Integrated control platform replaces special subassemblies

Traditional blow molding machine controllers are based on special hardware that is difficult to extend with new tools, for example. Turnkey software for blow molding applications plus a Panel PC with a 15-inch...
display and a high-performance Intel® Celeron® processor place all of the advantages of open PC-based automation technology at the user’s disposal: Instead of special modules, e.g. for controlling the wall thickness or the temperature, the Industrial PC constantly controls all machine functions. Thanks to the modular structure of the Blowmolding framework software, different measuring systems such as analog encoders or SSI sensors can be more easily connected to a machine.

The electrical signals from the sensors, valves and motors are picked up and output with the aid of the Beckhoff Bus Terminal I/O system. Eliminating specialized “black box” modules increases the availability of the machine while at the same time reduces service expenditures and the required spare parts stock. In the case of large machines in particular, the placement of distributed I/O modules, e.g. on the extruder cylinder, saves costs and increases functional reliability. Beyond that, safety-oriented Bus Terminals permit the simple and fast implementation of safety functions. Compact Flash storage is used instead of a hard disk, which guarantees the user low failure rates.

**Short sampling times are decisive for the quality of the product**

Of course, optimum wall thickness control is crucial for the quality of the final product. Since this controlled system possesses a high natural frequency, short sampling times are decisive for quality. This requirement is fulfilled perfectly by the employment of a high performance industrial PC and EtherCAT as a fast fieldbus system. Since, for example, sampling times of less than 1 ms can be achieved, the profile accuracy is increased to the maximum and plastic products with consistently high quality can be produced.

**Clear and convenient user interface**

The productivity of a machine depends, among other things, on how quickly the operator can intervene in the manufacturing process and that the information needed for this is available at a glance. Beckhoff’s industry-specific CP6202-1026 Blow Molding Panel PC is equipped with over 40 manual operating buttons, which are partly assigned to the right and left sides of the machine. The buttons are labeled using convenient push-in strips and can be adapted to each unique application. A 15-inch touchscreen displays all information in a clear format.

The user interface of a blow molding machine often supplies an abundance of unstructured information, making it difficult for the machine operator to distinguish between important and unimportant data. Therefore, particular importance was placed on a clear structure when designing the Beckhoff user interface. At the same time, ergonomic approaches were also utilized; i.e. the color design is “easy on the eyes” and the amount of visible data is intelligently condensed. The operator finds important data in the same place on each page. In addition, soft key functions support intuitive operation. The machine and recipe data are stored in XML format, which has a hierarchical structure that ensures the safe processing of the parameter files, e.g. for language versions and axis parameterization using external editors. The data structure is imaged directly in the data model of the visualization software by the use of XML; this simplifies data processing and reduces the load on the system. The XML standard also facilitates automatic machine configuration using external configuration programs.

**Wall thickness editor guarantees ideal production results**

The user interface for the wall thickness control, for example, is characterized by a clear division into four equally large fields. The header field contains status information, such as language version, operator name and alarm messages. Access rights are specified and operator inputs registered with the aid of user management, so that the production process can be completely documented. The configurable status bar contains the most important process information, such as cycle time, extruder data or piece counters. This means that the operator specifies which data are to be permanently displayed, allowing them to ascertain the machine’s condition at a glance. The third field contains the soft keys, while the fourth field contains variable contents, such as wall thickness or temperature control.

**Using XML, the data structure is imaged directly in the data model of the visualization software; this simplifies data processing and reduces the system load.**

The wall thickness editor contains all important functions for the fast, clear creation of the wall thickness curves. Support points and curve segments can be represented in an easily recognizable manner by means of colored graduation. Up to 25 profiles can be illustrated and edited. Partial wall thick-
drive concepts are supported, such as driving the main pump with a servo drive. Short cycle times are achieved by the optimum control of the transport movement and the clamping unit, among other things.

For this the Blowmolding Framework uses the proven motion modules from the TwinCAT hydraulic library in order to obtain an optimum balance between fast movement and accurate positioning. The operating page for the axis movement allows the parameterization of up to 25 motion axes. Up to five movement segments with optional holding points can be defined for each direction of movement. For the control of additional functions, a selection of 10 cams per axis is available that can be edited in relation to the direction and with variable hysteresis. As a result, the user is able to operate even complicated tools without intervention in the control program. The advantage of this is that the operator can define the individual movement segments independently and label them accordingly.

Precise, fast temperature control
Likewise, one of the main prerequisites for high product quality is precise and fast temperature control. The TwinCAT Blowmolding Framework integrates a software temperature controller with clear operating pages, which has been proven in many applications in the plastics industry. Special attention was paid during the development of an intelligent auto-tuning algorithm, which is optimized for the smallest possible overshoot when changing the set value. The retrofitting of additional heating zones can be easily achieved, since the software is prepared for a maximum number of zones and only further I/O terminals need to be installed to expand the system.

All important control zone parameters can be seen at a glance on the user interface; critical temperature deviations are indicated by a color change. The input of an entire group of temperature zones is especially simple, e.g. in the case of a cylinder. As a result the operation – compared to single temperature controllers – is accelerated and simplified considerably.

Motion control for all hydraulic, hybrid and servo-electric axes
The TwinCAT Blowmolding Framework is suitable for blow molding machines with hydraulic, servo-electric or hybrid drive technology. Energy-efficient control at the hose circumference is also supported. The curve shape is changed by pointer with the aid of the touchscreen. Of particular interest is the Un-Do memory, with which the operator can easily cancel the last changes made.

Automatic adaptation of the mass flow rate
The hose length and the actual curve value are shown in real-time during production; deviations from the set value are displayed and monitored. Perfect production of plastic items in the blow molding process requires an extruder mass flow rate that is automatically adapted to the cycle time and constant hose length with no undesirable weight fluctuations. In order to correct the extruder speed, the TwinCAT Blowmolding Framework offers the option to constantly correct the hose length with the aid of a photocell during continuous operation. For intermittent operation, a battery level controller is available. The optional master-slave coupling of several extruders additionally facilitates the optimization process.

Support for production cells
Modern production facilities frequently have special insertion units for placing prefabricated components into the mold, such as handles for drums or printed foils. Servo-electric handling systems increasingly perform article transport. Insertion units and handling systems are integrated either by

All important control zone parameters can be seen at a glance on the user interface for the temperature control; critical temperature deviations are indicated by a color change.
fieldbus interface or integrated directly with the aid of the Blowmolding Framework. For quality certification, an automated article check is performed, and its results are optionally displayed on the screen and stored in the production log. A free network interface is available as standard for the transmission of these data.

Quality and efficiency requirements optimally fulfilled
The high performance of Beckhoff’s PC-based controller platform makes short reaction times possible, guaranteeing the efficient production of high-quality plastic products. A large touchscreen display is available for ergonomic operator guidance and fast user intervention. The integration of the controller into company networks facilitates the complete documentation of the production process, the logging of operator interventions and the assignment of user rights. Beyond that, the high requirements of modern quality assurance systems are met. The analysis of machine errors is also supported by a sophisticated messaging system. All fault messages are stored and can contribute to the continuous improvement of the production process as well as to the minimization of downtime. If service should be necessary, there are extensive options for Internet-based remote diagnostics, so that the customer can quickly analyze and rectify malfunctions.

The modular hardware and software architecture of the controller flexibly accommodates subsequent plant expansions or the integration of peripheral devices. This guarantees the user that their investment is secured over many years.