Combining Injection Moulding and Extrusion Technology

Barbara Schulz

Called the Flat Die Unit (FDU), this hot runner system passes melt through a long slit instead of a circular hole like a conventional nozzle. The result is said to be faster injection of more melt through a thinner gate opening, with lower shear and injection pressure, as well as lower melt temperature.

Source: Schulz

A thinner gate opening for faster cycle times.

There have been numerous incremental advances in hot runners over the last years, the latest is from FDU Hot Runner GmbH, Frankenthal/Germany, which has developed an open hot runner nozzle shaped like a sheet extrusion flat die. The FDU (Flat Die Unit) was originally a development synergy project of Haidlmair Group companies under the leadership of the Haidlmair Research & Development department. It combines the benefits of the injection moulding and extrusion technology. It passes melt through a long slit (there are currently three different sizes available) instead of a circular hole like a conventional nozzle. The result is said to be faster injection of more melt through a thinner gate opening, with lower shear and injection pressure, lower melt temperature, and up to 25 % faster cycle time in several projects.

According to Andreas Kißler, CEO of FDU Hot Runner, an independent company dedicated to the development of FDU hot runner solutions, the FDU is particularly suitable for the use of engineering plastics including polyolefins and Polyamid 6. "However, recycled plastics have also been used in some projects," Kißler says. "Due to the wide slit in which the melt flows over a triangular shape into the mould larger particles in recycled materials can more easily pass than in conventional systems."

Handling more melt volume with reduced shear rate

The special nozzle is particularly suitable for large parts because it can handle more melt volume with less shear than conventional systems, which are round and according to Kißler are available with a maximum diameter of 10 mm because the heat needs to be dissipated to ensure precise temperature control of the molten plastic to avoid degradation.

"To achieve the same amount of molten material flow through the nozzle, you need a 10 mm diameter in a round conventional system for a cross-sectional area of 50 mm². We realise the same cross-sectional area with a slit of 25 mm x 2 mm. The advantage is that we are only 1 mm away from the cooling cavity wall, while the center of the round nozzle is 5 mm away, which limits the design in terms of size to realise adequate cooling."

Nozzle sizing is important for maintaining sufficient molten material flow or injection rates, especially for moulding parts with low wall thickness or unfavorable flow distance/wall thickness rela-

tion. "We simulated the moulding of a popcorn cup, for instance, which exhibited a flow distance of 285 mm and 0.75 mm wall thickness, which according to the Mouldflow software simulation was not possible using conventional open round nozzles. Our system managed to keep the required injection rate into the cavity because of the higher volume flow rate."

FDU ensures a more even pressure distribution

In order to increase the density of plastic to compensate for the shrinkage after the mould cavity has been filled with plastic, pressure holding is necessary to continue to exert pressure to the melt plastic.

"In the holding process, the plastic flow rate is very low, so the flow is no longer a leading role here; pressure is a main factor affecting the packing process," Kißler says. "In the holding period, due to the high pressure, the plastic part can be found to be compressed locally. In the area of high pressure, the plastic is more compact, so the density is higher. While the pressure is lower for some other places, the plastic is loose and the density is lower. So the density distribution changes with position and time. Our special design of our flat die unit ensures a more even pressure distribution."

Another advantage of the FDU's design is said to be the avoidance of free jet formation at the gate ("sausage injection moulding"), which occurs with rising injection speed and results in non-uniform mould filling and surface faults. If assistance cannot be provided here by suitable mould design, the machine must be operated at a low injection speed.

Flat die unit vs. conventional open round nozzles

Kißler describes several comparisons of moulding parts with the FDU vs. conventional open round nozzles.

In one case, an FDU 25 mm long x 4 mm wide provided 3.6 times the flow volume of a 2.5-mm round nozzle with approximately equal shear rate. Because the FDU gate is only 2 mm wide, it allows for faster gate freeze than the round nozzle. In another case, one FDU molded a 500 g polypropylene (PP) part with the same fill rate and shear rate as two 6-mm round nozzles, but at 5-10 % lower cycle time.

Kißler claims that the lower shear provides less stress on the melt and more uniform fill temperature than conventional nozzles. One example he mentions is an injection-molded toolbox, illustrating the more uniform fill temperature distribution and as a result a 25 % cycle time reduction.

Another example involves the manufacture of a box for meat transportation, where the FDU-moulded the part with a 17 % reduced cycle time compared to a valve gate system and a 200-bar reduced pressure. In another case, a pallet made from PP (MFI 15g/10min) was injection moulded with an FDU with an injection pressure of 700 bar (specific), injection time was 3.6 seconds, holding pressure 5 seconds, resulting in a claimed cycle time reduction from 58 to 42 seconds.

www.fdu-hotrunner.com

About

A core component of Haidlmair's philosophy is to think outside the box when it comes to its projects.

www.haidlmair.at

Info

FDU will be represented at the Moulding Expo. They will be part of the VDWF's joint stand.

www.messe-stuttgart.de