Microwave consistency measurement: Energy and process optimisation in the forming Section

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Today's paper machines require an impressive amount of data collecting and huge papermaking expertise to run at optimum 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 the access is limited for safety reasons. The logic of the Cristini planar microwave sensor technology is typically orientated to provide an easy integration into other elaborate systems (DCS, MCS, QCS), found in the control loop of the papermaking process (Fig.1).

APPLICATION BASED ON MICROWAVE TECHNOLOGY

The key point of a successful story, that started 20 years ago, is the substitution of the radioactive source or the standard radio frequency resonance. 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 first portable microwave consistency meter, Cristini Diagnostic Systems has developed 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.

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Figure 1. *FiberScanFIX microwave sensor installation point in restricted areas*

The 24/7 unmanned data collection in the forming section has allowed impressive results of process control and paper quality improvement.

IMPROVING PRODUCT QUALITY

The direct measurement of water on the wire provides visibility into drainage rates and the effects of stock preparation (raw material quality, chemicals/additives) and former set-up. This information can help to 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 be used afterwards in a variety of methodologies. Advancements in instrumentation have opened new avenues for effective use of vacuum table elements to control sheet consistency for a variety of papermaking applications. These include 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 the machine efficiency.

Fig.2 provides a good example of what can happen when too high a 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 in the low vacuum zone of about 50%.

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

Case Study Propapier PM2

This paper describes a case study from the world's fastest corrugating medium machine, the Propapier PM2 in Eisenhüttenstadt, demonstrating a control strategy that allows the mill to reduce considerably the energy consumption in the forming section. This is thanks to a consistency control operated by four sensors, placed in strategic positions of the former (Fig. 3). Propapier PM2 is producing corrugated board base paper, using 100% recycled fibre, and has an annual capacity of 650,000 t/y.

Tests have shown reliable results in terms of accuracy. The FiberscanFix™ readings were absolutely comparable to the lab results – even more linear, because they are not affected by the "sample taking" (Fig.4).

OPTIMAL DEWATERING IN THE FORMER

A key factor for energy savings in the drives and vacuum blowers is optimal dewatering in the former. Various tests, conducted by applying different

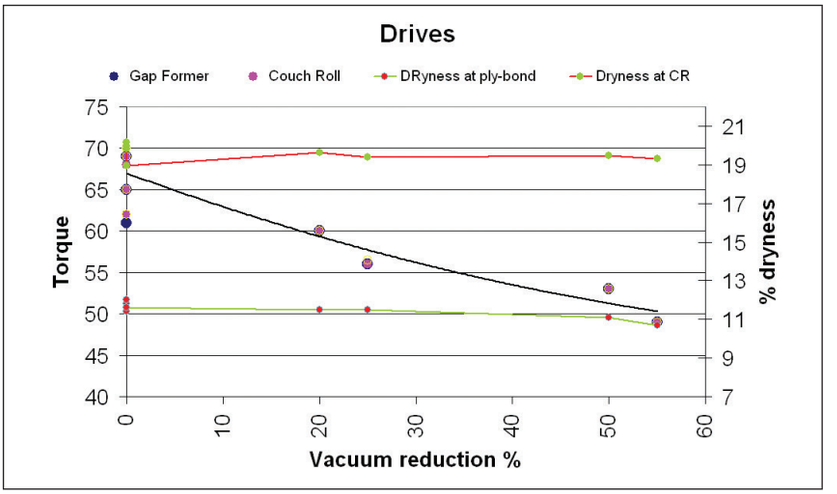

Figure 2. *Drive load saving*

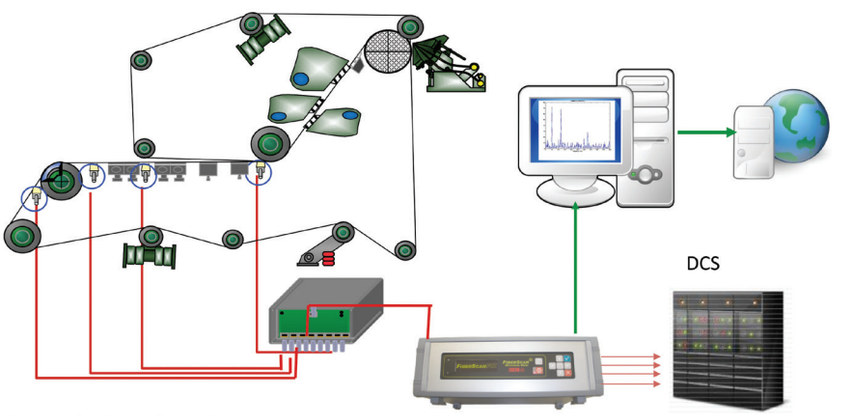

Figure 3. *FiberScanFix system layout*

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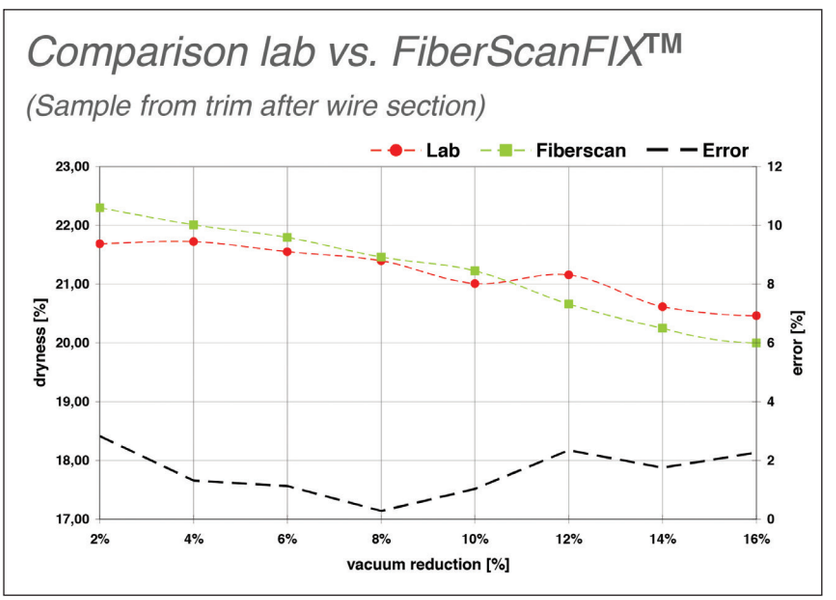

Figure 4. *Laboratory vs measured comparison results*

Δdryness wire section [%]	vacuum reduction		energy savings	
	mv [%]	lv [%]	drives [%]	RC-Blowers [%]
0,75	10	16	11	4
0,88	12	12	10,8	3
0,94	12	13	11	3

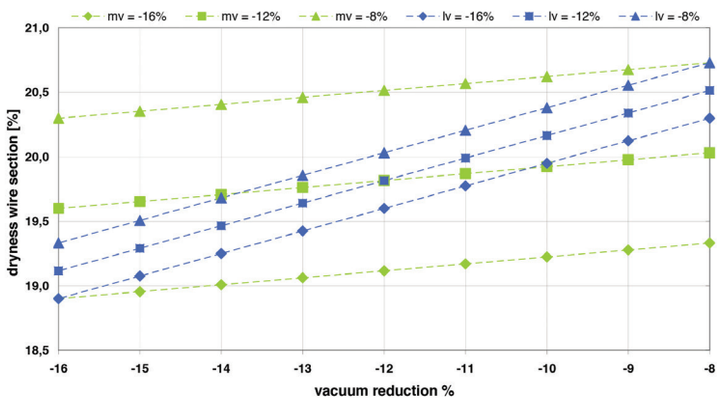

Figure 5. *Vacuum reduction vs energy saving*

Figure 6. *World speed record corrugating medium 100% recycle 80gsm @ 1650 m/min*

combinations of vacuum levels at the installed suction boxes (low and medium vacuum zones), have shown electrical energy savings of about 10% in the drives and 4% in the blowers.

HIGH VACUUM SUCTION BOXES

The biggest effect on the electrical energy consumption is due to the fabric friction in the medium vacuum suction boxes. The friction, in fact, depends on the level of water that is carried by the forming fabric and correlates with the dryness of the web sheet. In detail, it is possible to reduce the vacuum level by about 16% in the medium vacuum boxes and 10% in the low vacuum boxes without effecting the press efficiency, machine runnability and steam consumption (Fig. 5).

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Fig. 5 shows the influence of the vacuum reduction on the consistency and the total dryness after the wire suction roll. In fact a dryness decrease of 0.75% in the forming section, with a production of 90 g/m2 at the machine speed of 1,540 m/min, has absolutely no negative impact on the machine efficiency. The press section, with this specific setting, is able to compensate the dryness loss. Furthermore, the results show that a high consistency level after the forming section bring no benefit for the dryness after the press section. Based on Fig. 5 the reduction of the low vacuum zone has less impact than the medium zone but at the same time offers a great potential in energy saving. This is the basis for asserting that, regardless of the machine speed and the basis weight, there is always a margin of saving with regard to the low vacuum zone.

OPTIMISATION OF ENERGY CONSUMPTION

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

CONCLUSION

The FiberScanFix™ sensors, placed in strategic positions, allow dewatering distribution in a better way and to define the best operative points for each vacuum element. A potential energy saving, thanks to specific vacuum settings, is calculated with 400 KWh and assuming an electricity price of 0,08 €/KWh, equates to savings of about 250 000 €/y. The ROI for the FiberscanFixTM system is less than 10 months. In an industry that is constantly evolving at a faster rate, this technology is a benchmark for better papermaking at lower production costs.