



Innovative Trends in Automation

Quality control systems of the future will put significantly higher emphasis on analytical tools. This will improve process control and disturbance analysis can be carried out sooner. The papermaker can use the analysis results to identify complex technological interrelations. Nowadays, – analytical tools are already essential, given the complexity of a paper production plant. The high quality targets cannot be economically achieved any longer in any other manner.



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Powerful quality control systems play an increasingly important part in this process, although important process data are also gathered from other systems and measuring devices. The origin of data is of no significance for the machine operator. It is only important that these data flows are channeled, archived and processed in a uniform manner. These analytical tools will determine the great development steps of the near future.

This trend in automation technology is primarily based on:

- machine-integrated sensors,
- information systems for data integration,
- quality and process controls which are increasingly linked and realized by DCS tools.

Machine-integrated Sensors

Conventional quality control systems require places with open draw, where the paper web is accessible from top and bottom, for installation in the paper machine. In modern paper machines with largely closed web runs, such places are becoming increasingly hard to find.

New measuring methods focus on single-sided quality measurement, increasingly even in places hard to access to date. The attempt becomes even harder, because this is often a great challenge due to the ambient conditions. And then there are the sensors of similar design, which do not monitor the paper, but the production process.

As examples, we mention the traversing moisture measurement after the press section by the EnviroScan (Fig. 1) and the traversing felt condition measurement by a permeability sensor and a moisture sensor (Fig. 2), all done under difficult ambient conditions in the wet end of the paper machine. There, potential trouble is detected early, which allows faster control, as the disturbance is detected close to the place of origin.

The EnviroScan can detect characteristic features in the moisture profile of the web after the press very quickly. This allows an assessment of the mechanical dewatering behavior of the press. The op-

erator can recognize the influence of the wet end and the press on the moisture profile.

The felt condition measurement can be used to assess the felt or, in conjunction with an automatic felt cleaning device, for specific felt cleaning action at the same time. The latter guarantees longer felt life and with it fewer machine downtimes for felt change.

Future quality control technology will be more concerned with the process itself not only with the final product. With smooth processes, quality is speaking up for itself.

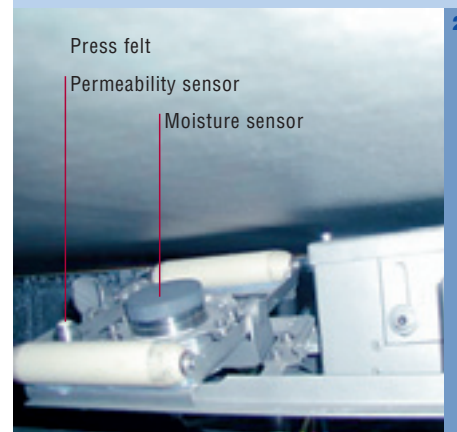
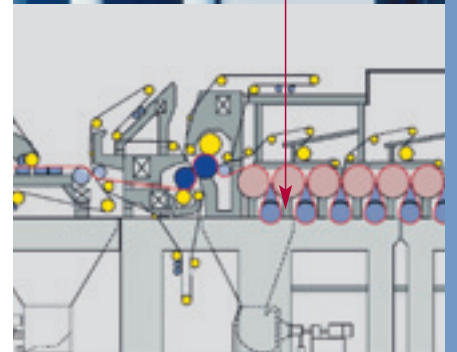
Process Analysis

Traditional analytical technology was based on the assessment of process data in graphic representation (trends). This can be refined further if a screen page can display both quality and process variables in the same diagram at the same time.

The present example (Fig. 3) shows the development of a felt over a period of more than 3 weeks. Specific cleaning allows one to extend the life of the felt. The data, however, show that the impact of cleaning does not have lasting effects. Twelve hours after washing, the felt reaches the same condition as before the cleaning process.

Fig. 1: EnviroScan installation location.

Fig. 2: Felt condition measurement.



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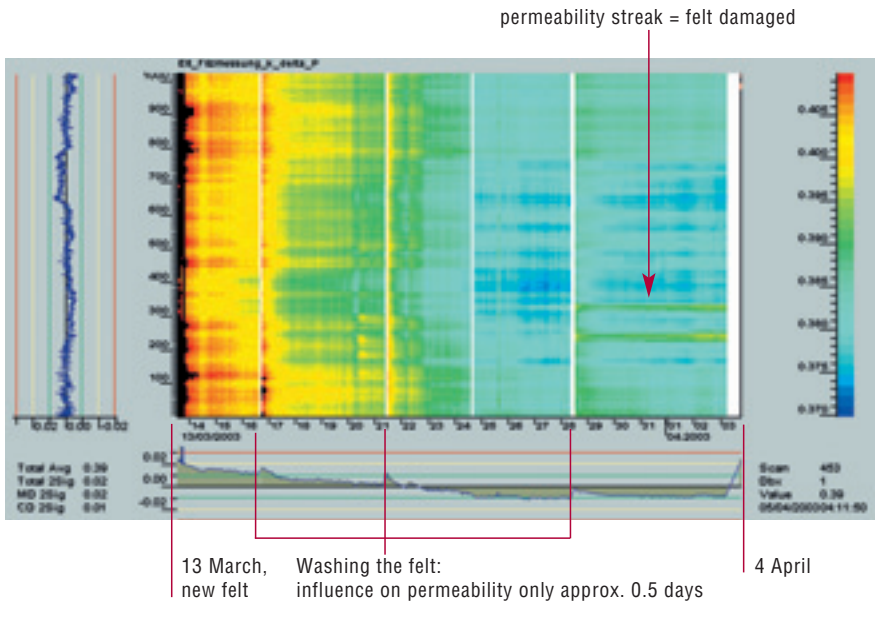
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Fig. 3: Development of felt condition over several weeks – permeability of the press felt.

Fig. 4: Integrated information display of quality data and paper defects.

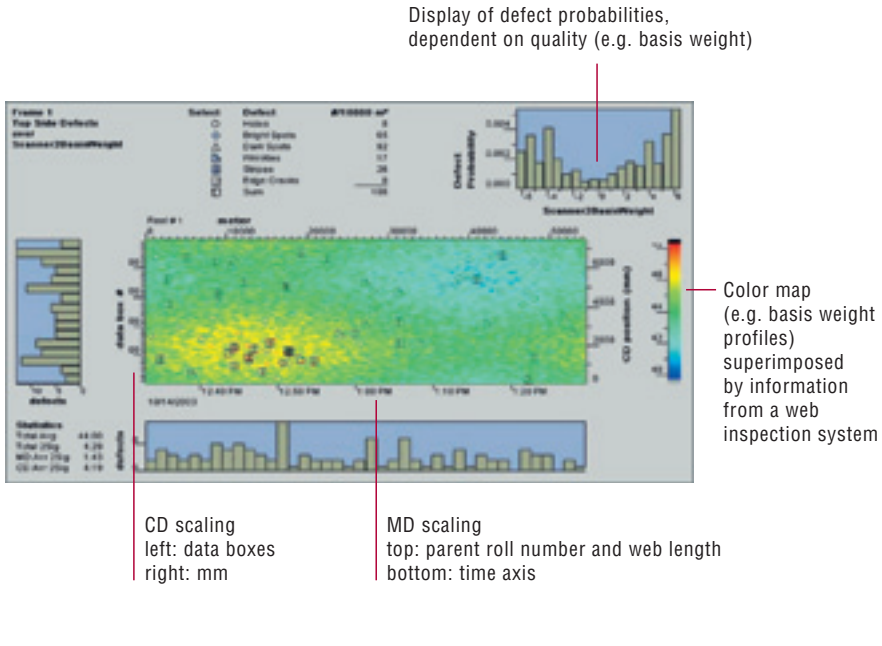
Fig. 5: OnQ traversing quality scanner at LEIPA-Schwedt.

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Although cleaning initially increases the uniformity over the entire web width and the permeability is briefly increased at the same time, it quickly and continuously decreases again. In the last phase, permeability streaks increasingly appear, which requires the felt to be replaced soon. The picture in particular shows two streaks of higher permeability after a shut-down. The increased permeability of the felt in these places was the result of damage to the felt during startup of the paper machine. The nap of the felt was partly rubbed off in two places.

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The example shows: Sequential analysis of the moisture profiles in different places of the process and carefully excluding influences allow successful performance of problem analysis.

Integrated Information Systems

Process information is obtained in a variety of places in the paper production process. It is important, however, that all this information should be seen in context. This is particularly true for the assessment of paper defects, for which a connection to other quality parameters can be assumed.

When such connections are found, measures to eliminate them can be found in most cases. But even without correcting actions, problem areas like that can be



taken into account later during finishing or optimized cutting.

An integrated representation of quality deviations and paper defects in connection with cutting optimization is, therefore, desirable. A so-called color map can show color-coded quality data and paper defects together (Fig. 4).

PaperMiner

In the above example of a color map, a relatively small amount of specific information is sufficient to allow a meaningful analysis. In paper production, however, – this is rather the exception. As a rule, the interrelations are complex and difficult to identify, although or because a huge amount of data is available. For example, the question under which process conditions good printability is achieved cannot be answered by simple means.

These and similar questions are typical tasks for the PaperMiner. But first, the data must be collected and prepared for the PaperMiner. The PaperMiner can pick up its information from this data pool.

The PaperMiner provides a number of methods for analysis. The most important ones of these are the so-called **Self-Organizing Maps** and **Decision Trees**, which originate from the area of “machine learning methods”.

These techniques allow both model-based forecasts and a deeper insight into the process interrelationships.

In the case of “Self-Organizing Maps (SOMs)”, the system starts with a continuous data set, which may comprise hundreds of data for one parent roll and reproduces the data on a two-dimensional display. Each data set is assigned to one spot on the display.

The SOM method can be used for forecasts with good success. Once a SOM has been generated, the place of a modified machine setting can be determined on the two-dimensional map, and it can be used to determine the expected values for the desired target parameters (porosity, formation etc.). Of course, the quality of such forecasts is greatly dependent on the number of data sets used to generate the map, and whether or not all major influences were included.

Decision Trees are another method of analysis. In order to use Decision Trees, a target value to be analyzed is first selected. The decision tree can then be used to find out which process adjustments must be made.

Generally, it can be said that the PaperMiner is a very efficient tool for data analysis. It is capable of handling large volumes of numerical and non-numerical data (such as grades, felt type, ...). It provides a high quality of results even for

complex physical relationships and facilitates the understanding of the process. This allows forecasts of process behavior, for example. However, the methods require good data quality from a large amount of data available, and they cannot be mastered without basic technological knowledge.

System-integrated Process Analysis

Due to networking via Ethernet and the communication standard OPC, it is today possible to exchange and link data, regardless of the place of their acquisition within a system’s network. This now provides a uniform user interface that allows functional data integration between QCS, DCS and other systems.

This is particularly important for all systems that provide process information. These include:

- Reporting of the quality control system,
- Web inspection,
- Web break analysis,
- The bearing monitoring system,
- The technology monitoring system,
- The traditional distributed control system and more.

All data acquired by means of these systems will be available in a central database in the future and can be linked to each other. This makes physical relationships visible and allows them to be processed in a total plant visualization for the operator.