

## Developments

# The next generation of online pulping & liquor analysis

By Mark Williamson, journalist engineer

**New online measurement applications for chip quality, fiber development, bleach plant lignin load, pulping and recovery cycle analysis promise to help stabilize and optimize plant operations.**

It's been over twenty years since the first online Kappa analyzers were installed in pulp mills. They have helped pulp makers to control more precisely the pulping, extended delignification and ECF bleach processes. Online alkali analyzers followed and have since been used to measure and stabilize white liquor, the causticizing process and black liquor loops. The breadth and value of measurements and controls have been increasing. In recent years some new companies and new measurement capabilities have appeared on the market. These new measurement products coupled with advanced process controls (APC) can help pulp makers to make a more consistent product, eliminate process bottlenecks, improve productivity and lower costs. Here is a look at some of the developments in online measurements available today. Some of these measurements allow the control and optimization of process variables that were not directly controllable before.

### Optical Bleach Plant

Online Kappa measurement is a crucial tool for precisely controlling the delignification in the early stages of pulp bleaching. Until now, the pre  $D_0$  stage lignin measurement has been done conventionally with sampling Kappa analyzers whose measurements are used in bleach line control strategies along with inline brightness and chemical residual sensors. However, BTG has introduced a new approach to the bleach plant measurement and control.



BTG's new inline Bleach Load Transmitter (BLT-5500) measures the total bleaching chemical demand

For the digester blow line and oxygen delignification applications the traditional BTG sampling analyzer (KNA-5300) is used to measure the residual lignin content of a washed pulp sample. For bleach plant applications, BTG has developed and recently introduced an inline sensor using similar optical technology to measure dissolved lignin in the pulp slurry filtrate as well as in the fiber. This Bleach Load Transmitter (BLT-5500) thus measures the total bleaching chemical demand, not just the lignin in the washed pulp of a sampling analyzer. Since it is inline, the need for sampling devices and long transport lines is eliminated.

The measurement has been implemented as an input to Honeywell's advanced process control (APC) for bleach plants. The concept has been called the Optical Bleach Plant. With this control, bleaching chemical savings of 5 to 8% have been demonstrated. BTG and Honeywell have had a cooperative pulp line process control development program in place since 2010. In cooperative pulping and bleaching projects BTG supplies all the analyzers, inline brightness and chemical residual sensors, sampling devices and consistency measurements required for APC.

### Following lignin removal and fiber properties

The company PulpEye, formerly known as Eurocon Analyzer, was formed in 2002 from the former Sunds Defibrator group which developed the PQM pulp analyzer for TMP. Since then, the pulp measurement capability has been expanded to include chemical pulp applications. The company and its mainline products were rebranded as PulpEye just recently. The modular product is aimed at measuring a number of important chemical pulping and fiber development properties.

The KappaEye Kappa analysis module for kraft fiberline measurement and control has been available since 2011. PulpEye's systems can be custom configured to suit the needs of the fiber line or stock preparation system. The online measurement modules include Kappa, brightness, dirt specks in the pulp slurry, fiber dimensions, shive content, freeness, consistency and pH. A measurement system can therefore follow lignin removal and fiber properties in the line. Dirt specks can be detected far in advance of the baling line so corrective action is more decisive. In a new development aimed at fiber refining control, the kappa analyzer optics have been adapted to measure "crill" which is microscopic fibrillated material that plays a significant role in developing paper

strength. This was a joint development with Sweden's Innventia research organization.

The company's new RedEye product provides sulfite cooking liquor analysis. The application to control dissolving pulp processes has just been licensed from a dissolving pulp producer that was a partner in the development. This development opens up further applications in the fast-developing dissolving pulp market. To close the loop, PulpEye provides complete process control applications implemented in a mill DCS by its partner Eurocon Engineering.



The KappaEye analyzer at the far right is configured with other PulpEye analyzers for pulp slurry dirt count, freeness, pH, brightness, and fiber dimensions/shives

### Online chip measurements stabilize pulping

Of course, downstream measurements indicate pulp quality instabilities that often originate from uncertainties in wood chip mass flow and moisture levels. To address this problem, TEXO Consulting and Controls of Montréal, Canada has introduced an online real-time Chip Management System (CMS) which measures chip mass flow, moisture, volume, dry bulk density and bark content on the chip conveyor. The measurement system was developed by Centre de Recherche Industrielle du Québec (CRIQ). The patented chip measurements and the company's COOK-X APC controls have been successfully commissioned at a Canadian Kraft pulp mill.

The results are encouraging as impregnation vessel and continuous hydraulic digester levels have been stabilized, liquor to wood ratio is controlled to target and Kappa number variability has been reduced. The measurements allow flash steam use to be optimized in the pre-steaming operation, while reducing venting to the atmosphere, allowing displaced fresh steam to be used in the mill's turbine. This provides an extra 2 MW of electricity to be sold on the grid. The ultimate purpose is to control the digester blow line Kappa number and achieve stability in power production.

Sampling devices can also play a role in defining chip input conditions. Andritz and PulpEye provide an online sampling ScanChip analyzer that measures chip size dis-



The TEXO real-time chip measurement system is located above the conveyor

tribution, chip dimensions, moisture content and brightness, the latter indicating chip age. Conmark Systems supplies an online sampling moisture analyzer based on microwave technology.

### Multi-purpose optical analysis for liquors, reduction efficiency

Historically, the most important and common liquor measurement has been white liquor alkali strength that is essential for starting the pulping reaction on the right foot by exact alkali to wood charging. In the causticizing plant, green liquor and lime milk measurement and causticizing efficiency calculation are used to optimize the chemical conversion process. Causticizing control applications, which often replace older conductivity-based controls, are well established and the benefits include elimination of bottlenecks, higher throughput, reduced process scaling, lower evaporation costs and fresh lime saving.

Most of these previous liquor measurements have been made by online titrating analyzers using standard methods and chemical titration reagents. However, as an alternate to titrating liquor analyzers, optical spectroscopic analyzers have been finding a foothold in the market. The optical signals are calibrated to the various chemical constituents of pulping and recovery cycle liquors. One of the advantages touted is that these analyzers require no consumable reagent chemicals. The technique also permits the measurement of multiple chemical constituents in a single stream.

FITNIR Analyzers, based in Vancouver, Canada, acquired the FT-NIR (Fourier Transform Near Infrared) measurement technology developed by Paprican (now FPIInnovations) and introduced it to the market in 2009. In addition to quantifying the complete ABC liquor properties in white and green liquor, the system reports sulfate content for the calculation of reduction efficiency. The measurements of the smelt dissolving tank liquor and weak wash liquor can be used to precisely control dis-

solving tank green liquor TTA and density. APC of the combustion process regulates the reduction efficiency.

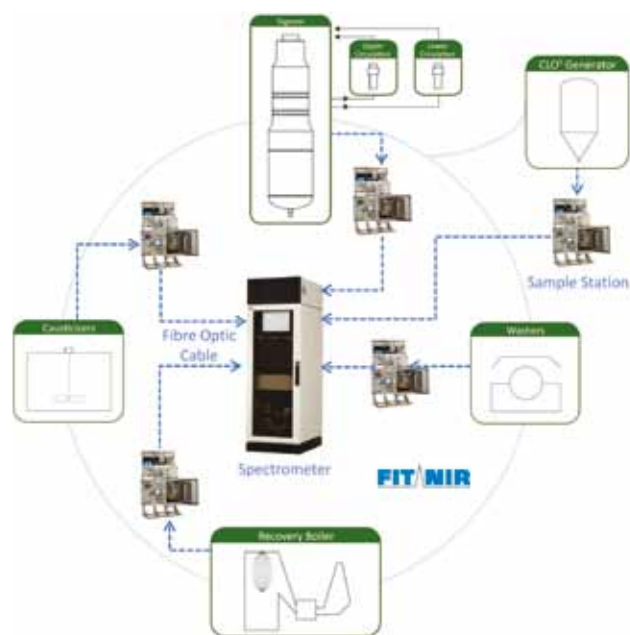
In black liquor applications the technique also determines the levels of residual effective alkali (REA), dissolved lignin, inorganic solids and organic solids. An MPC supervisory control is employed to manipulate liquor charge at the various stages to achieve a target H-Factor. Pulp producers report more stable pulp quality. Other applications of the multi-purpose measurement include process chemistry for control of chlorine dioxide plants and COD in pulp washer filtrates. The central spectrometer of the FITNIR analysis system can serve up to eight sampling stations linked by fiber optic cables. These stations can sample from six process streams in various process unit operations.

A benchtop FITNIR laboratory liquor analyzer measures the same liquor properties. FITNIR continues to develop additional measurement applications for pulp and paper processes through a recently announced agreement with FPIInnovations.

Using a different infrared spectroscopy method developed at Auburn University, Conmark Systems of Atlanta, USA also provides a wide range of online liquor analyses and controls. The company supplies a benchtop laboratory analyzer. Japan's Yokogawa also supplies an online FT-NIR analyzer.

### More possibilities

These online measurements can help pulp makers refine the control of the chemical pulping and liquor recovery cycle, allowing the management of many previously



The FITNIR analysis system

unmeasured variables. Of course, the role of APCs in the supplier solutions should not be underestimated as they have previously proven to deliver good results and are an important part of the return on investment.

In addition to measuring the chemical inputs and residuals of the lignin removal and brightening processes there are now online measurements which determine simultaneously the fiber property development at various stages of the process. This opens up more possibilities for managing fiber development and quality throughout the line. ■