Stephan Nissen, Siemens AG

Fully electric for higher efficiency

Faster starting, more compact, flexible and convenient, as well as safer, quieter and more energy-efficient in operation. These are the wide-ranging benefits of upgraded rollup machines for insulating materials. These benefits are achieved thanks to the latest controller, high-performance motion control and, for the first time, a fully electric drive system.

The machine and plant construction company Kaibel & Sieber GmbH (K&S), based in Worms, Germany, has taken a significant step to make its tried and tested rollup machines for insulating materials fit for the future. From the mechanical and hydraulic systems to the electronics, all components and concepts were put to the test. As a result, the entire hydraulic system was eliminated and the world's first exclusively servomotor-driven rollup machine, the WM12 was developed (See Figure 1).

The rollup machine

The rollup machine is located at the end of a production line for glass or mineral wool and winds a continuous feed of insulation mats of varying lengths and thicknesses onto rolls in an automatic process. The WM12 prototype is fully capable of production, has a working width of 3m and packs two or three rolls of insulation simultaneously. It is mechanically and electrically prepared for the integration of a customer-specific plastic film wrapping system.

The machine is designed for winding speeds of up to 160m/min. In conventional 'high-speed' production lines with production speeds of up to 80m/min, the processing of 4m-long cuts results in a cycle time of seven seconds per pair of rolls. This means that any faults or, worse still, failures of the rollup machine would result in massive logistical problems. This is because the glass flow through the defibration machine cannot simply be stopped, which means that a continuous flow of material must be processed. As a result, extreme reliability is demanded from all plant components.

The designers at HMR Automatisierung und Prozesstechnik GmbH from nearby Weinheim were also well aware of this fact. This system integrator, and long-term partner of K&S, was involved in the development from the start and had drawn up a completely new control and drive concept. The concept is based on the Totally Integrated Automation Portal (TIA-Portal) engineering framework from Siemens and on control- and drive-components with the highest performance. The software was also redesigned from the ground up, in order to be able to fully exploit all possibilities and advantages of the integrated system.

High-performance and flexible motion control

The actual winding of the insulating material imposes particular demands with regard to precision and options for intervening into the system. The layer thickness, and thus the diameter of the roll, is determined by the interaction between the precompression at the material infeed and the guidance of the winding roller. For 'regulation' purposes, the



Right - Figure 1: The first fully electric WM12 rollup machine for insulating materials has a significantly more compact design than its hydraulicallydriven predecessor. The new approach by Kaibel & Sieber also reduces energy consumption by up to 60% while significantly reducing noise.

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Above - Figure 2: Modular Sinamics S120 converters and the Simotion D motion control system from Siemens are the core components of this now fully electric drive system.



Above - Figure 3: Cleanly structured and space-saving alternative to hydraulics: Simotics servomotors from Siemens permit fast, precise winding with smooth motion to reduce the stress on the machine.

pre-compression is performed in the longitudinal direction of the machine, while the winding roller moves in response to the increasing diameter of the roll. The resulting winding curve is not linear, which means that a different amount of compression is required when starting the winding than at the end. In addition, the distance between roller and the pre-compression must be adjustable by means of an override option during operation. This is so that the operator can respond to fluctuations in the density. This could only be implemented by using a highperformance motion controller.

In order to implement everything on a single platform, the TIA-Portal, the system integrator HMR decided on the Simotion D435 high-end motion control system (See Figure 2).

"Since Version 13, the TIA-Portal has supported the configuration and programming not only of Simatic F-CPUs, but also of Simotion with Scout TIA, so that we were able to solve everything on an integrated basis for the first time," says managing director Edgar Eder. The integration of the Simotion hardware and of the Scout TIA engineering tool into the new engineering framework also standardises the creation of motion-control applications. In this way, coordinated Simotion controllers, Sinamics converters and Simotics motors can be dragged from lists and dropped into a project, graphically linked together in the network view and then programmed subsequently.

Programmer Andreas Wolf has utilised the functionality in Simotion in order to precisely coordinate the applicable servo axes with one another in the required relationship and with the highest degree of flexibility. The interpolation points generated on the operator panel are transferred to Simotion using an ActiveX control specifically created for the purpose. This uses these points at runtime to calculate winding curves with smooth gentle motion that reduces the stress on the mechanical systems.

With united, distributed forces - Including safety

The normal control and safety-related functions of the upgraded rollup machine are controlled by a Simatic S7-1500F with a fail-safe 1517F-3 PN/DP CPU. This enables the entire application to be configured and programmed in the TIA-Portal with a standard look and feel, which further reduces the engineering time.

The PLC coordinates about 12 servo axes, which require no special electronic interconnections. For this purpose, it communicates via Profinet with converters of the modular Sinamics S120 series, which control the servomotors of the Simotics S-1FK7 series (See Figure 3). A SIMOTICS M-1PH8 is the feed drive and line master to which all other servo axes are electronically coupled.

The fail-safe communication between PLC, motion controller and drives uses the PROFINET functionality of the I-Device F-Proxy in the Simotion. This routes the Profisafe telegrams of the Simatic F-CPU via the Simotion to the Sinamics converter and controls the safety functions - integrated in the drive. The integrated Safe Torque Off (STO) and Safe Stop 1 (SS1) functions prevent the drive from inadvertently starting. Even at the first downstream machine, the SLS (Safely-Limited Speed) function allows a safely limited speed to be set, ensuring safe operation in all circumstances.

User-friendly HMI according to a proven model

HMR used and further expanded the tried and tested operating concept of the machines into the new engineering world and onto a new Simatic HMI TP1900 Comfort Touch Panel (See Figures 4 & 5). One new Right - Figure 4: System integrator HMR Automatisierung und Prozesstechnik GmbH has also created an intuitive visualisation system on a Simatic HMI TP1900 Comfort Panel in the TIA Portal.

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Right - Figure 5: The operator can conveniently edit winding curves on the Touch Panel and transfer them via ActiveX Control to the Simotion D motion control system as a table of interpolation points.





addition is a user-friendly 'curve generator' to create and edit material-specific winding curves directly at the machine. On the Touch Panel, the operator can adapt a calculated setpoint curve quickly and easily to the actual machine behaviour, for example, if the target diameter does not correspond to the recipe's specifications. Curves modified in this way can be stored and later reloaded and processed at the touch of a button.

Structured programming for easier software maintenance

"The new mechanisms for clearly structuring the programme and automatically tracking variables in the TIA-Portal make the work very easy and efficient,"



explained Andreas Wolf. This means he can quickly and easily create a program encompassing all functionalities of a rollup machine, from which all variants can be simply derived by activating and deactivating modules. The library concept supports this modularisation and also makes future expansions significantly easier.

Summary

With the first fully-electric rollup machine, Kaibel & Sieber realises a whole range of benefits for itself and for the companies operating these machines. The integrated, simplified engineering for PLC, motion controller, drives, HMI and I/O in the TIA Portal leads to an operation machine in a shorter time than ever before. The plant-wide integrated diagnostics also speed up commissioning, because faults can be pinpointed sooner. Programmer Andreas Wolf has 'never before commissioned a comparable new machine so quickly.'

Where permitted by the operator, remote diagnostics are also possible, right down to the drive level; previously this stopped at the interface to the hydraulic system.

The electric drives are more compact than the hydraulic ones. This means that the $10m^2$ of space previously required to install the hydraulic unit is completely freed up. At just over 3m in length, the control cabinet takes up just half of the usual space.

In addition, there is an energy saving of at least 60%, as the electric drives only run when they are required. Also they do this significantly more quietly than the existing hydraulic systems, which improves the ergonomic quality of the workplace.

"One advantage for us as a machine builder is the openness of the integrated system," says K&S managing director Walter Siegel. Until now the hy-

> draulic controller was always a 'black box' and modifications and new functions could only be carried out jointly with the manufacturer, and sometimes also the service department. The new Siemens system is open in every respect and can essentially be maintained by any PLC programmer. "This allows us to be even more flexible and able to be active in the global business arena. Taking this step has also secured the availability of spare parts for years in advance," he adds.

Left - Figure 5: Satisfied with the joint development (left to right): Edgar Eder (MD of HMR), Michael Balz (Automatisierung K&S), Walter Siegel (MD of K&S), Andreas Wolf (Programmer at HMR), Volker Weiss (Sales at Siemens AG).