Energy saving & sheet formation improvement using microwave meters

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Today's paper machines require an impressive amount of data collecting and huge papermaking expertise to run at their peak efficiency. Recent instrumentation technology from Cristini Diagnostic Systems allows real time data output for consistency and drainage in the most critical parts of the forming section, even where access is limited for safety reasons. The direct measurement of water on the wire provides visibility into both drainage rates and the effects of stock preparation (raw material quality, chemicals/additives) as well as former set-up.

This information can help improve product quality, forming fabric performance and process efficiency while reducing the energy consumption of the forming, pressing and drying operations. Changes on the table are measured in real time and these measurements can then be used in a variety of methodologies.
The logic of the Cristini planar microwave sensor technology is typically oriented to provide an easy integration into other elaborate systems (DCS, MCS, QCS), found in the control loop of the papermaking process.

APPLICATION BASED ON THE MICROWAVE TECHNOLOGY

The story began over 25 years ago, and lead to the actual substitution of the radioactive sources (or radio frequency sensors). This new and innovative application based on microwave technology has changed the principles of the consistency measurements and is setting a new standard.

After the important success of the world's first portable microwave consistency metre, Cristini Diagnostic Systems has developed FiberscanFIX™ (Fig.1): fixed point and/or traversing measurement sensors that allow direct connections to the machine's own DCS/MCS systems for data analysis. Fast Fourier Transform (FFT) capabilities are included with this line of sensors, providing near instantaneous read-out of pulsation or vibration issues. The 24/7, unmanned data collection in the forming section has led to impressive results of process control and paper quality improvement.

Figure 1. *FiberScanFIX™ microwave sensor*

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IMPROVING PRODUCT QUALITY

Advancements in instrumentation have opened new avenues for effective use of vacuum table elements to control sheet consistency; this has led to a variety of papermaking applications including dandy rolls for improved formation, multiple formers for optimum formation, coverage and ply bond as well as numerous chemical dosage applications.

Several studies, performed on different former configurations, including traditional Fourdriniers, revealed the opportunity to reduce the electricity consumption, without compromising (and often actually improving) the machine efficiency.

Fig.2 provides a good example of what can happen, when too high vacuum is applied to a gap former producing white top liner. The consistency levels in the two critical points (before the ply-bonding and the couch roll) remain almost unchanged, although there is a decrease of low vacuum zone about 50%.

In addition, a better distribution of the dewatering between the low and medium vacuum zones leads to a better paper quality with greater strength properties.

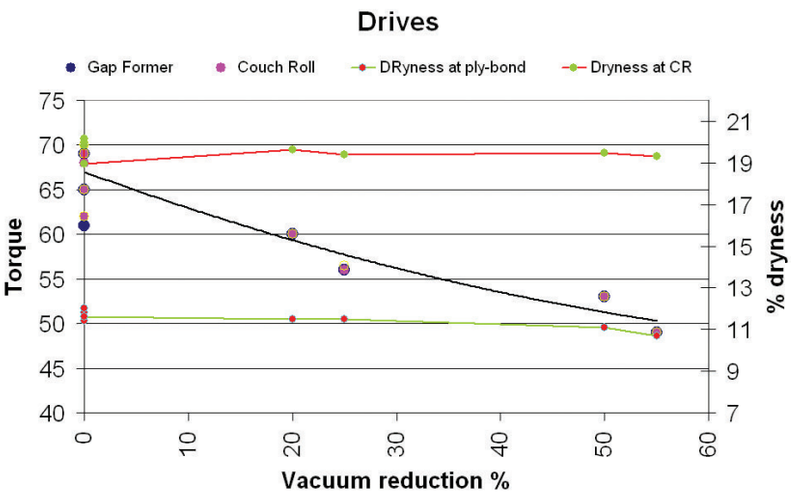

Figure 2. *Drive load saving*

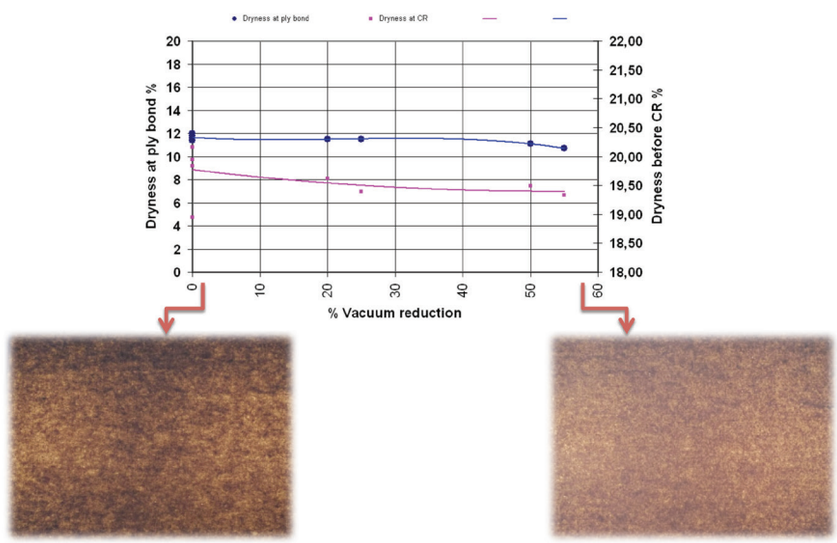

Figure 3. *Consistency measurement @ ply bond*

OPTIMISATION OF THE ENERGY CONSUMPTION

The optimisation of the energy consumption in the paper machine consists of expending the necessary energy only where it is required, and thus avoiding wasted energy that might lead to excessive wear of the machine elements (forming fabrics, ceramics, motors and pumps).

SHEET FORMATION VS. CONSISTENCY AT PLY BOND

The formation of each single ply has a direct impact on the formation of the entire board. Dewatering can be optimised in order to achieve the best sheet properties.

Water distribution is a key factor in water removal and energy consumption.

On-line monitoring of the ply consistency allows dewatering optimisation and to obtain specific settings by paper grade.

An example of this is the evident improvement of sheet formation with 50% vacuum reduction on the gap former (Fig.3).

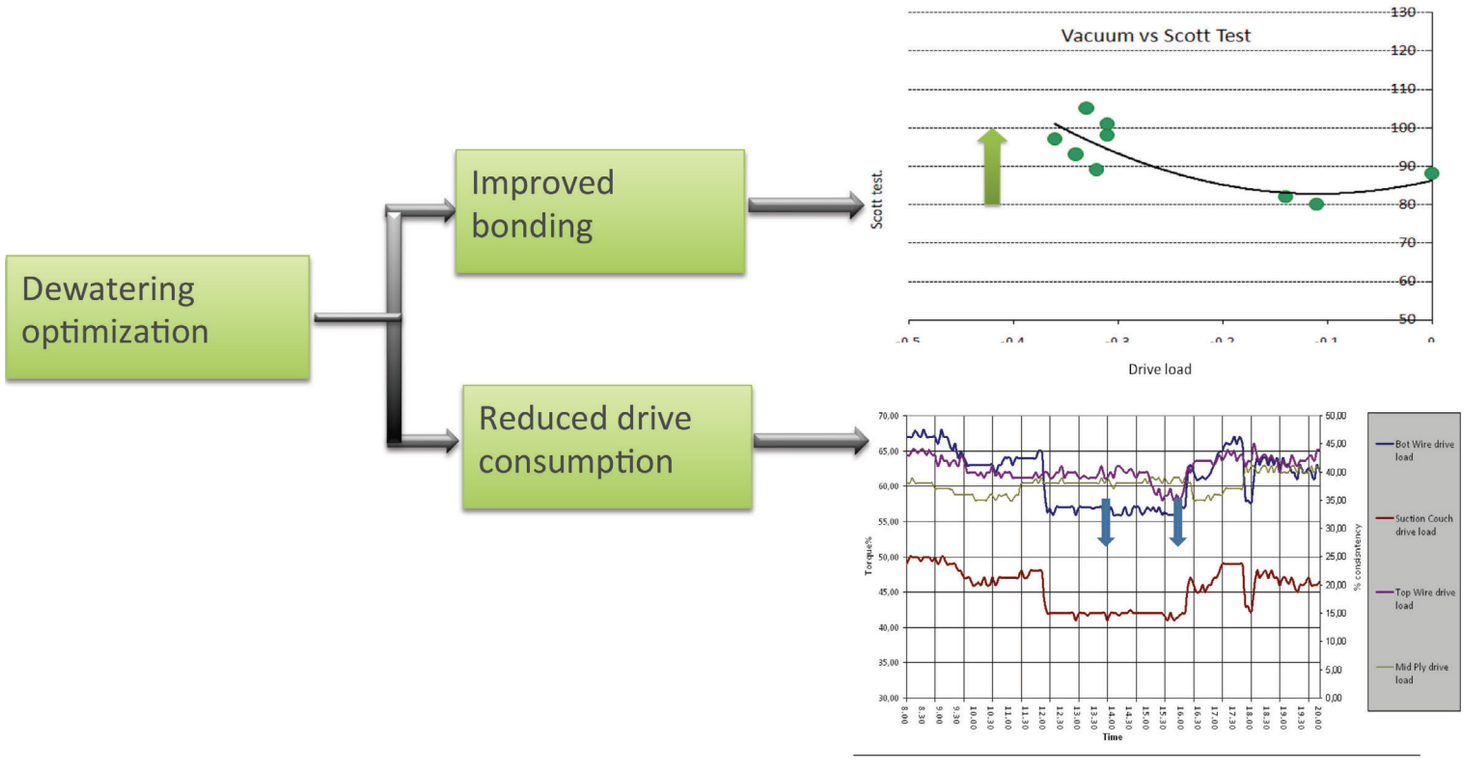

Figure 4. *Quality enhancement and energy saving*

Dewatering distribution on each single ply ensures better quality and more accurate (and therefore lower) energy consumption. Ideal conditions at the bonding stage leads to better fibre cohesion and distribution.

The use of excessive vacuum at low consistency range (from 1,5% to 5%) is very common; in many cases, this leads to "sheet sealing". A fast dewatering in the low vacuum area results in poor dewatering efficiency in many cases at the suction boxes.

PLY BONDING ENHANCEMENT ON A TEST LINER MACHINE

The test focused upon the dewatering of all ply. The reference sensor was located just before the bonding on each ply and before the suction roll.

The vacuum reduction was gradually reduced in all ply except at low vacuum of filler ply. One of the targets during the vacuum reductions was to keep the consistency before couch roll stable; in addition, stable steam consumption provided further evidence in support of this as a success.

REDUCED CONSISTENCY AT BONDING ON FILLER AND BOTTOM PLY

Thanks to the consistency sensor on the filler ply, operators can set the proper vacuum on the top former, in order to achieve the best board quality (Fig.4).

The sensor installed at couch roll controlled the global dewatering performance of the forming section.

CONCLUSION

When placed in strategic positions, the FiberScanFix™ sensors allow the dewatering to be distributed in a better way, and to define the best operative points for each vacuum element. In several case studies, the potential energy saving obtained through vacuum reduction has been around 500 KWh, which equates to approximately 4,000,000 KWh per year.

Given the average electricity price in Europe, this represents a saving of well over 380.000 €. The ROI for the complete sensor system payback was, in each case study, only few months.

The impressive results are even more important when considering the reduction of Green House Gases (GHG). 4,000,000 KWh/y equates to a reduction of 1.716 GHG t/year. Or, to put this another way, this is the equivalent GHG emission produced by 233 people in one year! Proven and repeated tests performed across Europe, Australia & North America have shown that very significant results in paper quality and energy consumption can be obtained in the vast majority of the cases.

In a paper world constantly evolving at a fast rate, this technology is a new starting point for better papermaking whilst enjoying lower production costs.

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