Trailer covers in thermoplastic which are particularly popular in Nordic countries (photo: Jaxal)

Control Technology. The production of large-volume hoods for car trailers necessitated the construction of a thermoforming machine with particularly big dimensions. A tried-and-tested heating control system, which has proven its worth in a wide range of applications, ensures a reproducible high quality and short cycle times.

The Biggest in the World

JAKOB EINWAG

With this, its third large-size series-T8 vacuum thermoforming machine from Geiss AG in Sesslach, Germany, Swedish processor Jaxal AB in Övertorneå has further expanded both its production capacity and its production facilities. In future, the company will be able to produce molded parts with dimensions of up to 5,500 × 2,200 mm and a thermoforming depth of up to 1,500 mm fully automatically. This corresponds to a thermoforming ratio of almost 3. To begin with, the main application will be hoods for car trailers, which are particularly popular in the Nordic countries. Jaxal makes these hoods from panels that are 6 to 10 mm thick, generally using materials such as PS, ABS or ABS+ASA.

Quality and Productivity Start with the Heating

One of the most important factors for achieving a reproducibly high molded part quality and short cycle times in vacuum thermoforming is still the heating control. This must be designed in such a way that different starting materials (in different thicknesses) can be heated up individually, as a function of the mold contour in question. The radiant heaters are required to heat up the sheets in as fine-grained a manner as possible, which means that they must have individual controls. They have to react rapidly so as to permit rapid cycle times and, in addition to this, they must permit the process to be configured on the basis of the surface temperature. In the area around the clamping frame, in particular, and also in the corners, where the radiant heat that is introduced is generally eliminated to a greater extent, it is necessary to apply more heat than in the center of the sheet. "At all events, overheating is to be avoided in all process phases so as to prevent void and pore formation, as well as burns or even long-term damage to the plastic's molecular structure", explains managing director Manfred Geiss.

Taking these requirements, the company, working in cooperation with Sie- ▶

The world's currently biggest thermoforming machine is able to produce parts measuring 5,500 × 2,200 × 1,500 mm (photo: Geiss)

Translated from Kunststoffe 3/2009, pp. 49–51
Article as PDF-File at www.kunststoffe-international.com; Document Number: PE110049

The HCS716I modular heating control unit is a key element for achieving a reproducible quality in the end products (photo: Siemens)

mens, developed a heating control system for thermoforming machines a few years ago, based on the many years' experience it had acquired with its own (analog and digital) solutions. This was produced exclusively for the Geiss company to begin with, which was trying it out in a pilot operation, and is now a standard product in the Siemens' catalog, available to everyone. This means that machine builders from other sectors can also benefit from the technological advantages and optimized unit costs. The system is also being successfully employed on blow molding and injection molding machines, as well as in tunnel ovens and baking lines.

When it comes to the optimum heating of thermoplastic sheets, the decisive factor is to have separate controls for a large number of individual radiant heaters, which can thus be individually aligned to a wide range of different circumstances. The thermoforming machines produced by Geiss have therefore always had two independent heating fields, with separately-controllable radiant heaters for the top and bottom side of the thermoformed part, i. e. for the inside and outside of the part. The machine described here is fitted with more than 1,700 radiant heaters, each with a heating capacity of 500 W. The system limit is 650 W.

The Swedish user opted for high-performance infrared halogen radiators (also known as "flash" radiators due to their rapid output of heat), which additionally offer a greater penetration depth and can attain any desired operating temperature considerably more rapidly and hence in a precisely controlled manner, thus permitting a reduction in both cycle times and energy input.

Modularized for Individual Use

The HCS716I (Heating Control System) developed jointly with Siemens is designed as a modular plug-in card system. This minimizes the outlay on wiring and also considerably simplifies servicing and maintenance. The heating control system is suitable for operation with all the standard radiator types (quartz, fused silica, ceramic, halogen, infrared) and also for processing all the plastics in standard use.

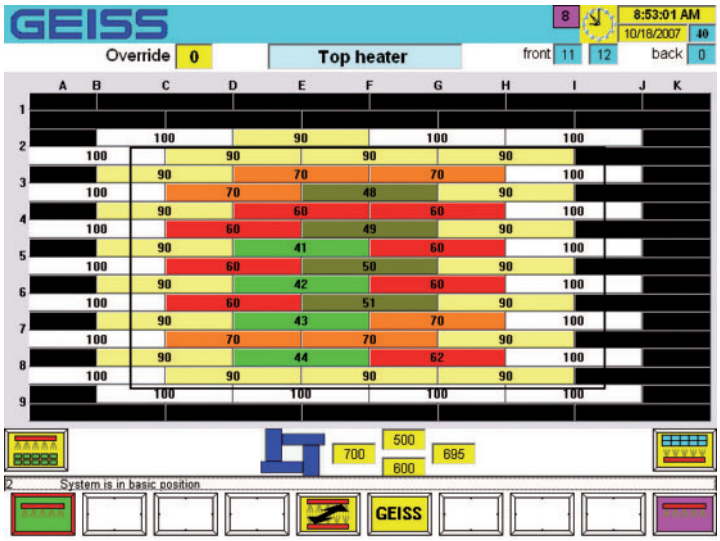
The system is based on a 19″ subrack (in a swivel frame, if required) with a bus board to take power boards ("power output" LA716) and a control and CPU assembly with a profi process field bus on the rear. A subrack of this type holds up to 12 power boards in double European format, each with 16 output channels, allowing a maximum of 192 radiant heaters to be individually controlled. Plug connectors on the front facilitate both the connection and the replacement of the radiant heaters. Communication with the higher-ranking sequence control (Simatic S7-300) is by means of a DP profi process field bus. Up to four subracks (= 768 radiant heaters) can be operated via a profi process field bus master. Used in its standard product form, the heating system can be fitted in Simatic-based automation solutions without any major outlay (totally integrated automation), thus harmonizing and cutting down on the engineering involved, as well as making for simpler commissioning, diagnosis and servicing.

The requisite setpoint values are forwarded to the heating control system via the field bus. The system then calculates the values to be set on the individual radiators for the required power output, implements these by means of pulse-width modulation and ensures continuous and harmonics-free utilization of the three phases. Diagnostics information of relevance, such as "output available/not available", "switch-on not possible" (triac, high-resistance), "heating circuit interrupted" (safety shutdown in the event of a cable or radiator breaking) or "short-circuit", is notified back to the higher-ranking control system.

For operating and monitoring the machine, it is equipped with a Simatic Panel PC677 (12″) from Siemens, designed for harsh industrial use. A flexibly configured operator interface which uses the Simatic WinCC visualization system constitutes a pioneering feature. This shows all the key process parameters at a glance. The most important images for the operator are colored presentations of the different temperature zones, which can be switched between the top and bottom heating at the push of a button and which highlight any irregularities in the temperature control or even the failure of individual radiant heaters. Since the operator interface has been ported to "WinCC flexible", the dimensions of the individual sheets are also shown.

Setpoint values can be set on the HMI (Human Machine Interface) system at between 0 and 100 %, in 1 % increments. Once settings have been optimized, they can be modified in freely definable groups, either as a whole or as a function of the individual surface temperatures, by means of a proportional override. This

More than 1,700 halogen radiators with an output of 500 W each are controlled individually and ensure optimum processing conditions (photo: Geiss)



The flexibly implemented operator interface based on Simatic WinCC provides relevant process information (in this case for the top heating) in readily comprehensible form
(photo: Siemens)

ensures that heating curves can be run through with a lower outlay, corresponding precisely to the material properties. These heating curves can be saved by the user and read in again as and when required, or can be edited or optimized if necessary.

Everything from A Single Source

In addition to the SPC, the heating control and the HMI system, plus the drives and motors for the fully automatic stroke adjustment of some 20 "programmable" axles, also come from Siemens, as, indeed, does the switchgear. As Manfred Geiss says, there are several good reasons for this. Alongside the reliable (heating) control and drive components that have been running in countless applications for many years without notable disruptions, it is also the close proximity to the fitter that is important, as well as the particularly smooth cooperation with Siemens which is of great benefit for both sides, as illustrated by the example of the heating control. As a globally active company, we also value Siemens' global presence, which ensures that spare parts are rapidly available on-the-spot should anything go wrong and hence also shortens stoppage times for production plant.

In Production in Record Time

This large-scale machine was developed in just four and a half weeks and manufactured in the record time of only nine weeks – thanks to the principle of "parametric" design that has been perfected by Geiss. The design is largely automated and precisely tailored to the requirements of the biggest thermoformed parts to be produced in each case.

A total of four days were required to transport this special consignment to Övertorneå at the border between Sweden and Finland, with the machine split into the front and rear boxes and measuring 15 × 11 × 7 m (L × W × H) in all.

By investing in a thermoforming unit with such big dimensions, the contract manufacturer is also opening up the way to further demanding (series) applications. This includes parts which have so far been made of (non-recyclable) GRP materials in an elaborate process, such as large-area interior components for buses, rail vehicles and aircraft, as well as for agricultural and construction machinery and boat hulls. The heating control unit will also provide evidence of its flexibility and play a key role in determining quality and productivity. ■

THE AUTHOR

DIPL.-ING. (FH) JAKOB EINWAG, 1958, is Marketing Officer Motion Control Systems Business Unit of Siemens AG Drive Technologies in Bayreuth, Germany; jakob.einwag@siemens.com