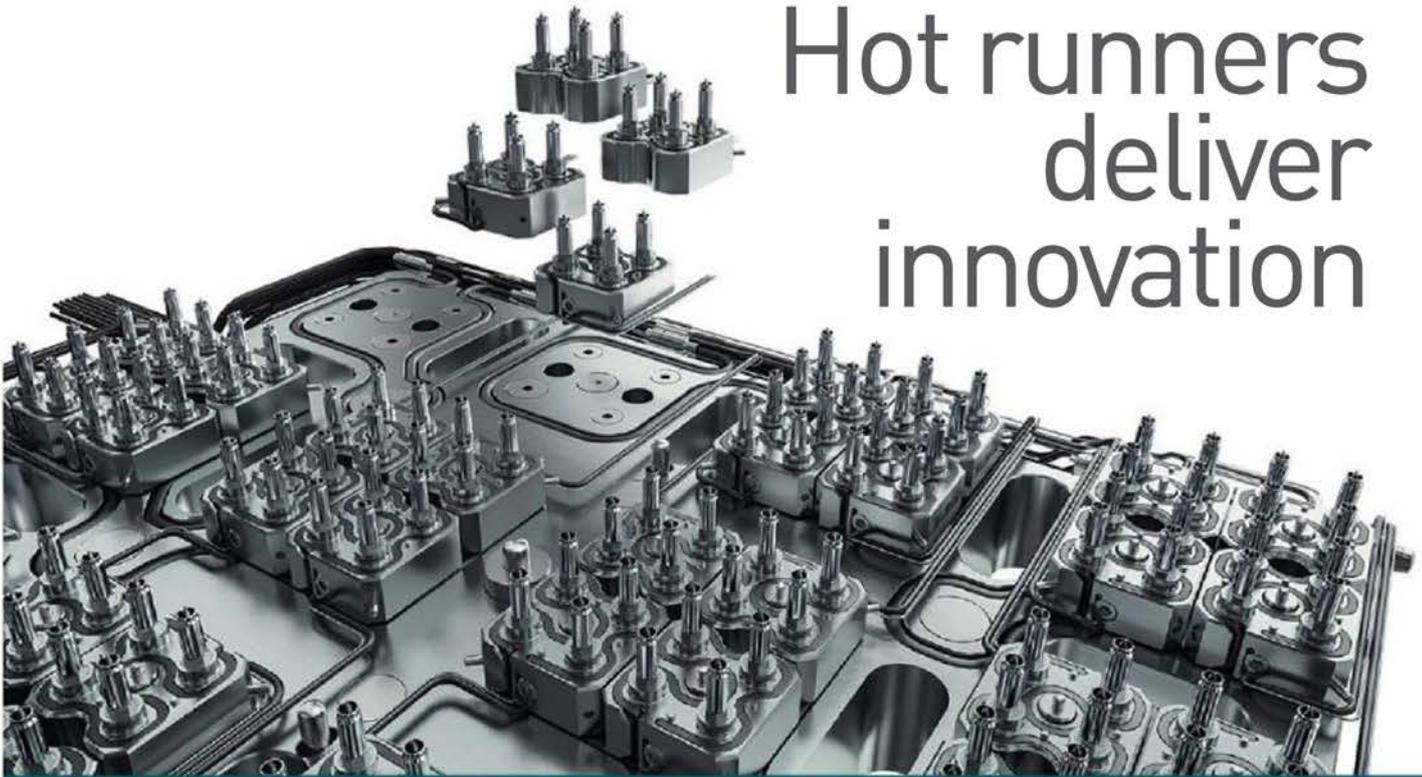


Hot runners deliver innovation



Hot runner technology can hold the key to more efficient injection moulding and higher quality moulded components. **Mark Holmes** rounds up some recent developments

High volume plastics manufacturing covers a multitude of industries but all face the same demands - produce more parts, more quickly, using less material and, ultimately, at a lower price. Melt delivery technology can help meet all those demands. As a consequence, hot runner system developers have been directing their efforts at developing equipment that enables part weight savings and shorter moulding cycles, supports higher cavitation and closer pitch, and can handle ever more challenging materials. This article takes a look at some of the latest developments.

Italian hot runner maker **Thermoplay** - which together with Männer Group, Priamus System Technologies, Synventive Molding Solutions and most recently Foboha sits within the growing Molding Solutions division of US-based Barnes Group - specialises in high performance hot runner systems with a strong place in high cavitation systems for applications such as packaging. Business development manager Chris Whitlam says it is a sector where every fraction of a second counts. That means analysing every detail of the moulding process to exploit all opportunities to improve performance. The company's R&D team, for example, is always testing new polymers for injection

moulding projects. Other priority areas of development include reducing the distance between injection points, and optimising heating and cooling of the system to produce parts at the highest levels of quality on the minimum cycle time.

Thermoplay's expanded small nozzle series includes the F Ø11. Designed for special applications in the packaging, medical, cosmetics and electronics sectors, the mini nozzle feature a small 13mm pitch and are now available in valve gate as well as thermal gate versions. The company says that the nozzles are ideal for use in applications such as cosmetic packaging where they allow injection on the 'inside' surface of parts with challenging access. The nozzle and tip arrangement is designed for low thermal dispersion, which gives the mould designer maximum flexibility in cooling system design, while uniform distribution of heat along the entire length of the nozzle means a low energy consumption (100W maximum per nozzle).

Valve gate actuation can be pneumatic or hydraulic, individual or plate actuated. Whitlam says the valve pin also offers 0.05mm increments of adjustment, allowing the gate vestige to be finely tuned. The pin itself is available in a cylindrical or conical option and is

Main image: Ewikon's micro manifolds use a modular construction well suited to high cavitation mould designs



Above: The F Ø11 nozzle is a 13mm pitch mini nozzle design from Thermoplay for multi-cavity applications in packaging, medical, cosmetics and electronics

designed to minimise the witness mark on the part (the company claims a gate area of between 0.8-1.2mm²). The F Ø11 valve gate nozzle series is available in lengths from 56-106mm as standard, with options for colour change and pin finishes available to optimise the design for specific applications.

Another Thermoplay development for the packaging industry is a new nozzle variant for applications where high injection speeds and pressures are the norm, such as production of thin wall containers. Whitlam says that additional crush seals are used at the face-to-face joint area between the nozzle head and manifold in order to optimise sealing performance at high pressure and to ensure an absence of leakage even when the system has not reached its fully thermally expanded state (such as in the case of an accidental cold start-up). A larger internal bore is incorporated to manage higher throughput rates, with a conformal cooling option available to improve thermal performance. Whitlam says that thermal exchange between the pin and cavity plate has been improved to achieve faster cooling of the gate area and better aesthetics at the injection point.

A sister company to Thermoplay within the Barnes Group, **Priamus System Technologies** has recently introduced FillControl Control V, an automatic valve gate controller for hot (and cold) runners. The company says that to balance hot runner moulds through the use of cavity temperature sensors, the melt flow in the individual cavities of a multi-cavity mould needs to be determined and then adapted and optimised via adjustment of the corresponding nozzle temperatures. If the pins in the valve gates can be positioned to manage the melt flow then multi-cavity moulds can be balanced without having to change the nozzle temperatures of the hot runners, with a resulting improvement in process control. This approach can be used to balance hot runner systems for thermoplastic materi-

als, as well as cold runner systems for injection moulding of LSR (liquid silicone rubber).

In the FillControl system the position of the melt front is detected in each cavity, allowing different fill times to be achieved automatically. The system calculates optimised settings of the pin stroke for each cycle, and transmits them to the valve pin controller.

Priamus has also introduced a mobile monitoring system - FillControl Monitor - that monitors cavity pressures to identify whether parts are completely filled or not. Additional conditions, such as fluctuations in process flow and viscosity, can also be automatically detected and monitored by means of cavity pressure and temperature sensors. By detecting the position of the melt front in the cavity, FillControl Monitor can be used to control switchover to holding pressure.

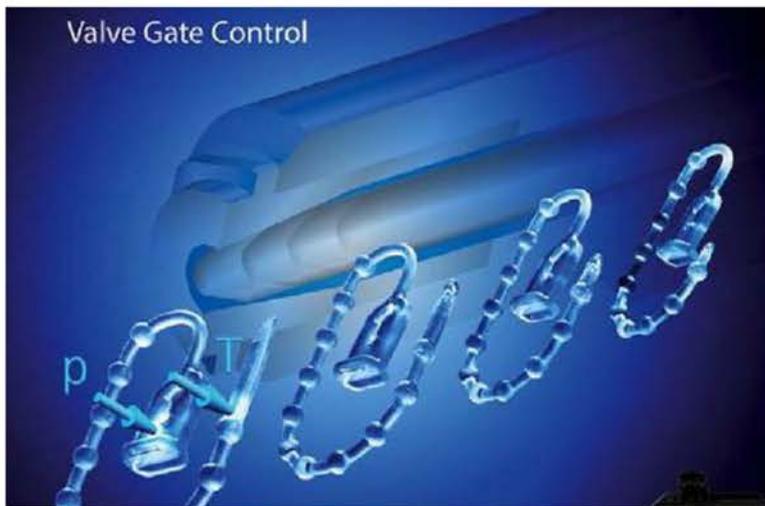
Synventive Molding Solutions, the first hot runner acquisition by Barnes Group back in 2102, has developed its SVG+ system to provide improved performance, efficiency and reliability in sequential valve gate 'cascade' moulding of large parts for industries such as automotive (cascade moulding delays the opening of individual valve pins in a multiple-gated part until the flow front has passed to create products without weld lines).

"With this new product launch, Synventive is poised to meet the future demands in the moulding industry," says Mark Moss, Executive Vice President, Business Development for Barnes Group's Molding Solutions. "Our modular approach provides efficient options to upgrade hot runner systems with additional technologies to realise the growing quality requirements of plastic parts."

SVG+ systems are equipped with new modular actuators and Synventive's SynCool3 technology, which provides indirect cooling of the actuators without the need for separate cooling lines. Claimed benefits



Thin wall parts such as this PS pot by Plastic Legno are typical applications for Thermoplay's new packaging series high pressure hot runner line



Above:
FillControl Control V is an automatic valve gate controller from Priamus

Right:
The Priamus FillControl monitor makes process monitoring portable

Right: **SVG+ from Synventive is designed for efficient and reliable sequential valve gate moulding of large parts**

include: the ability to preheat without damage to actuator or seals; elimination of the risk of clogged or leaking cooling lines; longer actuator seal life and reduced servicing requirements. The elimination of the cooling plate also means mould changes are faster, as there is no need to cool down the hot runner, while temperature uniformity of the manifold is said to be better.

A Valve Monitoring Interface (VMI) is included in the system to enable monitoring, diagnostic and troubleshooting. Outside of the moulding machine control, VMI is said to provide measured individual pin movement data and opening times, allowing operators to check whether the valve pins are moving as intended. SVG+ actuators are also equipped with sensors that enable a simple upgrade to the company's activeGate control technology.

ActiveGate provides precise control of each valve pin to regulate melt flow and pressure for the most demanding sequential moulding projects including filling family moulds. It is said to enable higher levels of dimensional stability to be maintained in tooling with complex geometries. Other claimed activeGate benefits include improved surface quality, increased production rates, clamp force reduction, lower scrap levels, and quicker start-ups.

Männer Group, part of Barnes Group since 2013, has developed its e-Plate system for moulding applications with large number of cavities and tightly spaced injection points. The company says the pin actuation plate is ideal for use with all-electric injection moulding machines where synchronised electrically-driven plate actuation is required. It adds that it is possible to

customise the movement profile with defined speeds and acceleration and to specify precise pin positioning through the e-control software.

The e-Plate system provides a direct, rigid connection from the drive to the pin. The company says this enables operation with no play, making it possible for the measuring system within the motor to monitor the pins continuously. This helps achieve high levels of part quality with maximum part-to-part consistency and accuracy, short cycle times, process precision and reproducibility, and wider processing windows.

The latest addition to the Barnes Group Molding Solutions business is the Foboha mould business, until earlier this year owned by the Swiss Advad Tech Group. The US firm paid CHF133m for the Germany-based company, which has sales of around \$75m and specialises in development and manufacturing of complex plastic injection moulds for packaging, medical, consumer and automotive applications, including Cube mould designs.

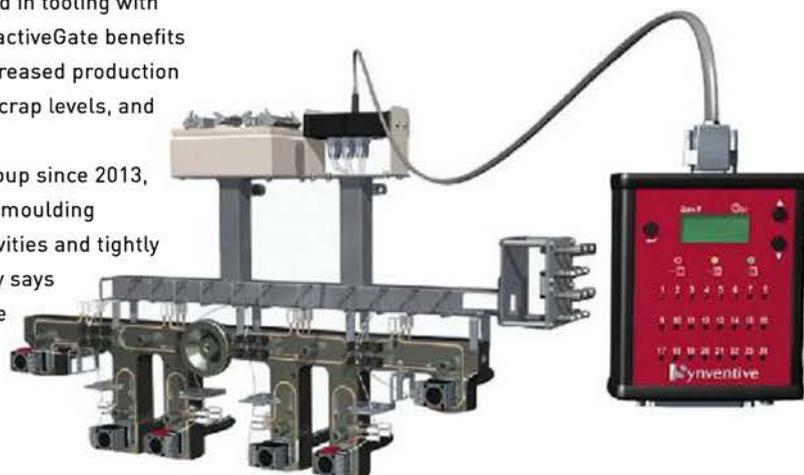


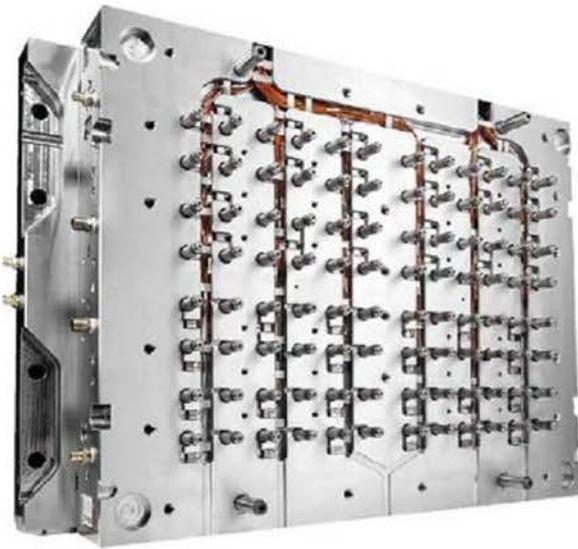
Robustness and longevity

Recent hot runner developments at **Milacron Mold-Masters** have been focused on enhancing performance, robustness and longevity. The

company says longer lasting systems are required today that need less maintenance and so cut downtime. In addition, solutions are required for new resins with more critical processing requirements. The company's latest Summit-Series hot runner nozzles, for example, offer four times less thermal variation from set-point compared with a typical nozzle with heater band.

The Summit-Series hot runner is built entirely from stainless steel, and is said to be ideal for moulding shear and temperature-sensitive resins such as PC, POM and PBT. The use of brazed in heaters with copper





infill results in a very good thermal profile, according to Mold-Masters Regional Sales Manager Eastern US and Canada Robert Glor, who adds that, although initially targeted at the medical sector, the Summit-Series design is proving attractive to packaging moulders.

Summit nozzles can also be ordered with the latest Mold-Masters servo-controlled valve-gate actuators, which allow for individual speed, time and position control of each valve pin in the mould. The Summit-Series is clean room-ready and is said to be a very good hot runner option for moulders looking to reduce risk and optimise moulding process parameters with minimised variance and strong, repeatable results.

Large part options

Mold-Masters has also introduced enhanced features to its Fusion G2 series for automotive and large-part moulding. The company says an extended nozzle length range now provides more flexibility while a compound nozzle can be used to avoid interferences with cavity cooling lines and to position nozzles in tight pockets. Fusion G2 is now available with valve pin open speed control and position monitoring to enable improved gate finishes. Options for extra-extended gate seals are now also available, as are high performance water-cooled gate inserts plus some additional new polymer-specific gating options.

The company has also revisited its Sprint hot runner brand for the closure industry with a new line of colour changing tips, which are claimed to reduce colour changeover times by up to 47% compared with standard gate tips. The new tips are available as a standard package for all Sprint systems and are suitable for direct replacement of current tips.

Closure production is also a target market for the Slim-Stack compact valve gate manifold design for stack mould production. "Typically in a stack mould

valve gate you either have to stagger the nozzles or build it up as two separate systems. What we are doing [with Slim-Stack] is use our Accu-Valve system, which has all of the actuation at the front, and put it up against a single manifold plate," says Glor. The system can reduce the height of a stack by up to 40%, allowing moulds to be used on smaller machines in some cases. "It's an early-on product at the moment but we have a few 32 and 48-drop stack systems in the market."

Meanwhile, the latest developments for the Dura+ hot runners for automotive lens and lighting applications focus on part quality and flexibility. New angled manifold designs are claimed to make installations easier and reduce the cost of mould machining while additional gating styles and valve pins improve the flow profile for better gate quality. Also new is Velocity LS (Light Speed), a configurable 1-8 drop hot runner system built around the Master-Series nozzles. It is claimed to offer high performance and fast delivery time at competitive price.

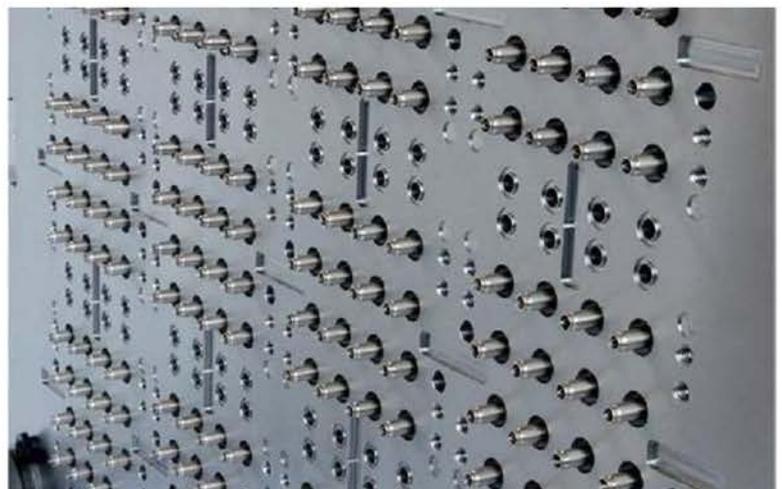
In the control sector, Mold-Masters has responded to the growing complexity of mould designs with the introduction of the M-AX version of its TempMaster control. This combines the standard temperature control functions of the TempMaster hot runner control system with the ability to control up to eight servo-driven linear or rotary movements. The company ran a demonstration M-AX unit at K2016 driving six servos. "In the medical industry they are going away from hydraulic core pulls for a number of reasons. One, it's cleaner, but it is also much more precise," says Glor.

The M-AX unit can control valve stems, core pulls, coining plates, index plates, stripper plates and ejector plates as well as driving Mold-Masters technologies such as E-Drive plates and Single Electric Valve Gates (SeVG).

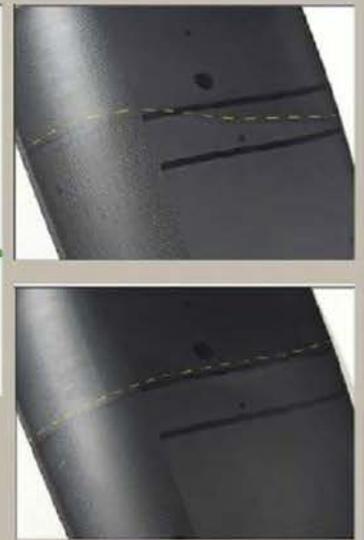
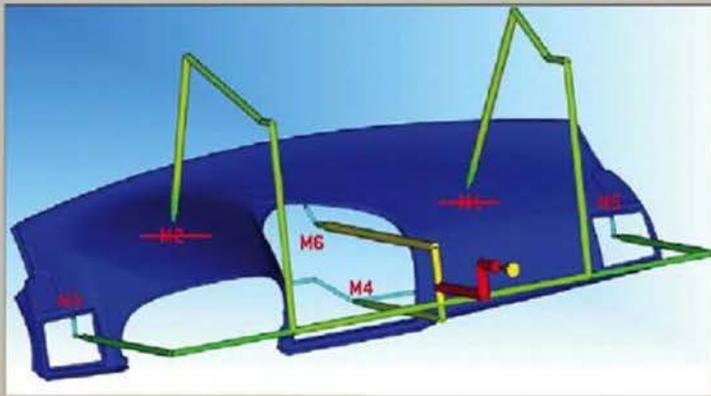
Evikon's micro-manifold technology is described as a new standardised solution for production of polyolefin

Left: Summit-Series hot runners from Mold-Masters are claimed to offer four times less thermal variation than typical heater band designs

Below: Evikon's micro-manifold system is designed for high cavitation moulding of polyolefin parts



The FLEXflow system from HRSflow is designed for weld line management. This example shows how a car dashboard, originally sequentially injection-moulded with six hot runner gates, was filled through only four gates (M3 to M6) using the technology. In the original set-up, the two flow fronts (one starting from M3-M6-M4 and the other one from M5) formed a weld line that was uncontrolled in terms of its shape and position (picture top right, yellow-dotted line). Using FLEXflow control of the valve pins, the weld line becomes straight by simply throttling valve gate pin M6 (picture bottom right) and its position can be moved.



parts with small shot weights in high cavity moulds. Target applications include the packaging and medical industries, where the technology is already successfully being used in moulds with up to 192 cavities.

The balanced micro-manifolds feature four screwed-in heat conductive tip inserts - each with a flow channel diameter of 3mm and a melt seal at the gate. According to Ewikon, a fully balanced flow channel layout is achieved by placing a main manifold on a second level. Four gates only require one heating circuit, which reduces control technology complexity and cabling. As a result, space is freed up in the manifold to integrate additional support sleeves or domes into the plate.

Compact solutions

The company claims that micro-manifold technology mould designs are more compact than conventional multi-cavity mould layouts. In addition, tip inserts can be exchanged easily after removing the contour plate without the need to dismantle the manifold system. Ewikon offers complete hot halves with micro-manifold technology as 16, 32, 64, 96, 128 and 192-drop versions with standardised dimensions built up as clusters of four micro-manifolds. The micro-manifolds are produced in three versions with different lengths of electrical connection. All feature an integrated cooling supply.

HRSflow, the hot runner division of INglass SpA, has developed its FLEXflow technol-

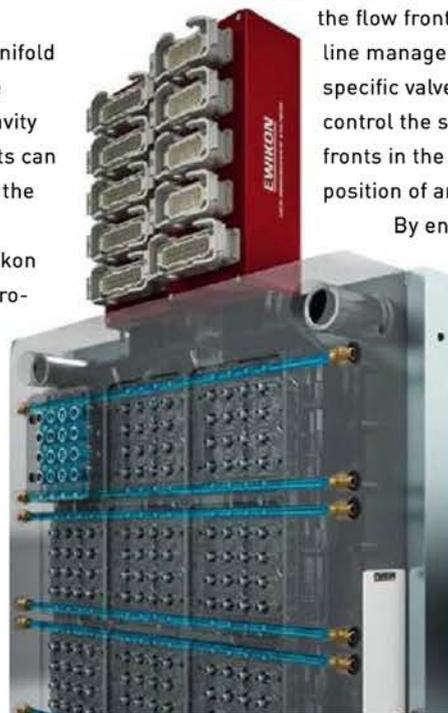
ogy for injection moulding of complex, large parts in multiple-gated and multi-cavity applications. Particularly suitable for cascade moulding, FLEXflow is a servo-driven regulated valve gate system that the company says has demonstrated surface quality improvement in production of large-format visible parts, especially with respect to weld line management. It has also shown quality improvements in production of thin-wall transparent headlamp lenses.

According to the company, FLEXflow allows precise, sequentially coordinated opening and closing of the valve gate pins with selectable profiles and velocities. This permits accurate control of the flow rate in each individual hot runner nozzle and, as a consequence, the flow front in the cavity as a whole. In weld line management, for example, throttling back specific valve gate pins makes it possible to control the shape and progress of the flow fronts in the cavity to modify the form and position of any resulting weld lines.

By enabling a more gentle opening and shutting of the valves, the pressure loss that often occurs with conventional cascade injection moulding through the abrupt on/off switching of the hot runner nozzles is avoided, says the company. This also helps to prevent flow marks on the moulded part.

The more even pressure distribution on the part that can be achieved through optimised position and speed control of central and peripheral valve

Right: Ewikon micro-manifolds feature standardised electrical cabling and an integrated cooling supply



Right:
VarioShot is the latest hot runner nozzle line from Hasco

pins means the application of FLEXflow technology can also lead to a reduction in clamping force as well as material savings through eliminating the need to over-pack the cavity. In automotive applications, this can be particularly beneficial in production of large-area exterior and interior parts such as bumpers, spoilers, instrument and door panels, roof frames and also lighting and glazing parts such as headlamp lenses and roof panoramic panels.



Thermal optimisation

Other recent HRSflow developments include the ECOflow thermal management system, which is claimed to reduce energy consumption by around 20% compared with conventionally designed hot runner manifold systems, and an expansion of the Multitech (MTR) hot runner nozzle line for multi-cavity moulds.

Aimed at applications in the medical, electrical and electronics, and automotive industries, the expanded MTR hot runner nozzle is available in three specifications: MTR-T, MTR-M and MTR-S. The MTR-T nozzle is specifically designed for the injection moulding of large containers with wall thicknesses from 0.45mm and a flow length to wall thickness ratio of up to 350. Injection pressures up to 2,200 bar and melt throughputs up to 180 g/s can be attained. The company says this hot runner nozzle is suitable for decorative injection moulding using the IML process (In-mold labeling). MTR-M nozzle offers advantages in the injection moulding of polyesters to produce thick-walled parts with a high-gloss finish. When used for cosmetic packaging, household articles or in medical technology, wall thicknesses of 20mm and more can be produced. The MTR-S type has also been developed for thick-walled parts up to 20mm, but is geared specifically to the injection moulding of DuPont's Surlyn, crystal-clear ionomer resin.

Husky Injection Molding Systems recently expanded its hot runner line with the launch of the Ultra Helix 350 valve gate, which it says offers near zero gate vestige and virtually eliminates mechanical wear on valve stems and cavity steel. "The gate quality of the Ultra Helix nozzles continues to impress many of our custom-

ers," says Stefano Mirti, Husky President of Hot Runners and Controllers. "The addition of the 350 valve gate demonstrates our commitment to bring industry-leading performance to an even wider audience."

The Ultra Helix design provides a very high level of stem to gate concentricity, which reduces wear, while a new heater design is said to provide a highly consistent thermal profile. According to Husky, the consistency and performance of the nozzles decouples short shot balance from nozzle heater performance, eliminating the need for balance changes when replacing a heater.

Hasco has also been working on its hot runner line-up, with the addition at K2016 of the Vario Shot nozzle series, designed to provide a compact mount, optimised temperature control, and ease of servicing in a modular design.

Vario Shot nozzles can accommodate depths of up to 300mm and can be used to process engineering and reinforced plastics with shot weights up to 2,000g. The nozzle is designed so that heaters and thermocouples can be replaced without removing the nozzle tip. Other features include durable wear resistant alloy torpedo tips with flow-optimised geometry.

The company has also introduced a new simple hot runner controller for one or two zone applications. The H1250 offers self-optimising control and soft start functions while LED displays present setpoint and actual temperatures, control parameters and error messages, and alarm diagnosis. Additional features include boost and standby function and automatic monitoring of the sensor and heating.

Click on the links for more information:

- | www.thermoplay.it
- | www.priamus.com
- | www.synventive.com
- | www.maenner-group.com
- | www.BGInc.com (Barnes Group)
- | www.milacron.com (Mold-Masters)
- | www.ewikon.com
- | www.hrsflow.com
- | www.husky.co
- | www.hasco.com

Below:
HRSflow's MTR nozzle family includes designs for thin-wall injection moulding and production of thick-walled parts

