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**HEWI and its
Customers Benefit
from Cavity Pressure
Technology**

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HEWI and its Customers Benefit from Cavity Pressure Technology

HEWI Heinrich Wilke GmbH of Bad Arolsen/Germany offers its own range of building hardware and sanitary equipment and supplies technical components to the automotive industry. A few years ago, during a quality-related molding project, the company's engineers encountered cavity pressure measurement for the first time. Since then, Hans Günter Herbold, Head of Process Engineering, and his team have been continuously implementing cavity pressure monitoring technology in their equipment. The benefits are higher product quality and lower defect rates, less material consumption, reduced inspection requirements, better tracking of production processes for safer handling of customer complaints and better utilization of machines and equipment.

The production facility on the outskirts of Bad Arolsen/Germany caters to all of HEWI's business divisions. All plastic parts are produced on the same machines – system components as well as building hardware for hospitals and old people's homes or automotive parts. The engineers at HEWI focus on different requirements, depending on the application at hand: production of parts from the classic HEWI portfolio for building hardware and sanitary equipment focuses mainly on surface quality rather than functional requirements. Automotive parts have the opposite requirements: strict adherence to the required functional specifications is more important than the optical quality of the finished part. The process engineers handle these requirements with a variety of process control and quality assurance measures.

Sanitary waste disposal containers without warpage thanks to cavity pressure-dependent switchover

Injection molding of sanitary waste disposal containers is a major challenge for the HEWI production team. The containers are to be wall-mounted in toilets and powder rooms. They will tilt towards the user at the touch of their knee, elbow or hand, and thanks to a mechanical construction, the cover will open. The core component is the container itself. It is made from polyamide PA12 with fins and attachment elements at the rear. HEWI manufactures this 1 050 g container on a well-used 10 000 kN injection molding machine in semi-automated production. Formerly, every container was manually removed and inspected by staff in order to ensure perfect surface quality.

Although HEWI was very keen to step up its production to fully automated processing, it was concerned about potential quality deficits, which would only show during assembly despite optical inspection: this concern was confirmed when warpage between two attachment elements affected the required actuation forces and the finished product failed the



Waste disposal container, HEWI-Series 477 (Photo by HEWI)

final product test. Careful inspection showed that stroke-dependent machine switchover from injection pressure to holding pressure was lacking the precision required for fully automated container production with repeatable quality. The management at HEWI came to the conclusion that more process stability would lead to better repeatability of the quality and ultimately, to a lower defect rate. Their objective was to first stabilize the process, then change from semi-automated to fully automated production.

The machine's inflexible control functions could only be handled by an external system, which was to provide better information on the actual processes at work during production. For this, HEWI elected Kistler cavity pressure sensors in combination with the CoMo Injection process monitoring and control system. A piezoelectric pressure sensor was retrofitted to the mold and the system was connected. It analyzes the cavity pressure profile during the injection phase. The CoMo Injection system can identify the point of volumetric filling on the pressure profile for every shot. The optimum switchover point lies after cavity filling and before melt compression.



Hans Günter Herbold explains the function of waste disposal containers made from PA12 and the benefits of cavity pressure monitoring

The CoMo Injection system generates a switch signal and transmits it to the machine. During every cycle, the machine will switch from injection pressure to holding pressure as soon as the pressure threshold is reached, independent of its own measuring and control systems. In addition to the switch-over function, a monitoring threshold along the cavity pressure profile allows fully automatic quality inspection of the containers. Failure to reach a defined minimum pressure along the cavity pressure profile will trigger a signal to the handling robot, which will not place the container on the conveyor belt but dispose of it in a reject box instead.

Ever since the Kistler system was implemented, which meant that the switchover from injection pressure to holding pressure was dependent on the cavity pressure and every container was inspected automatically, the defect rate was reduced to a fraction of the previous figure – to less than 2 %. Cavity pressure technology now protects the company from a high defect rate, which is a very important aspect considering that the production involves shot weights of about 1 kg of an expensive PA12 grade.

Process monitoring in multi-component technology

In addition to building and sanitary technology, HEWI also specializes the production of different automotive parts, including kinematic components and air conveying components of air conditioning systems for different automotive platforms from Porsche, BMW, Mercedes, GM/Opel and Volvo. Among the supplier's typical applications are functional air conditioning components such as air flaps and valves as well as mechanical operating handles made from SEBS, PP and PA. Many air flaps have different dimensions and diameters and often they are overmolded with a soft TPE component, which serves as a circumferential seal. The sealing surfaces are either smooth or dented. Along with two-component technology, HEWI also introduced hot-runner technology, formerly only used for the hard component. In this business division, cavity pressure measurement is also used to monitor the production of many critical parts: sensors and the CoMo Injection process monitoring system analyze the pressure profile in real time for compliance with the part quality requirements. In addition to monitoring the hard component, HEWI is currently planning to start monitoring some of the soft component injection processes, too.



Having successfully introduced cavity pressure monitoring to their waste disposal container production, HEWI now decided to also use this technology for injection molding technical supply components for air conditioning systems

Master pressure profiles control the quality monitoring process

HEWI's team of process engineers managed by Hans Günter Herbold and Bernd-Dieter Honsberg are dealing with about 170 initial mold settings and mold samplings every year. During mold sampling, the team systematically searches for the

correct setting for each parameter that will combine perfect process stability and part quality with a cost-efficient cycle time. Often, this task is like the quadrature of the circle. The cavity pressure profile created during the mold sampling sessions becomes the future master profile for large-volume production. This strategy makes complicated mold changes a thing of the past – be it changing the machine type or changing from smaller to larger machines of the same brand. During the production process, the machine parameters are adapted to deliver the required pressure profile.

The process engineers will set the parameters of the CoMo Injection system corresponding to the required pressure profile: the pressure profile is used to define the criteria for positive quality analysis, which are displayed as evaluation elements such as boxes and contain a defined pressure interval over a defined time period. The pressure profile has to pass these boxes in a defined process. Minimum pressure levels can be defined with the help of threshold values. If the pressure profile fails to pass the box in the defined way or if the pressure falls short of the required minimum defined by the threshold value, CoMo Injection will tag the part as defective and will set the reject gate to "NOK" or give a signal to the handling robot for removing the part as defective.

Balancing hot runner molds

Impressed by the successful implementation of the cavity-pressure dependent switchover to holding pressure and continuous quality monitoring of large-volume production processes, HEWI also integrated the MultiFlow automatic hot-runner balancing function in the CoMo Injection system. Hans Günter Herbold: "Mold balancing by means of



At HEWI, CoMo Injection process monitoring systems are mounted on mobile carriages. This way, they can be moved from machine to machine



Kistler application specialist Dominik Cordes (left) and Christian Stöhr, apprentice process technician at HEWI, discuss the MultiFlow system



HEWI runs their production of different two-component assemblies for air conditioning systems with cavity pressure monitoring

partial fillings is way too complicated. This is why we badly needed an automatic balancing solution. Thanks to Kistler systems we are now much faster and more efficient!" Automatic hot-runner balancing aims at creating identical filling and pressure conditions in all cavities of multi-cavity molds. As the pressure inside the cavity correlates directly with the fillings, the quality of the balancing process is represented by the pressure profiles of all cavities. Optimum balancing requires identical pressure levels in all cavities during the compression phase – both in terms of the pressure profile and the pressure head.

HEWI multi-cavity molds are balanced with the help of a cavity pressure sensor in each cavity. The sensor signals are transmitted via a multi-channel connector on the outside of the mold to a multi-channel cable, which connects to the MultiFlow of the CoMo Injection system. The pressure profiles of the individual cavities are treated as control variables while the temperatures of the hot-runner tips are used as actuating variables: the higher the tip temperature, the higher the melt temperature and the lower the melt viscosity, which translates into less flow resistance in the tip and in the cavity and makes cavity filling much easier. For every cycle, MultiFlow analyzes and compares the measured pressure curves, calculates new required tip temperatures and transmits them to the hot-runner control system or an integrated control system in the injection molding machine via an interface. This creates a closed-loop control circuit, which automatically ensures homogenous and synchronous filling of all cavities.

When the multi-cavity mold starts operation, MultiFlow automatically balances the hot runner. During the production process, MultiFlow automatically controls the hot runner temperatures and maintains permanently stable filling conditions in all cavities – without any manual interference. The system automatically controls process changes, material fluctuations as well as influences from the production environment and other process interferences.

If automatic balancing fails to deliver the required results because of process control-related problems, the pressure profiles recorded by the MultiFlow in CoMo Injection are a

helpful tool for detecting and fixing errors. "We only need to send images of the pressure profiles to the hot runner manufacturer and they will know exactly what to do." Now that many HEWI multi-cavity molds have been equipped with CoMo Injection for monitoring the injection of the hard component – some are even running MultiFlow for hot-runner balancing –, the company has decided to install cavity pressure sensors for monitoring the injection of the soft component, which is very important for the functional operation of the part.

Better utilization of available capacities of older machines

Automotive projects often involve mold samplings and large production start-ups as well as an ever-changing demand for parts. Equipping prototypes and manufacturing test vehicles demands major flexibility in terms of lot quantity and delivery deadlines. It also requires a flexible approach to the utilization of free capacities for exactly these types of projects. Nonetheless, absolute safety is paramount and requires 100 % quality production. HEWI operates 71 injection molding machines with clamping forces between 220 kN through 10 000 kN, 24 hours a day, six days a week. Some of these machines are older, but well maintained and fully functional. But not all of them can be retrofitted to state-of-the-art conditions with reasonable measures. As part of its "zero rejects" strategy, HEWI was looking for strategies that would allow monitoring without changes to the machines' hardware or software.

Process monitoring with cavity pressure measurement sensors and Kistler CoMo Injection now provide end-to-end in-line quality control without interaction and independent of the machine. The monitoring system analyzes the pressure profile in the mold and automatically removes any defective parts. Depending on the equipment and the production unit it also controls different ancillary systems: robots will not place the defective part in the box with OK parts, but in a reject box or in a granulator instead. Alternatively, HEWI operates reversible conveyor belts: OK parts are conveyed in one direction while defective parts move in the other. Falling parts are separated into OK and NOK at the delivery chute of the reject



Stefan Schaller, Head of HEWI polymer processing

gate according to a signal triggered by the CoMo Injection system. Thus, quality assessment is carried out by peripheral systems and the defective parts are removed as a result of the interaction of these systems. In order to maintain flexibility even when using different machines, HEWI mounted the monitoring systems to mobile carriages. This way, they can be transported to different machines and integrated into the peripheral systems at hand – to be at service to the machine that is dealing with the current production order.

Integral approach favors monitoring

It is true that monitoring systems require higher investment before the start of the project. "More investment into sensors, systems and molds is compensated for by lower costs in large-scale production," Hans Günter Herbold explains. Herbold has been working in plastics processing for 33 years, and has been responsible for HEWI's process engineering department since 1988. "If we try to save money by operating without these systems, we will definitely have higher

HEWI in profile

HEWI is a system provider specializing in the business divisions of building hardware and sanitary equipment. Building hardware includes door and window fittings, handrail systems for halls and staircases as well as signs and boards for orientation in public spaces. Functional and specially designed products for sanitary applications support people with limited mobility. These products are at the heart of the company's strong position as a supplier of building hardware to hospitals, rehab centers and homes for the elderly.

Premium-quality HEWI fittings with their specific design of basic geometrical elements and up to 19 characteristic colors have already become a popular product with cult status.

Recently, HEWI expanded its material range to cater to changed market requirements. The family-run business with 600 staff members now offers door handles made

from stainless steel and aluminum as well as sanitary accessories made from chrome, stainless steel or glass.

When HEWI founded its polymer processing department, the company moved into the new millennium with an extended portfolio and a new business segment. The specialist's service portfolio includes development and engineering of plastic components, injection molding and assembly as well as storage, freight management and recycling solutions. Injection molded technical components are HEWI's core products, which are mainly supplied to the automotive industry. In addition to classic compact injection molding, HEWI works with special techniques such as two-component technology, mono-sandwich technology, gas-assist injection molding or insert molding of metal or plastic inserts. Among the company's specialties is injection molding of pipe-shaped handrails and long handlebars in their own special molds.



Typical HEWI injection molds: handlebars and handrails for sanitary and building equipment

costs during large-scale production: we need closer inspection, testing takes longer and manual sorting and removal of defective parts involves higher risks of defects turning up in deliveries." HEWI's integral and cross-managerial approach to costs and benefits took courage and time. "But thanks to the support of our factory manager Klaus Rohde, we were able to integrate all benefits into the calculation: fewer defective parts, better utilization, less staff for defect management. After this calculation, the benefits of these systems became crystal clear!"

Using a new strategy Stefan Schaller, Head of HEWI's polymer technology department illustrates the monetary benefits of the new strategy: "If we express defect rates in terms of monetary loss, i.e. in Euros, instead of using absolute numbers or percentages of the production output, we can take into account the heavy dependence of parameters on both the lot size and the number of changes. Showing the effects in Euros is much more descriptive and conclusive".

When process technicians "catch on"

When apprentices in the profession of process technicians for polymer and rubber technology join HEWI during their second year, they learn all about the company's specific approach to quality management and multi-cavity process monitoring. At this early stage of their training they become well acquainted with the details of different processing methods, the start-up of production orders, sampling of new molds and the operation of monitoring systems during high-volume production. Hans Günter Herbold: "Our apprentices catch on to the new technology". After completion of their apprenticeship, the young process technicians work in process engineering for another year before they move into a managerial position. Herbold: "At that stage they are not only familiar with the operation of cavity pressure monitoring systems but they also know all about the benefits of process monitoring. Our apprentices are convinced of the positive effects of this technology and they will make sure that cavity pressure monitoring becomes well-established in high-volume production".

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