PC-based control increases flexibility and part quality in injection molding processes

Injection molding machine manufacturer Mitsubishi takes advantage of open control architecture

Japanese company Mitsubishi Heavy Industries Plastic Technology (MHIPT) specializes in plastics injection molding machines. These solutions are primarily used in the automotive industry, but also in household appliance manufacturing and in the PC industry. The company chose PC-based control technology from Beckhoff for its latest MEIII machine series, regarding the openness of the control architecture as forward-looking, offering everything required for connected production facilities. In addition to an improvement in repeatability and greater production flexibility, MHIPT considers the simple integration of condition monitoring and implementation of predictive maintenance to be a major step forward.

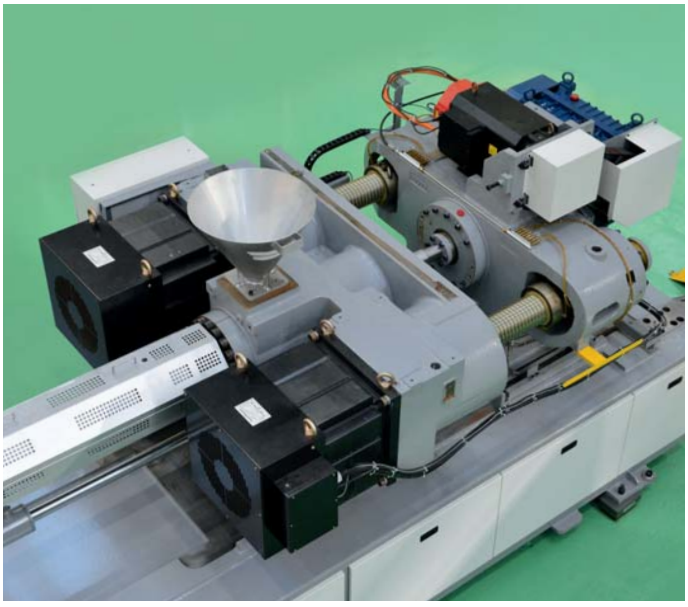
The new MEIII injection molding machine series and its developers

Injection molding machines essentially combine an injection unit with a clamping unit. The injection unit heats up and plasticizes the raw material before injecting it through a high-pressure nozzle into the tool. The clamping unit opens and closes the tool (mound) and keeps the two halves of the mound closed during the injection process. The force exerted by the clamping unit is an indicator of the size and the mechanical power of the machine. The MHIPT machine portfolio encompasses machines with clamping forces that range from 350 to 4000 tons.

Open automation platform brings competitive advantages

The MEIII, which is the latest injection molding machine generation from MHIPT, features medium-sized machines with a clamping force that ranges from 550 to 850 tons. Where most injection molding machines are equipped with hydraulic drives, drive control in the MEIII is achieved with servomotors. "This leads to higher production quality and reduced power consumption," says Takashi Mizuno, director and chief executive of the engineering department at MHIPT. "With regard to the automation technology, MHIPT has changed its previous development strategy for the MEIII machine series. We now rely on PC-based controllers throughout the series. Previously, we developed our controllers entirely by ourselves; the use of PC control systems allows us to concentrate our development capacities entirely on the software side. We aim to integrate all of our expertise as a company that specializes in injection molding machines into the software for the injection molding process, distinguishing ourselves from the competition."

Employees from MHIPT and Beckhoff involved in the development of the MEIII. Front row, from left: Takashi Takii (engineering manager, MHIPT), Toshimitsu Kawano (managing director, Beckhoff Japan) and Takashi Mizuno (director and chief executive of the MHIPT engineering department). Back row, from left: Tomohiro Umeda (deputy head of the MHIPT engineering department), Osamu Aoishi (Beckhoff Japan), Masanori Obata (Beckhoff Japan), Tsutomu Ayusawa (head of the MHIPT engineering department) and Yasuhiro Kai (MHIPT engineering department)



The injection unit of the MEIII. Synchronous control of two DD motors results in a highly precise injection process.

Like the preceding MEII series, the MEIII series comes equipped with DD (direct drive) motors developed in-house by MHIPT. These motors do not need reduction gears, as they generate a high force with a low number of revolutions; this gives the advantage of a dynamic injection drive and facilitates easy maintenance as pulleys, belts and other consumables are not required. The MEIII series is characterized by a design that replaces a mechanical connection system between the two DD motors with highly-precise software synchronization. "The speed, reliability and precision of the servo-electric controller directly determines the quality of the product," emphasizes Takashi Mizuno.

Open control technology: independence from vendor-specific standards and specifications

Takashi Takii, head of design in the MHIPT engineering department and project leader in the development of the MEIII, explains: "The big advantage of the control architecture openness is that we, and our customers, are no longer dependent on vendor-specific standards or specifications. PC-based control provides an extremely efficient control system based on open standards, while at the same time being flexible and universal, offering us the necessary reliability and quality."

The MEIII controller is a Beckhoff CP6216 Panel PC.

High efficiency in machine development

Given the flexibility and expandability of the PC Control platform, MHIPT is able to offer its customers around 200 optional specifications for the use of different tools or molds to achieve the geometries of the plastic part to be produced. "That's about three times as many options as a conventional controller. Specifications formerly available only at extra cost can now be offered to our customers with standard pricing and delivery times. In addition, the use of open standards gives us the flexibility to comply with the sensors and servomotors specified by our customers. Through the use of EtherCAT and TwinCAT, as a universal communication system and universal software platform respectively, a uniform data flow can be achieved that considerably increases the repeatability of the machine operation," explains Takashi Takii.

"All in all, machine engineering is much more efficient through the use of the PC platform," says Takashi Takii. "Modular design of the control cabinets is simplified through the use of decentralized I/O stations that communicate over EtherCAT, resulting in advantages not only with regard to the flexibility, for example the implementation of modifications at short notice, but also shortening the time required for the manufacturing, disassembly, transport and installation of machines. The high scalability of the PC Control platform ultimately makes it possible to control several injection molding machines of very different sizes and in different areas of application using one central PC-based controller."

The MHIPT machine software must manage more than 30,000 data points in order to achieve the diversity and flexibility of the plastics injection molding applications. MHIPT uses an Oracle database to manage software design configurations. "The required close connection of the database could not be achieved using the tools of conventional control system vendors," explains Takashi Takii. "The seamless connection of TwinCAT with Oracle database represents a gigantic step forward for us to implement automatic or semi-automatic software configuration. In addition, the online debugger, software oscilloscope and other development tools offer valuable functionality."

New business models enabled by the open control architecture

Takashi Takii also sees potential business benefits in the PC-based control architecture. "Large-size injection molding machines are typical examples of small-quantity and large-variety production, almost equivalent to special machine manufacturing. Our ideal scenario is to meet every single one of the customer's requirements. Where conventional control technology often imposed restrictions on us, the controller used for the MEIII enables efficient and flexible software development. Diverse options for injection molding processes can be automatically generated from the software without the need for programming. I can confidently say that the software design has reached the point where we can enjoy high customer satisfaction. The magic triangle of quality, cost and time has made a quantum leap," Takashi Takii stresses.

Ready for Industrie 4.0

Takashi Takii also sees benefits in the open control architecture with respect to the current trends in the manufacturing industries. "The open and flexibly-controlled flow of data with EtherCAT and TwinCAT is not just limited to the individual injection molding machine, but also enables modularization and uniformity of data flow throughout the entire factory. In this way, we can offer highly responsive support for the technologies targeted by Industrie 4.0 in Germany and the Industrial Internet of Things (IIoT) in the USA. I think it will be essential to use Big Data to extend the mean time between failures (MTBF) and shorten the mean time to repair (MTTR). We must put ourselves in the position of being able to collect, save and analyze large quantities of data in order to determine how our machines change over time, how they are used and how we can standardize and compare the data collected in different production environments," Takashi Takii concludes, outlining future strategy.

Further information:
www.mhi-pt.co.jp
www.beckhoff.co.jp