



Müller Weingarten:
PC-controlled multi-curve press at Volkswagen

**On the fast lane
with PC control**

Control technology based on PCs is no longer a problem for machine constructors. Integrating PCs into more complex machines does, however, call for a wide range of connecting components to be available, and requires appropriate automation software with which the application can be structured rapidly. The press builders Müller Weingarten found that Beckhoff proved to be partners who made the technological jump from PLCs to PCs easy.

Successful automobile production requires that downtime and refitting time be kept to very low levels. The Volkswagen group is no exception to this rule. New press tools, for instance, which have been tested in trial presses, reduce the fitting times on the transfer lines by up to 90%. Ten to twenty large sheet metal parts were formed in one day using the hydraulic multi-curve presses in Hall 16 at the Volkswagen works. They pass from the forming line, consisting of six enormous presses, and move on to the measuring station. The parts involved are complete roofs, side panels or bonnets. It is not just that their dimensions are now measured with great precision, but they must also satisfy the critical eyes and sensitive fingers of skilled workers. It is Mr Kuznik's judgement that "the relationships within these projects are so complex, and the structure is often so varied, that only unerring methods of measurement and sensitive assessment can result in the ideal sheet-metal part." Kuznik, head of the stamping department and maintenance manager at VW, went on to comment that "the precision with which tools and moulds are manufactured has a direct influence on the product quality of an automobile."

When minimisation of the gap dimensions in the bodywork become quality features by which the manufacturer is judged, the demands on presses and stamping tools become extremely high. This means that "breaking in" new tools on the

transfer line involves too much expensive downtime to be an option. The tools are therefore broken in on what are known as try-out presses, under conditions as close as possible to those of production. Mr. Kuznik knows that "a high level of agreement between the characteristics of the production press and the try-out press, for instance the speed characteristic of the ram, the pull-out parameters, the behaviour of the die cushion system and the deformation of the table and the ram is needed." The modern solution for the automobile manufacturer is the hydraulic try-out multi-curve press. It was developed three years ago by Müller Weingarten, the press manufacturer based in Germany, as an economical alternative to mechanical presses. The automobile company VW rebuilt Hall 16 in 1999, and this is where the multi-curve press is located. Little by little it is also being used for tool testing and simulation. After just over a year, a total of six presses now simulate the real production environment, and an increase to a total of 12 machines is planned.

PC technology makes presses flexible

As large as a house, and with a pressing force of up to 25,000 kN, the powerful drive and control system for the press is itself a remarkable piece of engineering. The control valves implement ram speeds of up to 500 mm/s, demonstrating their



This is Müller Weingarten

Müller Weingarten are internationally leading suppliers of equipment and engineering systems for forming metallic materials. Müller Weingarten's core business is the design, specification and equipping of press tools for the manufacture of body parts by the automobile industry and its suppliers. Their principal production sites are located in Weingarten and Esslingen in Germany. Other production, marketing and service branches are situated in Germany, France, Great Britain, Switzerland, the Czech Republic, China and the USA.



→ The hydraulic tryout multi-curve presses from Müller Weingarten in use at Volkswagen. A total of six presses simulate the real production environment at the automobile factory.



extraordinary process dynamics. Press manufacturer Müller Weingarten's Andreas Hahn underlined their engineering approach by commenting that "the key to this control behaviour is certainly the Industrial PC control system." As the manager of electrical construction at the company's Esslingen branch, he can look back over many years of co-operation with Beckhoff as pioneers of PC-based automation. "We have been using PC-based controllers from Beckhoff since 1990," commented Hahn, "and for the last three years more than 90% of the machines in the hydraulic press sector have been fitted with PC-based controllers." The controller expert found the reason for using PC technology was its scalability and flexibility, combined with its excellent price/performance ratio.

Lightbus is a match for the tough industrial environment

Back at VW, Kuznik can also remember the beginnings. The presses were still controlled by PLCs, and in order to achieve high data transfer rates in the presses, Beckhoff developed interface cards that were inserted into the PLCs. For Kuznik it was primarily a matter of cost optimisation that boosted the prospects for the application of PCs. For a number of reasons Beckhoff were immediately accepted, in agreement with the press manufacturer, as suppliers of control systems. On the one hand, Beckhoff already had sufficient experience in the processes in-

volved in press construction, while on the other hand their range of products, including Industrial PCs, the TwinCAT automation software and a large number of fieldbus components, was unique on the market. "The fibre optic technology used in the Lightbus in particular, impervious as it is to interference, was immediately attractive" reminisces Kuznik. The particular problem was that cranes and thyristor-controlled actuators working in the production hall at Volkswagen had a considerable potential to generate electromagnetic interference.

Volkswagen therefore gave a green light to using PCs on the press equipment. The newly developed multi-curve press was first installed early in 1999 in Wolfsburg, Germany – and fitted with Beckhoff technology. The computer supplied by Beckhoff was of the highest performance class available at the time, with a Pentium III processor and a 700 MHz clock frequency. "This solution replaced the complex large PLC solution with three PC plug-in cards" remembers Kuznik, the maintenance specialist. He goes on to mention a further argument. "The standard PC solution allowed us to make a drastic reduction in the storage costs for spare PLC parts."

For the user, the application of PC controllers together with the use of Windows NT provides those features that are familiar from the office environment. Andreas Hahn clarified the situation, pointing out that "standard interfaces and software



What does a multi-curve press do?

If production press downtime associated with tools is to be minimised, the tools must be broken in on try-out presses under conditions as close as possible to those of production. Hydraulic multi-curve presses simulate the stroke characteristics of a variety of mechanical presses. The technology of the hydraulic multi-curve presses, with their regulated drives, makes it possible to reproduce the displacement-time curves of the working stroke generated by the rams on a variety of different mechanical and hydraulic production presses. This means that a try-out press of this kind can simulate the forming behaviour of various large-part transfer presses constructed in various ways by different manufacturers. The adjustment values found can be adopted with very little adaptation, because the forming behaviour is so similar to that of the production presses. Because tools can be broken in for a number of production presses, high usage ratios and economic viability are achieved.



permit printer drivers, network protocols and remote service functions to be used, and this allows easier and more cost-effective integration into our customers' environment." The control expert added that "the replacement of classic hardware PLC interfaces by PC software interfaces also brings a reduction in development times."

Müller Weingarten use the type C6140 Control Cabinet PCs on the multi-curve series. The PC obtains its computing power from a Pentium-III-850 processor. The high-speed Lightbus provides smooth communication between the computer and the sensors. The Lightbus PCI cards, FC2001 (1-channel) and FC2002 (2-channel) from Beckhoff give the highest possible performance to the fieldbus interface. Hahn emphasises the flexibility and capacity for extension of the solution by pointing out that "up to six fieldbus rings are used to implement fast regulation tasks on a version of the press with particularly high dynamic performance". And he has yet another example ready. "For electrical drives, we use the SERCOS interface. Here again we were able to achieve optimum quality of regulation, because Beckhoff offered tailor-made components with the 1- and 2-channel SERCOS PCI cards (FC750x)." Within the presses themselves, Hahn uses the Lightbus, while the higher level connection to the other parts of the plant is made via Profibus, using DP Profibus (PCI cards FC310x). Robust Lightbus modules are used as I/O modules.

One press simulates a variety of transfer stations

The press constructors use TwinCAT as the automation software for the Industrial PC. This solution has now proven its capacity in machines and equipment as a software PLC, software NC or camshaft controller over a number of years. The user can also make use of the Beckhoff Control Panel for optimal control and visualization of the multi-curve presses. Kuznik, the VW man, is convinced that "one of the great strengths of the TwinCAT software, with its rich range of control functions, is its capacity for extension." Control know-how from the MW experts in the form of software modules can be integrated, as can the development of two different operating interfaces. The benefit is clear. The simply-structured user interface allows the toolmaker's entries to be made efficiently and without error. In contrast, those with detailed process expertise can employ an extended level to access, for instance, the parameters for adjusting the actuators, valves or pumps. In this way the ram displacement-time curves for mechanically operated presses with various articulated or cam drives can be entered and simulated. The standards from Microsoft make this possible. Andreas Hahn: "We use Windows NT 4.0 as the operating system. We created the PLC modules for the digital controllers of the presses' hydraulic axes and for the user interface using Visual Studio from Microsoft, writing in the C++ high-level language." The control expert proudly points to the modules' performance: "We have implemented up to 10 pressure

controllers on each machine, with sampling times of 0.2 ms. We have also not had difficulty with applications having up to 18 electrical SERCOS axes on each PC, or 44 electrical assembly and servo axes."

Remote diagnosis with PC Anywhere

Andreas Hahn on servicing facilities: "We currently use PC Anywhere for remote diagnosis. Customers who have a telephone line laid to the machine, or who couple the machine to the company's PC network, can benefit from immediate remote diagnosis from any of our service locations." A connection facility via Internet/intranet is in preparation.

For Hahn it is clear that, as far as hardware is concerned, a cost comparison comes out clearly in favour of PC technology. He is unable to provide a generally applicable comparison for the software sector, because this depends heavily on the availability of PLC and high-level language programmers. Nevertheless, the progress of PC technology in press construction is nothing short of triumphant.

