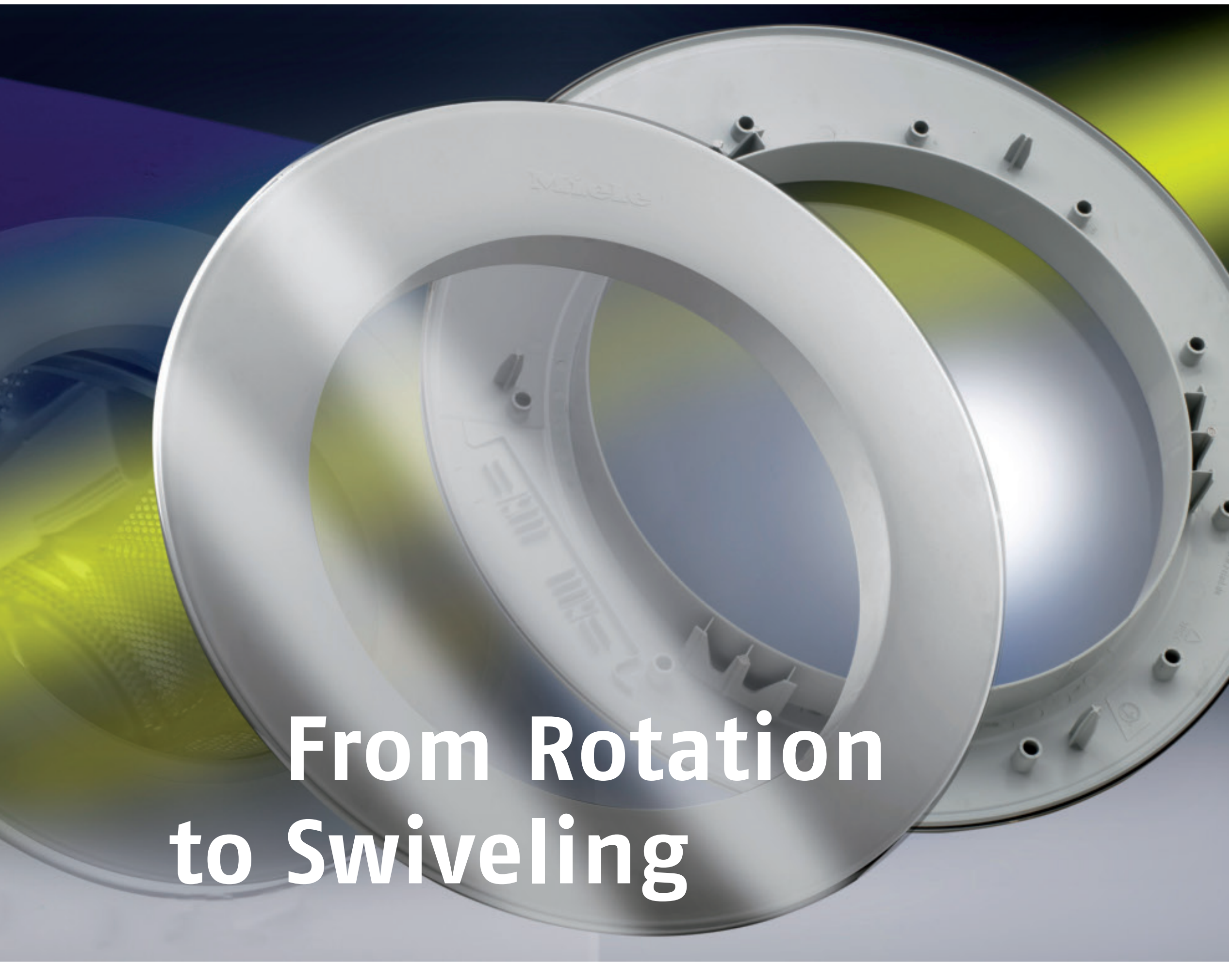

A PC washing machine door: for production, swivel-platen technology was combined with injection-compression molding (all pictures except figure 5: KraussMaffei)

From Rotation to Swiveling

Swivel-platen Technology. SpinForm technology can improve multicomponent injection molding, doubling output for the same clamping force. It also allows additional operations to be integrated without lengthening the cycle. Swivel-platen technology has already successfully replaced existing rotary table applications in a number of production operations.

ANDREAS HANDSCHKE

International competition sets difficult conditions for plastics processors. For successful market development, it is often necessary to use new or flexible technologies in order to satisfy often contradictory criteria, such as cost pressure, increasing quality requirements or design preferences. Under these circumstances, multicomponent technology, with its track record of over 40 years, is increasing in importance because of its many advantages.

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The Rotary Table is a Hindrance

The part geometry determines which mold technology is to be used in production. A typical mold solution for many two-component moldings is the rotary table. However, in practice, it poses certain restrictions:

- The substrate and part lie on the same side of the mold, so that only 50 % of the area is used for production of the part.
- The tie-bar clearance of the injection molding machine, within which the mold is rotated, limits the mold size, particularly in the case of large molds with many ancillary units.
- The tilting torque that generally occurs during rotation about the horizontal axis increases with the mold size and limits the size of rotary tables to 1,600 to 2,000 t.
- The size of the rotary feedthrough on the moving platen is limited by stability considerations, which restricts the fluid feed.
- There are problems with achieving thermal separation of the rotary unit from the rotary table.
- Separate injection-compression molding – only the first component or only the second component – is impossible.

The swivel-platen technique allows a 2-component process to be made more flexible and efficient. It is based on two molds connected in series, which are identical at the moving half and are mounted on a vertically rotating swivel unit (**Fig. 1**). This results in two parting lines, each of whose full surface can be used for producing substrates or finished parts.

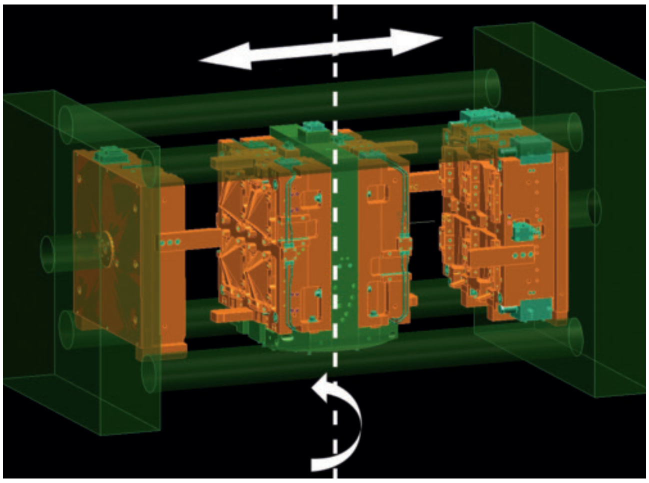

Fig. 1. Schematic diagram of a swivel-platen mold: the two parting lines are one behind the other; in the center portion there is located the swivel unit, which rotates about the vertical machine axis

Production Doubled

The substrate is injected in the first cavity and remains fixed on the core of the swivel unit when the mold is opened. After the swivel unit has rotated through 180°, the substrate is located opposite the second cavity and is overmolded with another plastics component. In parallel with this, the first component for the next part is produced in the opposite mold half. Productivity is doubled for the same clamping force.

The injection units are opposite one another in the machine axis. As a result, the second component must only pass through a short flow channel at the machine end and does not have to be diverted. The hot runner is designed for a 1-component standard machine, allowing uniform filling characteristics. Moreover, this reduces shear, pressure loss and dead spots – an important prerequisite for producing optical parts from polycarbonate (PC) or polymethylmethacrylate (PMMA). There are also none of the tilting torques that occur during rotation. As a result, the opening in the sliding table can be much larger to incorporate large rotary feedthroughs and thermally insulate the cooling media. At the same time, the mold size is not so greatly restricted. There are also much lower restrictions on the part dimensions, since the molds can be rotated through the upper and lower tie-bar pairs. The mold remains freely accessible from the side to incorporate automation and ancillary equipment.

Parallel, Not Tilting

The 2-component standard machine is equipped with an extended machine bed, extended tie-bars, two opposing injection units and a swivel unit, which is mounted on a moving sliding table between the platens. Since two molds are clamped, the machine must be very stable. For the moving mold platens, a particularly thick, ribbed design has proved effective. This achieves the required stiffness and the force is optimally transmitted from the clamping blocks to the mold. At the same time, because of the very low weight, the system has very rapid dynamic response compared to solid platens.

The tilting torque is a crucial criterion for designing the guides and bearings and dimensioning the swivel unit and sliding table. The fact that the tilting torque is taken into account and the generally stable design permit excellent platen parallelism while the unsupported swivel unit is moving, even for large machine sizes. No tie-bar supports and controls for platen parallelism are thus needed in the standard model.

For large machines or large-area parts, an additional guide via the upper tie-bar pair can be implemented. The second rotary feedthrough, coming from above, is advisable for optical applications with mold temperatures well above 100 °C. It helps to avoid excessive thermal expansion of the swivel unit, to make more cooling medium available, and separate the hot water from the other fluids in general.

The SpinForm lines from KraussMaffeiTechnologies GmbH, Munich, Germany, are additionally available as 1-component machines or 2-component index-platen machines with suitable dummy elements. A dummy element in this case is a type of substitute mold with built-in ejector. In addition, the production lines must also be clean-room compatible, since a clean production environment is essential for optical parts. Special hydraulic modifications, water-cooled motors and the enclosure concept ensure the lubricant-free clamping unit (**Fig. 2**).

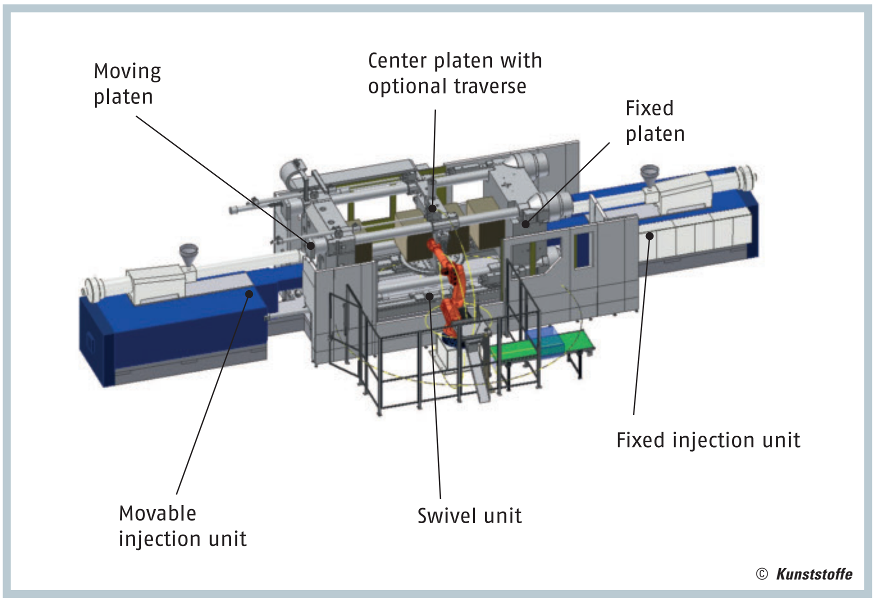

Fig. 2. A concept for a SpinForm machine with automation: the injection units are opposite one another in the machine axis and the swivel unit is additionally guided via the upper pair of tie bars

Two-Stroke Compression

Injection-compression molding is usually used to produce optical parts (e.g. lenses and displays) or thick-walled parts (e.g. cosmetic jars). Glazing processes for →

Fig. 3. The 2-component disposable razors have a polystyrene hard component and a thermoplastic elastomer for soft touch

car windows are generally performed by compression because of the strict requirements. That allows relatively high flow-path/wall thickness ratios to be achieved and internal stresses to be eliminated. Swivel-platen machines make the injection compression of a 2-component part possible for the first time. If both components are to be compression molded, two different strokes are required, which are carried out sequentially for each component, tailored to injection volume and wall thickness. This separate movement is only possible on the swivel-platen machine.

During compression, a tilting torque is generated on the moving platen. To counteract this, the machine can be equipped with a parallelism control for individual adjustment of each individual pressure pad. To control the parallelism, a measurement system registers the values directly at the mold gap. This improves the adjustment possibilities to allow for the narrow tolerances during glazing.

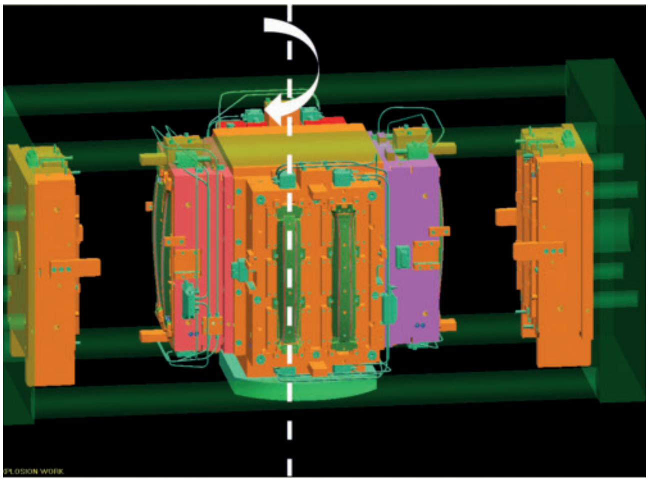

Fig. 4. Schematic diagram of a mold with cube technology: all four sides are used, e.g., for inserting films or metal inserts

In Practice

Swivel-platen technology is proving its potential in many applications, such as the production of a washing machine door from PC **(Title photo)**. Here, SpinForm technology has reduced the machine size, at the same time, with injection-compression molding technology, it was possible to produce the transparent window element with low stress and considerably lower warpage. This reduced rejects at the same time. Furthermore, the system was equipped with a plastication unit optimized for PC, and complete automation.

Another example is handles for disposable razors, produced in a cycle time of less than 9 s **(Fig. 3)**. A 24+24-cavity mold produces the 2-component parts on a 380 t C3-model machine, equipped with a fast and precise electrical rotary unit for high mold weights. Because of the production speed, a high cooling performance is particularly important due to the generously dimensioned feedthroughs. Depending on the production requirements, processors can therefore change to smaller machines for the same output as the former rotary table application, and additionally reduce the footprint and energy and water consumption. With the appropriate machine outfit, applications with more cavities and cycles of less than 6 s are feasible.

Integrated in the Cube

The logical successor to the stacked swivel-platen technique is cube technology with four usable mold sides on the swivel unit. This allows operations to be integrated in the side cavities during injection while the mold is closed, reducing the cycle time. It allows, e.g., insertion of films or metal inserts at the 90° position and/or removal of the finished part at the 270° position. Because of the higher mold and machine costs, it is only appropriate to use it if at least three of the four sides are used simultaneously **(Fig. 4)**.

A practical example with cube technology is the production of the center por-

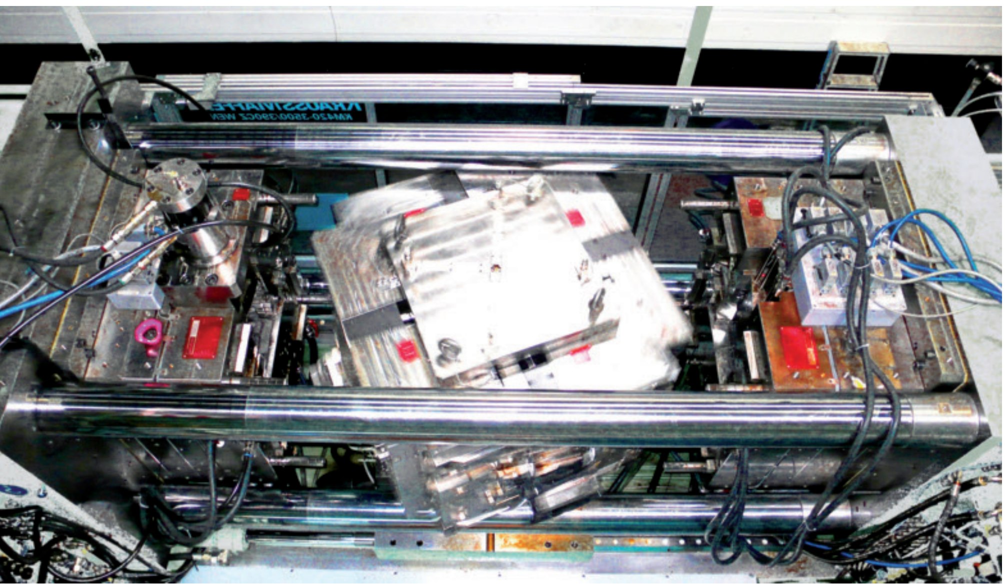

Fig. 5. Plan view of the rotary cube: it produces the center part of the instrument panel of the Audi A4; the mold is rotatable between the tie bars (photo: Peguform)

tion of the instrument panel for the Audi A4, to subsequently house the radio and ventilation, by Peguform GmbH Neustadt, Germany, (**Fig. 5**). In the first cycle, the base structure is produced from a 30 % short glass fiber-reinforced polyamide (PA 6-GF 30). In parallel, in the second stroke, dam elements are molded on with a thermoplastic elastomer (TPE), and bellows seals for the ventilation are created. In parallel, a swan-neck robot removes the parts at the 270° mold position and transfers them to the assembly station, where the eleven assembly clips are fitted by two more robots, including laser monitoring.

The hot-runner systems of PA 6-GF 30 and TPE are very effectively thermally separated by the swivel platen. By extending the tie-bars it was possible, despite the large and complex mold construction, to retain the same size of injection molding machine, with 420 t clamping force. Before retooling, the company used 1-component technology and manually fitted the clips and the sound-insulation felt. Thanks to the cube technology and automatic clip mounting, cycle times of less than 40 s are now possible.

In Combination

For most articles, the strict requirements are synonymous with increasing costs, large numbers of process operations and costly logistics. Production can only be made economical by combining operations and reducing their number. A process combination of this type is the complex manufacturing cell, which produces large parts with a polyurethane facing (PU) for the automotive industry: An injection molding compounder (IMC) produces the filled thermoplastic material for the backing, which is then injection molded. On the opposite side, the part is subsequently flood coated with PU by the SkinForm technique.

The use of IMC reduced material costs. In addition, the high-quality, scratchproof facing increased the surface quality and performance of the finished part. The surface technology that was used additionally increased the scope for part design, since the hardness can be regulated due to the variability of the wall thicknesses. Color exchange can be completed without significant rejects [1]. The integrated automation covers both the removal of the finished parts and all downstream processes. In planning the production line, the system supplier had the advantage that all the departments involved, extrusion, injection molding, reaction and automation, were combined under one roof.

Summary

Techniques that can integrate additional functions in one process and open up new application fields make a substantial contribution to improving efficiency and quality. This is exactly what has been contributed by swivel platen technology in the numerous process combinations and applications implemented so far. This technology will continue to enable new production technologies and options in future. ■

REFERENCES

1 Gruber, M.: SkinForm – Die neue Mehrkomponententechnologie mit Polyurethan. Talk at VDI Injection Molding Conference, Baden-Baden 2008

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