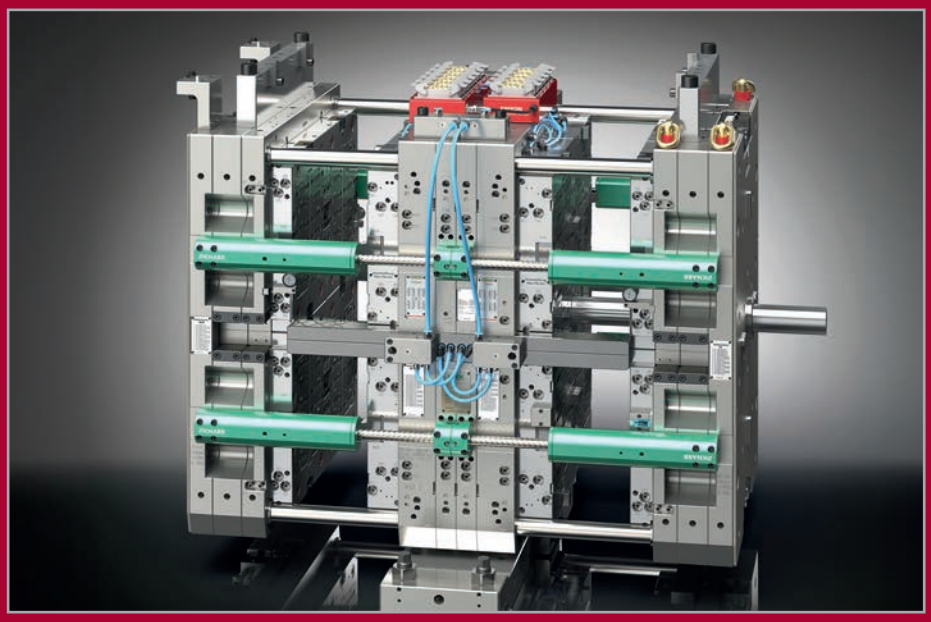
October 2023

Hotline

Customer information from **EWIKON Heißkanalsysteme GmbH**



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Valve gate stack mould and direct side gating

Two mould concepts for more production safety in the production of syringe plungers

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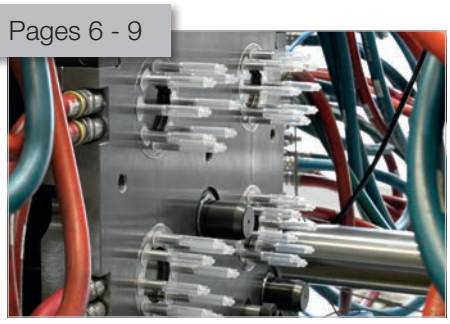

Compact and standardised

64-drop mould for Luer-Lock syringe barrel

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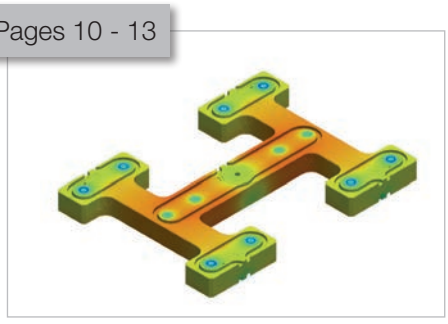

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EWIKON is carbon neutral

EWIKON

Valve gate stack mould and direct side gating

Two concepts, one goal – production safety

As a subsidiary of B. Braun Melsungen AG, ALMO in Bad Arolsen in northern Hessen is one of the world's leading manufacturers of disposable syringes with an annual production volume of 2 billion units. For the production of two versions of syringe plungers, different concepts from the mould making specialist Hack, which are equipped with hot runner systems from EWIKON, are used, adapted to the respective production process. Whether valve gate technology or direct side gating - process stability and thus trouble-free mass production always have the highest priority.

For the production of a syringe plunger made of PP for a B. Braun Omnifix® 10 ml syringe, a 48+48-cavity valve gate stack mould with full hot runner was built that replaces two older partial hot runner moulds at ALMO.

Stable process with valve gate

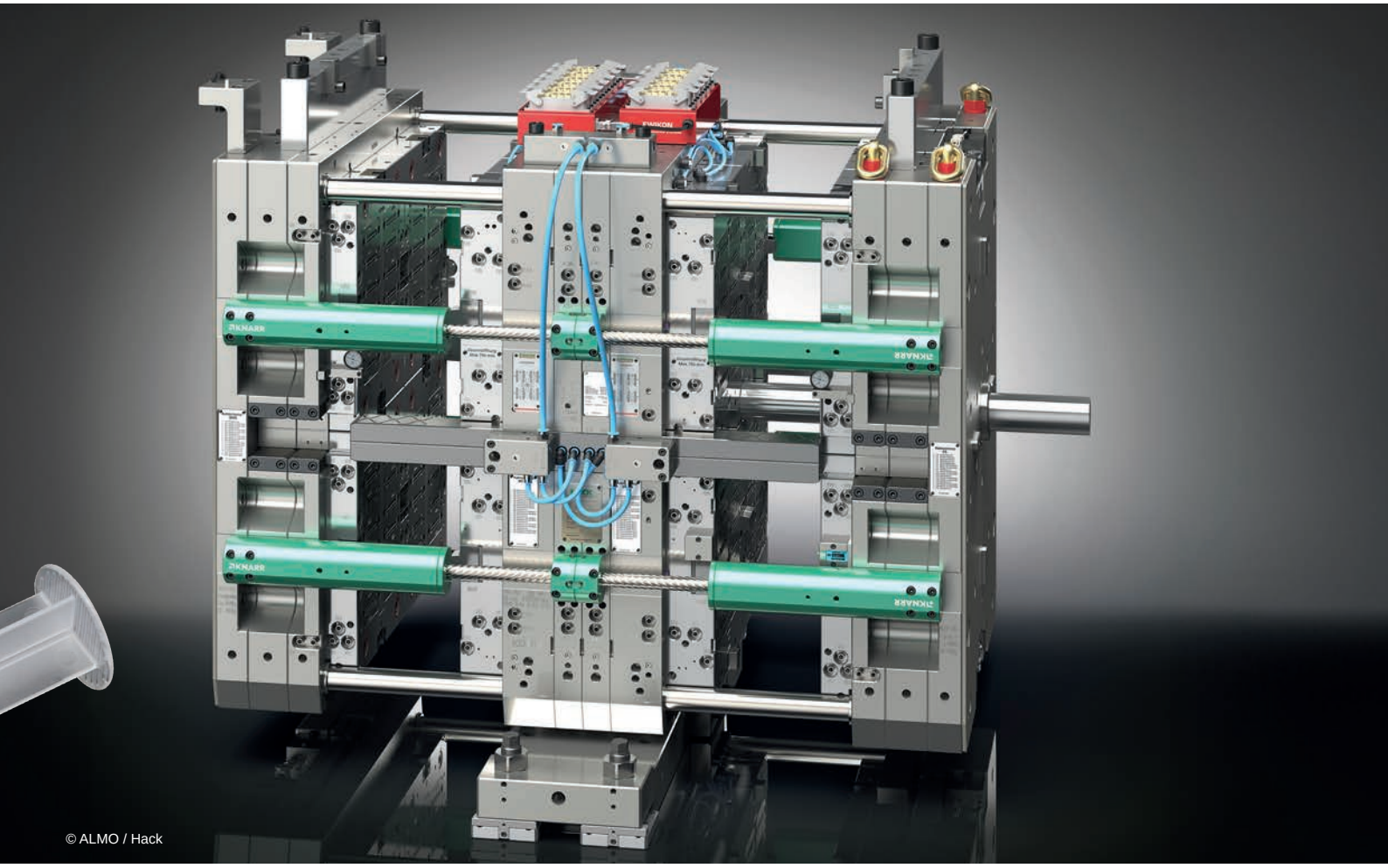
The decision to use valve gating was made at ALMO for reasons of process stability. The decisive factor was minimising the reject rate, because with the high-viscosity PP used, there was a concern that open gating would cause decompression problems in the stack mould, which could lead to moulded part defects. "Since the parts are temporarily stored before further processing, rejects would only be detected late in the quality control process at the automatic assembly machine," explains Alexander Ernst, project engineer at ALMO. "Valve gate gating offers significantly higher process reliability here by sealing the gate after each shot."

Mould making and hot runner expertise

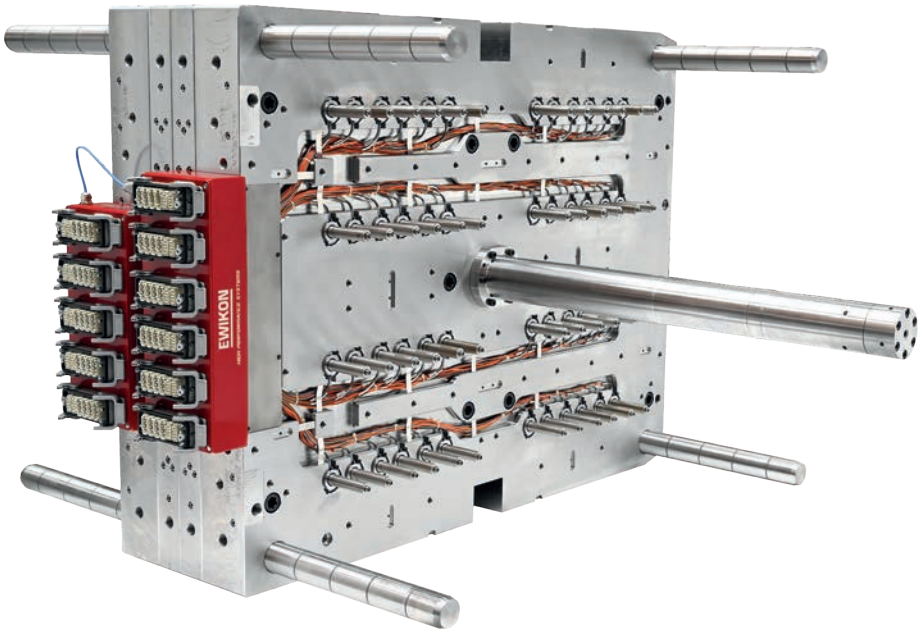
Due to the limited floor space available, ALMO decided to produce on a hybrid-driven midsize injection moulding machine from Sumitomo-Demag. Hack had to orientate itself on the specified machine size with regard to the maximum possible mould dimensions and weights when designing the production stack mould. With mould dimensions of 1146 x 910 mm and an installation height of 1080 mm, all of ALMO's specifications could be met. The centre block of the mould was supplied by EWIKON as a complete hot half with the hot runner system already integrated and electrically tested, electrical wiring ready for connection and the pneumatic connections for the valve gate drive units. This made Hack's job much easier, as it was possible to concentrate on the production of the ejector and contour plates as well as the opening mechanism. The mould inserts, each with 12 cavities, are designed to be exchangeable for easy replacement during maintenance. Steep threaded spindles are used to open the mould. Compared to rack-and-pinion mechanisms, these allow faster travel movements and at the same time facilitate disassembly for maintenance work.

Compact hot runner design

Due to the specified mould size, a compact solution was also required for the hot runner system. For the manifolds, EWIKON uses the proven HPS III-T technology, which enables natural full balancing in a small installation space. 4 manifolds are installed per parting line, each feeding 12 hot runner nozzles. A centrally positioned bridge manifold with melt outlets on both sides supplies all 8 manifolds with melt. It is integrated into a compact plate package



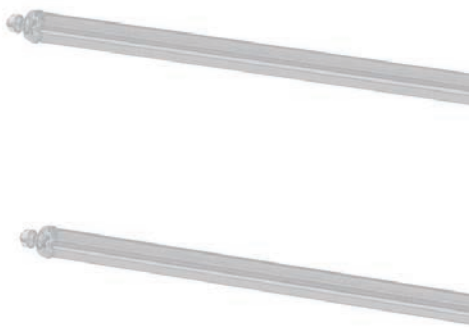
48+48-drop valve gate stack mould for the production of the 10 ml syringe plunger (above). EWIKON supplied the hotrunner system as a complete hot half (below).



that also contains the single pneumatic drives arranged back-to-back to drive the valve pins. Leakage-free melt transfer from the machine nozzle is achieved via a specially designed snorkel system. The hot runner nozzles used have a flow channel diameter of 6 mm, the valve pin guide is permanently located in the front area of the hot runner nozzle to minimise gate wear. The gating takes place on one of the bars of the syringe plunger with a gate diameter of 1.2 mm.

From the pilot series to reliable mass production

During the project, a 12-cavity pilot mould was built in advance for testing purposes. "Without compromising on the design," emphasises Michael Halbhuber, Technical Sales Manager at Hack. "Our pilot moulds always represent full-featured production moulds." Accordingly, the mould is still used by ALMO for the production of syringe pistons after the successful completion of the test phase.



96-cavity mould for direct side gating for production of the 1 ml syringe plunger made from PS.

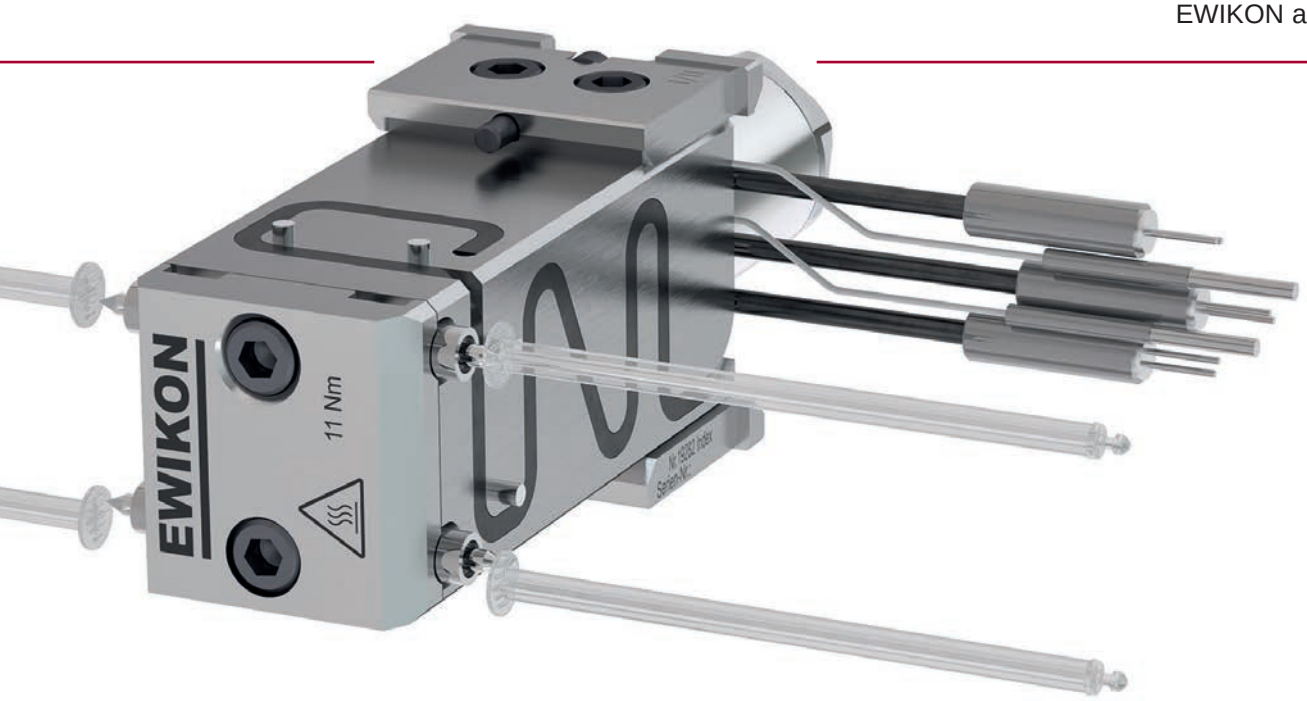
The final production mould has been producing since March 2022. In addition to a general increase in product quality, ALMO achieved a significant saving in material with the new concept compared to the partial hot runner moulds used previously. At the same time, it was possible to reduce the cycle time and thus significantly increase productivity. As a result, only one machine is now needed to produce the required quantity of syringe plungers. With approx. 3 million shots to date, the stack mould is running stable.

Serial production modernised

A different mould concept was realised for the production of a syringe plunger made of PS for a B. Braun Omnifix® syringe with 1 ml filling volume. A 96-cavity full hot runner mould for direct side gating of the component runs on a Sumitomo-Demag all-electric injection moulding machine, which is directly integrated into a new production line for highly automated manufacturing, assembly and packaging. This has significantly increased the production capacity and at the same time reduced the required floor space within the injection moulding shop. Whereas several injection moulding machines with partial hot runner moulds were involved in the production process before, only 2 machines are needed in the new line.

Side gating offers advantages

In the compact mould with dimensions of 1046 x 796 mm and an installation height of 623 mm, 24 HPS III-MH hot runner nozzles for direct side gating are arranged in 2 vertical rows of 12 nozzles and are fed by a fully balanced manifold. This system was also supplied as a complete hot half. Since a part of the flow channel is already integrated in the multi-tip nozzle, short flow paths could be realised in the overall system despite the very high number of cavities. This is advantageous because the temperature-sensitive polystyrene material should be processed with the shortest possible residence times and high shear. To additionally achieve the shortest possible cycle times, the linear 4-drop version of the MH nozzle with 2 tips per side was chosen for this application. "The cavity spacing possible with this version



The hot runner nozzles are arranged in a row in the mould.
Gating takes place on the thumb rest of the syringe plunger.

allowed the integration of an optimal part cooling." explains Uli Schäfer, project manager at Hack. "This enables minimum cycle times." Gating is done on the thumb rest of the syringe plunger, the gate diameter is 0.7 mm. A perfect gate quality is achieved by using a special tip insert developed by EWIKON.

Easy to maintain concept

Also with this mould, Hack has designed the mould inserts to be exchangeable for ease of maintenance. Four cavities are integrated into one insert. The exchange is extremely simple and can be carried out directly on the machine after the tip inserts of the relevant nozzles have been removed. This is where the advantages of the HPS III-MH concept become apparent. The tip inserts are only installed after the nozzle body and the mould insert have been mounted from the parting line and can be removed or replaced just as easily. This simplifies mould assembly, facilitates the integration of the powerful cavity cooling in the inserts and at the same time increases mould stability.

After successful trials at Hack, the mould was integrated into the production line at ALMO. After completion of the final coordination work for the transfer from the production machines to the assembly and packaging machines, serial production will start soon.

Expertise combined

Depending on the application and production requirements, completely different concepts may be required for the production of medical mass articles in order to guarantee efficient and safe processes. In both projects, mould maker Hack and hot runner manufacturer EWIKON combined their expertise to provide customised solutions. The high precision, functional reliability and ease of maintenance of the moulds designed by Hack were achieved not least thanks to the hot runner systems provided by EWIKON from its broad product portfolio for medical technology applications, which could be flexibly adapted to the technical mould requirements.

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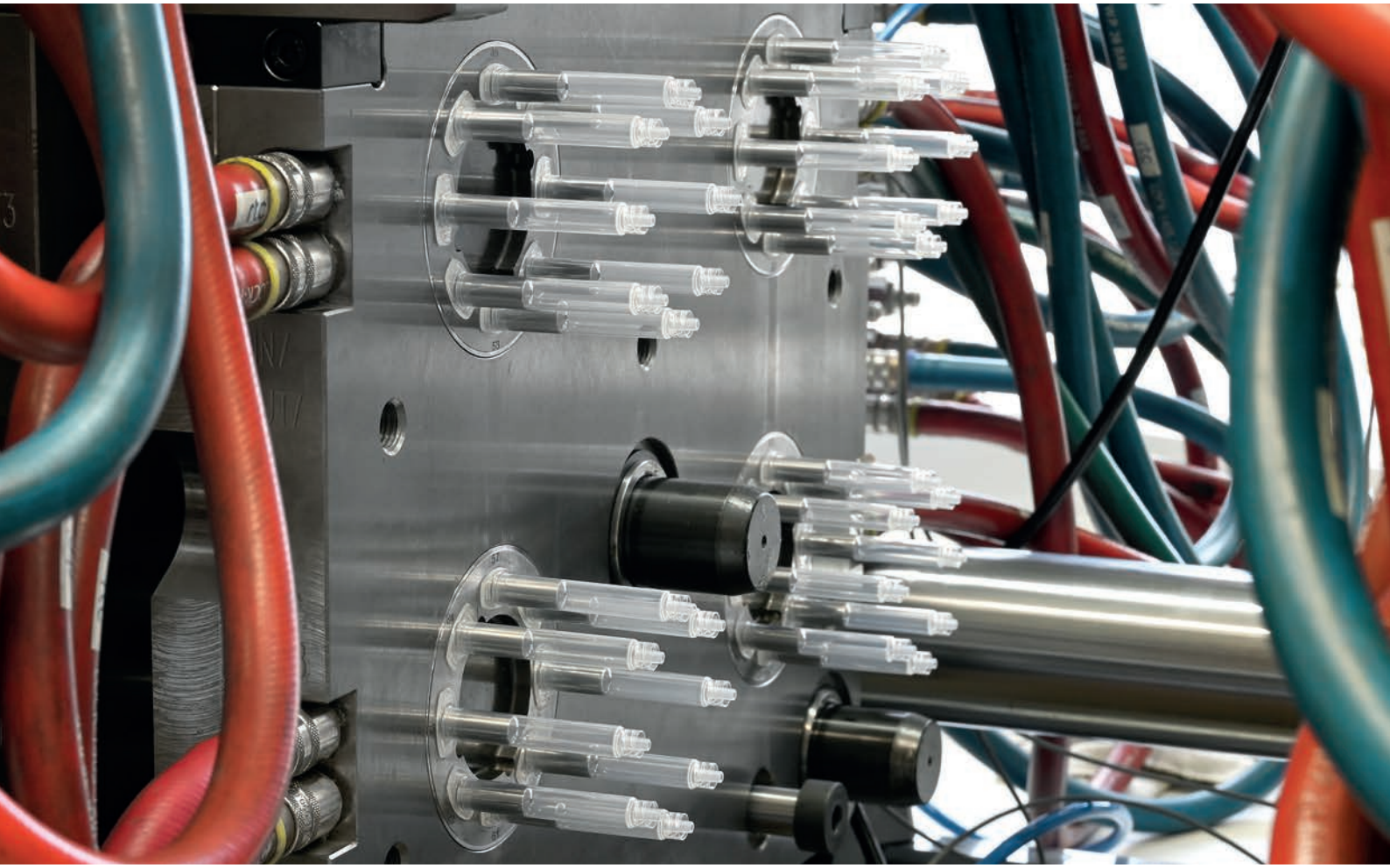
Functionality combined with compact design

64-drop mould for Luer-Lock syringe barrel

Due to the necessary unscrewing mechanism, disposable syringes with a Luer-Lock connection place particularly high demands on mould making. Werkzeugbau Ruhla GmbH, a specialist for medical precision mould solutions, realised a compact 64-drop mould with direct side gating for a Luer-Lock syringe barrel with EWIKON as hot runner partner.

As a specialist in precision moulds for medical technology, Werkzeugbau Ruhla GmbH in Seebach, Thuringia, generates a high percentage of its turnover in this sector. The export share is 50 %, with India, Asia and Africa as important sales markets. Most of the moulds are supplied in a 64-drop version as a complete package with a complete hot runner system and control technology. EWIKON usually supplies the hot runner systems as complete hot halves with integrated electrical wiring and connection technology. Currently, the HPS III-MH multi-tip nozzle concept for direct side gating is mainly used. In the course of more than twenty years of cooperation between the two companies, Ruhla, with the support of EWIKON, has been able to develop a modular and weight-optimised mould concept with a high degree of standardisation. The moulds



View of the ejector side of the mould during the trial phase in the Ruhla technical centre (above). Due to the compact mould dimensions of 546 x 896 mm, only a small Sumitomo Demag IntElect 180-700 injection moulding machine with 180 tonnes clamping force was required.

are made almost exclusively of stainless steel to ensure perfect operation even under less than ideal climatic conditions. They are also extremely compact. This allows them to be used on smaller injection moulding machines, enabling energy-efficient production.

Ease of maintenance is a must

Another result of the standardisation is a very high level of maintainability, both on the mould and the hot runner. "This is a basic requirement in the medical sector, because our customers want to produce efficiently and with minimum downtime," emphasises Ruhla Managing Director Lena Lüneburger, "but in the export sector, maintainability is even more important, because despite long distances, different production conditions and personnel requirements, the high demand for a continuous, uninterrupted production process has to be met. "In general, customers demand a guarantee of three to five million shots. In addition, the supply of all important spare parts must be guaranteed at all times. For this reason, the moulds are supplied as standard with a complete service package including the most common wear and spare parts, a detailed operator's manual and detailed disassembly and assembly instructions. Additional components are available at short notice if required. "Once again, the close cooperation with EWIKON pays off," says Lena Lüneburger, "we form a well-rehearsed team and, thanks to standardisation, the required spare parts for the installed hot runner systems are always available at short notice.

Self-developed unscrewing unit

The 64-drop mould for a 2 ml polypropylene syringe barrel with Luer-Lock thread is the first of a series of moulds. In this version, the valve pin is not simply attached to a cone, but is additionally screwed in place via a thread formed on the syringe. To release this thread prior to demoulding, an unscrewing unit had to be integrated into the mould. "For this purpose, we used a planetary gear developed and designed in-house, which is installed in a separate plate package between the hot half supplied by EWIKON and the contour plate," explains Udo Köllner, Technical Managing Director at Ruhla. "Above

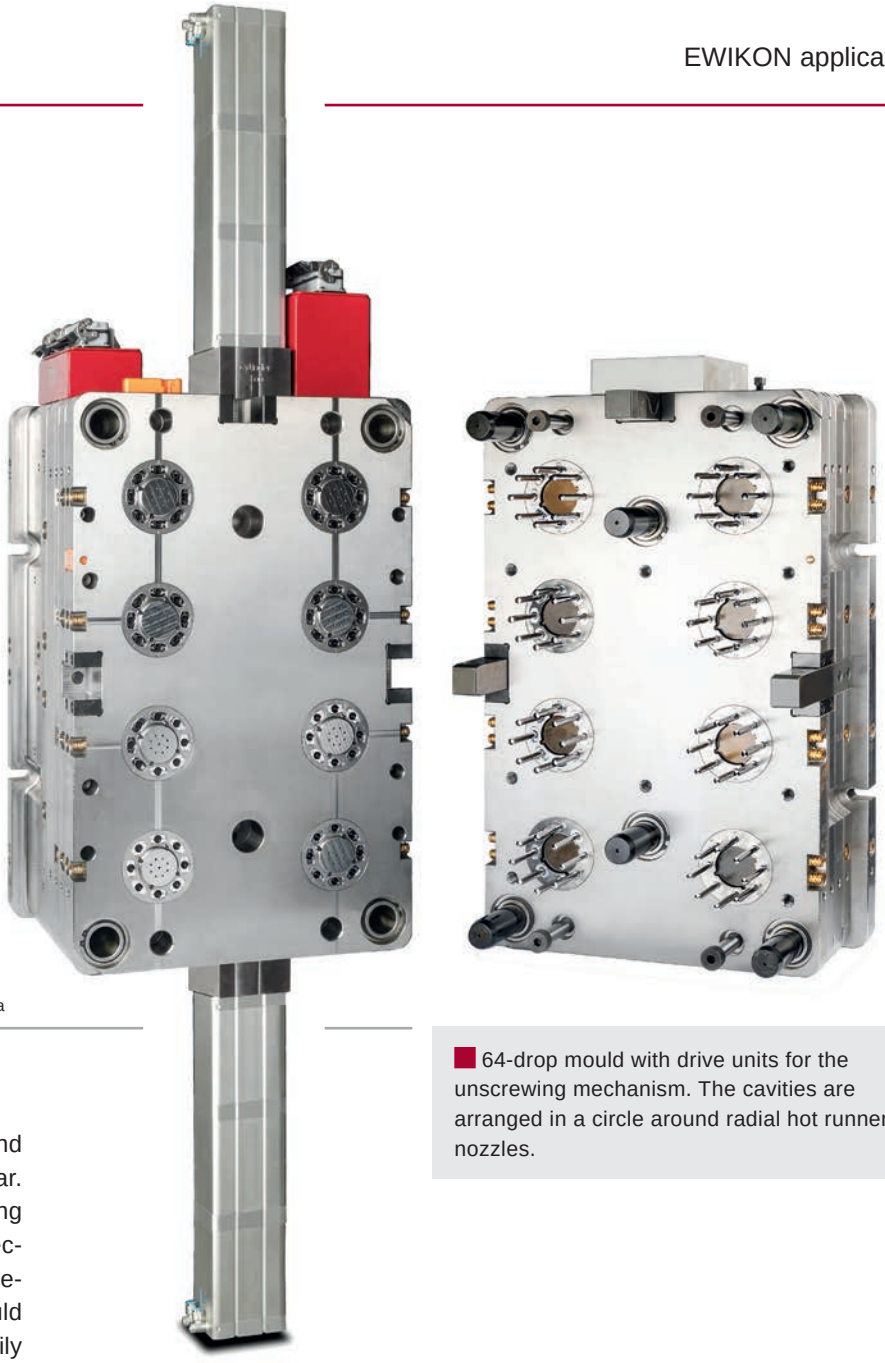
Standardised mould insert with parts of the unscrewing mechanism and assembled hot runner nozzle (top). The hot runner system was supplied by EWIKON as a complete hot half. The nozzle length was adapted to bridge the additional distance caused by the unscrewing mechanism (bottom).

© Ruhla

all, a space-saving solution was required to keep the mould compact. And with dimensions of 546 x 896 mm, we were able to meet this requirement. We do not build much bigger than a comparable mould without the unscrewing unit. The trials in our technical centre could therefore be carried out without any problems on a relatively small Sumitomo Demag IntElect 180-700 injection moulding machine with a clamping force of 180 tonnes.

Variable hot runner concept creates benefits

In the design of the mould inserts, Ruhla achieved the greatest possible standardisation with effective mould venting and cooling. Here, too, the close cooperation with EWIKON proved advantageous. The HPS III-MH111 nozzle used, where the parts are arranged in a circle around a particularly slim nozzle body, was specially developed for the production of medical technology articles, in particular syringes and pipettes. Combined with extended tip inserts, the compact nozzle concept gives the mould maker more installation space between the cavity and the nozzle. Ruhla uses this space to integrate all-round cavity cooling in all its mould inserts, which, in conjunction with inner cores that are also cooled, enables short cycle times and warp-free parts. In the current mould, however, a larger cavity spacing was required to make room for the unscrewing mechanism. At the same time, the additional plate package for the drive required longer nozzles. This is where the multi-tip nozzle concept really shows its flexibility, as both the pitch diameter of the nozzle tips and the nozzle length can be adapted very flexibly. The nozzle tips were extended by EWIKON and adapted to the changed pitch diameter. To be able to change the total nozzle length without problems due to thermal expansion, the HPS III-MH111 nozzle uses a special nozzle holder in combination with a transfer nozzle. Both components can be varied over a wide range of lengths. This makes it possible not only to adapt to different part lengths, but also – as in this case – to easily bridge additional distances in the mould. With an intended cycle time of 10-12 seconds, the mould is designed for a



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64-drop mould with drive units for the unscrewing mechanism. The cavities are arranged in a circle around radial hot runner nozzles.

production volume of between 125 and 150 million syringe barrels per year. Comparable moulds without unscrewing mechanism achieve around 8-10 seconds. The modular and maintenance-friendly mould design allows the mould inserts to be replaced quickly and easily if necessary. Changing the heat-conducting tips of the hot runner nozzles is just as easy. Routine replacement of these components can be carried out directly on the machine with the mould open. In the event of a malfunction, individual cavities can also be shut down by using dummy tips in order to be able to continue production temporarily.

More flexible with combi moulds

Another special feature is that two of the moulds are designed as combination moulds, allowing the syringes to be produced either as a Luer-Lock version or as a simpler Luer-Slip version with a cone. "Due to the high degree of standardisation, this is easily possible," says Udo Köllner, "in this case we simply supply a new intermediate plate which replaces the drive plate during the conversion. In addition, the front part of the mould inserts is exchanged for those with a Luer-Slip contour. This allows the customer to make the changeover in a short time and to become much more flexible in production.

Contact

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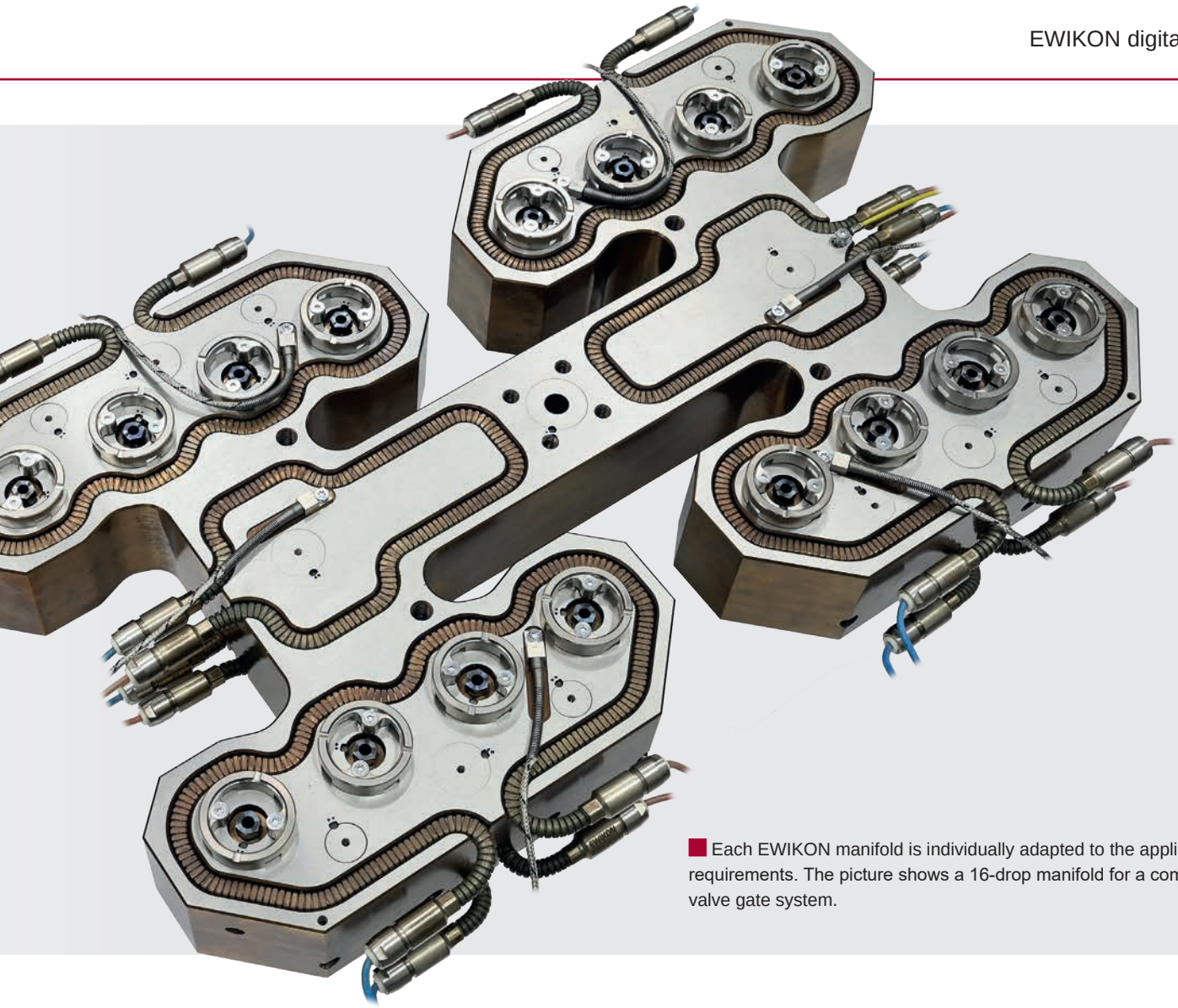
Digital solutions for optimised customer service

AI paves the way – Fully automated manifold design in hot runner technology

When using hot runner systems, thermal homogeneity in the manifold system is at least as important as the fully balanced design of the flow channels. Both factors are the basic prerequisite for a stable injection process and consistent part quality. A demanding large-scale project, which EWIKON is realising together with the simulation and AI specialist IANUS, aims at the AI-supported, fully automated design of manifold systems under thermal and energetic aspects.

The current state of EWIKON manifold technology is the result of decades of experience and continuous technical development. A naturally fully balanced design of the flow channels in the manifold has been standard from the very beginning. The element technology used with streamlined flow channels allows absolutely symmetrical distribution of the melt with equal paths to each cavity, avoiding dead corners where no melt exchange takes place and the material is unavoidably thermally damaged with increasing residence time. At the same time, it guarantees a gentle melt flow to safely process even sensitive materials and at the same time facilitate colour changes. Branches and deflections on several levels can also be realised very compactly within a manifold block using this technology.



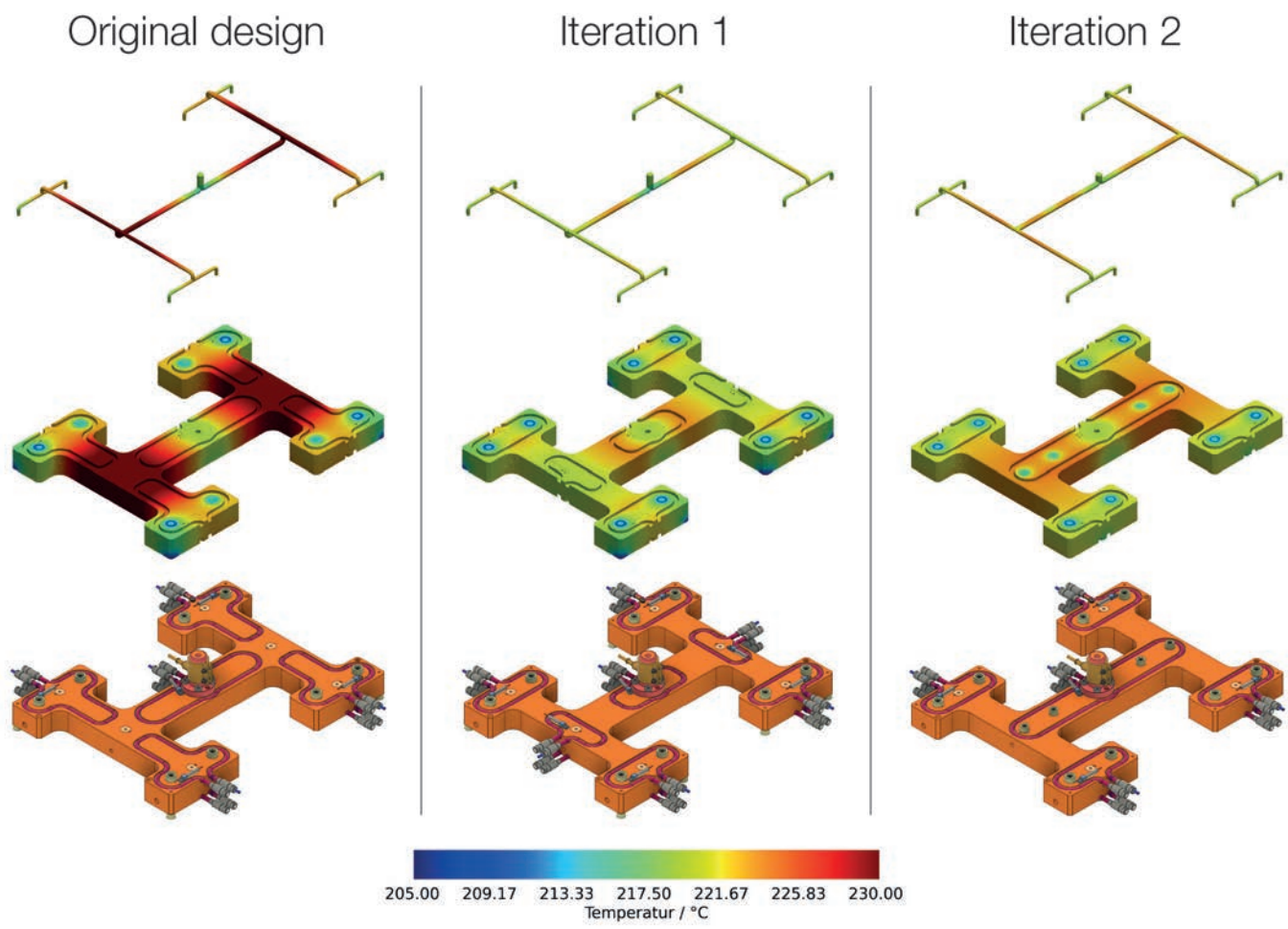
Each EWIKON manifold is individually adapted to the application requirements. The picture shows a 16-drop manifold for a complex valve gate system.

Each manifold unique

Since each manifold is designed and manufactured precisely to the customer's application-specific requirements, the manifold systems differ both in terms of external geometry and in the number of contact points with the surrounding cold mould plates, which can influence the temperature profile of the manifold. Due to the increasing number of special applications with very complex mould construction, for example for the integration of additional functions during injection moulding, extremely complex manifold designs are also the daily routine.
Each manifold is designed according to the EWIKON design manual with regard to geometry, flow channel layout, heater placement, number of control zones and required heating power. The project carried out with IANUS aims to design a manifold, regardless of size and complexity, in an AI-supported, fully automated process, considering all decisive factors. The implementation is taking place step by step.

Customers already benefit today

The first project phase, which has already been realised, is a thermal simulation, which every EWIKON manifold undergoes during the design phase in order to check the heating design determined by the designers and to optimise it further if necessary. Until now, such a simulation could only be realised with a considerable expenditure of time and money and is only carried out in practice in exceptional cases. Networking the CAD model was difficult even when using current simulation software. Often the meshing generated by the software did not meet the requirements. In critical areas and with complex geometries, adjustments or corrections of the meshing grid were necessary by hand. In addition, the boundary conditions such as thermal conductivity, materials, ambient temperatures and heat transfer coefficients at the contact points had to be defined and entered. In total, including the preparation of the results report, between one and five working days were estimated for a manifold simulation.
EWIKON and IANUS succeeded in completely digitising this complex process and integrating it into the design process without any additional time expenditure. In the process, a digital twin of the CAD model is generated at IANUS, which is sent to an AI-supported simulation. Component recognition is automatic, as is meshing. The boundary conditions are already predefined. The result with a detailed report is already available after two to five hours. In the meantime, the responsible designer can work on other projects. With the help of the simulation, not only thermal deviations from the nominal value, but also the thermal symmetry within the fully balanced flow channel can be detected and evaluated. If necessary, the designer can



Thermal simulation for an 8-drop manifold system with 2 optimisation steps.

make further optimisations, for example in the positioning of the heaters, the thermocouple position, the number of control zones and the number and position of the pressure pads.

The graphic above shows several manifold versions of an 8-drop manifold for POM. The thermal deviations from the nominal value 220 °C and the thermal homogeneity were evaluated in 2 iteration steps. The temperature distribution in the flow channel, the surface temperature of the manifold block, and the corresponding 3D model of the manifold are shown. The temperature deviations in the flow channel could be reduced by approx. 60 % compared to the original design.

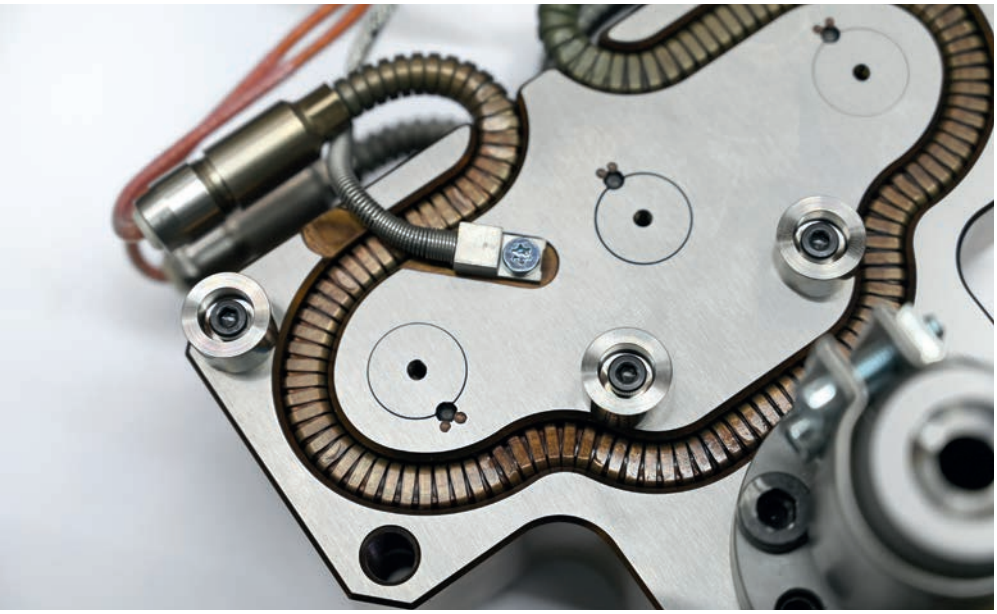
Already today, the customer receives a system that has been extensively thermally optimised in the design phase without additional financial expenditure. Especially when processing temperature-sensitive materials, such as POM, the probability of necessary corrections in the sampling phase can be significantly reduced. But also for all other applications, a further optimised thermal design of the manifold system means a significantly extended process window.

Before the market launch, there was an extensive testing phase in which more than 2000 manifolds went through the simulation process under the control of the R&D department. All results are stored in a database, which forms the basis for the further project phases. In addition, the results were used to fine-tune the EWIKON manifold design.

The other phases of the project build on the first and aim to completely integrate the optimisation steps, which are currently still carried out manually by the designer, into the process.

AI opens up new possibilities

In the second phase of the project, which is currently being implemented and is already delivering reliable results, the positioning of the thermocouples is also to be automated. IANUS uses state-of-the-art AI methods with the help of its core competence, the automated and cloud-based simulation of all types of flows. Thanks to the connection to the largest and fastest high-performance clusters in Germany, it is possible to train the most complex AI structures using a multitude of parallel simulations in a short time and thus pave the way for automated and precise optimisation of the most complicated systems.



In further project phases, the positioning of the thermocouples and pressure pads will also be fully automated.

In the world innovation of automated thermocouple positioning in the hot runner, the digital twin of the manifold first runs through the thermal simulation as described in the previous section. In the process, the heat distribution in the entire component is precisely determined on the basis of the PID-controlled heating structures. Through the calculation on the high-performance clusters, an in-depth analysis of the thermal conditions in the component can then be carried out directly on the basis of the generated results. For this purpose, the component is intelligently divided into several sections without any further intervention by the user. This unique procedure is essential for parallel simulation on the one hand, and on the other hand for the possibility of calculating increasingly complex, customer-specific systems. Then artificial intelligence comes into play. Thanks to the large number of simulations already carried out and enrichment with real-world data, the best possible position of the thermocouples can be precisely determined on the basis of the average temperature in the flow channel. The optimal position aims at a homogeneous temperature in the flow channel according to the set temperature and thus minimises temperature differences in the channel, which in turn could lead to faulty balancing. The manifold geometry itself is also considered, in which structural conditions such as pressure pads or recesses can prohibit the positioning of thermal sensors. Another target parameter is the reduction of the generally necessary heating power as well as the settling time of the entire control system.

Thus, after step two, a simulated and optimised hot runner geometry is available with regard to thermocouple positioning and temperature homogeneity. Through the unique use of simulation and AI, an enormous savings potential can be generated by reducing possible rework on the hot runner or the process settings as well as the use of human resources to a minimum.

The road to complete automation

Further steps are then to be realised in project phases three and four. From phase three onwards, the ideal heating layout, the number of heating zones and the required heating power will also be calculated with the help of AI. Determining the optimal number, size and position of the pressure pads that support the manifold relative to the mould plates is then the goal in project phase four. As with the definition of the heating layout, the focus here is also on energy efficiency, because heat flows into the surrounding plates via the pressure pads as contact points. Optimisation at this point can significantly reduce the energy consumption of the entire system.

The final result of the ambitious joint project will be a simulation environment provided by IANUS, in which a fully automated manifold layout is generated at the push of a button by the designer. This combines the perfect natural balancing of the flow channels with optimum thermal homogeneity and minimised energy consumption, thereby significantly increasing process reliability and energy efficiency for the customer. In the future, this combination of AI and simulation will generate solutions that represent an optimum with regard to the large number of target variables, which would be difficult to achieve through manual design. EWIKON already offers its customers thermal validation for every manifold system, which illustrates the potential of modern technologies, such as automated simulation in this case.

Our project partner

IANUS SIMULATION

www.ianus-simulation.de

EWIKON is carbon neutral

EWIKON Heißkanalsysteme GmbH became a carbon neutral company in March 2023. This means that all greenhouse gas emissions have been recorded, continuously reduced and the remaining emissions balanced out by climate protection projects. Thus, an important self-imposed goal has been achieved.

Sustainable building concepts in wooden construction and the consistent focus on solar power, which is generated in the company's own solar power plants, increase energy efficiency.

For years, EWIKON has consistently reduced its greenhouse gas emissions and increased its energy efficiency through constant optimisation in all areas of the company. This includes the purchase of 100 % certified green electricity, regular energy audits by the responsible supplier, the continuous optimisation of lighting equipment towards LED technology, the improvement of switching times and switching zones of the hall lighting as well as the use of exclusively electrically powered industrial trucks. Furthermore, in the construction of the last two production halls, sustainable building concepts in wooden construction were implemented.
Together with the independent certification company ClimatePartner, the CCF – Corporate Carbon Footprint – has now been calculated. This includes direct emissions caused within the company, such as electricity and heat generation, the vehicle fleet and fugitive gases, as well as indirect emissions from purchased energy, business trips and employee travel. The calculation did not include other indirect emissions that occur outside the company in the production of raw materials and intermediate products, external logistics and the use and disposal of products or other processes.
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Residual volume balancing through certified climate protection projects

However, it is not yet possible to completely avoid the harmful emission of CO_2. The remaining residual amount of 1,160 tonnes is balanced by supporting a combination of certified climate protection projects in which, among other things, 10 kg of plastic is collected from beaches as well as from dunes and forests for every tonne of CO_2 offset. "We made a conscious decision in favour of such a project," says Managing Director Dr. Stefan Eimeke, "because our products make a significant contribution to avoiding waste already during the production of plastic parts. Therefore, it is particularly important to us that waste that cannot be avoided is professionally disposed or recycled and does not pollute the environment."

25 % of energy requirements soon to come from own solar plants

EWIKON will continue to expand its energy efficiency in the future. A photovoltaic system with a maximum output of 380 kW is already operating on various hall roofs, and a further system with 350 kW is currently being implemented. This means that in the foreseeable future, up to 25 % of the company's annual energy requirements can be covered by solar energy. Furthermore, the CO_2 footprint caused by employees' travel, which currently still accounts for a significant proportion of the residual amount to be offset, is to be reduced by promoting mobile working, car pooling and subsidies for the purchase of e-bikes.

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Technical information subject to alteration EWIKON 10/2023