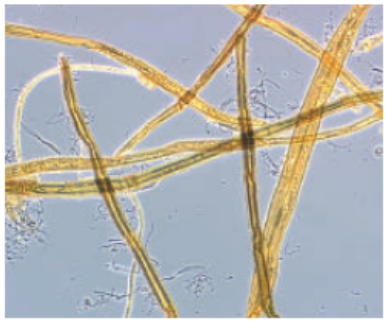
HAIRY FIBERS MAKE **STRONG PAPER**

A new online crill (fiber hairiness) measurement is a valuable tool for managing fiber bonding potential and end-use paper tests while minimizing refining energy

By MARK WILLIAMSON and SÖREN BACK

THE LABORATORY scale measurements of minuscule fiber and fibril properties developed during pulping and refining are coming on line and the theories of fiber to fiber bonding known for years by physicists are now being implemented with real-time processes. Although it could be used by scientists it's now a practical operator reference tool that allows them to gauge fiber quality every few minutes. Fiber bonding science meets the production floor. Originally developed as a portable instrument by Sweden's Innventia research organization, the online crill measurement has been made into a robust online sampling and analysis unit by the PulpEye company. The CrillEye product as it's called has been operating as a production tool since December last year at Waggeryd Cell, a Swedish BCTMP producer.

Important pulp strength properties of Waggeryd Cell's pulp can now be calculated online, which contributes to a stable pulp quality, quicker grade changes and reduces man-hours for lab tests. So far the results look very good and the potential of this new technology has been found to be very promising. Ulf Karlsson, President of Waggeryd Cell, reports, "We do believe in measuring crill and being able to calculate important pulp properties by using this technology. From our customers' point of view it means that we can produce pulps optimal to each customer, with the right level of energy used. If customer A wants a certain combination of bulk and strength, he will get it. This offers an opportunity to tailor-make qualities for customers without using an excess of energy."



Very fine crill particles attached or detached from the fibers are resolved with ultraviolet light in the CrillEye measurement

CRILL CORRELATES TO PAPER STRENGTH

The existence of very fine fibrous material called crill has been known since the early 1960s but the term has not yet found its way into the daily lexicon of pulp and paper makers. Therefore, it needs some explaining. Crill is finely divided cellulosic material liberated during the refining of pulp. The crill particles, that are typically 0.25 micrometers in width, are about a hundred times thinner than the fibers. In spite of the fact that only about one per cent of the weight of fibres and other particles in the furnish is crill, it can correspond to as much as 50% of the total free surface area. This shows the importance of crill for the strength properties of pulp or a paper. Research studies at Innventia have shown that crill is the single variable having the strongest connection to paper strength. Lab results in Fig. 1 show a strong correlation to paper tensile strength index. The more crill there are on and around the fibres, the stronger will the paper be. By measuring the amount of crill it is possible to pre-calculate the strength of the paper and hence to define the refining needed to optimize the amount of crill. The crill content of the pulp is shown in Figure 2 is a linear function of the specific refining energy applied. This linearity makes managing crill content a simpler task.

The crill measurement is based on the comparison of two optically measured surface areas by light absorption. It is adapted from the kappa measurement optical detection system. The total area of fibres and crill is measured with ultraviolet (UV) light. The total area of fibres only is measured with infrared (IR) light. The light absorption measurements are extremely fast, which is an advantage for online detection and measurement update speeds. The "crill variable", KFP, is a concentration independent ratio, obtained when the fibre plus crill area (UV) is divided by the fibre only area (IR). The measurement can differentiate between crill particles that are detached from the fibers and those which are still attached. Figure 2 illustrates the principle of measurement.

MODULAR FIBER ANALYSIS SYSTEM

CrillEye is a new measurement module of the modular PulpEye system that the Waggeryd Cell mill has used for the last four years to measure freeness, shives, fibre length and brightness online. Data from PulpEye and crill data are fed into the ExtractEye calculation module where tensile, tear, and burst strengths as well as bulk and Scott bond properties are calculated, as shown in Fig. 3. This is done every fifth

minute and the results are shown online to the mill operators on screens. They can therefore follow the actual quality situation and make necessary adjustments to keep the quality on specified targets. In May 2013 the CrillEye technology was fine tuned at the Waggeryd Cell mill site and as of December last year it is an integrated part of the PulpEye system and of the mill's quality control and follow up system.

The mill has a production capacity of 175,000 tonnes/yr of bleached and unbleached CTMP pulps, mainly based on sawmill chips. Customers for the pulp grades are mainly board manufacturers, which means that the bulk, stiffness, strength and cleanliness are very important properties. Major end-uses are food and liquid packaging. The mill consists of a three-stage refiner line with peroxide bleaching and a flash dryer. There are three measurement points, one after the first refining stage, one after the last refining stage and one for the finished product.

CLOSER TO QUALITY TARGETS

The production is run by two operators on each shift. This means that the possibility to frequently take samples for manual testing is limited. During the start-up period samples were taken frequently to check CrillEye and to confirm the capability of the equipment to supply correct data. The data were very accurate and now the operators have full confidence in it. They can easily and quickly see the result of a process change, which makes it easier to run closer to the quality targets.

Michael Nylander, mill manager, says that they are still in an evaluation phase to be able to make the most out of this investment, but it looks very promising and they see the potential for producing their products even closer to the quality targets and with less energy consumption. Before the installation of the PulpEye equipment they took manual samples four to six times per shift checking CSF, shives and brightness. Bulk and strength properties were tested for each quality change and as a final delivery control. However, now they get results from the PulpEye system every fifth minute, which of course is a tremendous improvement and has reduced quality variations even further.

"Regarding thoughts on implementing automatic controls we are not so sure of the benefits," Michael Nylander states. "Most likely we will not bypass our operators and close the loo as we want them to be active and interested in the process anc how it should be run. They should feel the responsibility for th entire process and the product quality, and therefore we think that a total automation would be a mistake."

QUALITY DEFINING PARAMETER

Are the mill's customers ready to accept pulp made to crill targets rather than traditional freeness specifications? Ulf Karlsson responds, "Still many customers buy mechanical pulps on freeness data, which I regard as an old fashion habit. You can achieve the same freeness value by running the refiners in different ways, but different refining will result in different strength and bulk properties. So you might get what you want according

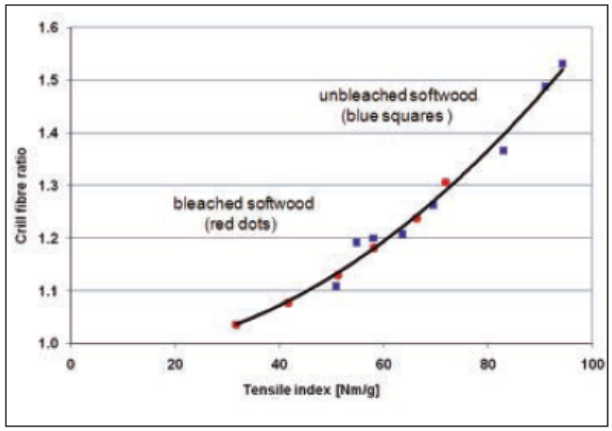


Fig. 1 - Lab crill measurement correlates very well to pulp and paper tensile strength index. Source: Innventia

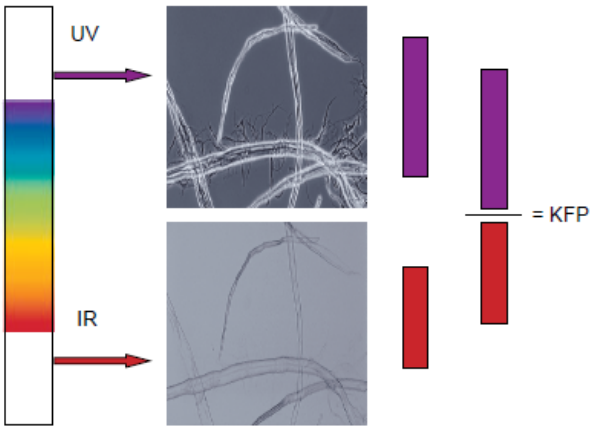


Fig. 2 - The principle of crill measurement

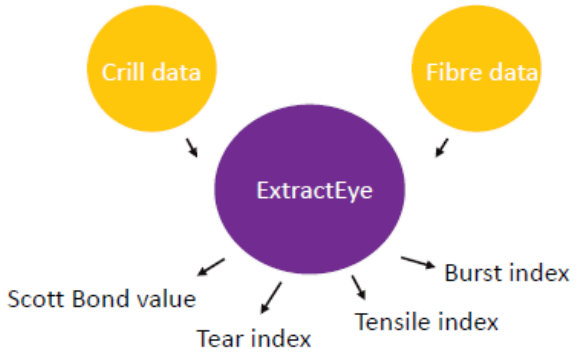


Fig. 3 - Process operators can follow calculated pulp properties and make necessary adjustments to keep the quality on specified targets.

The CrillEye measurement(5), with the same optics as the Kappa module (6), is an integral part of the modular PulpEye system. Other measurements include freeness (1), pH (2), brightness (3),fibers/shives (4), and pulp slurry dirt (7).

to the freeness value, but not what you want regarding important properties for the end product. Having run the PulpEye system with integrated CrillEye measurement for three months we have gained a lot of experience and our operators are now well acquainted with the equipment and what they can get out of it. Due to our conviction in what the measurement can do for us, we aim at getting away from freeness as a quality parameter and use the crill measurement data as a quality defining parameter for our customers."

Although Waggeryd Cell uses CrillEye to keep the quality tolerances to narrower limits for their CTMP pulps, the same method is applicable also to chemical pulps. As a matter of fact, the original crill research project started out investigating the importance of crill for chemical pulps. The development of this important fiber property measurement adds another dimension to fiber line quality management. There are now online measurements that determine simultaneously the fiber property development at various stages of the process, the progress of delignification and brightening, and warn of any dirt contamination. This opens up more possibilities for managing fiber development and quality throughout the line.

Mark Williamson is a journalist/engineer based in Thornhill, ON, Canada. Sören Back is owner of SB Kommunikation in Örnsköldsvik, Sweden. **PPI**

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