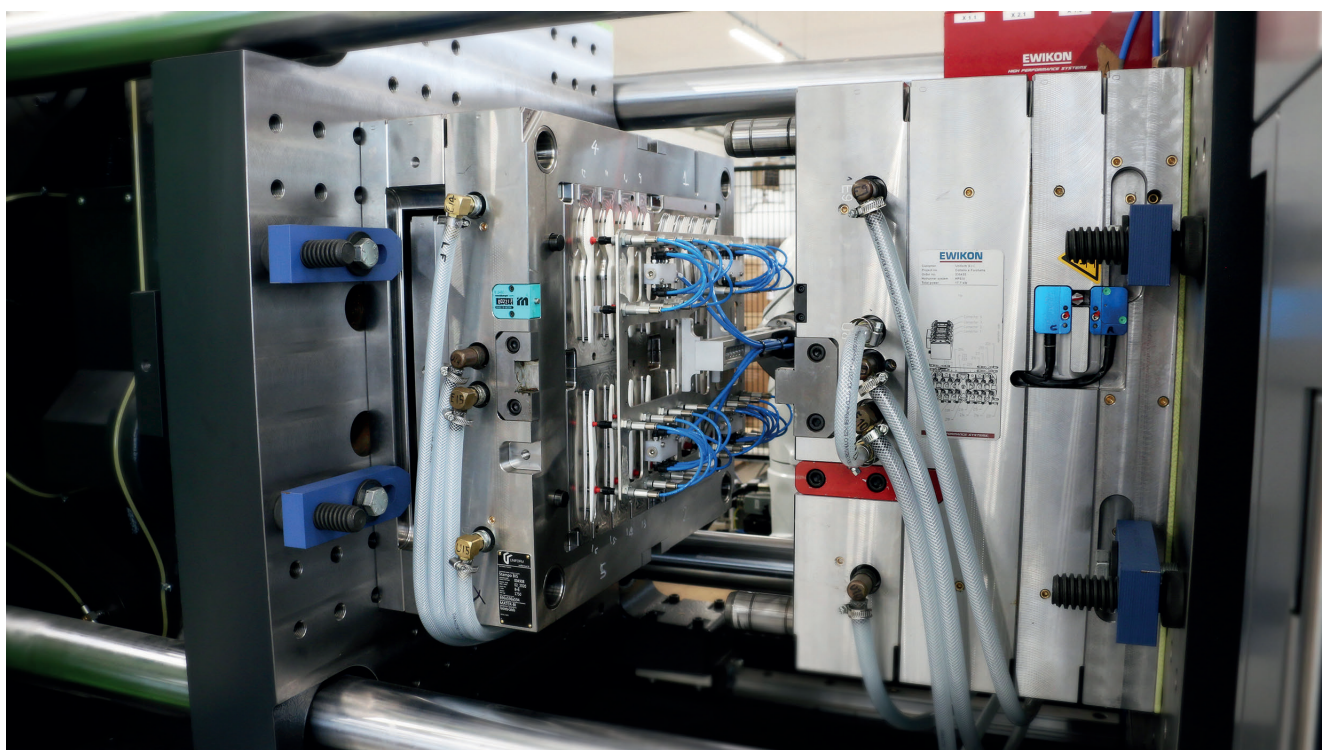


Process Reliability Is Crucial

Complete Digital Hot Runner Solution for Automated Biopolymer Processing

Ecozema is one of the leading brands for biodegradable and compostable catering products, such as tableware, cutlery or containers made of paper, compostable plastics and wood. For a cutlery series made of a new biopolymer, three full hot runner molds with digital process monitoring were developed in close cooperation with mold maker Uniform and hot runner specialist Ewikon.



The 16-drop family mold on the machine. The removal and packaging of the parts are fully automated © Ewikon

The project included a 16-drop valve gate family mold for the production of a complete cutlery set with knife and fork, another 16-drop valve gate system for a single fork and a 24-drop system for the production of an ice cream spoon (Fig.1). For all three tools, Ecozema planned full automation right through to the packaged product. Also included in the planning was comprehensive digital process monitoring. "Cost-efficient mass production while maintaining high hygienic standards are essential factors for being competitive in our industry," explains Antonio Munarini, managing director at Ecozema, "so it is important to have a high level of automation with

minimal human involvement and optimal process control."

Demanding Material Processed Safely and Automatized

With a multitude of already realized applications with biopolymers and an extensive database of material tests in the company's own technical center, hot runner manufacturer Ewikon has the necessary extensive knowledge for the safe processing of this demanding material family. During extensive tests, which toolmaker Uniform and Ewikon carried out together with the customer at the company's headquarters in Frankenberg, Ger-

many, various valve gate concepts were tested for their suitability for processing the compostable starch blend (type: Mater-Bi, manufacturer: Novamont). Due to the performance of the solutions presented, Ewikon was able to beat out international competitors.

In the case of the 24-drop ice cream spoon mold – originally designed for open gating – the decision was made to give preference to side gating after simultaneous tests with the HPS III-MH multi-nozzle concept (Fig.2). "The direct side gating solution proposed by Ewikon convinced us", says Antonio Munarini, "it is much more compact than a standard system and is also more cost-efficient



Fig. 1. The product: cutlery made of compostable biopolymer © Ewikon

with shorter cycle times and lower production costs'.

The two valve gate systems mentioned above are equipped with HPSIII-S hot runner nozzles with powerful direct heating and a flow channel diameter of 6mm. Valve pin actuation is synchronized by using plates with pneumatic drive, which are directly networked with the injection molding machine via position sensors, thus enabling a precisely coordinated injection process. To increase ease of maintenance, gate exchange inserts made of wear-resistant material have also been integrated. These contain the pre-fabricated gate contour and can be quickly changed individually for each cavity in the event of wear, without having to replace the entire mold insert. The 24-cavity system for direct side gating features six in-line HPSIII-MH nozzles in linear design, each with two melt outlets on the long side. These are positioned centrally between two vertical rows of cavities.

Rheological Balancing via Stepped Flow Channel Diameters

The first delivered and at the same time the most sophisticated system was the family mold for the simultaneous production of fork and knife, which not only have different shot weights but also significantly different geometries (**Title figure**). In addition to the automated removal of the articles by means of a handling system, the complete packaging is integrated into the process. After the fork and knife have been placed on a conveyor belt, they are picked up in pairs under camera control, automatically placed on a paper



Fig. 2. View of the contour plate on the hot runner side of the mold for the production of the ice-cream spoon. The parts are side gated © Uniform

napkin and finally packed and sealed. When developing the hot runner solution, the highest process reliability and uniform filling behavior therefore had top priority in order to minimize rejects and thus avoid malfunctions or downtime in the subsequent automation steps.

The balancing of the hot runner system with two horizontal rows of four cavities for knife and fork in each mold half was therefore of particular importance (**Fig. 3**). Two possible solutions were considered: a naturally balanced system with one synchronous plate each for the simultaneous actuation of all valve pins of one article type, in which the filling differences are compensated by a time-delayed opening, or a rheological balancing via stepped flow channel diameters, in which all valve pins are actuated by only one plate. After

carrying out extensive filling simulations and calculations at Ewikon, in which the material manufacturer was also involved, the decision was made in favor of the rheological version, which is more cost-effective in terms of mold technology.

Digital Process Monitoring Provides Transparency

To guarantee consistently high performance, Ewikon supplied the system with a complete digital package consisting of a matching 24-zone hot runner controller with external touch-screen operating unit (type: pro Control) and the Ewikon smart Control process monitoring and diagnostic unit. This unit is installed directly on the hot half (**Fig. 4**) and integrated into the Ecozema company network. It enables seamless recording and logging of all operating parameters of the hot runner system in real time (**Fig. 5**). In addition, it also monitors the temperatures of the mold plates, which have been equipped with thermal sensors for this purpose.

"For us, this is a very useful additional investment," says Riccardo Passuello, sales manager at Uniform, "especially for applications with such a high degree of automation, a high level of process transparency is important. With smart Control, Ecozema has an overview of the system performance at all times and, at the same time, a valuable tool for quality control in the process. In case of deviations, it is possible to react at an early stage – for example, by initiating maintenance measures – before a drop in part quality or an unplanned shutdown of the system occurs".

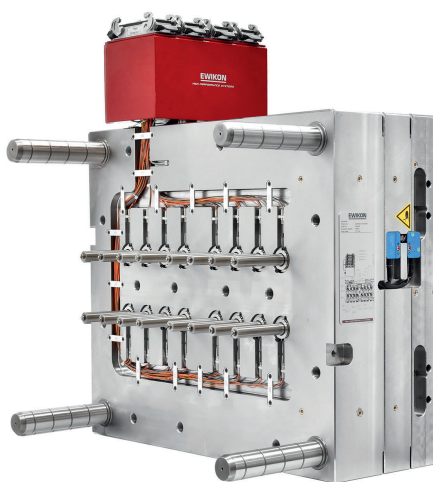


Fig. 3. 16-drop valve gate family mold for the production of knife and fork, delivered as hot half © Ewikon



Fig. 4. The compact smart Control process monitoring unit is attached to the wiring box in a space-saving manner © Ewikon

The second 16-drop valve gate mold and the 24-drop side gating mold were completed shortly after the family mold. Since automation with a handling system for fully automatic article removal and packaging is also used here, both molds are also monitored by digital "smart Control" units.

Start-up Delayed due to Pandemic

The family mold was put into operation for the first time at the end of January 2020. The good results in article filling confirmed the decision for the rheologically balanced variant. After the project had experienced some delays due to

the Covid-19 pandemic and the lockdown measures in Italy, the mold has been producing trouble-free in series for a few months, just like the two other molds, which produce alternately on one machine.

At the same time, Ewikon has already launched the second smart Control generation. It offers significantly enhanced performance features and can now be fully integrated into networked injection molding production via OPC UA. In addition to monitoring the hot runner mold, communication with the machine, peripherals and higher-level software systems is also possible and thus the recording and monitoring of all relevant injection molding parameters.

Furthermore, the optionally integrable "Virtual Rheology" function enables live simulation of the shear rates and the residence time in the hot runner system based on the material and geometry data stored in the system as well as the hot runner temperatures and injection parameters of the injection molding machine recorded for the current shot. This offers the possibility of targeted process optimization, especially when processing shear-sensitive or residence time-critical materials, and thus guarantees optimum part quality. Especially for processes that require a high level of safety, monitoring with smart Control represents a useful additional investment. ■

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Fig. 5. With smart Control, all relevant operating parameters can be monitored in real time, shown here by Managing Director Antonio Munarini © Ewikon