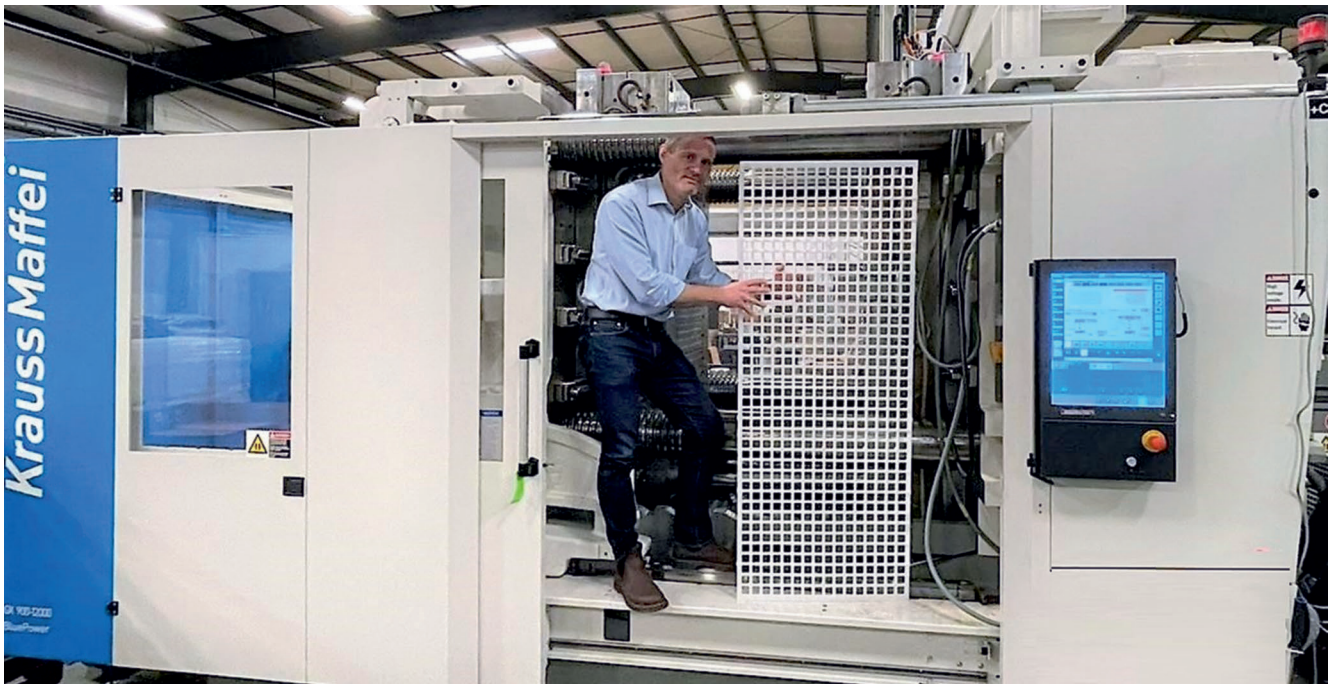
A Simple Cascade

Sequential Injection with a 6-Fold Valve Gate System for a Floor Grate

Products intended for use in building services must meet very high quality requirements in terms of both their constituent materials and functionality. A single-cavity mold for a floor grate made by Barku, which appears to be a simple part at first glance, called for a certain level of technical sophistication. This was provided by a moldmaker with the necessary technical understanding and hot-runner manufacturer Witosa who, between them, devised the right solution for what proved nevertheless to be a complex mold.



Sebastian Lotzin, CEO of Barku's U.S. subsidiary, with floor grate (3250 g) in the 10,000-kN injection molding machine that makes the part © Barku

Experienced polymer engineers are only too aware that a product which at first sight appears incredibly simple and, moreover, is to be made in a single-cavity mold is not necessarily easy to realize in practice. So, too, with the floor grate that Andreas Stietz, project manager at Barnstorfer Kunststofftechnik GmbH & Co. KG (or to use its short form, "Barku"), worked on most recently.

Barku designed a mold for the part, which measures 1500 x 600 x 30 mm, is used as a protective grating in animal husbandry and is intended for the American market.

As Stietz puts it, the part posed a number of challenges: "A part might look simple but the production of large plastic parts is not a simple matter. This application is designed for modular use and requires that certain dimensions be maintained – e.g., shrinkage and warpage must be kept in check – and sink marks eliminated. This only works if the right technology is used."

In order to successfully test this technology at the end of such a project on one of the 50 injection molding machines at the main plant in Barnstorf, Germany, the various pieces of the puzzle would first have to be brought together, coordinated and then slotted into place, says Stietz.

Long before a part and mold concept are created, several items have already made it onto the checklist. Right from the design stage, Barku's vast experience in material deployment, mold concepts, and determination of injection points, play a key role. Even aspects that come right at the very end of a process, such as part handling on the machine or packaging, are factored into all deliberations from the very start.

A regional mold maker with whom Barku already had a long-standing business relationship was contacted about

making the mold. First, though, Barku commissioned Witosa GmbH to conduct a 3D filling simulation because the insert floor, expected to weigh from 3200 to 3300 g, would require a complex injection molding process.

The simulation was needed, on one hand, to determine the pressure requirement, the flow behavior and the heat distribution in the mold, and on the other, to identify the location of flow lines.

Six Individual Drives for Cascade Control

This moldflow analysis was used by all three parties to optimize the mold concept, which featured a 6-fold valve gate system from Witosa with individual drives for cascade control (**Fig. 1**) and which Barku ultimately commissioned the mold maker to produce.

The floor grate was to be produced from low-cost HDPE at Barku's sister plant in the USA. This semi-crystalline thermoplastic, which is considered an easy-to-process polymer, would provide the requisite smooth surface for the part. During processing, however, several challenges arose, because HDPE's tendency to shrink considerably would lead to warpage in such a large plastic part. Working with this material therefore calls for specialist expertise and a high level of technical know-how along the process chain, from part design and mold construction to hot runner design through to injection molding.

Fig. 1. Fully wired 6-fold valve gate system (DS-40.200) including tubing for pneumatic control of the individual NK4 drive units

© Witosa

Challenges for the Mold Maker and Hot Runner Manufacturer

Barku had already laid down the injection points during the part design process. Using simulations, it worked with Witosa to locate the nozzles in positions that would allow the thick-walled part to be produced true to shape. The hot runner manufacturer had already used the filling simulation to calculate the optimum flow paths for the material. To ensure that the part would meet the desired level of quality without warpage, sink marks or shrinkage, the 6-fold valve gate system was balanced in such a way as to enable a cascade control system to »

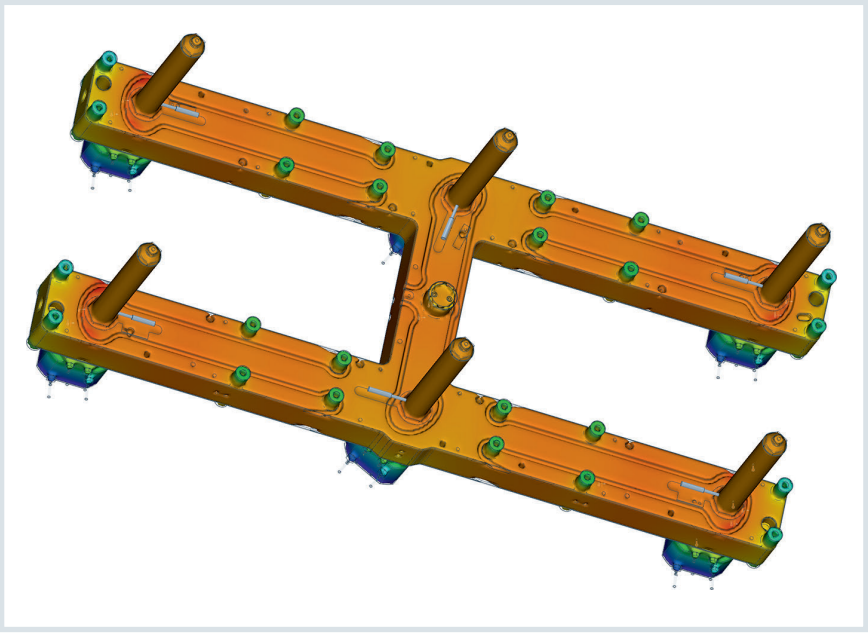


Fig. 2. Simulated temperature distribution of the hot runner system in the heated state © Witosa

actuate the valve gate nozzles via individual drives.

Andreas Stietz kept cycle times in production as short as possible and thus economical by paying particular attention to heat control in the mold, in addition to cascade control of the hot runner. The cooling circuits in the mold were incorporated in such a way as to allow individual temperature control of different areas. Furthermore, a Witosa motion controller (type: MC-0.18.16) was incorporated to regulate cascade control and improve cycle times. It offers a convenient way to program time-shifted opening and closing of the needles and thus enables optimum cavity filling.

Coated Needles for Process Optimization

Barku inspects all molds in Lower Saxony, Germany, before shipping. This also applies to the roughly twelve-ton mold for the floor grate. At the customer's request, a member of the application engineering staff and the sales manager from Witosa, Stephan Ochse, were on site for the mold trials.

The trials served to work out the final injection molding process. It was already apparent after the first shot that the part had several hot spots upon demolding and that the process, as expected, needed to be optimized. The trick now was to adjust the process so that the part would have an almost constant temperature over its entire surface upon removal from the mold. The cascade process for gating the part provided the necessary scope for making this adjustment. As the material also exhibits quirks during the manufacturing process and material buildup on the valve gate had to be avoided, Witosa used coated needles to help optimize the process.

Once the parties involved had completed each of their optimization cycles – Witosa worked on the hot runner system (**Fig. 2**), the regional mold maker on the mold and Barku's process mechanic on the injection molding process – it was now possible to define all the process parameters for cost-effective production of the floor grate.

Production in the USA

The single-cavity mold is in production about seven months of the year, with a high utilization rate, on an injection molding machine of 10,000 kN clamping force at Cleveland, TN/USA (**Title figure**). "People don't generally give a lot of thought to this clamping force," Stietz says. "Just to give you some idea: the floor grate is manufactured under a pressure of 1000 tons, which is equivalent to the weight of about 1000 Smart cars stacked one on top of the other." ■

The Author

Franciska Thomas works in the marketing department of Witosa GmbH Heisskanalsysteme, Frankenberg, Germany; franciska.thomas@witosa.de

Company Profile

Barnstorfer Kunststofftechnik GmbH & Co. KG was founded on October 1, 1977, as a subsidiary of Lubing Maschinenfabrik GmbH. Barku has long since become an autonomous and independent company with headquarters in Barnstorf, Germany, where it injection molds precision parts and extrudes profiles and pipes.

↘ www.barku.de

Aside from hot runner nozzles and hot runner systems featuring open gating or valve gates, **Witosa GmbH Heisskanalsysteme** offers control technology. The product range offered by this family-run company, which was founded in 2006, is developed and manufactured at the Frankenberg site in northern Hesse, Germany.

↘ www.witosa.de

Service

Digital Version

↘ A PDF file of the article can be found at *www.kunststoffe-international.com/archive*

German Version

↘ Read the German version of the article in our magazine *Kunststoffe* or at *www.kunststoffe.de*