



FITNIR ONLINE - RECOVERY BOILER / DISSOLVING TANK APPLICATION

FITNIR's fully automated online analyzer reliably measures complete liquor compositions to help pulp mills decrease process variability for improved efficiency and profitability. Fast, frequent and accurate measurements drive process control strategies for optimization. FITNIR Online is capable of sampling from multiple sources and testing numerous components simultaneously, providing true concentrations of unclarified and clarified green liquor chemical compositions in the recovery boiler and smelt dissolving tank. With its proven application for the recovery boiler/dissolving tank, FITNIR is the next generation of process analyzers for pulp mills.

Innovative Solution to Traditional Measurement Challenges

THE NEED FOR ACCURATE & TIMELY DATA

There is considerable interest in, and benefits of, maximizing the energy efficiency and recovery of chemicals in a recovery boiler for the economic viability of a Kraft mill. The stability of a dissolving tank is highly dependent on tight control of the Total Titratable Alkali (TTA) concentration. Traditional measurements at the dissolving tank rely on density measurements and manual testing such as Baume or hand titration. Unfortunately, online density measurements are subject to drifts, while manual testing is prone to errors.

Optimization of the recovery boiler in a Kraft mill has been an ongoing challenge for the pulp industry due to the lack of a reliable online sensor to measure true liquor compositions of key green liquor parameters such as TTA, carbonate, sulfide, sulfate, thiosulfate, and Effective Alkali (EA) for control. Direct measurements of these key green liquor (GL) compositions performed more frequently would provide greater opportunity for stabilizing smelt dissolving tank TTA and maximizing reduction

efficiencies. Tight control requires reliable data to maximize recovery operations and provide safe operations of the dissolving tank.

INNOVATIVE SOLUTION

Traditional online techniques (i.e., density, conductivity, differential pressure, and bubble tubes) only infer key measurements and suffer from drifting due to probe scaling. Online titrators require multiple steps to measure and titrate green liquor, necessitating considerable time to achieve results.

FITNIR Online is a fully automated process analyzer capable of sampling from multiple sources and testing numerous components simultaneously. FITNIR Online is the fastest online process analyzer that can provide true green liquor ABC compositions as well as Reduction Efficiency (RE) and suspended solids content.

PROPERTIES MEASURED

As shown in Table I below, FITNIR Online's recovery boiler/dissolving tank application measures a

KEY FEATURES

- > Fully automated for frequent testing
- > Patented application with large pathlength flow cell
- > High repeatability, accuracy and reliability
- > Automated flushing of sample lines and cell with water to prevent scaling
- > Sample scanning and measurements take only minutes
- > Data transfer to mill's DCS via Modbus and OPC
- > Automated process and diagnostic alarms ensure reliable operations
- > Remote analysis via fibre optic cable
- > Little or no need for recalibration resulting in nearly 100% uptime
- > No chemical requirements

comprehensive set of properties associated with the raw green liquor (RGL) and clarified green liquor (CGL). Information on sulfate and sulfide provide Reduction Efficiency (RE) measurements.

Table I: Liquor measurement accuracy

GREEN & WEAKWASH	MEASUREMENT RANGE	ACCURACY (1 sigma value)
Effective Alkali (EA)	4 - 120 g/L as Na ₂ O	± 0.5 g/L Na ₂ O
Active Alkali (AA)	6 - 120 g/L	± 0.80
Total Titratable Alkali (TTA)	10 - 150 g/L	± 1.00
Carbonate (Na ₂ CO ₃)	4 - 100 g/L	± 0.80
Sulfide (Na ₂ S)	0 - 50 g/L	± 0.50
Sulfate (Na ₂ SO ₄)	0 - 20 g/L salt	± 0.25
Thiosulfate (Na ₂ S ₂ O ₃)	0 - 15 g/L salt	± 0.25
TTA (weakwash)	0 - 15 g/L	± 0.80

MEASUREMENT PRINCIPLES

Near infrared (NIR) spectrometry, which roughly spans the frequency range 14000 cm^{-1} to 4000 cm^{-1} (700 nm to 2500 nm), comprises of overtones and combinations of fundamental vibrations of -CH, -NH, -OH and -SH. Molecules and anions have unique spectral features that can be used for quantification as the absorption bands are proportional to concentration. By scanning the entire spectral region, simultaneous measurements of multiple chemical properties can be determined. NIR spectrometry has seen wide spread use due to its lower water absorption bands. Consequently, NIR can operate through glass, can be transmitted via low hydroxyl fibre optic cables, and generally requires minimal sample preparation. Moreover, NIR is more amenable for use with large pathlength cells, up to 20 mm, thus eliminating plugging.

Together with FPIinnovations, FITNIR Analyzers continues to cultivate a comprehensive set of process analyzers for measuring key parameter for process control in Kraft pulping operations. FITNIR and FPIinnovations have patented applications for digester, brown stock

washer, recausticizer, recovery boiler/dissolving tank, chlorine dioxide generator operations, and wet and dry pulp kappa measurements.

RECOVERY BOILER / DISSOLVING TANK OPTIMIZATION & CONTROL

The primary advantage of applying FITNIR Online to the recovery boiler/dissolving tank is its ability to provide reliable and accurate online measurements of true GL compositions including TTA, EA, AA, carbonate, sulfide/sulfidity, RE and solids. Control strategies based on FITNIR data have resulted in 50% to 70% reductions in TTA variability. With complete liquor compositions provided by the analyzer, algorithms can be set up to prevent GL strength from reaching the pirssonite deposition limit. This increases liquor strength, while minimizing deadload content. Savings in the range of \$500,000 to over \$1M (depending on mill production) can be achieved, while optimizing chemical recovery and maximizing energy generation.

KEY BENEFITS

- > **\$0.5M - \$1.2M savings/year**
- > **6 – 12 months ROI**
- > **Reduces TTA (and carbonate, EA, sulfide) variability**
- > **Maximizes TTA target while providing true TTA compositions**
- > **Reduces deadload content (sulfate)**
- > **Requires fewer lab tests**

DISSOLVING TANK INSTALLATION & RESULTS

Installation: Figure 1 shows a schematic diagram of a smelt dissolving tank integrated with FITNIR Online, sampling from both lines of the pump outlet to measure GL and weakwash compositions (Table I). Measurement sequencing is controlled by a user-defined table on the DCS and can be configured by a mill engineer. Typical measurement frequency is every 5 to 7 minutes on a stand-alone system. Boosted demineralized water is used to flush the flow cell as well as backflushing the sample lines, thus ensuring reliable performance.

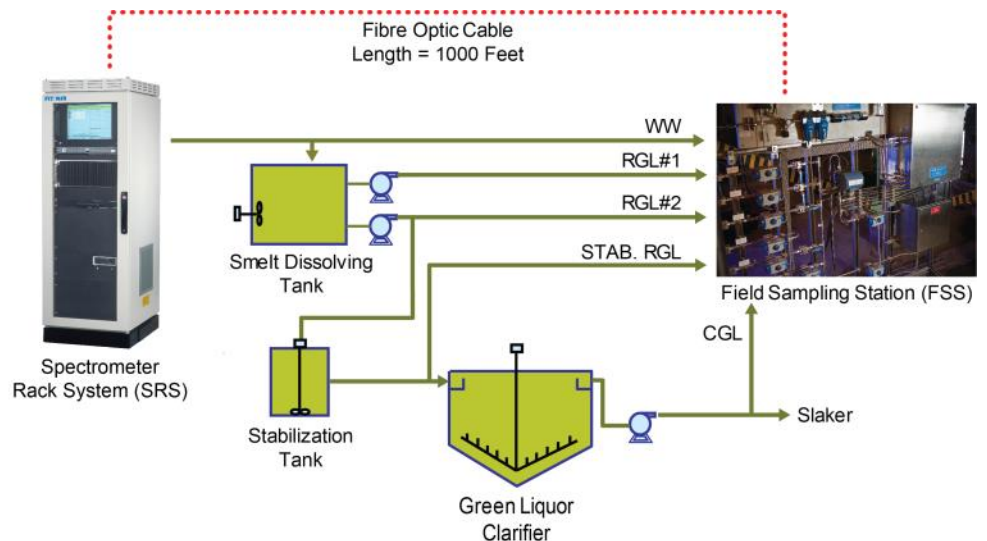


Figure 1: Schematic diagram showing smelt dissolving tank, stabilization tank, and GL clarifier integrated with FITNIR Online. Measurement points provide complete GL measurements for compositional control.

Results: Figure 2 compares the results for dissolving tank TTA between density (bubble tubes) and FITNIR Online's TTA measurements. For short-term measurements, density tracks TTA.

However, density is prone to drifts from scaling. By integrating FITNIR's GL measurements for TTA control, upwards of 60% to 70% reduction in TTA variability can be achieved (Figure 3).

Reducing GL variability benefits slaker operations by providing stable TTA and carbonate levels that are required for lime addition.

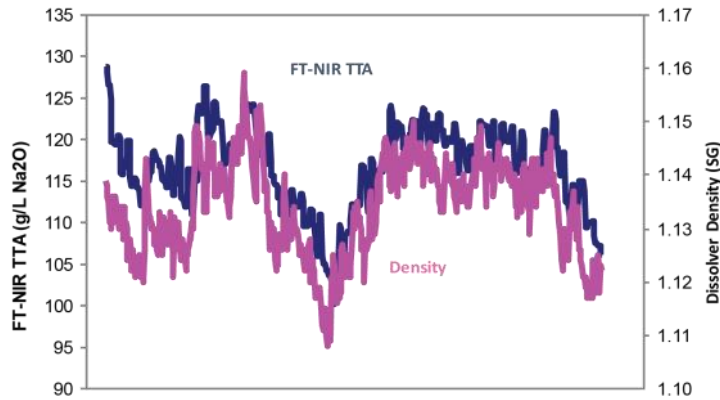


Figure 2: FITNIR RGL TTA with density

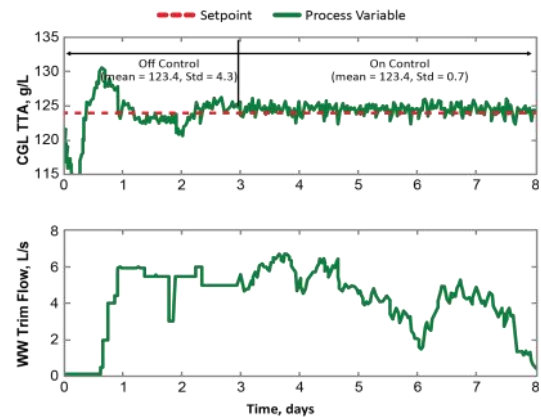


Figure 3: CGL TTA trim control OFF and ON

PLATFORM TECHNOLOGY

FITNIR Online for the recovery boiler/dissolving tank samples liquor from the discharge of the GL pumps, measuring both GL and weakwash. A remote field sampling station located near the sampling point is connected to the analyzer spectrometer via fiber optic cable. Being a true platform technology, the system can easily be expanded to measure other process streams outside of the recovery boiler/dissolving tank such as the digester, recausticizer and ClO₂ generator by simply connecting additional field sampling stations to the spectrometer via fiber optic cables. One centralized

spectrometer can service up to eight field sampling stations. Each field sampling station can handle up to six process streams. Due to its quick scanning ability, one spectrometer can provide measurements for multiple areas of the mill. This platform capability, unique to FITNIR's analyzers, minimizes analyzer hardware and maintenance as configurations can be done centrally at a single station.

ROBUST EQUIPMENT

The sample interface between the process and the spectrometer is a rugged flow cell with a large optical pathlength.

The window material has high hardness and excellent chemical resistance for acid and caustic environments as well as a large temperature range. All piping and valving utilize standard mill store parts, including 1/2" to 3/4" stainless steel tubing and valves. Boosted high pressure demineralized water is used to flush the sample lines, ensuring reliable operations without plugging. Water references are performed every hour to eliminate measurement drift. Many mills have been running with the same calibration for as long as 10 years without the need for recalibration. The result: excellent reliability and superior uptime.

FITNIR SUPPORT

At FITNIR, we understand your business. Our expertise in both the lab and in the field goes into every aspect of our product development. Our innovations, process knowledge and dedication are focused on supporting your business success.

FITNIR offers a wide range of customer support services, including project coordination, application engineering (including kickoff meeting, system configuration calibration and validation), system verification and testing, application documentation, training and after-sales support.

Contact FITNIR Analyzers Inc. to find out how we can partner with you to optimize your recovery boiler/dissolving tank operations.

FITNIR

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