TwinCAT: Jerk-free loading and unloading thanks to electronic cam plates

Improved handling and synchronization

Roboworker's unloading robots can handle blanks made of metal or ceramic powder, the preliminary products for indexable inserts, gear wheels or sealing discs. The high-performance RAG2 unloading system removes the blanks smoothly and reliably from the press. This system is controlled by a Beckhoff Industrial PC with TwinCAT automation software.

Roboworker Automation GmbH, based in Weingarten, Germany, designs and manufactures systems for loading and unloading presses and machine tools. Roboworker custom machines have been fitted with Beckhoff control technology for more than seven years. Today however, PC-based control from Beckhoff controls all Roboworker production machinery including the high performance RAG2 unloading system.

Ultra-fast control plus short cycle times

At the heart of this machine is a 3-axis robot with a transfer gripper. The gripper carefully extracts the blanks from the press, subjects them to quality control and places them onto a tray. The RAG2 unloading system handles molded parts from molding, forming and stamping presses. Gripping, transfer and placement of the molded parts made of metal or

The high-performance RAG2 unloading system removes the blanks smoothly and reliably from the press. It is controlled by a Beckhoff Industrial PC with TwinCAT automation software.

The heart of the RAG2 unloading device is a 3-axis robot with transfer gripper mechanism. It carefully extracts blanks from the press, subjects them to quality control (weighing and measurement) and places them on a tray.

ceramic powder, which form the fabricated materials for indexable inserts, valve seat rings, gaskets or gear wheels, is a huge challenge because the blanks are still very soft and breakable. "Too much gripper force or rough placement due to jerky movements can damage the blanks and make them unusable," explains Norbert Mehrle, control technology manager at Roboworker. "Consequently we require a control system with which we can grip the blanks gently and move them without jerking – even at the highest velocities. Beckhoff offers exactly what we need for this: extremely fast control systems with short cycle times and plenty of extra functions such as Motion Control and Electronic Camming in one system."

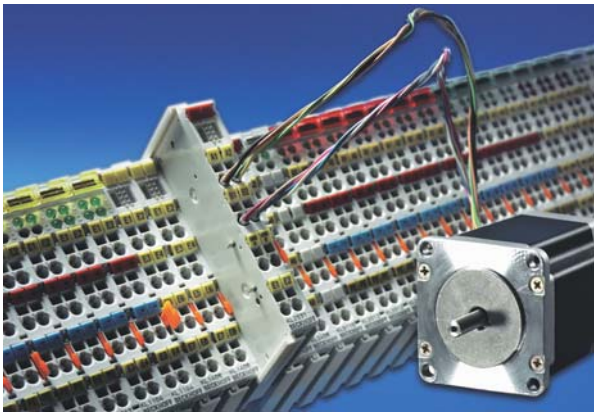
Achieving ideal integration

The heart of the unloading system controller is a C6140 Industrial PC with Windows XP Pro operating system and TwinCAT PLC/NC I automation software. The unloading system is operated by a handheld device. Its Windows-based graphical display runs on the Industrial PC along with the control system. The control system and the graphical display communicate via TwinCAT ADS. An optional Internet connection via the Industrial PC's Ethernet interface enables remote maintenance of the system.

Roboworker uses Beckhoff Bus Terminals to integrate all data points from the unloading system into the controller. "We assemble the ideal combination from the huge range of Bus Terminals available to suit the design of the unloading system", explains Norbert Mehrle. "For example, identical terminals detect the dimensions of the blank while serial interfaces detect the data from the weighing cells. We control the less dynamic axes of the transfer gripper and the tray handling simply and cost-effectively with stepper motor terminals. Thanks to the openness of Beckhoff technology, we can provide specific fieldbuses for all the devices thereby fully exploiting the performance potential of each. For instance, we use Bus Couplers to connect the highly dynamic, CANopen-driven robot drives to the controller."

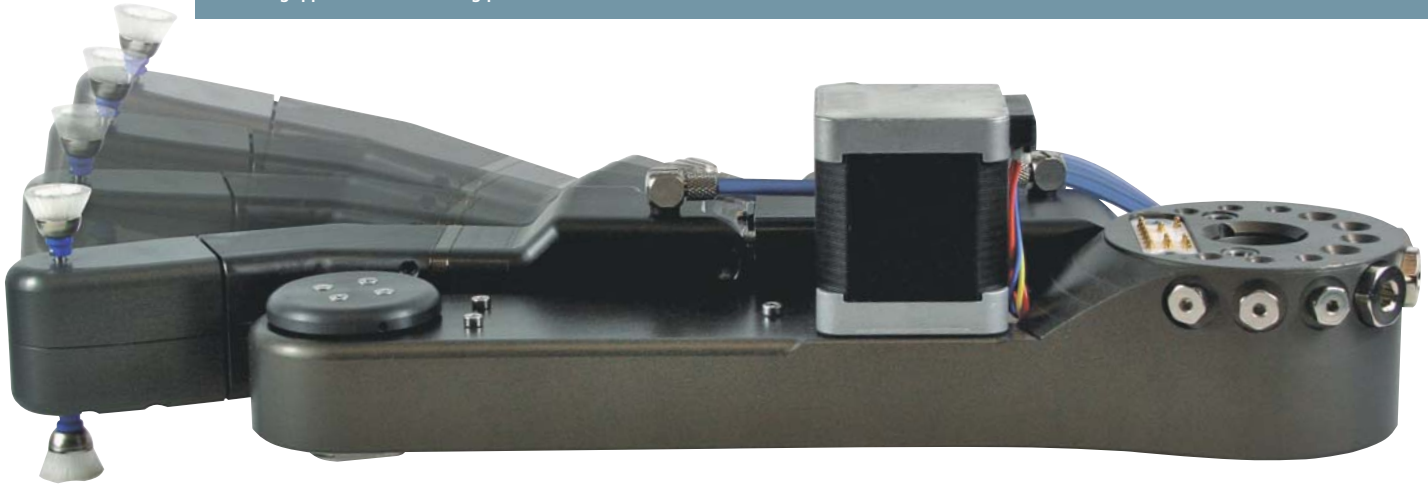
Performance and flexibility prevail

The shape, size and material type of the blanks as well as the required quality and production quantities determine the transfer gripper type, tray handling process, machining process and additional functions such as deburring, quality control and punch cleaning. "We handle up to 30 parts per minute on some unloading systems," comments Sabine Sterk, who is responsible for marketing at Roboworker, and adds: "We achieve such high clock rates by the parallel alignment of process steps. While one part is being weighed, the transfer gripper is transferring another part from a second weighing scale to the tray." Roboworker implements this complex process in real-time with TwinCAT PLC and Motion Control. "It is absolutely genius – real-time capability with no special hardware," enthuses Norbert Mehrle. Roboworker configures the application software specifically to each application and sets the machine parameters accordingly. Roboworker uses TwinCAT as a development and run-time environment and it also uses TwinCAT ScopeView for diagnosis and optimization of the system.



The KL2531 and KL2541 stepper motor terminals are a cost-effective alternative to traditional drives.

Transfer gripper with co-travelling punch cleaner



Optimize motion sequences

The transfer gripper transfers the pressure- and impact-sensitive blanks smoothly and gently from one processing station to the next, placing them finally onto a tray. Roboworker implements this complicated process with the TwinCAT software camming function. "We are currently using the camming function to optimize only velocity, acceleration and transfer gripper handling. We define the trajectory as a fifth order polynomial and use this to connect the slave axis to the master axis. In the future, we'll use cam plates for time optimizing as well by coupling the X-, Y- and Z-axes to a virtual time curve. This way, we intend to achieve continuous operation with no waiting times. This will increase the stroking rate and reduce energy consumption," notes Norbert Mehrle.

Optimum synchronization of press and unloading systems

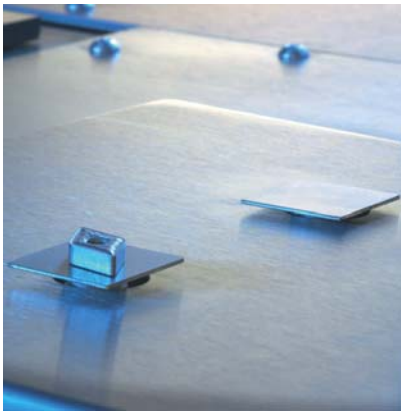
To achieve an uninterrupted process, the presses and unloading system must work in synchronicity. The complexity of this synchronization process depends on the application. For simple press machines the machine status is communicated via digital interfaces. For more complex functions, the press and the unloading system communicate via CANopen or PROFIBUS. In this case, the press and handling device are coordinated when a part is ready for unloading and must be unloaded and when the transfer gripper is not permitted in the press zone. The press also receives the data recorded with the unloading system including weight and dimensions of the blank and then determines the fill rate and press force for the next pressing step.

"We have completely redesigned our application software for the unloading system. The ease of use of TwinCAT has simplified the design. At the same time, the benefits have increased: we have achieved significant improvements in the handling and synchronization of the presses and the unloading system," says Norbert Mehrle and in summary: "Roboworker has profited predominantly from the openness and simplicity of the Beckhoff technology and the excellent price/performance ratio."

Roboworker Automation GmbH **www.roboworker.com**

Sabine Sterk (marketing) and Norbert Mehrle (control technology manager)

Loading, unloading, palletizing and inspecting are the core competences of the Roboworker robotic systems. They offer fast, reliable and accurate loading and unloading of grinding machines, presses, stamping machines and injection molding machines. Once removed, the parts are immediately placed onto trays for further processing or are packed for dispatch. Measurement and checking systems ensure uninterrupted process steps and high quality parts. Roboworker uses "Advanced Robot Technology" with Beckhoff control technology for all systems. Beckhoff Industrial PCs with Windows operating system as well as TwinCAT NC I/NC PTP control platform and camming function control the entire system in real-time.



Maximum clock rates can be achieved by parallel alignment of process steps. While one part is being weighed, the transfer gripper is transferring another part from a second weighing scale on a tray.

The heart of the unloading system controller is a C6140 Industrial PC with Windows XP Pro operating system and TwinCAT PLC/NC I automation software.