



Figure 1: The communication in the PM2 paper machine of the Trostberg paper mill is based on the PROFIBUS fieldbus

PROFIBUS Monitor detects critical changes in the fieldbus system and prevents downtimes

Maximum Availability through Network Analysis

A breakdown of the fieldbus communication system can quickly become very expensive, particularly if it causes unplanned downtime of complex machinery like paper manufacturing facilities. To avoid network problems, it is essential to know the current age-related states of the installed PROFIBUS components. The PROFIBUS Monitor (BC-502-PB) diagnostics tool for the continuous monitoring of PROFIBUS networks supports the early detection of potential failures. In addition, the analysis data provided by the PROFIBUS Monitor can be used as the basis for scheduling preventive maintenance action during planned machine downtimes.

The Hamburger Rieger paper mill in Trostberg, Germany, was founded as a family business by Johann Rieger in 1912. Last year the paper mill celebrated its 100th anniversary. With its continuous innovations, its consistent strategic investments in cutting-edge technology and its in-depth knowledge of paper and paperboard manufacture, Hamburger Rieger has grown to become the European market leader for white corrugated raw papers. Today 400 employees at several locations produce around 500,000 tons of paper and paperboard per year.

With a daily production of over 400 tons on two machines, the Trostberg paper mill contributes a significant share of Hamburger Rieger's overall production volume. This high level of production output can only be achieved if the paper machines run 24/7 and machine availability is, ideally, at 100 percent. Unplanned machine downtimes will in most cases interrupt the production for several hours and rapidly run up losses of several ten thousand Eu-

ros. For this reason, planned downtimes are regularly scheduled for cleaning, upkeep and maintenance work on the paper machines.

Modernization of the PM2

Since 1992 the PM2 paper machine, a special-purpose machine for the manufacture of four-ply white lined and coated testliners based on waste paper, has been at the core of the machine park of the Trostberg paper mill. The high-quality testliners are used as the top ply of corrugated board and are particularly well suited for brilliant four-color prints on packaging. Following comprehensive modernization in 2002, the PM2 was able to step production up a notch, bringing the paper machine's speed to 850 meters per minute and thus daily production to 290 tons. As part of the three-week modification work, the electrical communication system was changed to state-of-the-art PROFIBUS DP technology.

Age-related material wear

After the PROFIBUS installation, the paper machine worked for several years without failure of the bus communication. As Hamburger Rieger initially knew relatively little about PROFIBUS technology, no planned maintenance work was performed on the PROFIBUS network at the time – until the PM2 paper machine broke down in 2010 because of a failure in the PROFIBUS network. It was later found that the breakdown had been caused by severe oxidation of connectors and connecting wires in the bus cabling. This, in turn, was due to the poor air quality in the control cabinet room as well as a fire in the control cabinet, which had been caused by polishing wool some time ago. Before the paper machine could be started up again, various bus connectors and cables had to be replaced and the bus shield had to be re-grounded. The repair work took a considerable amount of time, which resulted in a long production downtime involving an accordingly high financial loss.



Figure 2: The paper roll slitter cuts and rewinds the produced testliners in different widths and lengths according to customer specifications

As a consequence of the machine breakdown, Hamburger Rieger decided to improve in-house PROFIBUS expertise and to learn more about the aging of PROFIBUS networks in order to avoid unplanned machine downtimes in future. An important step in achieving this aim was to commission the communication specialist Softing Industrial Automation to perform a comprehensive analysis of the PROFIBUS network at Hamburger Rieger. The results from the network test confirmed the corrosion-related aging of several network components. However, the signs of aging detected in the tests did not yet affect the performance of the overall network so that another machine failure was not to be expected in the short run.

To develop expertise in troubleshooting PROFIBUS networks, the engineers at Hamburger Rieger took part in a training course offered by Softing. For Markus Schweiger, head of measurement and control technology at Hamburger Rieger, the training was an eye opener: "I didn't just learn about PROFIBUS functionality there. I also found out a lot about the problems that can occur during operation. The training explained what factors cause aging of the bus and how age-related downtimes can be avoided." For Markus Schweiger, another important part of the training course was the hands-on exercises, which focused on the physical and logical analysis of PROFIBUS networks.

PROFIBUS Monitor keeps a watchful eye on the network

Using the newly acquired PROFIBUS know-how, the engineers at the Trostberg paper mill now efficiently monitor the PROFIBUS network and its different lines and segments. The monitoring strategy is based on a special diagnostics tool. Before making the purchase decision, Mar-

kus Schweiger had thought long and hard about the appropriate tool for their needs. Following extensive market research and detailed comparisons of the functions and features of various offers, he decided to opt for the PROFIBUS Monitor (BC-502-PB) from Softing. "This diagnostics tool has many different functions we can use for the continuous monitoring of all data traffic in the PROFIBUS network. Especially regarding the analysis of the PROFIBUS frames, Softing's PROFIBUS Monitor has major advantages," says Markus Schweiger.

As a result of monitoring the network, the diagnostics tool reports everything of interest that may cause unplanned machine downtimes. During the analysis, the bus cycle times are measured and criti-

cal events are logged, e.g. the number of frame errors, message retransmissions, drop-outs and restarts of PROFIBUS devices, and device faults that are displayed as internal and external diagnostics. Based on this data, the PROFIBUS Monitor determines information about the "age" of the PROFIBUS segment and its connected devices, without causing interference or influencing data traffic. In this way, the progressive decrease of operating reserves for the bus communication, which takes place over time, can be detected early on when the PROFIBUS network itself is still working properly. In selectable intervals, the machine operators can be notified whether the operating state is OK or BAD. This can be done by visualization on a web page or directly by the LED indicator on the PROFIBUS Monitor. The web interface displays additional information, such as the events and alarms that occurred as well as a list of available PROFIBUS nodes. Today the Trostberg paper mill uses the PROFIBUS Monitor for the seven most critical PROFIBUS segments – three bus segments for drive control with 100 drives and four bus segments for machine control. An additional PROFIBUS Monitor was installed in the machine controller for the KM1 paper-board machine.

Installation without modification work

The PROFIBUS Monitor was easy to install in the PROFIBUS segments of the paper machine because no changes to the bus addresses and control programs were required. All that needed to be done



Figure 3: The PROFIBUS Monitor can be installed directly in the control cabinet with a minimum of effort.



Figure 4: The machine control room also provides access to information about the current state of the PROFIBUS network via the PROFIBUS Monitor.

was to provide the diagnostics tool with a 24V power supply and to connect it to the PROFIBUS network in series with the other bus devices. Where necessary, the tool was connected using potential-free contacts. The PROFIBUS Monitor is completely independent of the manufacturer and the type of the controllers and field devices being used. To implement a central monitoring and operating station, the Ethernet connection is used via the paper mill's intranet. From this control room, shift supervisors can directly access the states of the installed PROFIBUS Monitors, without even leaving their desks. A major advantage of this solution is the great amount of time saved by eliminating the need for on-site inspection of the paper machine, which has huge dimensions.

If the bus state deteriorates in the paper mill, the PROFIBUS Monitor notifies the staff early on. This monitoring strategy now also offers the possibility to include the PROFIBUS network in the list of preventive maintenance actions that are scheduled for the planned downtimes of the paper machine. "The PROFIBUS Monitor gives me the peace of mind that the entire electrical communication is running reliably and that such a costly breakdown of the PROFIBUS network and the time-consuming troubleshooting it involved will not happen again. When the tool's LED indicator is green, I'm satisfied," Markus Schweiger explains. "Ever since we've been using the PROFIBUS Monitor, the paper machine has been running without any problems. This has increased plant availability to a level where we can produce testliners round-the-clock."

In addition to the PROFIBUS Monitor, Hamburger Rieger also uses Softing's PROFIBUS Tester 4. This mobile diagnostics tool is particularly useful for locating faults in the PROFIBUS network. With

just the push of a button, the tool tests the bus physics by measuring the signal quality, and analyzes the transmitted frames. To pinpoint the fault, this process can be repeated at different locations in the network. The results are then clearly structured and displayed.

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