Automation. Efficiency, precision and reproducibility are fundamental requirements in plastics processing. Thomas Kosthorst, Business Management, Plastic Processing Machines at Beckhoff Automation GmbH, Verl, Germany, speaks about the competitive advantages which PC- and EtherCAT-based control technology offers in this context.

"End-to-End" PC Control Improves Efficiency and Quality

The portfolio comprises a wide range of performance components for servo drives. They suit the various requirements of plastics machines in an optimum way and comply with the demands of energy efficiency

Tailor-made solutions are offered complete with software and hardware which help users master the control of complex injection molding processes. The proven technology software includes standard functionalities for injection molding machines, such as the precise and highly repeatable control of speed, pressure and temperature

■ What are the current hot topics in plastics machine engineering?

Kosthorst: Temperature control is, and always has been from the outset of plastics processing, a very important aspect. This topic is not in the least trivial, as it requires that relatively large cylinders, with their correspondingly high thermal inertia, be heated. What is more, this thermal inertia must be managed as well as possible in the software, which is exactly what PC-based Control from Beckhoff was designed for. Packaging technology, characterized by the mass production of one-cent products and therefore demanding extremely productive and compact machinery, is one of the key applications for plastics. In the plastics industry this means, above all, minimizing non-productive time as, for instance, the time required for opening plastic molds or for cooling. This can be achieved by deploying powerful control technology. It does, however, also demand correspondingly rapid actuator systems or drive technology, especially in handling.

■ Do developments that affect the final product also have a role to play?

Kosthorst: Trends also grow from the increasing demands of the end users. For instance, the toothbrush has developed in re-

**Thomas Kosthorst,
Business Management
Plastics Machines,
Beckhoff Automation**

(figures: Beckhoff)

■ For what areas of plastics engineering does Beckhoff offer automation solutions?

Kosthorst: Our flexible PC- and EtherCAT-based control technology is able to offer ideal automation solutions for injection molding, blow molding and extrusion machines, as well as material handling systems. The universal platform also seamlessly integrates safety and measurement technology alongside PLC, motion control and robotics functionalities. In addition, we offer a turnkey solution for injection molding machines that makes the development process easier and faster. Plastics industry expertise from Beckhoff guarantees rapid and precise control of time-critical process variables such as speed and pressure, along with the control of hydraulic, electrical and hybrid drive systems. The servo motors and drives made by Beckhoff are particularly suitable for energy-efficient machine designs. Mention must also be made of the wide range of EtherCAT terminals for capturing energy data, e.g. for grid monitoring. The information gathered by these I/O components can help initiate comprehensive energy management in conjunction with the relevant functions in TwinCAT automation software.

■ Where would you position electrical drive technology against hydraulic technology?

Kosthorst: Most plastics machines, meaning injection molding machines, are still driven hydraulically as this allows high forces to be generated at relatively low cost. The trend here, however, towards greater precision, reproducibility and energy efficiency clearly favors electrical drive technology. This trend has been seen for some time now in areas that demand high precision or hygiene. There is also a second aspect: servo hydraulics, i.e. hydraulic pumps driven by servo motors. Thanks to the advanced control characteristics – e.g. for stopping in a cooling phase – a great deal of energy can be saved with servo pumps of this kind compared with the combination of an asynchronous motor and a hydraulic variable displacement pump. We offer suitable solutions for all of these applications.

> **» Flexible PC- and EtherCAT-based control technology is able to offer ideal automation solutions for injection molding, blow molding and extrusion machines, as well as material handling systems. «**

cent decades from a simple plastic part into a product that is very complex in respect of color, design and function. TVs are another very clear example of the fact that higher and higher demands are being placed on plastic components. Very high reproducibility and extreme precision are indispensable for creating the modern bezels, many of which feature piano-black lacquer-like finish. This can only be achieved consistently with PC-based control technology which is able to process even complex algorithms with sufficient speed while offering the detailed documentation required today.

■ Handling is of particular importance when it comes to plastics machines. What are the key features of your portfolio in this regard?

Kosthorst: The Beckhoff AM8000 series of highly dynamic servo motors with One Cable Technology (OCT) represent a notable innovation, especially in the motor-intensive handling sector. With this one cable solution, feedback signals are transmitted interference-free over a digital interface directly and together with the voltage supply through the motor connection cable. The AX5000 series servo amplifiers supply higher power →
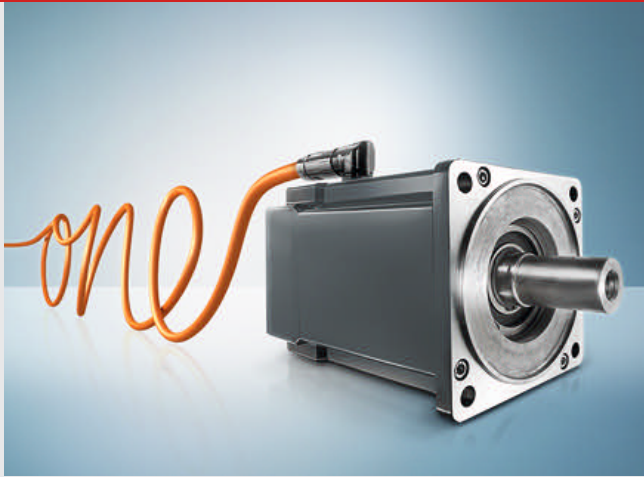
The OCT (One Cable Technology) solution for connecting servo motors significantly reduces the costs of cables, connectors and commissioning

The TwinCAT software integrates a robot control system seamlessly into the standard control technology

up to 170 A. Highly productive manufacturing cells require rapid handling systems, e.g. for in-mold labeling. TwinCAT is able to offer practical solutions for this with its powerful NC functions. This results in less expensive, more compact and, above all, more flexible machines.

■ Robotics is an important facet of plastics processing. How can PC control minimize integration efforts?
Kosthorst: The TwinCAT Kinematic Transformation software integrates a robot control system seamlessly into the TwinCAT

■ How important is EtherCAT communication for innovative plastics machines?
Kosthorst: There are two important aspects to this. On the one hand, machine builders in the plastics industry benefit from the openness and widespread market penetration of the Ether-CAT standard; beyond the broad range of solutions from Beckhoff, the choice of third-party components is practically unlimited. On the other hand, the extremely high performance of EtherCAT communication creates opportunities for innovations, particularly in the form of eXtreme Fast Control Tech-

> » *As part of our Scientific Automation technology, the PLC, Motion Control, HMI, measurement technology and robotics can all run together on an Industrial PC.* «

automation suite and thus into standard control technology. As part of our Scientific Automation technology, the PLC, Motion Control, HMI, measurement technology and robotics can all run together on an Industrial PC. The software is configured and programmed in a single TwinCAT environment so that there is no need for special robotics tools, languages, or even a robot control system so engineering efforts can be significantly reduced. Cartesian, articulated arm and SCARA robot types are implemented as kinematics systems. TwinCAT Kinematic Transformation also offers tracking functionality to synchronize the robot with a moving object. Seamless integration is also supported by our hardware: robust IP 67 I/O components can be deployed outside of electrical cabinets, directly in the robotics environment. Here, the EP1816-3008 EtherCAT Box, which can be installed directly on moving robot elements offers great advantages: it captures binary control signals with 16 digital inputs and also incorporates two 3-axis acceleration sensors.

nology (XFC). XFC is based on an optimized control and communications architecture that consists of a modern Industrial PC, ultrafast EtherCAT terminals, EtherCAT itself and Twin-CAT automation software. I/O response times better than 100 μs can be achieved with this seamlessly integrated system, opening up new possibilities for process optimizations. For example, very fast algorithms are required when injecting plastic into the mold in order to switch over to holding pressure at precisely the right moment during the injection process. XFC enables the associated pressure curve to be resolved to an extremely high degree. Thanks to oversampling this can even be clearly below the minimum I/O response time and, using distributed, synchronized clocks, at precisely defined times. This results in very precise process control, exact reproducibility and ultimately high quality and minimized consumption of raw materials. The outstanding features of the XFC technology and its potential for process optimization have been proven in practical use with injection molding applications. ■

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