Due to its low density of between 50 and 100 g/m³, its good sound and heat insulating properties, and its excellent resistance to chemicals and aging, foamed polyethylene (PE) is ideally suited for making moldings for air duct systems. Its regular, closed cellular structure also means that it does not absorb water. Nearly all cross-linked PE foams have excellent thermoplastic properties and so are ideal for vacuum forming. Previously, air ducts were formed in two parts from foamed material mono-sheets and then joined and glued. However, this method was too time-consuming and costly for series manufacture.

Newly developed control and drive concept

With the aim of rationalizing this process to make it more cost-effective and therefore suitable for series manufacture, developers at Geiss AG in Sesslach, Germany, upgraded the twin-sheet process so that now complete PE foam air duct sets with complex three-dimensional shapes can be produced in one forming operation. The process uses the T9 vacuum forming machine, which was modified to include roller feed and needle chain transport for the top and bottom roll conveyors or for transporting the finished part. As a supplier of complete solutions, Geiss also

Everything from a single source

Thanks to the tried-and-tested twin-sheet process, the new Geiss T9 vacuum forming machine produces complete PE foam air duct sets. These are efficiently made to a high and reproducible quality, direct from the roll in a single operation.
designed and produced the complex molds. This meant that the developers were able to directly determine and optimize the spatial position and joining surfaces of the top and bottom halves in the mold.

Automation of the new thermoformers is based on a control and drive concept developed with Siemens. The key components are a Simatic 677C industrial PC, a Simatic S7-317 to control the sequence, and a Simotion D435 in the Sinamics S120 design. This system provides precisely reproducible and infinitely variable programming of tenter frame and window plate adjustment. The motion controller provides accurate and dynamic coordination of nine servo-axes with Simotics S-1FK7 series servo motors. The result is precise process control without any quality loss resulting from compressed air fluctuations.

The drive system can also be extended by single- or dual-axis motor modules (power supply units). This means that a cost-optimized design is possible for any machine configuration. The Simotion D435 integrated control unit is designed for servo-controlling up to 6 axes. The quantity structure can be extended to 32 axes with additional Sinamics control units (CU320-2). The machine builder uses the Drive-Cliq digital system bus, via which the control units automatically read the motors’ electronic type plates. A Simatic IPC677C visualizes the heating control and initiates a temperature control sequence customized to the relevant material and molding.

**Integrated forming processes for new design applications**

The integrated flash heating for the top and bottom roll conveyors is equipped with adjustable infrared halogen lamps, which emit relatively short-wave radiation suitable for processing closed-cell foamed materials. The closed chamber of the thermoforming machine is advantageous when it comes to achieving consistently high molding quality, since the closed chamber principle ensures that the top and bottom roll conveyors move precisely in each process phase and can be securely located and advanced in a controlled manner. This prevents sagging during heating. The two advanced molded halves are precisely joined and welded together at an appropriate pressure for the material. All these steps are performed in one operation, with average cycle times of between 28 and 68 seconds. “Our process produces a complete air duct set from individual parts that are punched out, sawn at the connection points, and then further assembled,” explains Wolfgang Daum, design manager at Geiss.

The new machine is designed to process 4- to 6-mm-thick PE foam. The useful forming area of 1,460 mm × 960 mm is adapted to the dimensions of the air duct set and the required output of around 2,000 units per week. In addition to applications in the automobile and components sector, the new thermoforming machine is also suitable for manufacturing parts for heating and air-conditioning systems and for sound and heat insulation.

“*Our process produces a complete air duct set from individual parts that are punched out, sawn at the connection points, and then further assembled.*”

Wolfgang Daum, Design Manager, Geiss AG