lost anymore either. After all, every detail concerning a tool is stored in the system, so that work is revision-proof.

Digital system pays for itself

In addition to simplicity and minimisation of errors, the continuous data flow also means that there is no paper. "We save around EUR 15,000 per year just from the printing and paper costs that are now eliminated." There are further potential savings that mean that the investment costs in the new system are quickly amortised: "The running-in of a new and complex tool on the production line can currently cost up to 40,000 EUR. Digitalisation and the associated optimised design and production processes, especially for the subsequent tools, will allow us to save around a third of the costs, i.e. 13,000 EUR, in the future. This is due to the fact that we can now take the last status of a tool in the form of the digital twin and use it as a template for the subsequent tool. This means that the subsequent tool is already very close to the required qualitative final status after steel

production, and we save on the corresponding input costs. We also call this the copy & paste strategy," says Norbert Gruner, emphasising the main effects of the digitalisation solutions.

Looking into the future, Norbert Gruner describes further possibilities that digitalisation allows and that will soon be implemented: "In the future, every assembly and every part of a tool could receive a QR code directly from the ERP system, which would be applied by needle embossing. Using this code, all work processes on the workpiece could

then be logged on and off or reported back to the system, so that it would be very easy to read out where each part is at any given time and how high the production and man-hours per order are. This brings even more transparency and optimisation potential. The toolmaking department of our parent company Veka is already involved in a great pilot project here, in which we will participate in the next few months and would then like to implement this technology at our company, adapted to our conditions." ■

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“On Fire for Injection Moulding”

How Wirth, as a toolmaker, is advancing to become a solution provider with innovative injection moulding technologies

Werner Wirth: "What counts are innovative technologies; you don't stand a chance in Germany with standard toolmaking."

German tool and mould making is a key industry and ranks among the best in the world. Nevertheless, small and medium-sized companies in this country have to hold their own in a tough global and largely price-driven competition. Wirth Werkzeugbau GmbH from Helmbrechts, recognised early on that precision, quality and reliability as natural criteria for success are not enough in the long run and set a new course ten years ago. Managing Partner Werner Wirth reports on why he expanded his toolmaking business step by step to become a solution provider for innovative injection moulding technologies and invested in three large machines.

Text: Dipl.-Ing. (FH) Sabine Rahner, Editor K-PROFI

In the middle of the scenic Franconian Forest, on a much-quoted greenfield site, Werner Wirth started 32 years ago with three employees. Today, the passionate toolmaker and enthusiastic developer employs 75 people at the same location, now produces on an area of 4,000 m² and can no longer be called solely a toolmaking company. "We used to do strictly toolmaking," Werner Wirth looks back, "we specialised exclusively in the production of tools and sampled them from other companies." In 2011, Wirth bought its first injection moulding machine, laying the foundation for its expansion into a solution provider and development partner for the automotive industry: "That was a real quantum leap."

Since then, Werner Wirth has been constantly investing in machine technology and equipment for his technical centre, around EUR 3 million in the last two years alone, he estimates. "Simply building standard tools no longer works. We had to find another way to counter the cost pressure and offer our customers added value." Wirth now operates three injection moulding machines, two with 10,000 kN and one with 16,000 kN clamping force and has tailored the equipment to the needs of the demanding automotive industry, and not just in terms of size. "Each individual machine is technologically virtually fully equipped," says a delighted Alexander Simon, who heads the technical centre,

Wirth develops innovative solution concepts in its technical centre with one 16,000 kN and two 10,000 kN machines including comprehensive technological equipment.



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referring to the broad spectrum: multi-component injection moulding with two or more components, cascade injection moulding, various physical and chemical foam injection moulding processes, and different embossing processes. The systems are equipped with a rotary table, turning plate, indexing turning unit or sliding table, and since the beginning of 2020 Wirth has had a mobile PUR system for flooding as an injection moulding lacquering technology that can be used on all three injection moulding machines.

It sounds like a land of milk and honey for the development of new technologies and component concepts. And indeed, he says, word has gotten around that Wirth offers this full range of equipment. "Companies also book in with us to simply try something out. Or they send us tools and materials for trials. Even during the pandemic, it became clear that standing still was not the order of the day. The companies used this time for further developments," reports Alexander

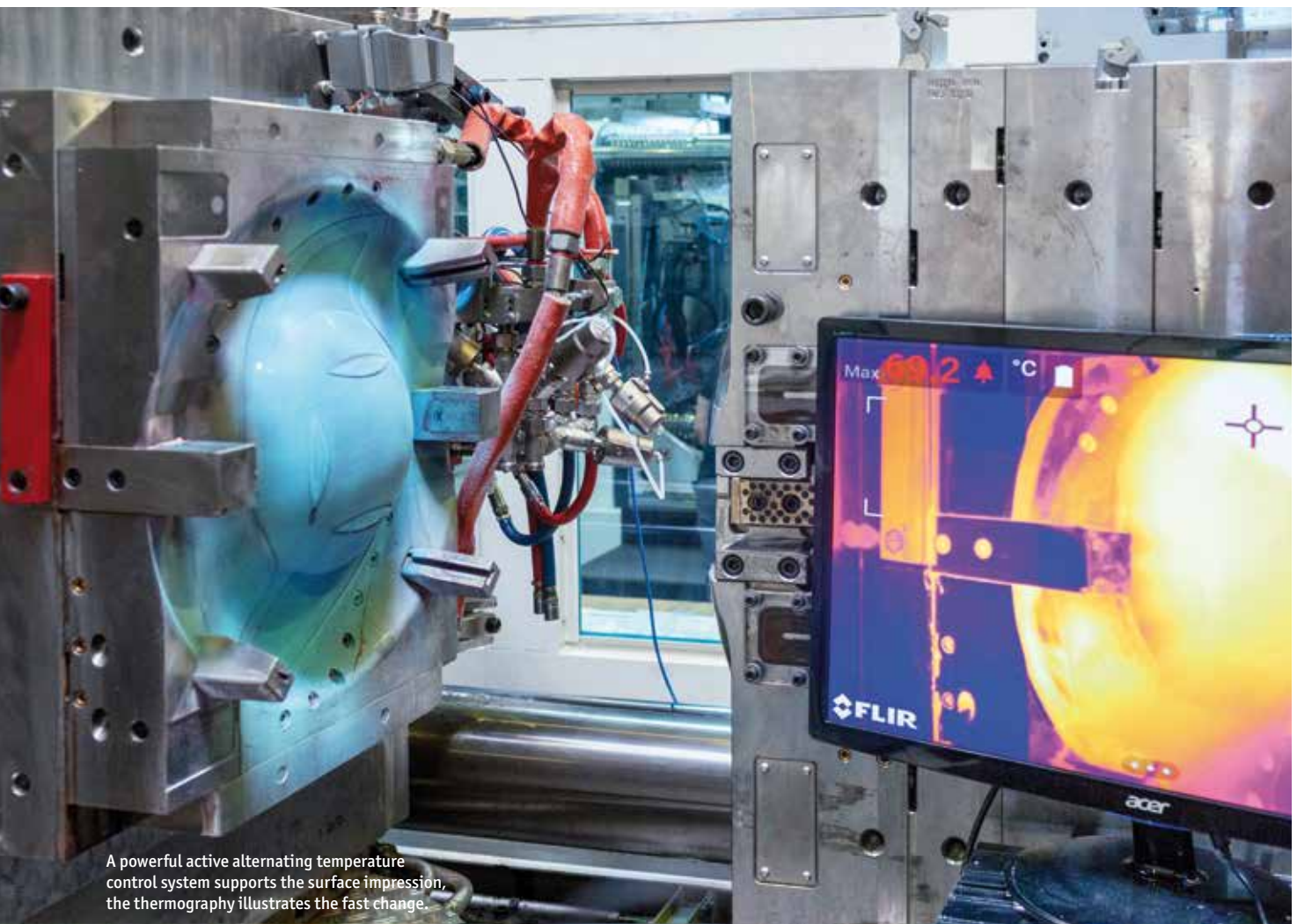
Simon. And Werner Wirth adds: "The OEM has an idea or a certain conception of a component, and we have the practical solution. It complements each other perfectly. And implementing these ideas is our passion."

Foamed visible components with a Class A Surface

The technical centre for the development and implementation of innovative injection moulding concepts is used in many ways. "We carry out the sampling of our moulds here and accompany our customers until their projects are ready for series production. We also deliver many moulds directly to the USA. Therefore, we work out all the tests and inspections here, the customers do not have to provide their own capacities, and the tools can be put into operation directly in the factory, no matter where in the world. This is a huge advantage for them," Werner Wirth is convinced. In addition, Wirth also processes orders for the

production of small series in the technical centre in order to cushion customer bottlenecks or to bridge the tool transport phase with pre-production.

The technological equipment in the technical centre hints at the fact that Wirth does not build run-of-the-mill injection moulds. The weight of the tools alone reaches up to 40 tonnes. More than half are tools for foam injection moulding. "For ten years we have been building up technology, know-how and personnel and have made a certain name for ourselves in foaming. We work with Mucell from Trexel, with the Somos Perfoamer from Protec and with various chemical processes. Together with many OEMs, we have already implemented a three-digit number of projects." Werner Wirth reports on parts for bumpers, centre consoles, 2K underbodies, on wiper water tanks or instrument panel support parts, but also on rear spoilers or engine covers from the visible region. "We are moving more and more in the direction



A powerful active alternating temperature control system supports the surface impression, the thermography illustrates the fast change.



Technical Centre Manager Alexander Simon: "We master PU flooding on a scale that is interesting for OEMs."

Innovation Days on 23 and 24 September 2021. "We achieve excellent surface results and cycle times of less than 60 seconds with it." The surface moulding is supported by a powerful active alternating temperature control of the mould between 150°C for the impression during injection and 80°C for the moulding of the component. The 32 kW Vari-therm equipment comes from the temperature control unit manufacturer E. Braun, Kammerstein. Wirth uses a thermal imaging camera to show that the mould surface actually reaches these temperature values in rapid change.

Endless: cascaded sandwich injection moulding

Working with OEMs usually entails that the projects are subject to secrecy. In order to nevertheless make technological innovations accessible to a wider circle of interested parties, the design of experimental and demonstrator tools takes on a key role at Wirth: "We can't get around this upfront investment if we want to show solutions." A current example is a ski that serves as a demonstrator for the cascaded sandwich injection moulding process newly developed by Wirth. Werner Wirth explains the special feature of the process, which he believes does not exist on the market in this form: "In conventional sandwich injection moulding, the core material is injected after the outer material. The disadvantage is that the 'wrong' material is in the sprue nozzle, so to speak, before I inject the next component. We avoid this by working without a sprue system, but instead with two separate hot runner systems. That means we go directly to the component and inject the edge layer, core, edge layer, core in continuous alternation. We can cascade this on and on, almost endlessly." The 700 mm long demonstrator ski is an illustrative example: it has a continuous core layer of TPU foamed using Somos Perfoamer, which is surrounded by an equally continuous edge layer without partial interruption. "Of course, there are many ways to use the core, either for a flexible, material-saving layer, as in this case, or for the use of regrunulate, low-cost material, bioplastics etc. in the interior. We foresee very good opportunities for this process in the future."

of visible components with foaming. On the one hand, we use the advantages for high dimensional stability and weight savings, and on the other hand, we even achieve Class A surfaces in combination with negative embossing or alternating tempering."

Limitless: Mechanically manufactured near-contour cooling channels

Wirth presented such technologically coordinated solutions a year ago at its second innovation day, "Foam injection moulding in new dimensions 2.0". Over the course of the last few months, the demonstrator used for this purpose, a decorative shell made of PC/ABS with a curved, structured surface with Class A components and foamed using Mucell, has undergone further development. While the previous mould integrated an additively manufactured mould insert for contour-following tempering, Wirth was now able to implement a significantly more cost-efficient solution. "The insert, which is 600 mm in diameter, is not generatively manufactured. We have developed a contour-following tempering concept that can be manufactured mechanically. This means that we can manufacture the insert here in-house and use standard insert material. Another advantage of this concept is that the size of the insert is not limited." Wirth won't reveal the details of how the near-contour flat tempering solution was realised, but he will show the application at the upcoming

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Trend towards single-shell components and dispensing with carrier parts

In close communication, especially with the automotive industry, Wirth has his ear to the market and can sense the needs and wishes at an early stage. Werner Wirth currently sees a trend towards single-shell components despite integrated functions and decorative surfaces, and to dispense with the classic structure using a support component. "There is enormous cost-saving potential in this. You save on components, processes, and tools. If an instrument panel with a length of 1.5 m is manufactured as a complete component with integrated screens, all individual parts such as trim strips, different decorative surfaces, etc. are eliminated. The variety of parts is significantly reduced, even more requirements are packed into the component itself, and thus the tooling technology becomes even more complex."

How can fastening elements be integrated into the back of the component without showing on the flawlessly desired functional decorative surface? Wirth addresses these issues in a demonstrator mould and chose a large 800 mm long and 110 mm wide cover panel with various clips, domes, and rib connections on the back as an exemplary component. In the first step, an inserted decorative or functional film is indirectly back-moulded with the PC/ABS substrate via a hot runner. The mould is designed in such a way that back injection is possible both compactly and by means of Mucell foam injection moulding in order to show the influence on possible sink marks. In addition, it is possible to increase the base wall thickness from 2.8 mm to 3.8 mm component wall thickness by means of the expansion stroke, thereby saving up to 40% in weight

Cost-efficient: Wirth manufactured the near-contour, flat tempering solution for the 600 mm insert mechanically and not generatively.



A ski with a foamed TPU core serves as a demonstrator for the cascaded sandwich injection moulding process newly developed by Wirth.

compared to compact injection moulding. Here, too, E. Braun's alternating temperature control is used for high-quality moulding of a Class A surface. "Creating a delta-T of around 70 or 80 degrees for this surface within the cycle time of less than one minute is a challenge."

Foil back-moulding and PU clearcoat flooding

In the same step, directly in the injection mould, the visible side, i.e. the film side, is given a high-gloss finish with a transparent 2K polyurethane lacquer system. For this, Wirth uses PU flooding technology, which is also marketed by KraussMaffei under the terms Clear Coat Molding or Colorform

technology. The injection moulding machine manufacturer presented this combination of injection moulding and polyurethane reaction technology for the first time at the K 2004. Colorform went into series production in 2016 with an A-pillar trim for the Peugeot 3008 SUV (PSA), manufactured by Techniplas in Switzerland. Werner Wirth believes that the future lies in injection-moulded coating technology. That's why he invested in the corresponding plant technology himself almost two years ago: "We carried out earlier projects with a borrowed system. For a new project, we have now bought our own system of the latest generation." Werner Wirth is enthusiastic about the technology and the PU lacquer system used. "The self-healing material from Rühl is our favourite. It is more

Clips at the back, high gloss at the front: the cover panel trial project integrates film back-moulding, foaming and PU flooding.

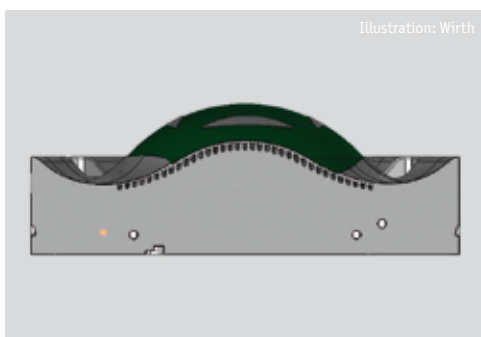


Illustration: Wirth



Illustration: Wirth

resistant to chemicals than car paint and can even be cleaned with benzine. We notice that there is a lot of experimentation in the industry now, also due to e-mobility."

Wirth itself meets this eagerness to experiment by implementing special machine technology solutions that are not available directly from the machine manufacturer. "We have, for example, implemented a sliding table arrangement with which mould halves weighing five tonnes can be moved over various stations and which is not available on the market in this order of magnitude," reports Alexander Simon, "we have also designed the connection of the polyurethane component via the moving clamping side ourselves, because we need this arrangement for test demonstrations, but it is not available for purchase. We can flood PU on a scale that is also interesting for OEM with regard to larger components such as bumpers or long interior mouldings."

Innovative all-in-one solution

Alexander Simon heads the injection moulding technical centre. He himself is a process engineer with a focus on plastics technology and has a broad-based team with many years of experience at his side. "This means we are well equipped for the highly specialised tasks in our technical centre. We are on fire for injection moulding." He says it's all about being able to offer customers the most innovative all-in-one solution possible around the mould. "The customers come to us with the complicated tasks, but then they get a mould in which the complete preliminary work has been done, which is clamped and runs. In addition, we provide support with the start-up. After all, some tools are not so easy to set up. Hanging them up, tightening the clamps and that's it, doesn't work with such complex tools. And with overseas tools, we create even more extensive documentation."

Presentation at the Wirth Innovation Days

Wirth is not only a sought-after partner in industry. Research institutes and networks also appreciate the opportunities for cooperation and access to the technical centre. In this context, Wirth



Cascaded sandwich injection moulding allows a continuous core and edge layer to be produced without partial interruption.



The technical centre team, with (from left) Daniel Rödel, Alexander Simon and Reinhold Artl, accompanies tooling projects until they are ready for series production.

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At the beginning of 2020, Wirth invested in its own PUR system for flooding or clear coat moulding.

testing (Teratronics) and corrosion protection of the temperature control channels at high temperature and alternating temperature control (Novoplan) are the core of these activities.

Technology and knowledge also flow into this year's innovation event and the exhibits planned by Wirth. In addition to the techniques already described, the terahertz measurement for non-destructive inline testing of component quality, among others, can be seen live. Furthermore, the coating expert Novoplan from Aalen announces the presentation of a mobile coating system – initially as a prototype. Werner Wirth: "This is an absolute novelty that we as toolmakers can carry out internal coating with electroless nickel ourselves." 

has specifically invested in the establishment and integration of cooperation partners in order to complement its own innovations with special techniques. Within the framework of the ZIM innovation network WinInMo, for example, the focus is on operationally reliable and efficient tools and

manufacturing processes. Cooling water treatment without chemicals (Ingenieurbüro Hannebaum), alternating temperature control (E. Braun), process control with hot runner data (Incoe), special measuring technology with data monitoring (Cavity Eye Germany), inline component quality

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Photo: Uni Geisenheim



Photo: Uni Geisenheim

Left: The plastic stopper could not prevail, its market share is declining.

Some winemakers use cork and screw caps in parallel for high-quality red wines.

Of biopolymers and synthetic polymers

When and why plastic is overtaking cork or horn for inlays, insulating materials, wine closures and eyeglasses

The bark of the cork oak, but also that of horn, are similar in their properties in many aspects to plastic, which was only invented 100 years ago. Cork and horn are elastic, pressure-resistant and resistant to numerous environmental influences. In addition, cork is hardly combustible, insulates cold, heat and vibrations and is hydrophobic. The characteristics of the natural hard foam cork were already discovered by the ancient Greeks for their wine closures. Industrialisation with its cold and heat processes took advantage of the insulating properties of cork beginning at the end of the 19th century. Orthopaedic insoles and foot beddings are also made of cork. Today, plastic replaces or supplements the applications of the hard foam from the bark of the cork oak. Eyeglass frames, combs, spoons, buttons and the like made of horn have also been replaced in many places by the cheaper plastic. Today, products made of horn are considered to be of higher quality than comparable products made of plastic. While mass-produced items such as buttons for a fashion collection for everyone are obviously made of plastic, a chic Bavarian janker, possibly even tailor-made, is fitted with real horn buttons. The situation is very similar in the manufacture of spectacles.

Text: Dipl.-Ing. Karin Regel and Dipl.-Ing. Gabriele Rzepka, Editors K-PROFI

97 % of all cork oaks grow in the Mediterranean region – mainly on the Iberian Peninsula. In Portugal, for example, cork oaks grow on the area of about one million football fields. This makes the country the largest producer of cork in the world. Here, the trees find everything they need in terms of soil and climate. Cultivations in Asia, on the other hand,

do not fare so well. A cork oak has to grow for 27 years before it produces its first usable cork. After that, it can be harvested every seven to nine years, depending on the water supply. For its use, the bark is peeled off. In order to produce natural corks for wine bottles, the resulting bark slabs, which are about 1 x 0.5 m in size, must first be washed

and disinfected in order to punch the natural corks from them. The resulting co-products such as edge pieces and punching waste are ground. This so-called cork granulate is the raw material for numerous products: Pressed corks, insulating material or insoles.

Pure closure

One of the oldest uses of cork is as a wine stopper. The properties of the material make it predestined for this purpose, explains Professor Dr Rainer Jung, deputy director of the Institute for Oenology at the University of Geisenheim: "The closure of the wine must maintain its quality. To do this, it must be liquid- and gas-tight and remain neutral to the contents. No substances must be allowed to pass from the closure into the wine." The lion's share of all corks fulfil this requirement – but a few do not. They contaminate the wine with trichloroanisole (TCA) and spoil the taste. The wine has the notorious cork taste. The cradle of wine is in Europe. Wine was made in Georgia as early as 8,000 years ago. Viticulture spread across Europe and the ancient Greeks

already came up with the bark of the cork oak as a sealing material 3,500 years ago. When it comes to the old wine-growing countries, there is talk of a tradition that goes back several thousand years. The new wine-growing countries like Australia, New Zealand or South Africa can look back on a remarkable 350 years of viticulture – but what is it against 8,000 years? The wines from the new countries came onto the European market about 50 years ago. “I drank the first wine from Australia in Germany in the 1970s. The breakthrough for the new wine-growing countries came in the 1990s,” recalls Wolfgang Schäfer of Tropical Viticulture Consultants Ltd, who advises wine producers worldwide on viticulture and cellar management.

If the old wine-growing countries have easy access to cork from the Iberian Peninsula, it is a different story for the “new” ones. They have to import all their corks. “At the end of the 1990s, there were supply problems with high-quality corks. Sales of wine from the new wine-growing countries increased sharply, so the demand for corks skyrocketed,” Jung looks back. The interest in alternative closure systems has therefore been increasing since the 1990s.

The plastic stopper made of foamed polyethylene came onto the market. But it did not really catch on. Jung describes the reasons for the wine producers' reluctance: “Often the plastic stoppers let too much oxygen through, which impairs the quality of the wine. It also happened that the stoppers were not odourless

and tasteless. The use of the stoppers is clearly declining.” Schäfer adds, “Much cheaper and of higher quality are screw caps. In the past, winemakers used screwcaps only for cheap wines; today, \$200 wines from the new wine-producing countries are on the shelf with screwcaps.”

Wines sealed with a high-quality screw cap experience almost no change in taste during subsequent storage. The be-all and end-all of the aluminium screw cap is its seal. Common sealing discs are the so-called Saranex and Saran seals. With the first, the basic structure consists of a closed-cell EPE core, laminated with PVDC at the top and bottom. The latter is composed of one layer each of EPE, paper, tin and PVDC. The closure manufacturer Meyer Seals from Alfeld uses a five-layer film made of EPE, paper, aluminium, Saranex film (PVDC/EPE/PVDC) and PE for wine seals. But PVDC-free sealing systems are also on the market. Amcor from Zurich developed a PVDC-free sealing system in 2013 that consists of a 6-layer film made of PET/aluminium/PE/aluminium/PE/EPE, for example. In the meantime, winemakers can find sealing systems with different oxygen permeabilities on the market. The idea behind this: If the wine still needs a period of post-ripening, it receives the necessary oxygen while bottled. From Jung's point of view, however, this is not expedient: “If a wine is to mature, then it should do so in a controlled manner in the wine cellar in the barrel under ideal conditions, and not subsequently in the bottle.” The reason: once a bottle is on the market,



Today, every third wine bottle is sealed with an aluminium cap with a plastic seal.

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Prof. Rainer Jung explains: "The closure of the wine must maintain its quality. To do this, it must be liquid- and gas-tight and remain neutral towards the product being filled."

it is usually sold quickly. Most of the time, buyers do not have access to optimal storage conditions. 70 % of the wines are sold through grocery stores, half of them through discounters. "Buyers consume the bottles within a few days or weeks of purchase and do not leave them for two years. But this time would be minimally necessary for the oxygen exchange via the closure to lead to the desired degree of post-ripening," Jung makes clear.

Thanks to high-quality plastic sealing technology, the screw cap is conquering more and more territory. According to the Aluminium Closures Group, Düsseldorf, every third bottle of wine worldwide was closed with a screw cap in 2020 – in 2008 it was only every sixth. The pioneers were Australia and New Zealand. These two countries initiated detailed comparisons between screw and cork closures at an early stage and subsequently switched consistently to screw closures. Some winegrowers – especially in Europe – rely on both the classic cork for particularly high-quality red wines and the screw cap for white wine and rosé.

It is not only the sealing properties that speak in favour of the screw cap, but also the price. Depending on the length, a natural cork costs between 0.35 and 1.00 EUR, the plastic stopper between 0.15 and 0.27 EUR. For both, the so-called capsule, the aluminium casing, is added at 0.05 EUR. The screw cap costs 0.07 to 0.15 EUR, including the capsule. Schäfer explains: "On average, about 7,000 to 10,000 bottles of



Pieces of bark of the cork oak:
Their structure is clearly recognisable.



Cork granulate produced
from the leftover pieces of bark.

wine can be produced per hectare. The classic German family winery cultivates between 15 and 30 hectares. If the winery sells about half of its wine or even more in bottles, the price difference in the cap is clearly noticeable."

There is still movement in the matter of closures. Research is working on variants that are based entirely on renewable raw materials and at the same time replace the classic cork. Already today, corks made of cork granulate, bound in a plastic matrix, are being used. Jung outlines the future: "We are working on replacing the plastic matrix of the granulate cork with natural raw materials, just like the aluminium in screw caps. I am sure that the cork and the screw cap will run parallel and not displace each other."

Healthy walking

Another area of application for cork is footbeds for sandals. "Natural walking" is how the world's largest sandal manufacturer, the Birkenstock Group, headquartered in Linz am Rhein, describes its motivation for using cork in footbeds. After all, cork is light, antibacterial, durable, hardly reacts with other materials, shows good cushioning properties and offers sufficient flexibility for the rolling process in the forefoot. Accordingly, the "heart" of every Birkenstock footbed consists of a cork-natural latex mixture, which is enclosed by a velour cover on the foot side and an EVA outsole on the bottom.

Birkenstock makes many millions of sandals from cork every year. The amount of cork needed for a single workweek has a volume like an Olympic swimming pool. "And this will not change in the near future, because the cork footbed is the heart and soul of our company and we are absolutely convinced of the material properties," affirms Cansu Elman, Head of Innovation at Birkenstock. The typical Birkenstock sandals, hiking boots, trekking shoes and work shoes will continue to have a cork footbed in the future; a substitution with plastic is not on the cards due to the many advantages.

Beyond that, however, Birkenstock also relies on plastic as a material for its shoes. Since 2014, the company has been producing injection-moulded EVA sandals and has thus advanced to become the largest manufacturer of plastic sandals in Europe. The great advantage of plastic is the freedom of colour and design, which allows adaptation to fashion and region. "With the plastic sandals, we

are appealing to a completely different clientele and a different field of application. EVA sandals are slightly cheaper than our established products and are ideal for all wet areas," explains Lutz Glahn, Director Global Sourcing and Purchasing, in an interview with K-PROFI. Even though the pure plastic shoes have a very small share of the company's total sales, the Linz-based company's sustainability and recycling standards also apply to them. "We are currently setting up a recycling circuit so that we can take back and recycle the EVA sandals in the future," Elman emphasises.

Not only for shoe soles, but also for orthopaedic insoles, cork was the material of choice until a few years ago. However, natural cork has completely disappeared here, mainly for ecological reasons, Thomas Penners, a master orthopaedic technician from Gangelt, reports from his daily work: "Cork does grow back, but it makes more sense to use it for other products. Because cork can only be recycled if it is processed without any additives – like wine corks, for example." In general, there is a mixture of cork meal and a phenolic resin that can be used for insoles, but Penners doesn't use it at all: "For one thing, the



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Photo: Birkenstock

Structure of a cork footbed of a sandal with a synthetic sole.

cork-based material is about 20 to 25 % more expensive than plastic, and for another, it's harder to work with." The master orthopaedic technician produces between 1,000 and 1,500 pairs of insoles a year. His speciality is the manufacturing method. "We basically use a block and mill out the individual contour previously determined by a footprint," he explains. The material used is an EVA foam with a Shore A hardness of 20 to 60. The advantages of EVA foams: they offer good cushioning and cleanability of the insoles and are easy to process. "Natural materials can contain small impurities such as tiny stones or coarser particles that shorten the durability of the cutters," Penners describes. Users can clean their EVA foam inserts either by wet wiping, disinfecting or even at 40 °C in the washing machine, which is not possible with the natural material-based products. With the latter, it can even happen that unwanted germs and fungi settle into the open surface structure. In contrast, EVA foams have a closed structure. But even this has its weak points for people who sweat a lot. The insoles do not absorb moisture. Penners says: "In these cases, we recommend an additional leather or textile cover." All in all, for Penners, the EVA foam insoles are currently the best solution for people with foot malpositions. A disadvantage of the EVA foam blocks, however, is the comparatively large amount of waste that is not recycled so far.

An ecological alternative is provided by novel 3D printers that produce orthopaedic insoles from TPU filaments. The advantage

of this material is that it can be recycled. It is even being considered that the customer receives his insoles for a deposit and returns them after the recommended useful life of about half a year. The collected deposits could be melted down again by the filament manufacturer to make new filaments. However, Penners sees the high investment costs for the 3D printer and its low speed as disadvantages. "In addition, many customers want to keep their insoles even if they get a new pair, so that they can still

apply the old one in a less frequently used pair of shoes and not always have to change the insoles," he says in his experience.

Climate protection as a driver

With industrialisation, the era of insulating materials arrived. Cold applications, such as the invention of the cold chain by Linde, were only possible with good insulation material. Invented in 1898, reformed cork – cork treated with pitch under heat and pressure in a vacuum – came into use.

Birkenstock produces many millions of sandals every year.



Photo: Birkenstock

In 1906, expanded cork with a low density and a thermal conductivity of 0.045 W/(mK) came onto the market. The products, which were insensitive to moisture, gained popularity both in the refrigeration industry and later in the building industry as an insulating material for interiors.

In the 1960s, cork disappeared more and more from the insulation market. Competition from rock and glass wool grew, and starting in 1960, rigid foams entered the scene. Expanded polystyrene took its place among the insulating materials. Polyurethane (PUR) and extruded polystyrene (XPS) were also part of the game. The latter, however, is used less frequently due to its price. But the good insulating effect, compressive strength and insensitivity to moisture have ensured PUR and XPS a solid market share to this day. While the thermal conductivity of EPS and XPS is between 0.035 and 0.045 W/(mK), PUR tops the scale with values of 0.02 to 0.03 W/(mK). When it comes to insulating industrial or public buildings, rigid polyisocyanurate foam (PIR) is suitable. Its thermal conductivity corresponds to that of PUR, and in addition, fire cannot spread in this material. It

was not until the energy crisis of 1973 that the importance of building insulation really came to the attention of politicians and the construction industry. Energy prices rose. At the beginning of the 1990s, the public discussion on climate protection gradually began. Funding programmes for building insulation came into existence, municipalities appointed energy officers, and the German states set up their energy agencies. The debate on resource conservation, climate protection and simultaneous reduction of energy costs gained momentum – and with it building insulation.

A 2012 study by the Forschungsinstitut für Wärmeschutz (FIW) Munich shows that the market shares of insulation materials did not shift significantly between 1990 and 2010. The market leader in Germany is mineral wool with 55 %, followed by EPS rigid foam with around 32 % and XPS and PUR with a solid 10 % each. Across Europe, mineral wool dominates even a little more, again followed by EPS. In 2010, the manufacturers sold about 28 million m³ of insulation material; in 2020, according to the market analysis of the industry radar, it was 39.1 million m³, which corresponds to an



Photo: Tropical Viticulture Consultants

Wolfgang Schäfer says: "In the past, winemakers only used screw caps for cheap wines, but today there are \$200 wines from the new wine-growing countries with screw caps on the shelves."

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Hard to tell apart at first glance:
The colouring and shading of the CA
glasses frame (top) clearly resemble
the real horn frame (bottom).

Plastics have long since gained the upper hand in the manufacture of spectacles. The demand is enormous; after all, for example, more than 60 % of all Germans over the age of 16 wear glasses. Plastic spectacles made of the materials cellulose acetate (CA), polyamide and some special materials such as the hypoallergenic, thermosetting Op-tyl with memory effect are used for the production of the centre piece and sometimes also for the temples. Metal is also still used in the manufacture of spectacles: almost always as a hinge and as a support material for the temple.

In some cases, spectacles are also made entirely of metal, whereby titanium has become particularly popular due to its lightness. The weight of glasses is a very decisive feature, after all, they should sit comfortably, preferably imperceptibly, on the nose. Horn spectacles are quite light, even somewhat lighter than those made of cellulose acetate. This is the material that has almost replaced horn and has been used for spectacle frames for a very long time. CA is considered one of the oldest thermoplastics and, as a derivative of the natural material cellulose, is counted among the bio-based plastics. Spectacle frames made of CA are created by CNC milling the desired geometry from an acetate block, which allows for an infinite variety of colour combinations and depth effects. Ulrich Zumfeld, managing owner of Zumfeld Sehen & Hören in Hückelhoven, estimates that around 80 % of all spectacles in his shop today are CA spectacles.

From a purely optical point of view, CA glasses can only be distinguished from horn-rimmed glasses on closer inspection. When it comes to price, the difference is immediately noticeable. "For a pair of real horn-rimmed glasses, the customer should plan on at least 400 euros, with hardly any upper limits. You can buy a CA frame starting at 100 euros," says Zumfeld. Injection-moulded PA frames are even more attractive in terms of price. They have the great advantage of being light. A pair of PA glasses weighs between 5 and 10 g, while a pair of CA glasses weighs about 20 g.

In addition to the variety of designs, the master optician sees the main advantage of CA spectacles in their long service life and ease of processing: "Cellulose acetate is dimensionally stable, heat-resistant and has a long service life. Our customers are very satisfied with the wearing comfort because the material is skin-friendly and stable. If necessary, we can easily rework and straighten the material and thus extend the wearing time." As with all products that are subject to fashion, the design of a spectacle frame plays a very important role. And it is precisely for these reasons that there are now spectacles in which the materials horn and plastic are combined. "The coexistence of the two materials will continue," Zumfeld estimates. ■

increase of 1.6 % compared to the previous year. There was growth in all product groups. With a plus of 1.1 %, sales of mineral wool developed more slowly than plastics, which recorded a plus of 2.1 % compared to the previous year. Including the building façade insulation, the industry had sales of just under 3.5 billion euros in 2020.

For the second year in a row, 2020 sales of insulation made from renewable raw materials – such as cork – increased significantly faster than the overall market. The revenues of the "eco-segment" grew by 3.1 % compared to the previous year. In 2019, the increase was even 7.6 % compared to 2018. Nevertheless, the absolute share of renewable insulation materials in the overall insulation market remains modest at 6.6 %. In fact, the renewable "new" insulation materials are the former market leaders of the twenties. Whether they will prevail on a wide front, despite their higher thermal conductivity and higher price, remains to be seen.

Not just a question of fashion

What was still common in the 1950s, the production of spectacles from real horn, is today considered more of a supreme discipline. It takes about 400 manual steps to make a pair of glasses from buffalo, sheep or goat horn. That is why today they are considered luxury objects. Horn-rimmed glasses are worn either by people who can afford them or by those who prefer purely organic products.

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Photo: K-PROFI

Thilo Stier, Division Manager Sales & Innovation at Akro-Plastic, envisions significant growth potential for long glass fibre-reinforced engineering thermoplastics in the coming years.

“We can also do long-fibre reinforced”

What Akro-Plastic considers when compounding LFT and which plant technology is used

Metal substitution and weight reduction are two areas that go hand in hand, and not only in electric vehicles. Substitute materials are often fibre-reinforced plastics that score points with their property combination of lightness, good processability and high mechanical strength. Long glass fibre reinforced engineered plastics (LFT) are particularly interesting. However, their production requires a lot of know-how in formulation and machine technology. The team around Thilo Stier and Dr Marcel Sittel-Faraj at Akro-Plastic GmbH in Niederzissen can tell you a thing or two about that. But they have made it. Today, three LFT lines with a capacity of 6,000 t/a are running here for high-quality granulates. During the on-site visit, K-PROFI found out what is so tricky about LFT production, what the solution looks like and where the journey is heading in terms of quantities and applications.

Text: Dipl.-Ing. (FH) Karin Regel, Editor K-PROFI

“Without our sister relationship, this development would not have been possible,” makes Thilo Stier, Division Manager Sales & Innovation, at Akro-Plastic clear right at the beginning of the conversation. He is referring to the close cooperation between the polyamide compound manufacturer Akro-Plastic and its sister company, the machine manufacturer Feddem GmbH & Co. KG from Sinzig, both of which belong to the Feddersen Group from Hamburg, Germany.

Akro-Plastic not only has a wealth of experience in processing technical plastics – after all, the company specialises in these – but also in incorporating fibres. Feddem is fully geared to customised extrusion lines and knows the requirements for processing technical compounds as well as fibre-reinforced products. Feddem also understands the specific requirements in Niederzissen very well; after all, Akro-Plastic is a major customer in Sinzig and only operates extruders from there.

This is not the only reason why the two “sisters” are accustomed to working closely together. They have already realised many joint projects. For example, they recently developed the Innovative Compounding and Extrusion (ICX) technology. “The ICX technology, together with the certified quality management and the in-house testing laboratory, enables us to ensure the same quality of products at any location worldwide when using raw materials of the same quality,” Dr Marcel Sittel-Faraj, Head of Technology & Projects at Akro-Plastic, makes clear.

Substitution potential is wide-ranging

In the latest project, the companies used their joint know-how and cooperative partnership to develop and optimise formulation and plant technology for the production of LFT. The basis is formed by engineering plastics such as polyamide, but also PEEK, PPA and PBT as well as PP/PA blends. Even though the estimated market volume is only about a fifth of that of PP-LFT granulates, which are already established in the market and are used worldwide at around 100,000 t/a, Thilo Stier sees enormous growth potential here.



Photo: Akro-Plastic

Coil unwinding from the outside prevents twisting of the fibre strands and thus ensures better feeding into the impregnation die.

This is driven by various factors. All LFTs have certain properties in common: they have a very high creep resistance, which makes them particularly interesting for

applications that are under permanent load, such as in automotive applications as seat structure components. From this derives the substitution potential for metals that are



Volume production

Production of customized injection molded parts

Volume production of high quality silicone parts using one- and multi-component injection molding technology.



The parallel arrangement of extruder and impregnation line saves about 40 % floor space compared to the vertical arrangement.

Photo: Akro-Plastic

significantly heavier with comparable properties. The good flow behaviour of LFT also makes it interesting for many applications that were previously sourced from metals.

For example, geometrically demanding parts for bicycles or for technical applications can be produced. "Equally, LFTs could replace short glass fibre-reinforced thermoplastics

in some applications, as they have better reinforcement and thus strength due to the greater fibre length and are less brittle," says Thilo Stier, naming another growth market. Long glass fibre reinforced thermoplastics can withstand temperatures around 40 °C higher than short glass fibre reinforced thermoplastics without a loss of strength, which makes them more interesting for some applications. In addition, LFTs could replace higher-grade thermoplastics with short-fibre reinforcement, but here they require a lower fibre content with a comparable property profile, so that the main argument of weight reduction applies again.

Even more potential in the future

Thilo Stier pays special attention to a PA/PP blend reinforced with long glass fibres. "This LFT combines several advantages. Compared to LFT based on pure PA, it is cheaper, has a density that is about 8 per cent lower, but



Photo: K-PROFI

Dr Marcel Sittel-Faraj presents one of the three lines optimally tailored to the requirements, which currently produce around 6,000 t/a of LFT granulate at Akro-Plastic.

in terms of strength and temperature resistance it is roughly on a par with PA." A long glass fibre-reinforced product based on bio-based raw materials is also conceivable, as Akro-Plastic will be showing in the form of short glass fibre-reinforced products at Fakuma in October. The plastic base is a bio-based PA 6.9 combined with a so-called bio-circular PP. The raw material source for the PP is vegetable oil and fat waste, which is generated in various processes, especially in the food industry. Reprocessed carbon fibres are used as fibres. The Akromid Next G presented here takes the concept of sustainability to a new level, the company announced in preparation for the fair.

Last but not least, Thilo Stier envisions enormous potential in foamed, fibre-reinforced products, which the polyamide specialist is currently manufacturing and investigating in its in-house R&D department. "This way, the reinforcing properties can be combined with a particularly low weight. This is of great interest for many lightweight construction applications," Thilo Stier is convinced, who of course also knows the downsides of LFT, "LFT components have two weaknesses that need to be taken into account." One is a weaker weld line strength, he says. "The weld line should not be in the load-bearing area," says Thilo Stier. On the other hand, the surfaces are somewhat more uneven due to the longer fibres, which could be a nuisance for components in the visible

area. "However, we can compensate for this excellently with surface-improving additives." Finally, LFT compounds are up to 1 EUR/kg more expensive than conventional short-fibre reinforced products, to name the economic aspect.

Convinced by the plant technology

"With the plant technology we have developed and optimised, it is definitely possible to produce technical LFTs that have an excellent range of properties. The key to success is the complete wetting of the fibres," explains Dr Marcel Sittel-Faraj. The entire process starts at the creel, on which up to 58 bobbins or even more if required are mounted. Continuous glass fibres, which are already coated with a sizing, are wound onto each bobbin. "The unwinding of the fibres is done from the outside, so that twisting is impossible," Marcel Sittel-Faraj begins listing the special features that have been realised. Each spool also has a kind of "brake" that prevents it from unwinding too quickly. The pull of the fibres through the die is caused by the belt haul-off at the end of the cooling section, which was specially designed and built by Feddem for this application.

The fibres first "run" from the creel onto the tensioning device, where they are preheated. Preheating the fibres is the next special feature that is advantageous for complete wetting. From here, the fibre strands run

With the high-performance mill, the wetting condition is checked directly at the plant.



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side by side through the core component of the line, the impregnation station. The FED 52 MTS is positioned parallel to this part of the plant. “We deliberately decided against the right-angled arrangement because it saves us about 40 per cent of the installation space,” the head of technology and projects explains further. In the twin-screw extruder, the plastic is gently melted, which in the case of polyamides must take place within a narrow but relatively high temperature window.

The polymer melt enters the impregnation die from below via a melt line. “The melt guidance in the die is another decisive factor for good fibre wetting,” emphasises Thilo Stier. After wetting, each fibre strand is guided through the perforated plate, which is more or less open depending on the desired glass fibre content and thus strips off more or less melt. Now the impregnated strands pass into the cooling section, which has spray nozzles and otherwise functions purely as air cooling, and from here through a mould roll package and the belt take-off into the pelletiser. Here the long-fibre pellets are cut to their final length of 10 mm and finally transferred to the quarantine silo via the cooled spiral conveyor.

Highlight modularity

“The intensive cooperation with Feddem made it possible not only to realise an optimal process technology, but also to implement a few extras,” Thilo Stier praises the employees of the sister company. The mould has a modular design and consists of one unit each with 29 pick-up points for 29 fibre strands. “We can thus attach several moulds next to each other depending on the required output and increase or reduce the throughput accordingly, which makes us very flexible.” Since the changeover times are kept very short at around one hour, customer orders can be carried out on demand.

If a strand breaks off during processing or a bobbin contains less fibre length than the others, a hole nozzle can be closed on the impregnation die and the entire process can still continue without interruption. Another special feature. After all, the processing of glass fibres naturally causes wear, especially in the sliver take-off. “Feddem has designed the belt take-off as a cassette solution. If the belts are worn, we can replace the entire cassette and continue production,” Dr Marcel Sittel-Faraj underlines another highlight.



At its site in Niederzissen with a total of 34 compounding lines, Akro-Plastic basically works with the principle of identical line set-ups. In this way, spare parts storage can be sensibly realised. Interchangeable machine components bring flexibility. The three new lines for LFT production now follow exactly this principle. They are built with the same line components, and a set of spare parts is always available, so that no line will be down for a long time.

Simple but effective quality control

Typically, when LFT pellets are processed, for example in the injection moulding process, there is a shortening of the fibre length. "Of the 10-mm fibres produced, more than 90 per cent of LFT must have at least 1-mm fibres remaining after processing. With short glass fibre reinforcements, it is only 0.3 mm," says Thilo Stier, naming the facts that are known and do not pose a problem for processors.

What is more of a problem are the fibre clusters that can form in conveying lines, for example, if fibres are not completely wetted and separation of fibre and matrix occurs. "If such a clump falls into the injection moulding machine during the production of a car oil pan, for example, the finished component has a weak spot at one point, which is not necessarily noticeable, but in practice can have serious consequences," Thilo Stier makes clear. That is why complete wetting is so important. However, since there is only limited space available for wetting in the compounding line, the process technology is so crucial. "We are sure that our pellets have optimal wetting. Our customers have already confirmed this to us."

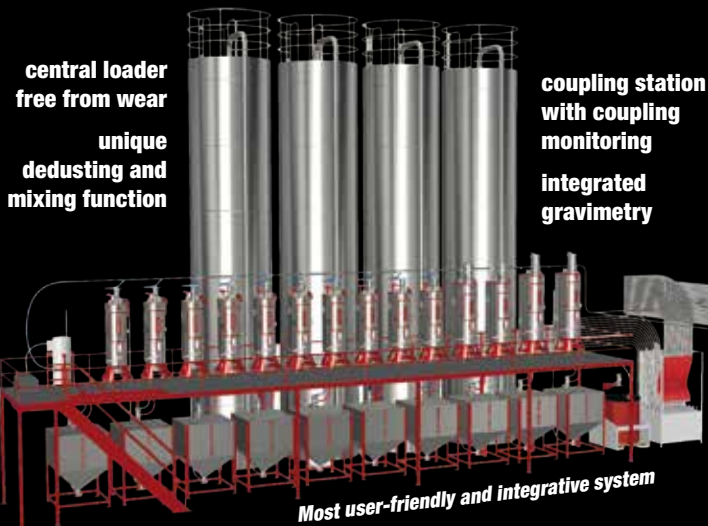
Testing the wetting is simple and is carried out at Akro-Plastic directly at the plant. A sample is taken from production and crushed for 5 s in a very powerful mill. The result is immediately obvious, depending on whether the sample contains a lot of individual fibres and dust or not. "Our granulates are hardly attacked," Thilo Stier points out, not without pride, and invites all interested customers to test this. "We produce LFT with fibre weight percentages between 10 and 60 per cent, on request with customers' own polymer formulations in contract manufacturing. But of course, together with Feddem, we also offer the plant technology and support with formulation and process adjustment." ■

www.akro-plastic.com; www.feddem.com

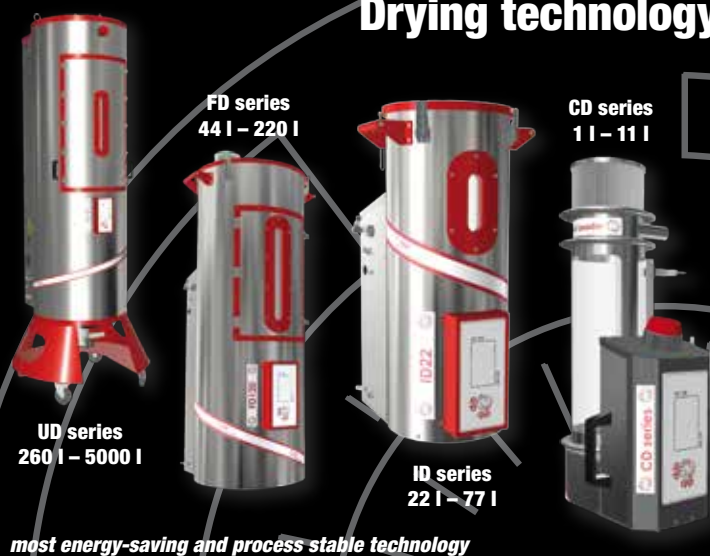
The impregnated fibre strands pass through the moulding roller package into the belt haul-off developed and built by Feddem.



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Code: Produkt: Produzenten Standorte

Auswahl

Produkte

Monomere

Polymere

Standard-Kunststoffe

Polyolefine

PE (Polyethylen)

PP (Polypropylen)

Styrol-Kunststoffe

PET (Polyäthylenterephthalat)

PVC (Polyvinylchlorid)

Technische Kunststoffe

Polyamide

Styrol-Copolymere

PBT (Polybutylenterephthalat)

PC (Polycarbonat)

PMMA (Polymethylmethacrylat) Formmassen

POH (Polyacetat, Polyoxyethylen)

Hochleistungskunststoffe

Polyurethane

Biopolymere (biobasiert und -abbaubar)

Regionen

Chart

Map

Forecast

Region

Kapazität (Jahre)

Anteil (%)

Asien

11.609.000

18.1

Nordamerika

8.409.000

11.8

Südamerika

3.224.000

4.5

Afrika

960.000

1.3

Australien/Ozeanien

300.000

0.4

Welt

72.211.000

100.0

Land (Welt)

Chart

Map

Forecast

Land

Kapazität (Jahre)

Anteil (%)

China

25.020.000

25.8

USA

7.899.000

10.9

Saudi-Arabien

5.230.000

7.4

Indien

4.480.000

6.3

Südkorea

4.150.000

5.8

Japan

2.733.000

3.8

Deutschland

2.505.000

3.3

Russland

2.140.000

3.0

Kapazitäten

Ausblick

Produzenten: PP (Polypropylen), Welt

Chart

Forecast

Produzent

1 Sinopec

2 LyondellBasell (LLB)

3 Braskem

4 PetroChina

5 Borealis

6 Sabic

7 Total

8 Reliance

9 ExxonMobil Chemical

10 Formosa Plastics

11 Ineos

12 Lott

13 Sumitomo

14 ETT

15 Shenhua Group

16 Sinopec

17 Sibur

18 Beaulieu (Polydan / Pimade)

19 Mitsui Chemicals

20 Mitsubishi

21 Oil Refineries (Came)

22 Indian Oil (IOC)

23 Yanchang Petroleum

24 Tasnee (Cristal)

Anlagen: PP (Polypropylen), Welt

Map

Forecast

Produzent

Total Petrochemicals & Refining USA Inc

ExxonMobil Chemical USA

Reliance Industries Ltd - (RIL)

Saudi Polyolefins Co - (SPC)

Equistar Chemicals

HMC Polymers

Braskem

Petro Rabigh

The Polyolefin Company (Singapore) (TPC)

Formosa Plastics USA Corp

Equistar Chemicals

PetroChina Dushanzi

Zhejiang Shaoxing Sanyuan Petrochemical Co

Sinopec Beijing Yanhan Petrochemical (BYPC)

Dattang International Power

ExxonMobil Chemical Asia Pacific

Honam Petrochemical (HPC)

Honam Petrochemical (HPC)

Bn Zahr Saudi European Petrochemical Company

Shenhua Ningmei (Shenhua)

Tobolsk Polymer LLC

Borsuige (Abu Dhabi Polymers)

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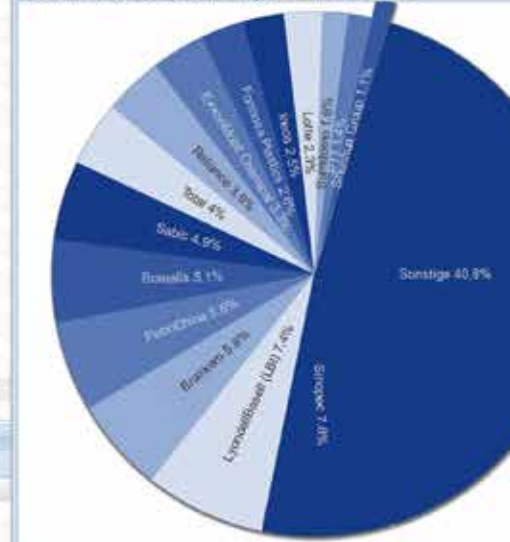
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Produzenten: PP (Polypropylen), Welt - Top 15 - Total 72,211,000 Jähr



Kreis-Chart * Optionen... Refresh

PP (Polypropylen)

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www.Gammaflux.com

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Panel sizing saws incl. software



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Plastics machinery



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info@weinreich.de, www.weinreich.de

Sensor sorting technology



STEINERT GmbH
Widdersdorferstr. 329-331, D-50933 Köln
Tel.: +49 221 4984-0
Fax: +49 221 4984-223
sales@steinert.de, www.steinert.de

Size reduction technology



Herbold Meckesheim GmbH
RECYCLING TECHNOLOGY
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Fax: +49 6226 932-495
herbold@herbold.com, www.herbold.com



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Note

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On to change!

Why it is time to rethink, question and change supply chains.

Every grain of sand in the gears of the Asian supply industry today leads directly to a deadlock in the entire production in our region. Gridlock in the Suez Canal, port closures in China, bottlenecks in container availability, price explosions for freight rates, chip crisis and wood as a scarce commodity. All these factors are currently preventing our products from being manufactured and delivered. The terrible news from the automotive industry of simply not being able to deliver and, on the other hand, seeing a clear increase in demand for vehicles is not a good combination.



*Dr.-Ing. Arno Rogalla
ist Interim Manager und
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Wood bottlenecks? What do they have to do with the plastics industry? – Without wood, there are no pallets, no cartons and no paper for packaging inserts. A simple but precisely specified packaging insert in medical technology, where it is important that it can be sterilised together with the finished product, is unfortunately not easy to replace because it is certified and approved exactly in this way. If you don't have a second source of supply that can deliver immediately, production is at a standstill.

I am very surprised about the shortage of wood – or not: at the moment, our dried-out, bark beetle-infested monoculture forests are being felled everywhere. The wood was no longer worth anything, and the forest farmers were facing ruin. However, anyone who drove through the German countryside in recent years could see that the wood was being loaded everywhere in masses of containers and collected by lorries. The quantities have gone abroad at much higher prices (again, also to Asia) and are stored elsewhere. Prices are rising extremely, and again we are footing the bill when the wood is then sold

off again by the slice ... On our own simple wood. This is called a free (world) market economy.

Fortunately, people have learned from the chip crisis, albeit late, and are building factories again in Germany to supply the market themselves. In my view, this must also apply to all other industrial sectors. We have to get out of our self-made dependence on monopoly supplier countries. This requires courage, foresight and then also the stamina not to weaken again when similar products can be obtained from other countries (especially China) at much lower prices. It does not help not to be able to supply an extremely cheap product, but not to want to serve the market with something more expensive.

I am happy about the first successful entrepreneurs who dare to produce their products in Germany again. A little more expensive, of course, but faster and, above all, more available in the supply chain. The process has also been given a nice term: Reshoring. – In the end, small suppliers must also be reactivated and encouraged to produce in the vicinity of such "reshorers". Our high wage costs should only be an incentive to work with the best possible efficiency.

The only catch to this medium-term future model is the required availability of raw materials. Unfortunately, the DACH region is not blessed here. We will always remain dependent on raw materials from other countries. This makes it all the more important to shine at this point through fair dealings and reasonable prices. This is the only way to secure direct access to the most important raw materials. – Please do not just stand by and watch the New Silk Road being built, but take your own courageous path. The ability to supply comes before price!

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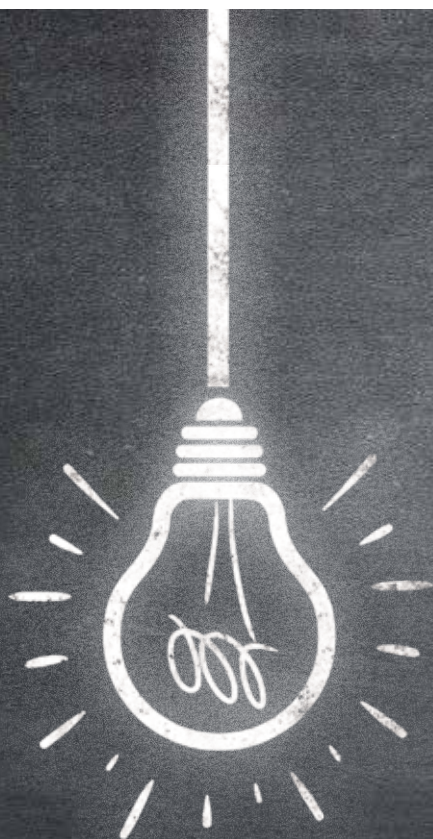
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