

Dürkopp Fördertechnik counts on TwinSAFE for system safety

A stylish solution: PC-based automation for ultra efficient garment warehousing

One of the central challenges for the mail order clothing industry is the logistics involved with the extraordinary number of clothing items in various sizes. In the past, shipping orders have been assembled from static warehouses that contained items sorted according to item type and size. Klingel, however, has modernized the logistics of hanging garments through the introduction of fully automated storage. The Pick-Rotor system, made by Dürkopp Fördertechnik in Bielefeld, Germany, rises to the challenge effectively and economically.

Clothing in movement

The dynamic storage for hanging garments consists of 21 "Pick-Rotors" together with the sorting equipment and around 60 independent transport systems. The stock is held in any convenient sequence, and, at the latest, is available to the dispatch department one hour after the pick order has been placed. The dynamic store regularly contains about 120,000 items supplied to it from static stores and from returns. "Our job was to handle the large number of returns that have to be reintroduced into the logistical flow" explained Dipl.-Wirt.-Ing. Dirk Sieksmeier, Development Manager at Dürkopp Fördertechnik, who was responsi-

→ Klingel, the mail-order company based in Pforzheim, Germany, has revolutionized the logistics involved with hanging garments by using smartly designed storage combined with fully automatic access and sorting into specific sequences. The automatic Pick-Rotor system from Dürkopp Fördertechnik stores highly varied clothing selections in a very small space and in any sequence, making them available for shipping quickly and sorted into the proper sequence. The automation of this dynamic warehouse is supervised by an Industrial PC working with distributed I/O stations featuring I/O terminals with integrated TwinSAFE technology from Beckhoff.



ble for the project. "Now that we have introduced this system, it is possible for goods that arrive on one day to be quickly shipped out again on the next."

The capacity of the warehouse, which is controlled by a higher-level stock management system, is sufficient for around 5,000 items to be stored every hour and for the same number of pieces of clothing to be made available at the outlet at the same time. The 21 storage units are, in principle, a distributed application of materials conveying, each with a capacity of 5,000 items, running semi-autonomously and operated in parallel. 21 islands are constantly in operation in order to fetch the quantities required from the stores every hour. The pick orders tell the controller which items have to be made available at the goods outlet within the next hour. Before they are sent out, the items of clothing are given a barcode and are sent in batches of 1,000 to the sorting equipment, which finally transports them to the dispatch workers' workplace.

The roller adapters, of which 120,000 are constantly circulating within the plant, are important elements in this application. They pick up the hanging garments and move them by means of two rollers through storage, conveying and inclined sections.

There are always between 100,000 and 120,000 items of clothing on hangers in the stores. They are automatically suspended on the roller adapters at a special working station.

Central, PC-based control concept

Dirk Sieksmeier explained the fundamental control concept: "We rejected our first idea, which was to control the entire system non-centrally, because of all the cross-connections between the 21 storage units and the conveying sections. Although the installation is quite extensive, we decided in favor of central intelligence, which also has the advantage of being easy to service in the event of a fault." The store extends over an area of 200 x 50 meters, and is controlled by a single Industrial PC with a TwinCAT PLC. Dürkopp's development engineer made the decision because "due to the large number of interlinked conveying systems, we did not feel able to manage the complex communication between the distributed controllers without the task becoming unreasonably complex."



An Industrial PC C5102 Pentium 4, 2.8 GHz running Windows XP, a RAID controller and exchangeable disk are used. It is fitted with four fieldbus cards (FC310x) for about 140 PROFIBUS slaves. The I/O stations are implemented as IP 20 Bus Terminals in distributed control cabinets or as IP 67 Fieldbus Box modules, close to the working machines. According to Sieksmeier, the use of PROFIBUS has historical reasons amongst conveying technology specialists: "Just like PROFIBUS, our equipment is also in use in many parts of the world and this means that our staff has the necessary know-how." Around 2,500 digital inputs, 2,500 digital outputs, some 40 absolute rotary encoders and 60 serial interfaces for the RFID readers are fitted in the installation. In addition, 40 asynchronous motors are supplied with complex data words and are cyclically read over the PROFIBUS.

Real-time position acquisition

Because the store regularly contains more than 100,000 items and because the conveying orders must be executed by means of a variety of intermediate stations, the software PLC must know the position of every roller adapter in real-time. Although the conveying system consists of nearly 60 independent sections, each 100 meters long, the computer is able to calculate the position of every single adapter to an accuracy of 15 mm within about 10 ms. In order to keep this quantity of data safe from a power supply failure, the IPC needs about 30 MB of non-volatile PLC memory.

The customer's own system, based on Visual Basic, is used for visual display and can be called up at any authorized workplace within the mail order company. As far as communication with other tools within the company is concerned, Sieksmeier adds that "to communicate with the visual display system we use the TwinCAT TCP/IP Server, which adds server functionality to the PLC". Communication with the supervisory material flow system is also implemented through TCP/IP. Commissioning the complex control system is made significantly easier by

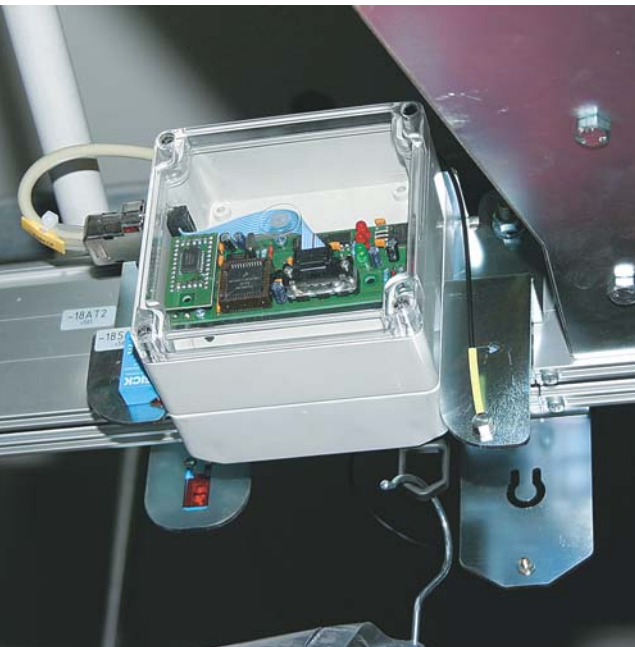
the option of recording all the events – to any desired precision – on the hard disk in the PC, as well as by TwinCAT's internal visual display system.

TwinSAFE: Smart safety for the entire system

Secure Bus Terminals have also been integrated into the I/O system. They connect the emergency stop switches and perform secure shutdown of the drives. This is the first time that Dürkopp Fördertechnik has used TwinSAFE Bus Terminals from Beckhoff. To handle the secure I/Os, each control cabinet contains five or six secure Bus Terminals, to which more than 100 secure I/O components are connected. Sensors and actuators of both standard and safety types can be freely mixed in the Bus Terminal system. It is not necessary to install an additional bus and I/O system. It is therefore possible to extend the safety-relevant functions in the I/O system at a later stage.

According to Sieksmeier, there are two particular arguments in favor of wiring the emergency stop circuits by means of secure Bus Terminals: "Changes are an everyday occurrence during the planning phase and while the electronic equipment is being constructed, the customer's requirements can change at any stage up to the commissioning. In the past, we regularly had to reconnect hard-wired emergency off circuits, and install new wiring." Sieksmeier also sees the interface to the existing belt conveyors and the conveyor belts for folded garments as a further important feature. The Development Manager added: "While TwinSAFE allows the structure of the system to remain flexible to the end, the technology also offers significant cost advantages." Beckhoff TwinSAFE Bus Terminals allow all the safety circuit wiring to be moved into the existing fieldbus, and for the secure signals to be freely mixed together with standard signals. This saves design effort, installation and material. Maintenance is simplified significantly through faster diagnosis and simple replacement of only a few components.

In addition to the KL19xx digital input terminal and the KL29xx digital output



The items of clothing are given a 125 kHz RFID chip for identification. This chip contains a unique 40 bit code, while stored in a database together with the code of the hanger, identifies the item of clothing being transported. A total of 60 RFID readers with serial interfaces are working in the system, connected via communication Bus Terminals.



terminal, the KL6904 TwinSAFE Logic Bus Terminal creates the necessary logical connection between the inputs and outputs. The secure Bus Terminals allow any common safety sensors to be connected, and are operated, stand-alone, with the TwinSAFE Logic Bus Terminal. The TwinSAFE protocol makes it possible to transmit safety-relevant data in a genuine "black-box" channel over any desired media, as the transmission medium does not contribute to safety. Fieldbus systems such as PROFIBUS, CANopen and Interbus or Ethernet systems such as EtherCAT can be used in conjunction with TwinSAFE. All these systems can also be mixed without restriction.

"We have also checked the use of specific secure fieldbuses", explains Dirk Sieksmeier. "But with the TwinCAT System Manager we don't need any other engineering tool for the safety functions. The System Manager saves the configuration and linking matrix of the inputs and outputs in the secure terminals. If there is a fault, this information simply has to be read back."

Leading edge EtherCAT replaces PROFIBUS

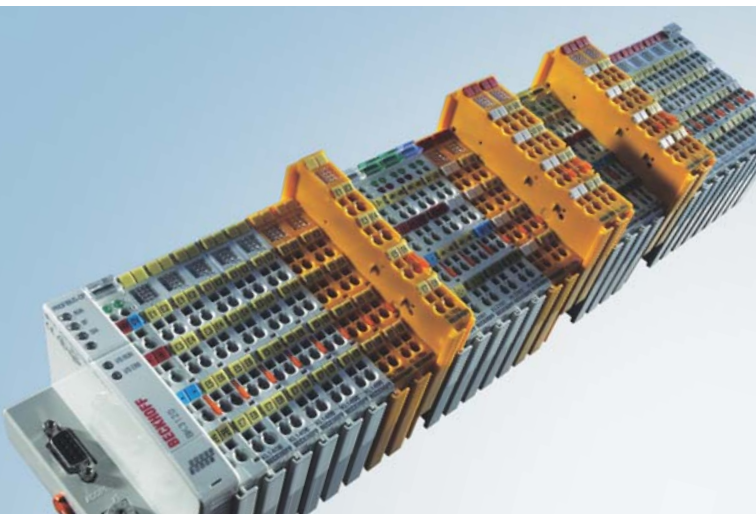
The advantages of using an Industrial PC instead of a hardware PLC is more than just a question of cost. Sieksmeier has found that working with libraries is also effective: "We have standardized much of the functionality of our equipment and saved it in libraries, which can be reused in new projects and, on occasion, modified centrally. The support service also benefits from this." Sieksmeier also points to the increasing significance of remote servicing: "Our service team can easily access the customer's controller over ISDN and a router with the aid of the Remote Desktop function, allowing faults to be rectified quickly."

Dürkopp Fördertechnik's designers also expect a further performance boost from the introduction of EtherCAT. "The data from 5,000 I/O points, including the TwinSAFE communication between the fieldbus cards, has to be transferred over the PCI bus every 15 ms. This makes a significant contribution to the workload of the IPC." There are already plans for an installation being designed in England to at least be partly based on EtherCAT.

→ Dürkopp Fördertechnik www.duerkopp.com

→ TwinSAFE www.beckhoff.com/twinsafe

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Dirk Sieksmeier, Development Manager at Dürkopp Fördertechnik: "In the past we had to rewire the emergency stop circuits again and again, whereas with TwinSAFE, the structure of the system can remain flexible right until the end."