

Figure 1: Rexroth PLC- and CNC Motion-Logic-System IndraControl L65



Graebener Group: Complete Automation from Rexroth for Hydroforming Presses

Increase in productivity for new and installed machines

Globally, automobile manufacturers are faced with two challenges: decreasing fuel consumption and reducing exhaust emissions. In addition to improved engine technology, they are especially focusing on reducing the weight of vehicles to decrease fuel consumption. New metal alloys with a thinner wall thickness but the same or higher strength are contributing decisively towards this goal. Hydroforming is therefore currently experiencing a renaissance in mass production. Gräbener Maschinentechnik GmbH & Co. KG – manufacturer of hydroforming presses and operator of the largest global of prototype hydroforming presses – relies on the Rexroth IndraMotion MLC Motion Logic system, which comes with predefined controls for hydraulics and Sercos bus system, to control its presses.

In the hydroforming process, a pipe or section is formed by a fluid under high pressure. As a result, the dimensions fit exactly with the surrounding molding tool. Depending on the process, material can be added via the pipe ends using a sealing punch to optimize the component's geometry. This process provides a whole range of advantages in mass production. It opens up a degree of freedom for design engineers in the automobile industry to create complex shapes for closed sections. Among other things, hydroforming means that a component, which up until now had to be put together using several subcomponents, is produced in one molding stage. The material is hardened when subjected to high pressure and as a result acquires particular properties. Reduced wall thicknesses are achieved this way, and the weight of frame structures and body panels is markedly reduced. This is a concept that will push lightweight construction forward in the automobile industry.

Suitable for manufacturers and users

Hydroforming experienced its first heyday in the early 1990s when control engineering first provided sufficient computing capacity in order to master reproduction of complex hydroforming processes with numerous hydraulic-controlled axes. Demand has revived of late through the automobile industry, which establishes new capacities and modernizes old facilities in order to increase productivity.

Gräbener Maschinentechnik GmbH & Co. KG plays a pioneering role as a provider of hydroforming processes. The Graebener Group company, a combination of companies with technological expertise in the fields of electronics, hydraulics, milling, separation and molding technology, provides the whole hydroforming supply chain: from simulating first drafts, to construction and prototyping or small-scale production, through to application-specific presses. Many customers seize the offer of small-scale production and of creating prototypes of components. That way they can test out the process for manufacturing new hydroformed components at Gräbener Maschinentechnik in Netphen-Werthenbach, Germany or optimize the process for large-scale production, while continuing production at their facilities. "By taking over the Schuler property for hydroforming in Wilnsdorf-Wilden, we doubled our stock in hydroform prototyping and small-scale production from two to four, and we now have the world's largest contingent of prototyping jobs," Torsten Adam, Sales Manager of Gräbener Maschinentechnik GmbH & Co. KG, explains. The machines have a locking force of 1,500 to 10,000 tons.

However, the outdated control system technology in the purchased machines needed a general overhaul. Gräbener Maschinentechnik used this as an opportunity to introduce a new generation of control systems for the new machine program. “As a machine manufacturer, we were looking for a control system solution that we could quickly and efficiently integrate, and which provides high functionality for complex processes”, Adam explains. “And as a machine operator in our prototyping center, we expect the automation to reduce the time for developing and trying out prototypes and to enable condition monitoring and a greater flexibility”.

Efficient engineering

The basis for the new generation of control systems from the Graebner Group is the Rexroth IndraMotion MLC Motion Logic system. This compact control system for hydraulic, electric and hybrid drives combines an open PLC in accordance with IEC 61131-3 with a powerful motion control. Previously, a high-level PLC and a NC multi-axis controller were always used in hydroforming presses.

Numerous best-in-class controllers are already predefined in the Rexroth software and then only need to be parametrized; which, when combined with the Rexroth IndraWorks engineering environment, markedly reduced engineering costs.

“Hydroforming requires a complex hydraulic process control,” Torsten Adam explains. The control system centralizes regulator functions for all hydraulic axes and increases flexibility in control structure design. For this, Gräbener uses analog Rexroth axis modules which communicate with the control system in real-time using an integrated Sercos® III bus coupler. Sercos plays an important role in the hydraulic control loop system, since demands for shorter time delays and a faster control rhythm are only ensured by the automation bus’s performance and efficiency. This technology allows the control structure to be flexible and centralized. Sercos has established itself as the de facto standard in all large automation markets when dealing with challenging applications which have great demands for dynamics and precision. Ethernet technology combines peripherals, drives, safety and office communication in one general medium and is therefore the ideal base for a cost-efficient overall network of installations.



Figure 2: IHU-Press at Gräbener technology center

Sercos combines numerous benefits that already constituted the standard in the 80s:

- High productivity and efficiency via the extremely compact Sercos automation protocol (summation frame method)
- High accessibility as a result of symmetrical ring communication and control redundancy function
- Flexible network structure with line, ring and tree as well as cascading via controller to controller communication
- The simplest integration into standard Ethernet networks (TCP/IP, IT, office, visualization, diagnostics, engineering, e.g. with Sercos/IP or FDT/DTM), Ethernet-based automation protocols (e.g., EtherNet/IP)
- Minimal installation costs, minimal maintenance and very little space required due to network structures that are consistently used and which function without switches
- Quickly implemented thanks to consistent specifications for all classes of equipment and standardized diagnostics information
- Simple diagnostic analysis using engineering tools and the Sercos service channel as well as using the Sercos/IP (S/IP) protocol or the free Sercos Monitor tool, which is independent of the manufacturer at each point in the network
- Open and independent standard for secure future developments

Tried and tested base – modern automation design

The completely reconditioned 2,500 ton press is designed to operate a total of eight tool control axes and two pressure boosters. The press tappet, as a controlled axis, allows the inserted raw primary material to be preformed. This allows the machine to work on the component without an upstream bending process and minimizes creasing. All control axes are operated via a digital axis controller in a closed-loop control system. Controllable axes are: the press tappet, tool cylinders, pressure boosters and hydromotors. Each control axis can be operated with position or pressure control dependent on another axis. If required, these dependencies can be altered several times during a product cycle.

Gräbener Maschinenteknik's own developed PressPro® program runs as an actual process operation program with visualization for the user. The user enters machine, tool and process relevant data onto the intuitive screen template and also takes the process data readings from the screen. Thanks to entries and their interfaces being clearly structured, the user can quickly adjust the machine to suit different presses, tools and processes.

Low life cycle costs

"We are manufacturers and users at the same time, which is why we know just how important low life cycle costs are in daily operations," Torsten Adam points out. Intelligent hydraulic pump management substantially improves energy efficiency. The installer can parametrize the pump set points to be process-oriented by using an

operating matrix. In this way, the pumps only generate as much energy as the process actually requires.

Sercos is also making a substantial contribution towards saving time and therefore also saving costs in the production phase. One needs to be able to modify presses quickly to suit different products. By swapping one tool, all of the corresponding hydraulic valves and control modules are also changed. As a result, the new tools must be able to be combined with the control system preferably using 'Plug and Play'. In order to achieve this, Gräbener uses analog Rexroth axis modules which communicate with the control system in real-time using an integrated Sercos III bus coupler. Unified and universal functions allow presses that are fitted with Sercos III to be operated in an energy efficient manner.

Another important manipulated variable is the accessibility of the machines. Due to all the important parameters being displayed in real values, the user can optimize processes more quickly and simply, and can pinpoint wear on the tool before it results in a malfunction. Gräbener Maschinenteknik uses the Rexroth WinView tool to do this, which is integrated into IndraWorks.

"Hydroforming is currently picking up tremendous speed again," Torsten Adam observes. "With the new generation of control systems and Ethernet buses, we are combining all the advantages of the process with a control system solution that is focused on the future and which is extremely financially viable." ■

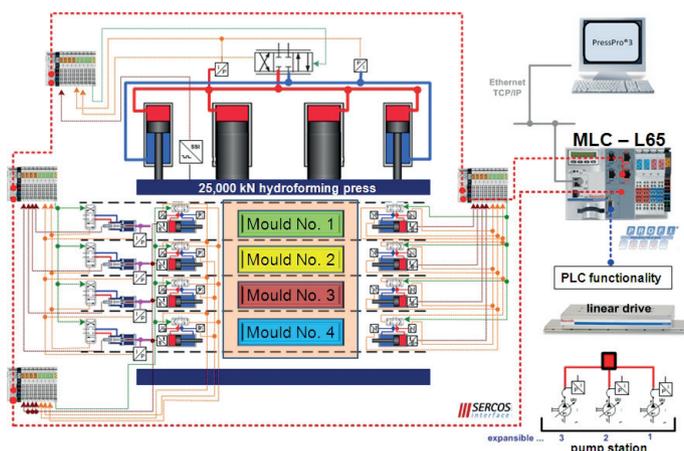


Figure 3: Control diagram

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