

Voith paper's pilot plant automation permits remote customer monitoring, Solutions!, Online Exclusives, October 2002

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VOITH PAPER'S PILOT PLANT AUTOMATION PERMITS REMOTE CUSTOMER MONITORING

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To remain state-of-the-art in the art of papermaking, Voith Paper's world-leading 1.25 ton-per-hour pilot plant in Appleton, Wisconsin, USA has upgraded to the latest in automation technology. A modular and scalable process control system – DeltaV from Emerson Process Management – has replaced a traditional DCS (distributed control system) installed when the plant was built 10 years ago.



Figure 1. Pilot plant, Voith Paper Technology Center, Voith Paper Inc., Appleton, Wis. The control room is at the top of the stairs (center).

The major reason for the upgrade: To access Voith papermaking equipment in customer plants around the world via the Internet to perform remote maintenance and performance monitoring. Remote monitoring could be best accomplished by bringing the pilot plant's control into the more open world of PCs, Microsoft, and Internet and wireless communications standards and by gaining powerful trending and data capture/analysis capabilities.

Savings gained by Voith and its customers from remote monitoring are expected to quickly pay for the automation investment by eliminating some of the need for Voith technicians to visit customer sites.

World's Largest Pilot Plant

The pilot plant, located in Voith's Technology Center, is the largest pilot stock preparation and papermaking facility in the world. It's also unique because it employs continuous flow, like a production paper line, not batch. Within the pilot plant is a testing laboratory for evaluating pulp and the final paper product during trial runs. The facility is even designed for hands-on training of customer operators.



Figure 2. The pilot plant's testing laboratory evaluates pulp samples and final paper products during trial runs.

The plant's process train, which is modular for maximum flexibility, can be quickly customized to add or delete process modules or to switch process sequences around. A typical customer trial, including customizing the train, making test runs, and performing evaluations averages about two weeks. Two trials are sometimes in progress at the same time.

Since the day the pilot facility opened, Voith has continuously updated it with the latest prototype and commercial technologies so that customers can benchmark the performance of their most up-to-date commercial papermaking lines. The pilot plant's new automation continues the company's upgrade philosophy.

Process Flexibility Essential

The plant's process train includes conveyors for loading pulp bales and/or recovered waste into either a high or low consistency pulper. Both have de-trashing loops. Typically, the customer supplies the stock; tons of material regularly arrive in Appleton from all over the world.

The slushed pulp proceeds to two dump chests of 2.5 tons capacity each, then moves on to refiners, deflakers, cleaning systems, screens with holed or slotted baskets, flotation systems to dislodge and float out inks, thickening presses, fiber loading machines, water clarification, etc. The thickeners recirculate water back into the process, which makes the plant very mill-realistic.

Automation must be flexible because customer trials seldom employ exactly the same equipment and sequences. This means that each piece of equipment must be capable of being operated as a standalone as well as being configured into an interactive process train.

The facility's lines and valves are oversize to allow a wide range of throughputs. DeltaV's expert autotuning permits back-to-back tests to be made when switching from 1/8 flow to full flow, as an example, without losing control – even if all equipment is started at once. Tuning optimization is not possible, however, because of no single design throughput exists. The plant is evaluating fuzzy logic to achieve even tighter control stability.

Personal knowledge of pilot plant equipment and processes –and a very good memory of test setups – is required by the three operators assigned. They also serve as the plant's pipefitters, equipment installers, electricians, instrument techs, and programmers. The new automation has made setup for test runs easier and faster, and flows and pressure drops are more quickly stabilized. Speedy navigation through Windows-based engineering and operator workstations helps.

Cost-Effectively Scaled

The automation has the power, flexibility, and capabilities of a traditional DCS in a compact, substantially more cost effective package. Although the pilot plant's basic configuration rarely needs to be changed, the graphical IEC Function Block Diagram and Sequential Function Chart languages employed are easy for operators to follow. Helpfully, interlock logic was written only for conveyors because of the need for trial flexibility.

If the pilot plant's control needs grow, the system can be scaled in 50 DST (device signal tag) increments to minimize additional investment. The initial system, which supports up to 500 DSTs, is comprised of a two DeltaV process controllers, about 450 I/O points made up of Foundation™ fieldbus instruments and valves plus discrete and 4-20 mA analog devices, two PC operator stations, PC application and engineering workstations, and an Ethernet network tying the controllers and workstations together.

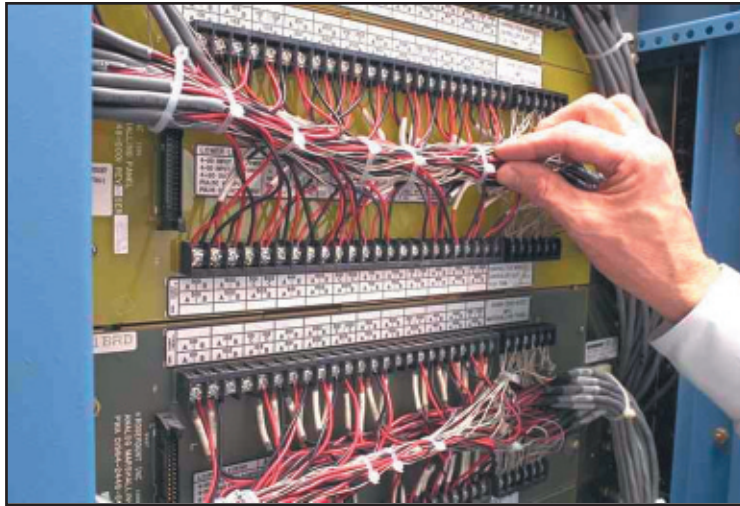


Figure 3. New terminal strips and wiring at the back of the DeltaV process control cabinet.

Most of the plant's existing valves and instruments remain. Fieldbus was selected for new devices because of the simplified wiring and because large amounts of information can be extracted from these instruments for remote monitoring purposes. Further, diagnostics and calibration can be performed from the workstations.



Figure 4. Rosemount FOUNDATION fieldbus transmitters (left) and fieldbus segment connector block (right).

Remote Equipment Monitoring Coupled to Process Control

Voith plans to use the new control technology to remotely monitor Voith papermaking machinery in customer plants all over the world. Although a remote monitoring system could be assembled independent from the pilot plant's process control system, there are advantages for coupling pilot plant monitoring and control, customer monitoring, and the pilot plant laboratory instruments as well.

The advantages owe to DeltaV's global database and built-in OSI PI historian, plus its ability to accept additional PCs and third-party PC software packages for gathering, storing, integrating, manipulating, and analyzing data collected from pilot plant, customer, and laboratory equipment alike. The system also offers OPC for open access to a variety of data sources plus DeltaV EasyIT for establishing Internet-based data transactions. Coupling remote monitoring to the process control system also permits Voith to perfect monitoring procedures in-house before offering them to customers.



Figure 5. DeltaV operator stations in the pilot plant control room.

The company only has the outlines of what it wants to do with remote monitoring, but the potential for assisting customers at a relatively low cost is enormous. If phone calls and emails can't do the trick today, Voith service technicians must fly worldwide to help customers re-establish equipment design conditions, among other tasks. The cost is obviously very high. Additionally, personnel within the Voith Technology Center often gain knowledge before the company's service technicians are made aware; at the minimum, they could bring other opinion into the mix.

Maintenance Monitoring First

Voith's first effort in customer monitoring will be to assist in equipment maintenance. After some experience is gained, performance monitoring will be added.

Maintenance monitoring, the easiest and most straightforward, can either backstop the customer in assuring maintenance intervals are followed, or it can be his primary resource. Via Internet technologies, Voith plans to view its machinery in distant plants and track such operating parameters as downtimes and uptimes. The idea is to alert customers about impending PM dates as well as dates for changing components such as bearings and motors. The information could also alert Voith Manufacturing when parts might be needed.

Performance monitoring – for equipment health, performance, and optimization – is more complex. Here, the Technical Center envisions installing sensors on customer equipment to indicate how well the equipment is operating, when it needs attention, and how to make it run better. More and more, open-platform sensors and sensor systems are coming on the market, which should speed performance monitoring development by Voith. Just keeping up with all of the new open sensing technology is a job in itself.

Performance Monitoring Undergoing Tests

To test the feasibility and cost-effectiveness of performance monitoring, Voith recently installed a shaft vibration/bearing temperature/kW/power factor analysis system on the pilot plant's newest Multi-Fractor screen and drive motor. This research project relates screen operating data moment-by-moment with stock consistency, also instrumented. Hopefully, comparing trended data from Time 0 will help the company ascertain the degree of equipment performance degradation and initiate an alarm before damage or shutdown occurs. It also might help predict equipment failure.



Figure 6. A shaft vibration/bearing temperature/kW/power factor analysis system instruments the pilot plant's newest Multi-Fractor screen and drive motor.

The Technical Center is evaluating wireless means for transmitting data within the plant. Wireless will allow sensing systems to be placed in customer plants quickly with little wiring. The company has already learned that frequencies distant from those of RF crane controllers are a must; the Bluetooth wireless LAN standard looks promising in this regard.

Concurrently, company engineers are creating remote monitoring report formats, web pages for passing reports over the Internet, auto dial-up methods for pushing or pulling reports to Appleton, and Visual Basic script for launching programs and supervising the remote monitoring process without human intervention. It's possible third-party application service providers might assist in establishing communications links.

15 Days to Convert



Figure 7. Cabinet containing two DeltaV™ controllers from Emerson Process Management, Systems Division, Austin, Texas.

Changeover to DeltaV from the former DCS took only 15 days and was accomplished by the three-person operating staff plus the full time assistance of an engineer. The physical conversion involved gutting two existing cabinets of DCS components and cards, then installing and wiring the modules of the two new controllers into just one of the cabinets. Layers of field wiring were pulled back through the abandoned cabinet, and terminal blocks installed for splices. Some existing marshalling panels were used for terminations, which simplified the work.

An Excel spreadsheet was employed to consolidate and arrange the DCS database for downloading into the new control system. Over years of operation, the DCS database had been modified for various trials, stock fibers, and equipment. Notes from the DCS's original installation and later notes from process engineers and operators were all brought together and conflicts resolved.

The 15-day changeover also included installing the control system software, checking out the I/O and loops, and testing five process sequences. Start up was fast and uneventful because plant operations are unchanged and operators were intimately familiar with all aspects of the new automation because of their installing it.

Only essential flows and automatic valves are presented on the new automation's dense but easily read, imported bitmap graphic displays. Many process lines are not shown, and no hand-operated valves are seen. Attempting to include all lines and valves would have made for excessively dense displays. It also would have been an exercise in futility, as many lines are re-routed for customer tests.