Pushing the Limit

New drive concepts and intelligent motion control enable to explore new possibilities in twin-sheet forming.

Twin-sheet forming is an established process for manufacturing complex hollow and lightweight parts from two thermoplastic sheets. The process had previously reached its limits with material thicknesses of less than 1 mm. This was due to the thin sheets cooling before the tool could be closed and the material formed and welded. Geiss AG from Southern Germany, a longtime leader in twin-sheet forming technology, has now pushed the technology past this limit thanks to a new drive concept in its latest machine generation, the Geiss T9.

A 1FT7 servomotor moves the 5-point toggle lever via a central ball-bearing spindle for the upper punch and table according to a cam disc generated in Simotion D435.
The basic idea was to employ 5-point toggle-lever kinematics to open and close the two halves of the mold, combining a highly dynamic process speed (particularly in the return stroke) with a high level of clamping force and precision. This enables clamping times of considerably less than one second to be achieved so that even sheet thicknesses of 0.3 mm (up to 2.5 mm) can be processed with exact reproducibility. The tried and tested closed-chamber system prevents the heated material from sagging, thereby guaranteeing optimum process conditions when handling practically all deep-drawing materials such as PS, ABS, PET, PMMA, PE, PP, PC, and PEEK. Additionally, high clamping forces of 60 t also enable prepunching and punching of parts in the machine.

The toggle-lever closing system integrated seamlessly into the modular Geiss system, thereby ensuring that it was not necessary to develop a completely new machine.

**Simotion as standard**

The speeds of the clamping system need to be freely programmable, while precise control must particularly be guaranteed at the limit positions. Speeds must also also be adaptable to the mold size, molding geometry, and vacuum flow. A solution with a servomotor and central ball-bearing spindle was therefore required for the toggle-lever drive. Additionally, the existing Simatic S7-300 process control and the proven Siemens heating control had to be retained, as all previous machine characteristics needed to be maintained without modifications. The solution developed jointly by Geiss and Siemens in less than three months provided the first ever motion control system for the toggle lever. The choice fell upon a Simotion D435, which is connected to the process control system (Simatic S7-300) as an intelligent DP slave (i-Slave) via Profibus and which transfers the data via its data modules.

Like the latest Sinamics S120 drive generation and the latest 1FT7 servomotors, the Simotion D is set to become the new standard for all servomotor-driven machine variants from Geiss. At a constant output, the 1FT7 motors can even be operated well above their actual nominal speed in the so-called field-weakening range. The resulting opportunity to design lower outputs from the outset not only saves space in the control cabinet but also reduces costs.

**Motion control made easy**

The proven HMI system was also meant to remain unchanged and to access only the Simatic data modules, not the Simotion system. Siemens adjusted the background data management accordingly and made no changes to the WinCC flexible interface on the Simatic panel PC – also standard in all Geiss machines. This enables motion sequences to be adjusted individually to different twin-sheet parts, as previously. “Users do not want to be concerned about the internal workings of the machine, nor should they have to be. Their priority has to be the process and their moldings,” explains managing director Manfred Geiss.

Separate screens for top punch and table can be set and/or edited extremely precisely by the user, along with the familiar travel paths/speeds and any stopping points. Simotion coordinates the drives via a cam disc, while servo-driven spiked chains guarantee precise synchronization of the upper and lower material transportation from the roll. For thicker materials, an alternative automatic or manual feed with precut plates is available. Additional three-phase motors allow the two halves of the tool to be moved up or down independently of one another, enabling the respective block heights to be adjusted quickly and easily. This eases and accelerates tool changes and keeps changeover times to a minimum.

**Proven in practice**

Ernst Hombach GmbH & Co. KG, in Uehlfeld, is the first operator to use the new Geiss T9 with the toggle-lever closing system. This twin-sheet pioneer, also from Southern Germany, has been manufacturing the most demanding thermoplastic parts for a wide range of applications for years. Thanks to the Geiss T9, Hombach is now able to produce thin-wall applications that were previously almost impossible or extremely expensive, including, for example, stable and lightweight heat-exchanger films, decorative lightweight panels, and translucent honeycomb structures for bioreactors.