PC Control and EtherCAT automate pipette-tip injection molding machine

Twice the throughput in half the machine footprint

Automation in the injection molding industry demands much more than just demolding technology in order to ensure truly efficient, economical and high quality production. This is particularly true for medical technology, such as in the production of pipette tips. Machine builder Hekuma has been able to meet the demanding requirements in this area by utilizing powerful PC-based automation technology and the high-speed EtherCAT communication system from Beckhoff. These technologies enabled the machine builder to achieve a high production throughput using half the footprint of the market standard, all while implementing 100 % quality control.

Hekuma, based in Eching, Germany, is a company in the elexis Group that creates lasting competitive advantages through innovative ideas, exciting technologies and high performance automation for the plastics industry. In addition to complex grippers for the loading and demolding systems in injection molding processes with upstream and downstream automation, the company’s core competences include the development of special turnkey solutions and product concepts such as "Sigma Inside" for dynamic parts handling. Hekuma focuses on the medical and automotive engineering markets, as well as the consumer goods industry.

Performance boost thanks to technology upgrade
The medical engineering division at Hekuma has just created the latest generation of its machine for manufacturing pipette tips. A controls technology upgrade was critical if the company was to continue setting new industry standards with its advanced machinery. Gorazd Jerič, Head of Software Development & Service at Hekuma explains: “The modular and open automation technology from Beckhoff, especially when combined with the extremely fast EtherCAT communication system, has made a true quantum leap possible. Compared with the competition our machine is only half the size, but achieves twice the production throughput. Fast EtherCAT communication has made a significant contribution to implementing a 100 % quality control process. The capability of detecting individual reject parts inline, to sort them out and replace them from a buffer represents a compelling added value for our customers.”

Small pipette tips demand complex manufacturing processes
The first element of this production system involves two electrical injection molding machines, each machine being operated with a 64-cavity mold. Automation essentially comprises the following process steps:

1. High-speed removal of the injected parts from the molds
2. Depositing the finished parts on circulating workpiece carrier systems
3. Using a camera system for 100 % quality control
4. Sorting out the individual reject parts that are detected
5. Filling empty spaces from a buffer
6. Filling combination racks with inspected good parts
7. Printing the date and batch number on the racks
8. Stacking and packing the filled racks in film with a tear-off strip

Precise handling and optimized inspection
Rapid and precise motion control along with highly efficient, “on the fly” quality inspection requires enormously powerful control technology and fast data communication. Gorazd Jerič explains: “The high complexity of the machines means that there are a great number of system interfaces that would be very difficult to cover with the PLC technology previously used. To implement this in a conventional PLC architecture would mean extremely high costs and it would have detrimental effects on runtime capabilities. In any case it would be necessary to shift the complex calculations onto a PC, which would in turn mean additional hardware and software and high overhead for communication between these two worlds.” None of this is necessary thanks to Beckhoff control technology. What is more, typical PC tasks such as file transfer, database connectivity and Ethernet communication can be integrated very easily.

EtherCAT communication lays the foundation for the high positioning accuracy and rapid processing speeds within the machine. Hekuma has used this to achieve a maximum deviation in axial control of 0.005 mm with a very good reference value processing and extremely smooth-running axes as a result. Gorazd Jerič added: “There have been other new features added such as the
overdrive functionality to reduce speeds in the reject station, which could be implemented quite elegantly and with significantly reduced engineering effort thanks to TwinCAT NC PTP software.” Gorazd Jerič described how important compactness and modularity was in addition to speed and precision with the example of the separating and stacking stations for the racks: “Three axes equipped with Beckhoff AM3121 servo motors and controlled through extremely compact EtherCAT EL7201 servo motor terminals are responsible for these motion tasks.” It was also possible to integrate advanced safety functionality using the TwinSAFE EL6900 PLC Terminal.

Foundation for consistently modular machine design
The sheer number of almost 11,000 variables and over 3,000 component instances bears witness to the high complexity of the complete pipette tip injection molding line. In spite of this, Gorazd Jerič exploited a further advantage offered by PC-based control to achieve a machine design that is easy to handle from engineering to operation: “Using Beckhoff automation technology we have implemented a consistently modular design of this machine, both in respect to hardware and software. The various modules have been abstracted in such a way that they can be used universally, independent of the application and machine type. Furthermore, subsequent modifications to the line have become significantly easier.”

Gorazd Jerič has achieved an immense leap in performance for the Hekuma pipette tip injection molding line by changing from PLC technology to PC-based control and sees further potential for improvements in the future, especially through consistent object-oriented programming using TwinCAT 3 and the deployment of the XTS eXTended Transport System.

The EtherCAT Terminal system enables compact automation solutions that are precisely scalable to match the machine modules. EtherCAT also incorporates complete machine safety – from monitoring to emergency stop functions via TwinSAFE communication on the injection molding machine.

Further information:
www.hekuma.com
www.beckhoff.com/EL7201