All in one: Integration of measurement and safety technology in the control system

Beckhoff stainless steel Control Panels manage filling plant

Plants with machinery that fill and dispense liquid and paste-like substances for the pharmaceutical, cosmetics and food industries must naturally meet the highest requirements for precision and throughput. VMS Maschinenbau GmbH, based in Engelhofen, Germany, specializes in filling plants for the foodstuffs and chemical industries. This leading machine manufacturer uses the PC- and EtherCAT-based control platform from Beckhoff as the control system throughout the company's production range.

About 90% of the machines designed and built by VMS are used in the packaging of dairy products, the other 10% being employed in the non-food sector. "Our target markets are the food and chemical industries, and their requirements vary greatly. This has a corresponding impact on the machine equipment levels," explains Roland Trittner, Managing Director of VMS Maschinenbau GmbH. The industry-specific requirements in the food sector include, among others, the aseptic, often sterile, filling of the goods as well as the necessary cleaning with hydrogen peroxide (H2O2), a process that must be closely monitored. "In the chemical industry, however, it is not necessary to monitor the cleaning process," notes Roland Trittner.

Universal Beckhoff control platform with EtherCAT

"VMS uses the PC-based Beckhoff control platform and EtherCAT in its entire portfolio of machines," reports Frank Würthner, Branch Manager for Packaging Technology at Beckhoff. Thus, all I/O terminals and drive controllers are networked via EtherCAT. This includes the safety technology, for which TwinSAFE I/O terminals are used. "The machines are usually controlled by a Beckhoff CP7702 stainless steel Panel PC with the Atom™ processor," continues Roland Trittner. The design of the panel features all-around IP 65 protection and the gapless housing design complies with the strict hygiene requirements in the packaging industry, and more particularly in the food industry. All the functions and operating modes of the VMS machines, such as final position monitoring or the monitoring of start-up from the base positions, are programmed in the application software, which is based on TwinCAT NC PTP automation software from Beckhoff.

Measurement functions integrated in the control system

In addition, some special metrology features are incorporated in the filling plants, such as the monitoring system for the container fill level, temperature measurements, and sensor monitoring of the cleaning process. On this point, Roland Trittner noted that "the sterilization is a very sensitive issue, since we have to reach a temperature of 143 °C (289 °F) and then maintain it. To record the temperature during sterilization, we employ the high-precision Beckhoff EL3312 measuring terminal with 16-bit resolution."

"When using the Beckhoff TwinCAT NC PTP software for servo technology, it was quite quick and straightforward to implement industry-specific functions, such as lifting the container, moving the piston, sealing the plastic bottles with aluminum foil or screwing on the sealing caps," explains Frank Würthner. "The ability to use the comprehensive libraries and function modules in TwinCAT made it much easier for us to succeed in the application. Another reason for us to choose the Beckhoff control and drive technology solution was the openness of the system," explains Markus Köger, Managing Director of VMS.

View of the container on the top of the polishing paste filling machine, together with the sensors for fill-level and pressure

The discharge side of the RX1000/4 polishing paste filling machine

(from l. to r.) Ulrich Vogel, Sales Engineer from the Beckhoff branch office in Balingen; Roland Trittner, Managing Director of VMS Maschinenbau GmbH; Frank Würthner, Branch Manager for Packaging Technology, Beckhoff

The polishing paste filling machine fills four 1kg containers simultaneously. The filling is done in a 12-second cycle.

Filling accuracy:
TwinCAT Motion Control software with camming functionality

The first preference of VMS Maschinenbau in its filling plants is the piston filling principle. In this process, the fill quantity is first sucked in by the piston and then, due to the forward motion of the piston, it is filled through appropriately connected nozzles. The stroke-dependent filling process is controlled using TwinCAT NC PTP, which also controls the filling bridge and the worm feeder. The filling bridge can be lowered vertically.

One of the machines that VMS has developed recently is the RX1000/4, a four-pump filling machine for car polish paste; this machine fills the paste mass into plastic bottles. As Roland Trittner explains, the car polish filling machine is also a piston filler, but in addition the machine also uses a diaphragm. "We're handling an abrasive polishing agent here, which would result in increased levels of wear in a typical piston filler." The diaphragm results in a special filling system for the piston, as the filling process is accomplished completely without direct contact from machine parts.

The RX1000/4 fills four 1-kg containers at the same time. The filling process operates at five cycles per minute. The entire process, from feeding in the container to discharging after the filling process, is controlled by AM3052 servomotors from Beckhoff. The plastic bottles are placed on the turntable, and from there they proceed automatically into the worm feeder. There, they are separated and precisely positioned relative to the filling nozzles. In the next step, the filling bridge is lowered from above and the four parallel filling nozzles enter the plastic bottles. During this process, the filling bridge is raised up again in proportion to the fill level. When the filling operation is finished, the nozzles are blocked. Finally, the containers that are filled with polishing paste are discharged by the worm, and the next four plastic bottles are fed in.

Integrated safety solution

VMS has also equipped its machines with safety features that are designed to protect the operating personnel as well as to safeguard the technical process. Beckhoff TwinSAFE Terminals are used to connect safety switching devices such as emergency stop buttons or door interlocks. In addition, the safety model is stored in a safety control system. "This solution was attractive," explains Frank Würthner, "because there was no 'legacy burden' with VMS. This meant that by using TwinSAFE, we could incorporate the safety model into the total control solution straight away. It is a stand-alone safety control system that exists in parallel with TwinCAT. The safety model is virtually the same for all machines, which also facilitates excellent design continuity."

Further Information:
www.vms-maschinenbau.de