# Metso's New Fiber To Print Solution For Optimum Paper Quality

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**ABSTRACT**

Metso's new Fiber to Print solution coordinates a complete suite of process quality and environmental control solutions based on time-synchronized data collection and management across whole chain from pulp production to end-product. Harmonizing data from automated paper quality laboratories and on-line paper quality sensors, all the way back to analyzers in pulp preparation, now provides a full picture of the quality building process. Users have reported that bottlenecks and opportunities for further optimization are more easily identified and significant improvements in productivity have been achieved. Printing house reclamations can be significantly reduced by applying new developments in online measurements of paper structure and surface properties.

Today's papermaker faces a variety of demanding challenges; to make a stable, uniform product at the desired quality level, while increasing efficiency, agility and flexibility to minimize downtime and off spec production with an increasing number of grades and alternative raw materials. Achieving the lowest possible papermaking costs without sacrificing quality requires a deep understanding of how the process works and the design of measurements and control systems that use this knowledge. By combining process performance controls together with product quality management from new online and corresponding offline measurements, Metso has developed a coordinated approach to quality and productivity from pulp production to end product.

**Fiber to Print**

Synchronizing data from a automated paper quality laboratory and on-line paper quality sensors, all the way back to analyzers in stock preparation, can provide a full picture of the quality building process. Variability between one reel and the next and some of the variability within a reel are usually fairly well controlled by the scanner and quality control system (QCS). However, a major part of paper, board or tissue quality is built before the headbox as the graph of basis weight variability shows in Figure 1.

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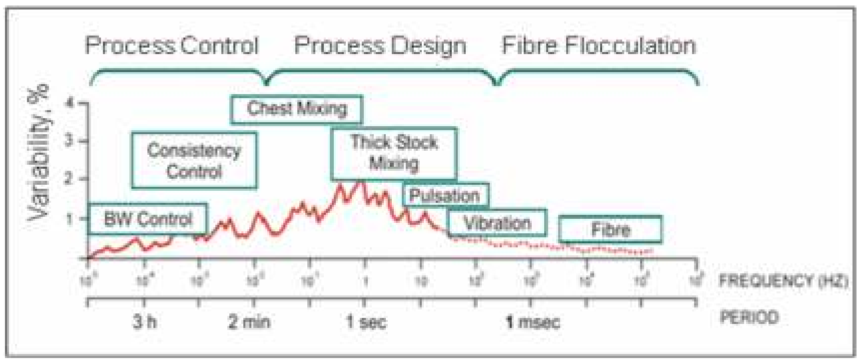
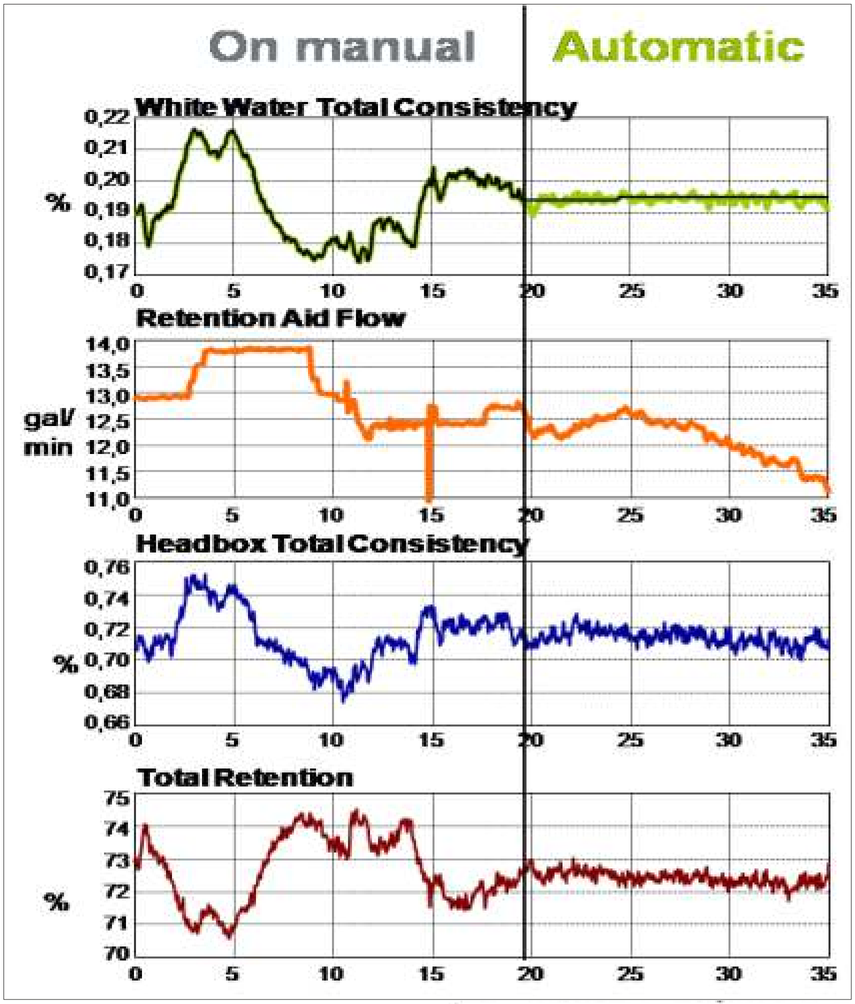



**Figure 1. Basis weight variability by period**

The variability that is generated in stock preparation shows up as part of the machine direction variability measured by the QCS. An unstable wet end exacts a higher price from a paper machine operation than merely product variations. It also has a major effect on machine efficiency. Since the web breaks at the weakest point, it is not the average value of pulp properties but the extreme values that adversely affect runnability. Stabilizing the wet end moves these extremes away from the danger zone. Retention control has repeatedly shown improvements in paper quality accompanied by faster startups and grade changes and by dramatic reductions in the frequency of wet end breaks (Figure 2). Often the real payback from quality improvements comes from these runnability gains. Earlier, results were limited by factors such as the time lags inherent in the process, the interactions between variables and how disturbances affect quality. To meet this challenge, multivariable and model-based predictive control systems have been in extensive commercial use since the year 2000. The multivariable controller manipulates thick stock, filler and retention aid flows and steam pressure to control dry weight, moisture, ash content and white water solids. During breaks when no scanner signals are available, control of the filler is switched to the headbox ash measurement to avoid a buildup of filler in the short circulation.

All the collected data from the wet end is time-synchronized with automated paper quality laboratory and on-line quality sensors into one quality report. Using tools provided in the system, true nature of the variability and effects on final product quality can be analyzed to collectively optimize the whole process by considering the function of the whole system when tuning an individual loop. The increased visibility of the process aids good operating practices to minimize many

**Figure 2. Automatic control of retention resulted in 70% fewer wet end breaks. short circulation consistency variations reduced by half and faster machine start-ups and grade changes**




potential problems, such as making gentle moves when changing broke usage.

**New measurements**

A major enabler in the development of synchronized fiber to print solution has been the introduction of new measurement technology for structural paper properties that have a high impact on printability. Camera based web inspection and online scanning by optical and imaging based technologies now provide new tools to determine formation, porosity, fiber orientation and surface topography with accuracy comparable to offline laboratories.

**On-line Formation**

As well as affecting dimensional stability and sheet strength leading to runnability problems, poor formation can also cause uneven coating pickup, printability and appearance problems. Using high speed imaging, the Metso IQ Formation sensor gives an instant response to formation changes caused by process adjustments and therefore on-spec quality can be reached faster and startup waste is reduced. Using the same image analysis technique as the automated laboratory formation measurement, correlation with offline tests and visual perception is excellent. Formation index and other numerical data, defining the distribution of fiber flock and void sizes are determined with dark spots, light spots and pinholes detected and classified by the analysis software. Formation pictures from the QCS system can be transferred directly to the operating displays for analysis.

**On-line Porosity**

Depending on the grade and end use, porosity affects coating pick up, ink penetration and absorption properties as well as determining how fast paper sacks can be filled or controlling the filtering properties of filter paper. Most online porosity sensors have been based on measuring air flow and very sensitive to dust and humidity, requiring frequent service e.g filter cleaning. The inaccuracies of previous techniques have been eliminated with the new Metso IQ Porosity sensor based on pressure measurements. The sensor lightly touches the moving web and porosity is calculated based on the pressure difference created by air flowing through the sheet. The sensor is self cleaning with no need for filters or

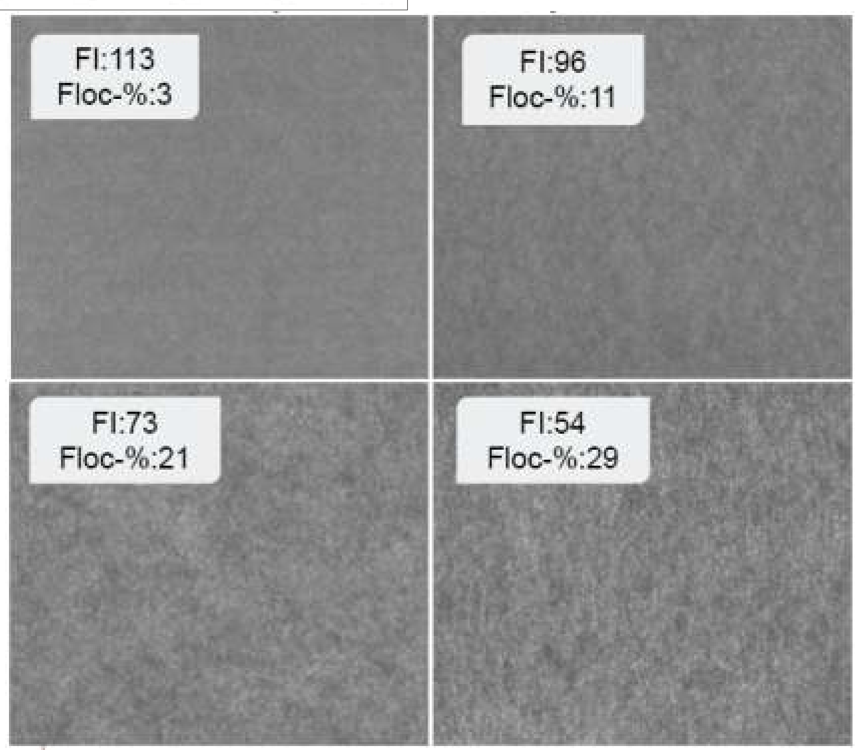



**Figure 3. Formation picture examples**

frequent service and provides a much more robust and accurate measurement insensitive to dust or humidity. All common measuring standards, i.e., - Gurley, Bendtsen, Coresta, Bekk, are available with excellent correlation to the automated paper laboratory.

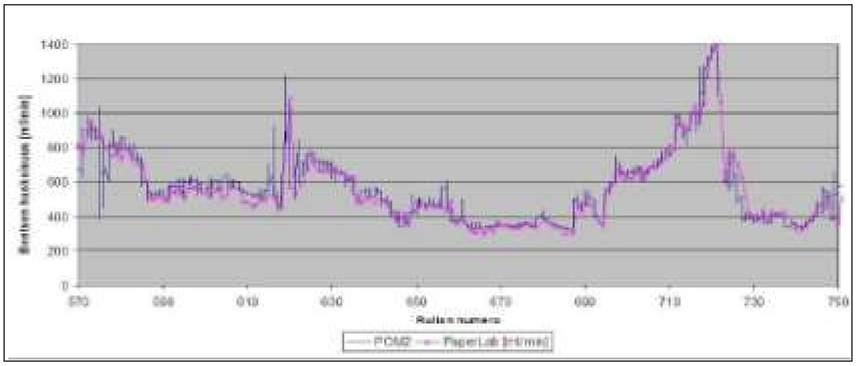


**Figure 4. Porosity can now be measured online with excellent correlation to the offline laboratory**

**On-line Fiber Orientation**

Affecting dimensional stability and strength, fiber orientation plays a large role in runnability and sheet handling in converting and printing. Using short pulsed light and high speed imaging technology enables the Metso IQ Fiber Orientation measurement to capture images of the web structure and calculate, in real time, orientation results comparable to laboratory methods. Applications include, board & paper machines with curl and paper dimension stability problems or machines which have web stability problems during unsupported web runs, such as before or after sizers/coaters or between dryer cylinders.

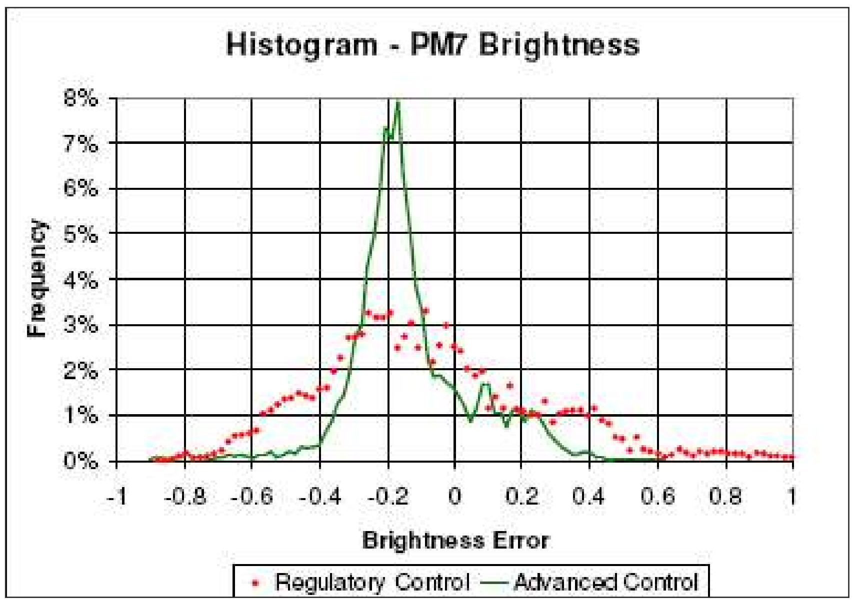
**On-line Surface Topography**

To complement existing Smoothness and Roughness parameters, a new measurement -Metso IQ Topography, brings fresh tools to printability prediction. This new online sensor captures true 3-dimensional images of the sheet to directly measure surface topography and identify surface anomalies that cause ink dropouts in printing. Well known roughness parameters (Ra, Rq etc.) are calculated as well as standard deviation and microdeviation. New parameters, such as, Spectra and Peak to Peak enable the paper surface to be characterized further. In addition the new sensor can be used in coating color and coater blade optimization applications targeting printability prediction.

**Millwide brightness control**

Controlling brightness development from the early stages of pulp production to final brightness at the reel is another area of process and quality control that benefits from time synchronization of actions. This advanced process control presents an opportunity for mills to reduce the cost of producing pulp/paper with minimum capital outlay, provided the required pulp and paper quality sensors are in place. The mill wide brightness control system combines multiple technologies, including model predictive control, real-time optimization, an operator advisory system, real-time sensor validation and automated system monitoring. These components work together to help minimize the cost of paper brightness.

**Figure 6. Brightness variability reduced by 43% with advanced millwide brightness control**



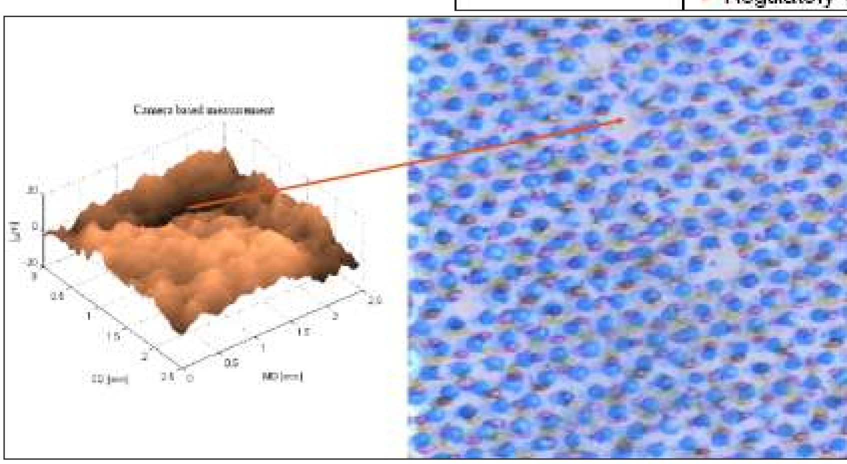



**Figure 5. Paper surface topography affects print quality**

Model predictive control software is used as the control platform to effectively handle the long process delays. The objective is to control the brightness target in a way that provides the best trade-off between bleaching chemicals added in pulping and the more expensive brightening chemicals added close to the paper machine. The incremental cost of brightness is determined by performing plant tests and analyzing historical data for the bleaching and brightening agents used in the mill. Using this information, a real time optimization system adjusts brightness targets depending on chemical consumption to achieve the lowest cost of paper brightness.

**Sensor validation**

A key part in any control system is the integrity of the measurements. Multivariate models have been developed to cross-validate the pulp quality measurements. If the measurement deviates too far from the model, the measurement will be replaced with the model and an automated email alarm is sent to facilitate maintenance.

The implementation of the new brightness control results in a significant decrease in brightness variability and in most cases allows a reduction to the final brightness average while still achieving target brightness.

**Conclusion**

The combination of new measurement and control technology together with a holistic approach, from fiber preparation to print on a page, provides papermakers with new opportunities for productivity improvement. New methods of analyzing the data provide new tools to visualize massive amounts of variability data collected over days and months to a simple graphical display. Warning of deteriorating process trends and developing performance problems, together with help screens detailing solutions, make the tools very useful. Perhaps the most important achievement is to make operators aware of just how highly interactive the papermaking process is and how this commonly causes upsets and disruptions to the process.