Production hall Wild & Küpfer AG.

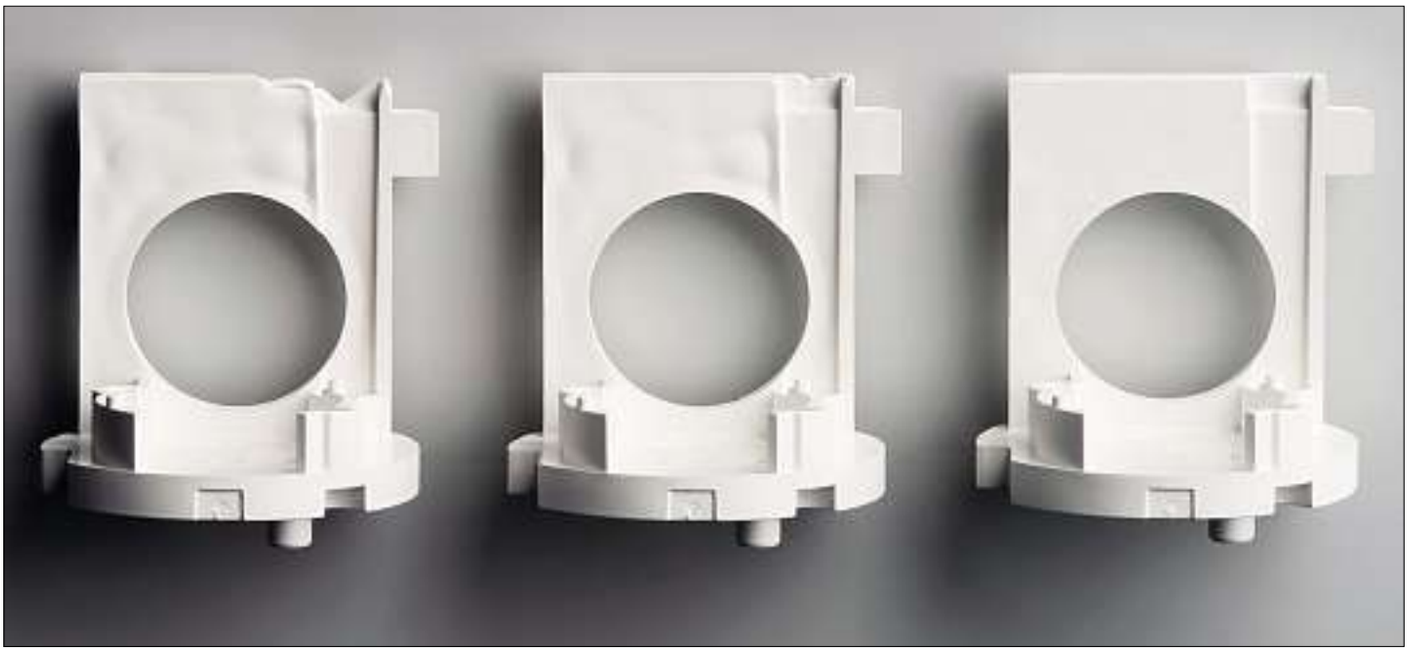
Process accuracy by cavity pressure and cavity temperature sensors

Compliance of tolerances

The Swiss enterprise Wild & Küpfer AG was challenged by a medical part which required high surface flatness. The part had to be machined in several steps to achieve this evenness. With real-time Priamus system control, this finishing is not necessary anymore.

Dipl.-Ing. (FH) Marco Lammer, *born 1979, is working since 2005 for Priamus System Technologies AG in Schaffhausen/Switzerland and is responsible for Switzerland, Austria and Eastern Europe.*

Wild & Küpfer AG, headquartered in Schmerikon (Switzerland), specializes in manufacturing technically sophisticated injection molds and molded parts. The company was established in 1979 and today has 100 staff members. In the last years, two digit growth rates were achieved. In 2004, the company started to manufacture components for the medical sector. A clean room production area has been in operation since 2006. Due to the company's focus on innovation and technology, they approached Priamus System Technologies (Schaffhausen, Switzerland) for measuring technology and an advanced closed loop control approach (Priamus Fill) for this challenging application. The part considered should have a surface flatness of max. 0,02 mm. The part was already manufactured by an injection molding process, but was not designed especially for such a process. In a second step, the surface of the molded part had to be achieved by milling. This required costly and time consuming further finishing steps for trimming and removal of fibers, as well as



Optimized switchover to holding pressure: Switchover with 15, 30 and 46 milliseconds delay time.

extra quality controls. Keeping the process conditions is the key for making precise parts. Because the process occurs in the mold, it has to be monitored, controlled and documented there. The company decided to utilize Priamus control systems to guarantee consistent part quality and therefore, eliminate the need for post-molding rework.

For that purpose, the 2 cavity mold has been equipped with the appropriate sensors. In order to monitor the process, cavity pressure sensors were placed close to the gate where they reflect the process most clearly and can be used for optimization. Cavity temperature sensors were placed close to the stamping cores to detect the melt front in real time and to control the cores accordingly. Additional cavity temperature sensors were placed at the end of the flow path in order to detect the volumetric mold filling automatically and to generate a switching signal that switches over to holding pressure at the optimum time of switchover. Since these parameters were read from the cavity where the action takes place, they are considerably more precise and increase the production accuracy substantially.

Functional principle of switchover to holding pressure

Classical switchover to holding pressure by cavity pressure sensors utilizes a fixed pressure threshold value to initiate where the switchover takes place. Yet the viscosity and its constant variation play a major role. Viscosity changes represent changes in volumes. If the viscosity of the material changes during production, the process is strongly influenced. Therefore, with fixed level pressure switchover, the molded parts are either ''under or over molded'' and are subject to variations.

In contrast, automatic switchover based upon flush mounted cavity temperature sensors at the end of the flow path, give an instantaneous indication of the melt front. An external signal for switchover is sent to the molding machine within 4 msec (1), only when the mold is volumetrically full. Any material viscosity changes are compensated for automatically. In addition, the Priamus system has a signal delay option. The cavity temperature sensors can be placed in the flow path, such that the switchover signal can be optimized using this delay option.

In case of a blocked nozzle, for example, the melt will not reach the cavity temperature sensor. This is ascertained by the Priamus system, and the bad part due to the blocked nozzle can be automatically contained.

In addition, the Priamus Fill system balances the filling in each cavity. By automatic adjustment of the hot runner nozzle temperatures based upon the melt front location, all cavities are filling equally at the same time. As a result, tighter process control windows are achieved for more consistent and uninterrupted production.

The chart from test sampling shows the dimensional deviation in mm. Parts that were produced without or with Priamus were compared.

Those parts produced with Priamus clearly show less deviation in

dimension. The diffusion as well as the variance are definitely smaller [2].

Priamus systems achieve more consistency in production over each cavity and each cycle.

The Wild & Küpfer parts have been produced on an electric machine which has a high reproducibility. It can be assumed that the results on a fully hydraulic machine would be even more considerable.

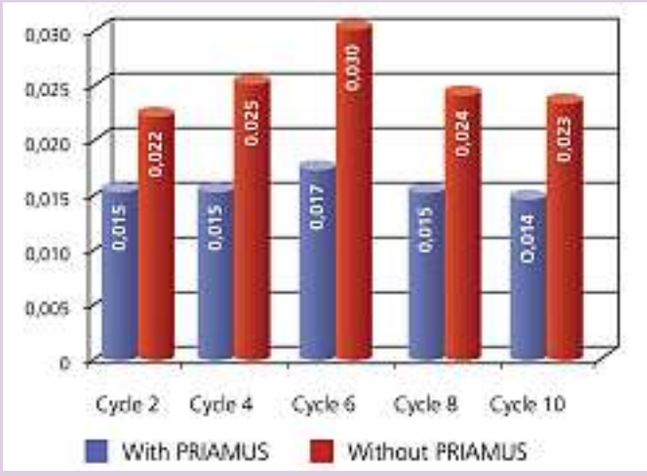
The question of the profitability

Even when the results of the measuring clearly show that by the use of Priamus significant improvements were achieved, the question of profitability arises by using such a system. That was also the case with Wild & Küpfer AG.

The annual costs for remachining the parts are many times the purchase price of a Priamus Fill system. With 200 000 parts produced annually, the system purchase price represents almost a 40% savings in manufacturing costs.

Sometimes it is necessary to retrofit the molding machine for interfacing with the Priamus Fill control system. These costs are dependent upon the machine manufacturer. Fully integrated Priamus Fill systems which are available by Gammaflux and Engel are very cost effective and efficient.

In this sample, the calculated overall costs divided by the costs of the remachining result in an amortisation of 0,46 years. The acquisition cost of the Priamus system is amortised in less than a half year, if the production lasts one year. The molded parts in the two molds (100 000 shots × 32 sec cycle time) are produced only 36 days per year. The remachining costs of one year are thus compensated in 36 days. Since the running



Comparison: Deviation of dimension without and with Priamus optimization.

From left: Tobias Wild jun. and Bruno Pezzani (Wild & Küpfer), Marco Lammer (Priamus).

Thanks

The author thanks for the data provided, the friendly collaboration and assistance as well as the trust expressed by Wild & Küpfer AG. Special thanks go to Tobias Wild junior (Head of Medical Device Technology) and Bruno Pezzani (Injection Molding Manager).

period of such project is usually between 5 and 10 years, the system pays off also for smaller annual volumes. So the Priamus system is cost effective not only for long production runs of high quantities, but also for shorter production runs of lower quantities.

Conclusion

The use of cavity pressure and particularly cavity temperature sensors is becoming more and more important. The user's understanding for process relevant data from the cavity is increasing. Parts produced with Priamus systems are characterized by a high reproducibility and consistency.

Bad parts can be sorted out for each cavity. Filling time differences over several cavities are being detected and controlled. The automatically generated temperature signals such as switchover to holding pressure or switching signals for cores, venting and stamping offer unique solutions for a number of applications.

For Wild & Küpfer it clearly means that they achieved their customer's expected savings of the manufacturing costs. The investment in a Priamus Fill control system is not only profitable in terms of technical and product perspectives, but also in view of economic aspects.

Literature

[1] Priamus data sheet: Cavity temperature sensor type 4005A
[2] *Pezzani, B.:* Degree dissertation as production manager, page 13

Switzerland (Headquarter)

Priamus System Technologies AG
Bahnhofstrasse 36
CH-8201 Schaffhausen

Phone +41 52 632 26 26
Fax +41 52 632 26 27
www.priamus.com
info@priamus.com

Japan

Priamus System Technologies AG
Japan Branch Office
15-12-1F Nanpeidai-Chou
Shibuya-Ku
Tokyo 150-0036

Phone +81 3 5456 1656
Fax +81 3 5456 1657
www.priamus.co.jp
salesj@priamus.com

Switzerland (Headquarter)

Priamus System Technologies AG
Bahnhofstrasse 36
CH-8201 Schaffhausen

Phone +41 52 632 26 26
Fax +41 52 632 26 27
www.priamus.com
info@priamus.com

USA

Priamus System Technologies, LLC
3061 Nationwide Parkway
Brunswick, OH 44212 / USA

Phone +1 (877) 774 2687
Fax +1 (877) 678 5062
www.priamus.com
salesus@priamus.com