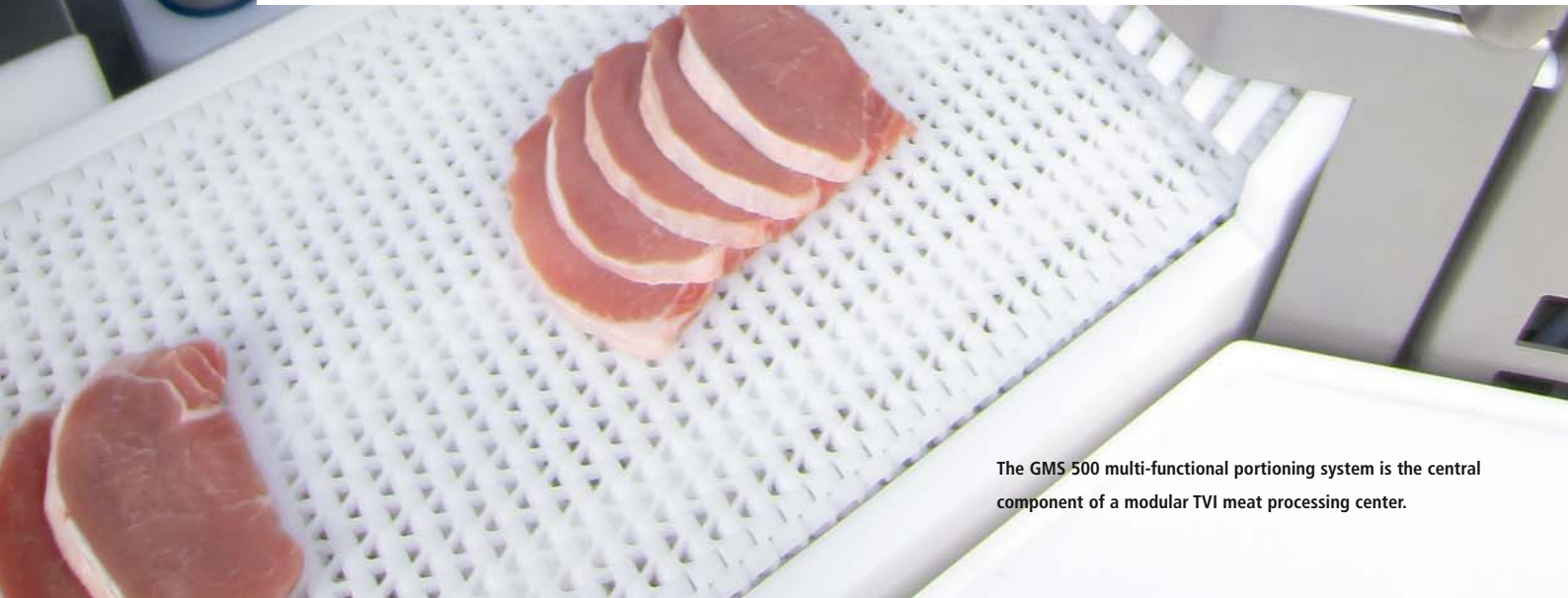




Automating meat processing centers to be more flexible and precise

Highly efficient meat portioning using PC Control

TVI Entwicklung und Produktion GmbH in Irschenberg, Germany, makes machines and production lines for all areas of meat portioning and processing – ranging from meat tempering to transferring cut portions to packaging machines. TVI benefits from its own long-term expertise in the industry as well as from the performance and flexibility of the Beckhoff controllers and drivers it installs on its machines to meet the steadily rising requirements of customers with regard to process speed and accuracy.

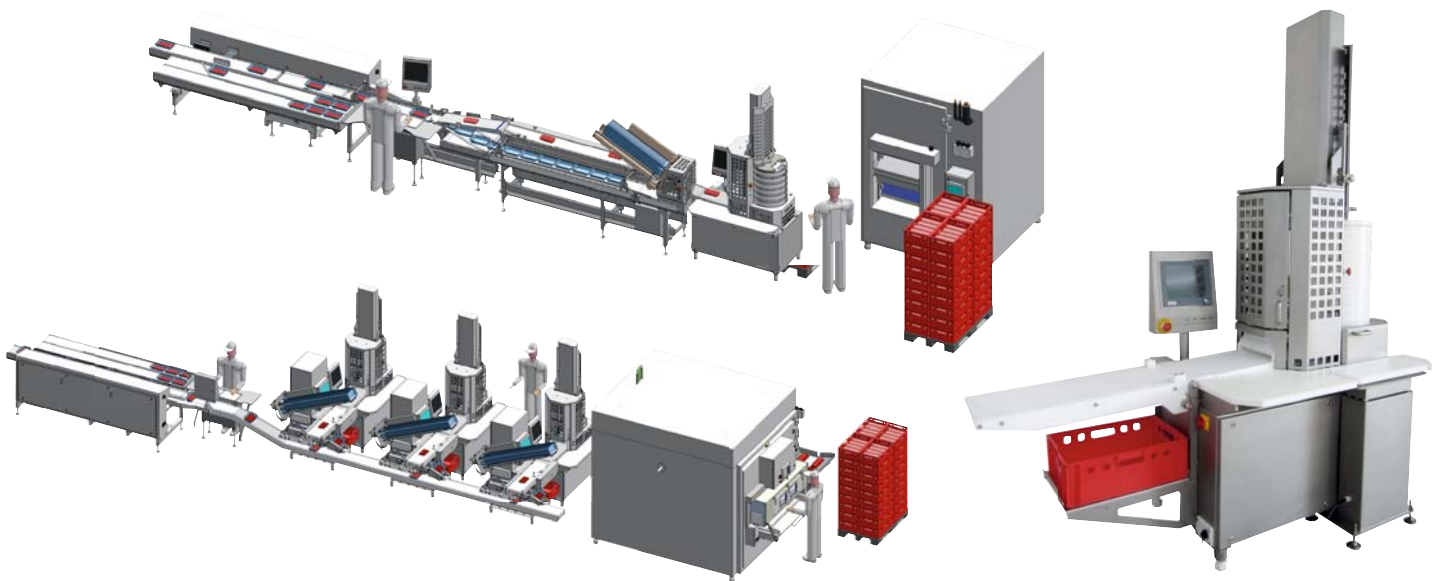


The GMS 500 multi-functional portioning system is the central component of a modular TVI meat processing center.

TVI machines are flexible meat processing centers that can be adapted to any portioning task with standard modules and customer-specific programs. Because the continuing consolidation of the food processing industry exerts enormous pressure to drive down costs, process efficiency is becoming increasingly important. Thomas Völkl, managing partner of TVI, references his company's motto to explain the rising requirements his company's solutions must meet: "Our machines portion any kind of red meat, of any consistency and cut type. We ensure optimum results in terms of weight accuracy and minimization of product waste along with maximum efficiency in terms of labor and energy." Just as important is the ability to offer comprehensive solutions for meat portioning and processing. This spectrum, says Völkl, comprises provisioning, tempering (warming up frozen meat and lightly freezing fresh meat), portioning (slicing, portioning, shingling), traying (manual or automatic), inspecting, and transferring the product to the packaging machine.

Machine expertise reinforced with flexible control technology

The use of energy-efficient and precisely controlled servo drives as well as pneumatic valves, which are optimized through precise and fast control, are just two examples of how demanding customer requirements can be fulfilled with PC-based control. This applies to individual machines as well as entire lines, as Thomas Völkl explains: "Thanks to our modular concept, we can build production lines with great flexibility from our individual components such as shock freezers, portioning machines and automatic tray fillers with tray dispensers and leftover disposal units. The modules are then linked with matching conveyors. By selecting the right individual components we can adapt the line to meet each customer's requirements. The control technology from Beckhoff has proven to be exceptionally flexible and suitable for all our applications – from the smallest system, the TDS 300 tray dispenser with just two pneumatic valves, up to the GMS 500 portioning system with its seven high-precision servo axes."



Both the Euroline (top) and the AIR Line (bottom) can be adapted to the customer's specific requirements.

The GMS 500 portioning system forms the core of a meat processing center.

Maximum energy efficiency is ensured in two ways: On one hand, servo drives replace most pneumatic and hydraulic actuators; this dramatically reduces the energy consumption of the machines. On the other hand, TVI's shock freezers are extremely efficient. Since the meat is removed seconds before the portioning process, the tempering crust needs to be only 2 to 3 millimeters thick and not 5 to 10 millimeters as is the case with most other systems. This cuts the energy consumption by roughly 80 percent. Most importantly, the shock freezer operates with conventional compressor-based cooling technology while most other systems continuously consume CO₂. This reduces the energy costs per kilogram of meat from the customary 5 to 10 cents to a substantially lower 0.4 cents.

The first component in a TVI meat processing line is the CBF Cyclefreeze, a rotary shock freezer. The meat is fed and discharged semi-automatically. Using a flap mechanism, the operator places the meat into one of the machine's baskets before pulling the drawer back again. The transport chain then advances the next basket. The CX9020 Embedded PC controller with its 1-GHz ARM Cortex™ A8 CPU moves the baskets through the freezer in such a way that the tempered meat is ejected after the specified time has elapsed (for example, 8 minutes). The shock freezer operator interface is implemented via a built-in, customer-specific CP6907 Control Panel that features a stainless-steel bezel and a flush 5.7-inch touch display. The panel is equipped with DVI/USB extension technology that allows it to be installed at a distance of up to 50 meters from the PC.



The portioning system (above) is operated via a customer-specific CP6901 12-inch Control Panel. The shock freezer (below) is operated via a built-in CP6907 Control Panel with a 5.7-inch screen..



Multi-functional portioning system is the heart of the line

At the core of most TVI meat processing centers and located directly adjacent to the shock freezer is the company's greatest revenue-maker, the multi-functional GMS 500 portioning system. The machine is controlled via a powerful CX1030 Embedded PC and TwinCAT NC I software. The Control Panel is an integrated CP6901, also with a stainless-steel bezel and a flush 12-inch touch display panel. Four compact AX5206 EtherCAT servo drives and five pole-wound AM3021 synchronous servo motors with AG2210 planetary-gear units ensure accurate motion control. Designed for highly accurate workflows, the GSM 500 carries out the following process steps:

- The operator places one or more pieces of meat into a mold.
- The machine rotates the mold to the cutting position and the appropriate piston is activated.
- The meat is perfectly formed and measured in the longitudinal direction.
- The machine portions the meat with no or minimal leftovers. The knife cuts the first slice after a linear unit has determined the slice's thickness in accordance with the target weight. The machine then continuously cuts the rest of the slices. Immediately after the last cut, the mold revolver moves the next piece of meat into position, and the process is repeated.

At the end of the meat portioning center sits the FPS 500 Euroline traying system, which places the meat into trays for catch-weight or fixed-weight portions. It consists of three coordinated modules: the MIS 3000-4000 manual inlay area with the TDS 300 tray dispenser, the automatic AIF 500 tray-filler, and the GMI 500 weighing and sorting unit. First, the portioned meat slices coming from the GMS 500 are placed on the conveyor belt of the MIS 3000-4000. From there they are placed into trays either manually or automatically with the AIF 500. The filled trays then move to the GMI 500, where they are buffered and weighed on a dynamic scale. Portions that are too light or too heavy are automatically pushed to separate buffer conveyors and moved to a rework station. Trays with correct weights continue directly to the packaging machine. All of these units are again automated with controller and drive technology from Beckhoff, such as the CP6901 12-inch control panel, four AX5206 EtherCAT servo drives and five AM3021 synchronous servo motors with AG2200 planetary-gear units.

Flexible and precise servo drives

The performance of servo drive technology from Beckhoff is evident in a wide variety of motion control tasks. In the GSM 500 portioning system, servo drives and servo motors ensure that the mold revolver and the spacer plate are rotated into exact position. The entire meat processing center operates with a wide range of rotating and pivoting movements – in the conveyor belts or the toothed-belt feeders for the trays, for example.

A special new development at TVI is the AIR 250 inlay machine with four servo axes that move a flap for leftovers, the conveyor and a so-called spring belt, and the toothed-belt feeder for the empty trays. On this machine, TVI also employs the new One Cable Technology (OCT) solution from Beckhoff where the feedback signals and power are directly transmitted via one cable. This eliminates the need for several wires and connectors on the motor and drive sides, resulting in significant component and commissioning savings. The OCT system is

implemented with two AX5206 servo drives and two AM8021 or AM8022 servo motors, each with AG2210 and AG2310 planetary-gear units.

Thomas Völkl believes that Beckhoff drive technology offers exciting potential for the future: "In our future developments we will integrate even more safety technology, and TwinSAFE offers a consistent system for drives and I/O with great implementation benefits. Accordingly, we will predominantly employ servo technology from Beckhoff."

PC Control offers speed and a broad spectrum of applications

TVI decided already in 2008 to replace conventional PLC technology with PC-based control systems. Thomas Völkl explains why: "Back then we ran into performance limitations, particularly when several synchronously operating axes had to be controlled. We initially programmed these applications in C++ and implemented them on an industrial PC. But we realized very quickly that the combination of PC and PLC technology slows the process down unnecessarily. Switching to an entirely PC-based control system was therefore an easy choice. Also, Beckhoff was the ideal supplier because their system is not only very fast, but open and extremely flexible." The Beckhoff system also allowed TVI to implement the necessary hydraulics controllers very effectively, adds Völkl. In addition, PC Control works equally well for small applications like the tray dispenser with its single air cylinder, vacuum valve and small control panel as it does for complex control tasks.

The flexible Beckhoff I/O system, with over 300 EtherCAT Terminals, opens up a wide range of applications and meets all of TVI's requirements. Its space-saving design is particularly important for Thomas Völkl: "Since our machines are very compact, the high density of the I/O terminal system is of great benefit for us. In our shock freezer, for example, we employ the EL2809 EtherCAT HD terminal, which features 16 digital outputs in a housing that is only 12 millimeters wide." Other benefits include the many terminals with special integrated functions. The EL3356-0010 dynamic scale sensor, for example, will make it easier to integrate the weight into the machine control, while EL34xx power monitoring terminals will document the shock freezer's low energy consumption.

For Völkl, the term systems supplier also covers another important aspect: "Beckhoff delivers the entire control technology pre-assembled in control cabinets as a value-added service. This is a huge benefit for us, because we no longer have to keep these components in inventory – unlike in the past, when we worked with a supplier who did nothing but build control cabinets. The fact that electrical and electronic components account for 30 to 50 percent of a machine's value today demonstrates how important this has become."

New TwinCAT 3 software generation offers higher potential for more efficiency

Thomas Völkl wants to continue on the successful path of making his machines and systems more modular in order to enable more efficient customization of meat processing centers with as little engineering effort as possible. The mechanics are already quite advanced, but the software development still has the potential to become even more modular,



Thomas Völkl, managing partner of TVI Entwicklung und Produktion GmbH in Irschenberg, Germany, shows off the multi-functional GMS 500 portioning system.

says Völkl. He believes that the new TwinCAT 3 software generation offers the right tools to increase efficiency: "Having the kind of object-orientation that TwinCAT 3 supports so effectively is essential for making electronics and programming more modular. TwinCAT 3 delivers two major benefits: object-oriented programming requires a lot less effort and it easily accommodates multiple developers' work on the same project simultaneously. That's why we will implement TwinCAT 3 on the next generation of our portioning machines."

Further Information:

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