Cycle time is money

HASCO –
innovative ideas for our customers

8-cavity mould for sealing caps, featuring state-of-the-art technology

"Cycle time is money" is especially true in injection moulding where manifold moulds are in permanent operation. Reducing cycle times has a considerable influence on the price of the final article and thus on the competitiveness of the supplier. Through the consistent use of the very latest innovative techniques, HASCO has succeeded in exploiting additional potential for lowering cycle times.

HASCO®

The project

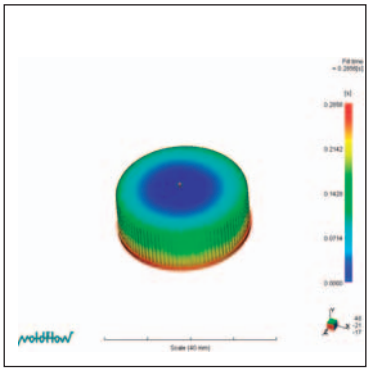
The idea for the project came about in talks with one of the world's leading packaging and closure manufacturers – HASCO's customer "Berry Plastics" in the United States.
Driven by the tough competition in this segment, the search for new innovative solutions is absolutely vital and it requires a certain amount of courage to abandon historic procedures.
Together with the firms Arburg in Loßburg, Germany, and GWK in Kierspe, Germany, HASCO has developed a mould concept that exploits to the full all the remaining potential for optimising cycle time. The injection moulding process can be broken down into the following sub-processes: injection, holding pressure, cooling and metering, and ejection of the article. It was only by utilising to the full the resources in each one of these sub-processes that a significant cycle time reduction was possible.
The injection and holding pressure phases are governed by a needle valve nozzle specially developed by HASCO for the processing of polyolefins. It optimises the time factor through active opening and closing of the gate.

The thermal behaviour and the heat flow balance of the process were subjected to a very thorough analysis, and the results were transferred to the mould concept. The thermodynamic calculations and the optimisation of the moulding tool were performed using the simulation software EFD (Engineering Fluid Dynamics) from the firm Nika GmbH in Frankfurt am Main. An optimum cooling time for the article was achieved through the close-to-cavity mould temperature control system from the firm GWK.
A major issue in the production of sealing caps as far as cycle time is concerned is the demoulding of the thread. Usually this is done by screwing out the thread mechanically, but, by opting for collapsible cores, HASCO has again chosen a rather unconventional route that saves a considerable amount of time when demoulding the article. The opening stroke is converted directly into a translation motion.

"HASCO HOT BASE" – The project management team

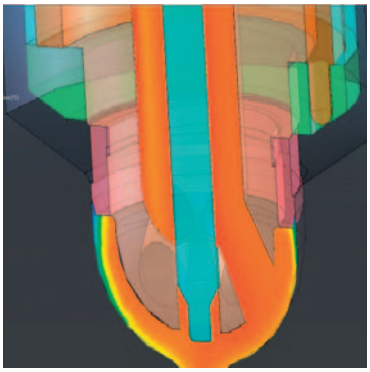
The development of the 8-fimpression sealing cap mould – like most new injection mould tools – necessitated the coordination of many specialised processes. The HASCO HOT BASE team once again excelled, and made a major contribution to the project's success. Thanks to the team's enormous experience, it was possible to have a functioning mould on the machine only 14 weeks after the first idea, even though a large number of simulations had to be carried out beforehand.

A lot of the work was performed in parallel through central coordination, and this helped to save a considerable amount of time. The consistent use of all the saving potential through the project management team made it possible to keep within the time frame and the financial budget.



Mould flow calculation


Sampling in the technical service department


FEM calculation

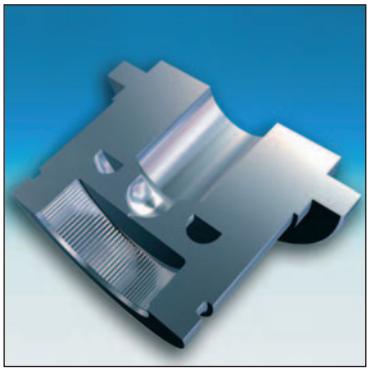
Mould cooling

As mentioned, the cooling time is one of the main factors influencing the cycle time. It begins with the injection process and ends when the mould is opened. Within this time, the article must be cooled down to the demoulding temperature. The heat introduced through the plastic is for the most part dissipated again via the cooling media. So that the heat dissipation from the article is not hindered through the heat introduced by the hot runner, mould inserts with a close-to-cavity cooling device were designed to provide for thermal separation between the hot runner and the mould. The heat introduced via the front titanium nozzle seal is dissipated directly from the mould with the aid of the insert cooling near the cavity. The mould insert, produced by vacuum fusing, consists of several parts but, after the soldering process, has the same mechanical properties as if it were made of one piece. The quality of the jointing surface was tested by ultrasound. To check the seal, a high-pressure test was carried out with water and the throughput volumes per cooling cycle were also measured. The firm GWK is able to provide complex geometries with this close-to-cavity cooling system, which, compared with a conventionally drilled hole, offers cycle time advantages of up to 30 % as well as quality improvements in the article itself.
The ante-chamber inserts are connected to a separate cooling circuit, which allows the injection and holding pressure behaviour and thus also quality characteristics such as flow behaviour, colour change, needle temperature and gate vestige to be influenced independently of the rest of the temperature control system. A separation of the cooling circuits in accordance with the heat flows allow the temperature profile of the mould to be specifically influenced and thus achieve an optimum cycle time and part properties. With the collapsible core mould, two powerful cold-water cooling units teco CW25 from GWK and eight itd® control modules were used directly on the machine. To achieve optimum results, it was absolutely essential to perform an accurate thermal mould calculation.

Demoulding with the HASCO collapsible core technology

As already mentioned in the introduction, the demoulding of threads plays a key role in optimising the cycle time. It is important to achieve higher speeds and shorter strokes. With the conventional unscrewing technique, the mould opening stroke is converted into a rotational movement with the aid of a gear transmission. The transmission has a relatively large inertia and transmission of the direction of motion necessitates slower opening strokes.
The deployment of spring elements was not possible because of the required high shot numbers in combination with the fast movements. The service life of these elements decline dramatically with the number of load changes and the stress rate. Should the elements fail, it can have catastrophic consequences for the mould.
The proven HASCO Z3600/… collapsible core technology used in the mould combines the extremely reliable controlled-movement dovetail guides with the advantages of less moving mass and shorter opening strokes. The cores are produced with a Balinit C coating from the firm Oerlikon/Balzers. The excellent wear/slip properties of this coating ensure a long service life of the moving parts and thus leads to


Connection block cooling


Temperature-controlled insert


HASCO collapsible core

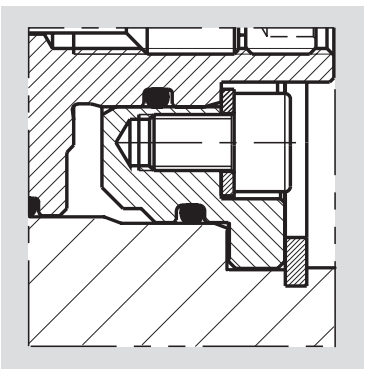
a reduction in maintenance costs. As far as cooling is concerned, the external segments of the collapsible core play a key role in heat transfer. The heat introduced through the plastic must be conveyed to the cooling channels via the contours. To achieve optimum efficiency here, the external elements are provided with special heat-conducing pins that convey the introduced heat to the cooling circuit. The central core is provided with intensive cooling, which can absorb and dissipate a large volume of heat via the large sliding surfaces of the moving parts. Through these design measures, it was possible to achieve optimum cooling of the demoulding mechanism.
All these actions together result in a considerable improvement in cycle time compared with the conventional technique. HASCO has thus succeeded once again in generating optimum customer benefit through the consistent utilisation of all synergy effects.

The hot runner concept – Optimisation of the filling and holding pressure phase

The combination of high-speed moulds and the processing of polyolefins makes particular demands on the opening and freezing behaviour of the gate, especially when the cycle time is so important. The new HASCO needle valve nozzle Z3145/… Valve Shot was designed specifically to satisfy these demands.
The needle valve nozzle enables active opening and closing of the gate, which has a positive effect on part quality and mould wear. The uniform filling of the cavities (provided a balanced runner is used) has a positive effect on the wear of the mould because there is no one-sided loading of the mould and the amount of variance in the dimensional stability between the individual cavities is reduced because the holding pressure phase begins at the same filling level. Optimum transmission of the holding pressure is ensured, and stringing is reliably avoided.
The permanent valve stem guidance close to the gate ensures a minimum stroke and precise insertion of the needle into the gate. This reduces wear to a minimum and extends the intervals between maintenance. Through the cleverly designed gate bubble geometry, very fast colour change is possible. Due to the special arrangement of the outlets, static material at the gate is avoided. The flexible heating elements allow rapid exchange of the heating units without dismantling the hot side.
Should one or more cavities fail, the pistons can be fixed in the front position and the nozzle switched off. Ongoing production can then be run to the end without the need to remove the mould from the machine.
For clean-room operation, the mould can be converted at any time to the tried-and-tested electromagnetic HASCO Z1081/… drive. The drive system creates no contamination whatsoever.

Z3145/… with Z10750/…

Monitoring with the Z12931/…



Locking possibility of the piston

The control technology

Nozzles with a low heat capacity in conjunction with a high energy input through friction require a control system that is geared specifically to the nozzle type. This is why the HASCO Z1293/… control unit was used for this project, because it offers particularly fast control for nozzles with small mass and optimum response. Because the nozzle and control algorithm are aligned to each other, there is no risk of the nozzles drifting, resulting in a stable injection moulding process.

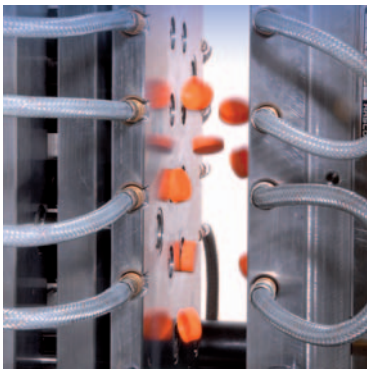
The maximum output of 3,600 W for each control circuits guarantees perfect flexibility both for operating small nozzles and for manifolds. The cards can be reached easily for maintenance from the front of the unit and can be readily exchanged through an innovative plug system.

Outstanding value for money makes the Z1293/… an attractive control unit for this particular application. The interface to the data read-out unit Z12931/… allows full process monitoring and documentation as well as quick response to process fluctuations in conjunction with statistical process control. This is especially important with such sensitive processes as the mass production of packaging components. The recorded data are held in ASCII format and can be integrated without problem into other applications.

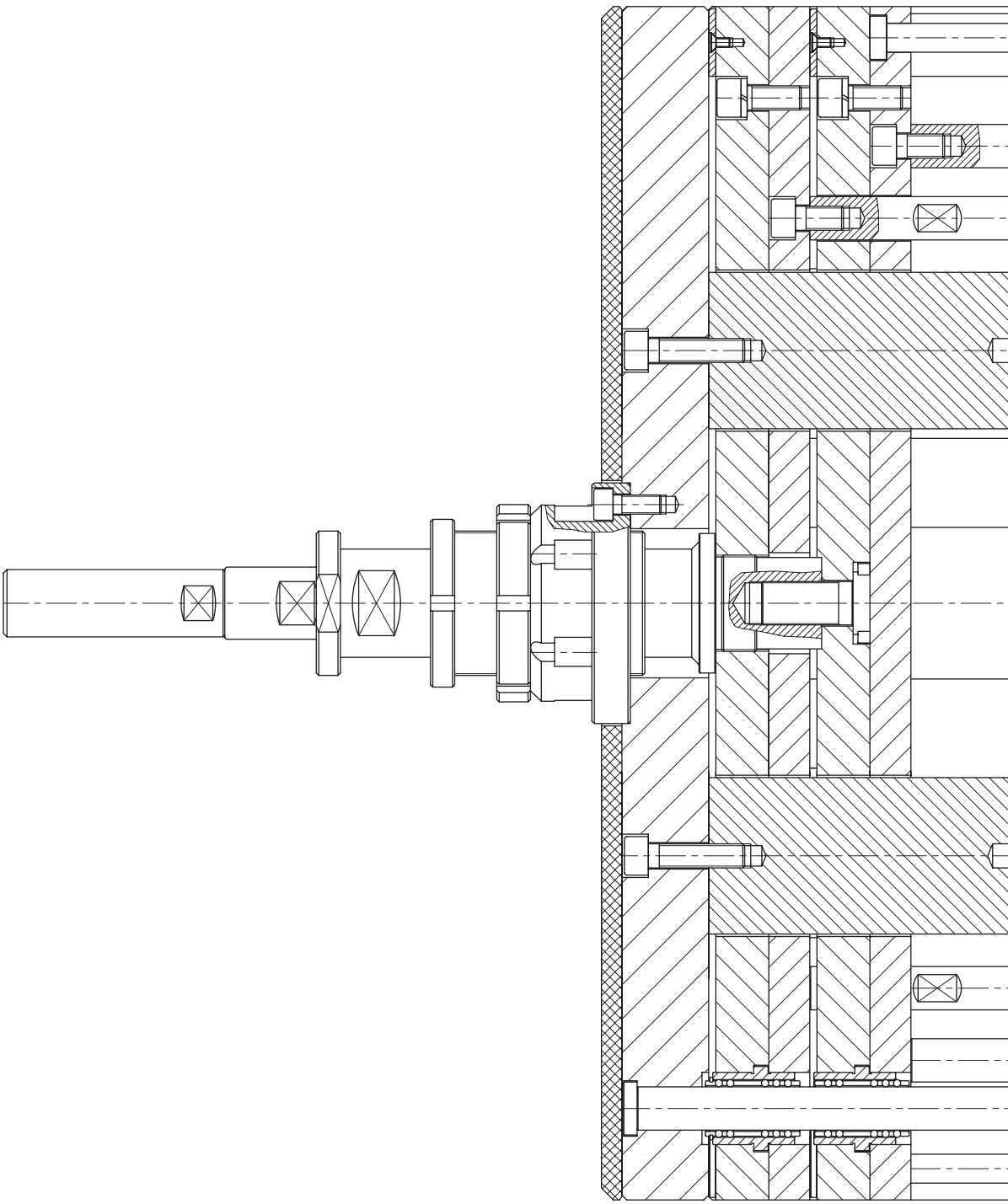
Conclusion

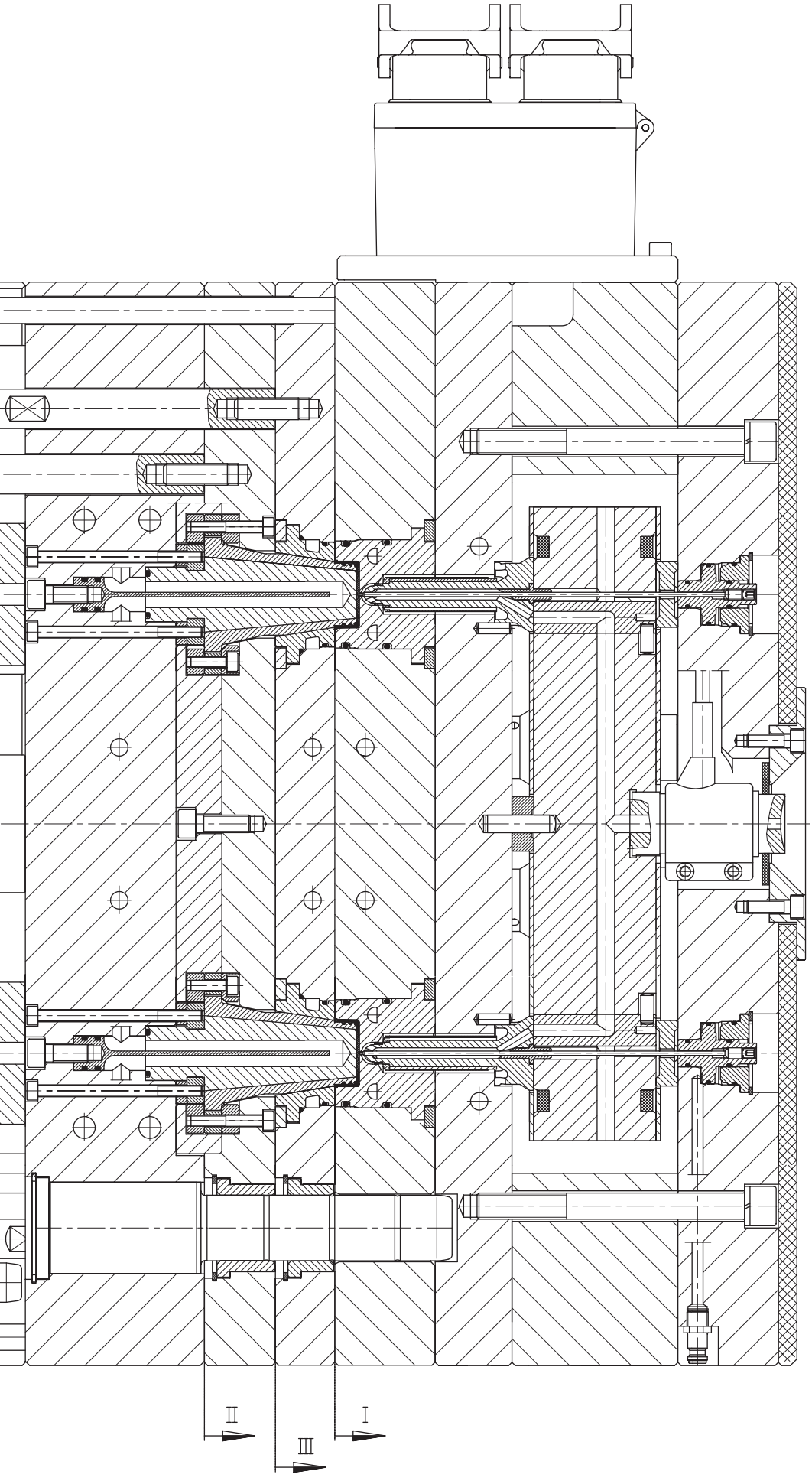
The outstanding cooperation between all the partners and the management of the HASCO HOT BASE team has shown that it is possible to further optimise existing processes and fully exploit all the remaining potentials. The innovative mould concept allows the cycle time to be improved by up to 50 % compared with existing concepts and thus leads to significant reductions in the cost of the final article. The project will be presented to the public for the first time at K 2007.

- Cycle time reduction of 50 %
- Trouble free start-up
- Easy restart
- Outstanding product quality
- No flash from over pressured cavities



Eight-cavity mould




II
III
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