Online Kappa & Brightness Measurements, Fiber Length & Shive Analyzer, Inline Brightness and Chemical Residual Measurement Technology

Presented by

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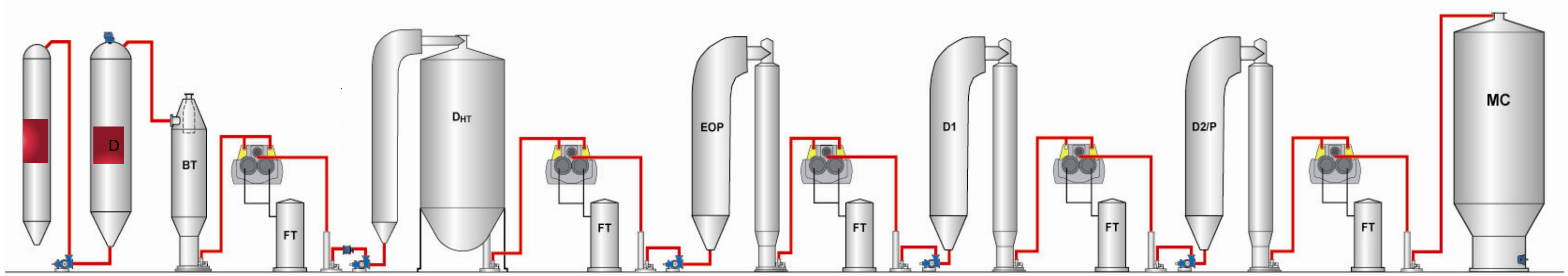
Stock Samples from Critical Process Locations

First Step in Optimizing your Process



	Blowline	Bleach Feed	Post Eop	Post D1	Final Pulp
K	K	K	K		
B			B	B	B
S	S	S	S	S	S
F	F	F	F	F	F

K Kappa (fiber lignin)

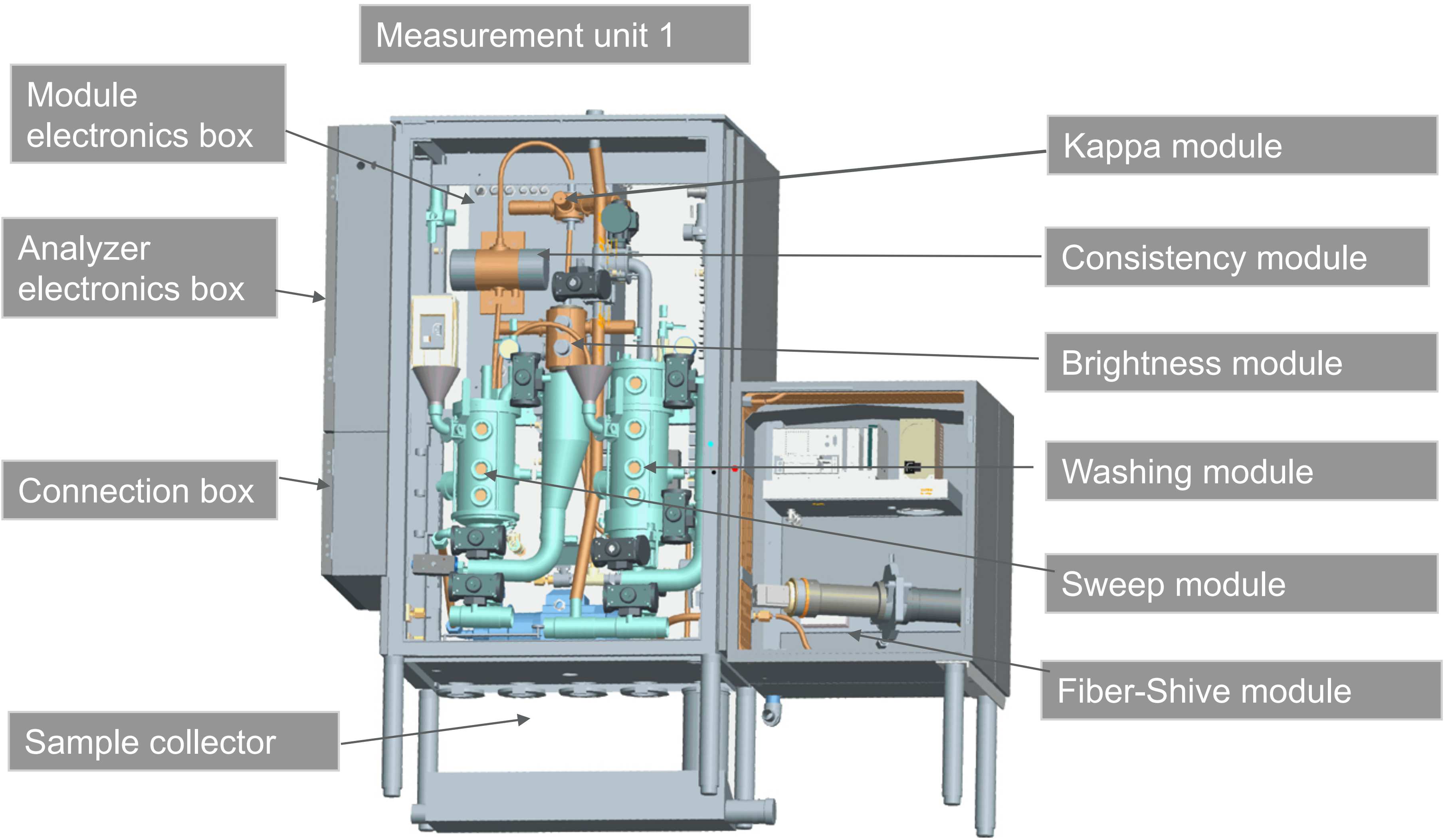
B Brightness

S Shive Count

F Fiber Length

Kappa Analyzer Overview

Main Components Of The Cabinet



Automatic Process Sampling Devices

Reliable Sampling

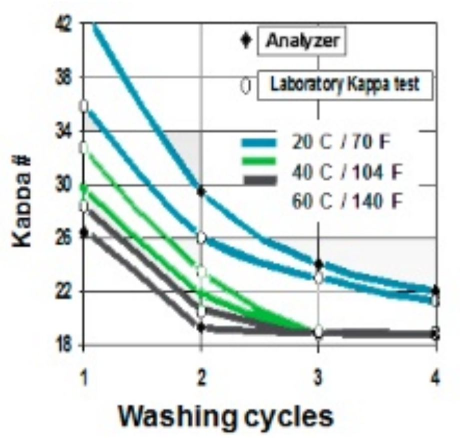
- Piston/Cylinder **metal to metal** construction, no gaskets, robust design and continuous operation for years. Minimum **service** period **one year**.
- Prescreening of knots and big particles already in the process; blow and midpoint with SD-502. Titanium based SD-505 for Cl_2/ClO_2 applications.
- Different sample volumes corrected by analyzer's **consistency adjustment.**

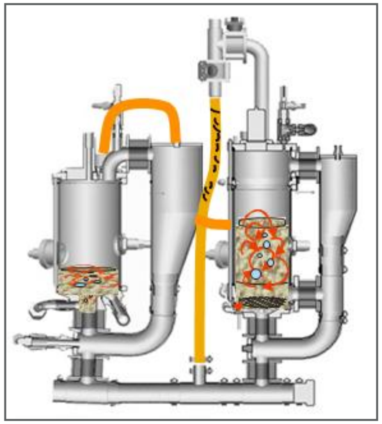
SD-502/505 piston open

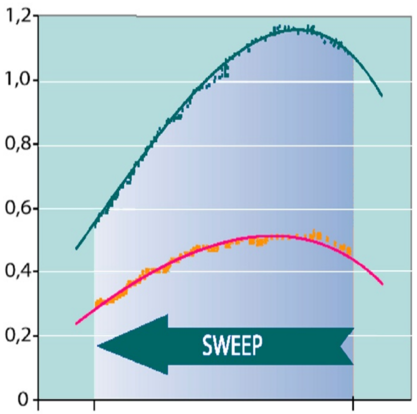
SD-502/505 piston closed

Performance

Unique sample treatment and measurement







Hot water sample transportation

- Important especially with brown pulp samples to avoid lignin precipitation on fiber

Hot water washing

- Removes all black liquor quickly

Mixing & Washing

- Air and water together give powerful mixing
- Pressurized washing
- Pulp meets measurement and laboratory test cleanliness
- No fiber losses

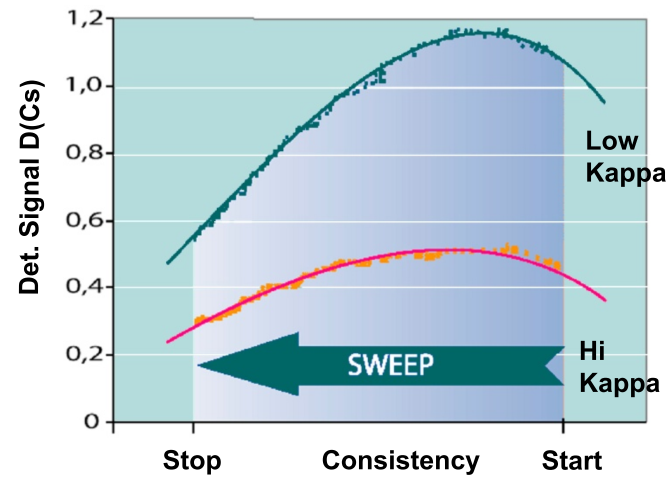
Sweep measurement

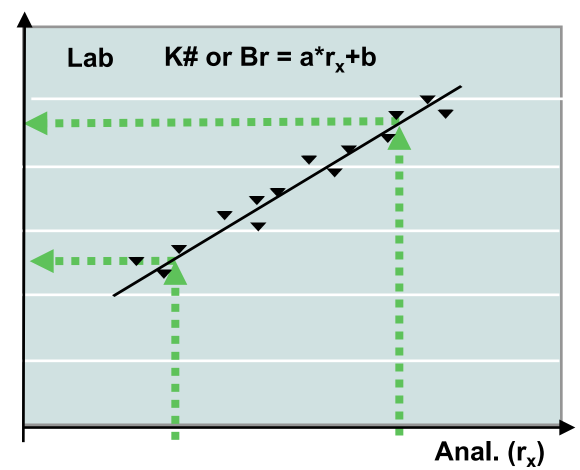
- Hundreds of Kappa measurements in a minute
- Brightness measurement with high accuracy up to 95 ISO
- Measurement response is linear to lignin content and brightness

Kappa Analyzer Measurement Principle

Sweep measurement:

- The sweep measurement is based on this continuous optical response curve over a pre-set consistency range
- Kappa measurement with high accuracy from high yield kappa pulp down to micro levels
- The measurement loop is pressurized during the sweep to reduce air bubbles that can affect the measurement

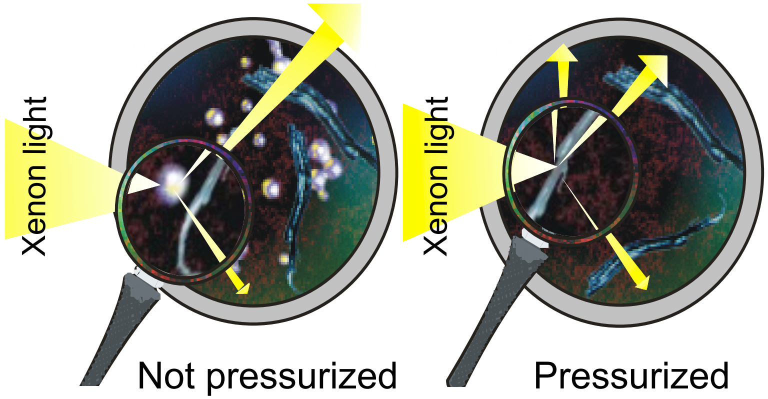




Kappa Analyzer Measurement Principles

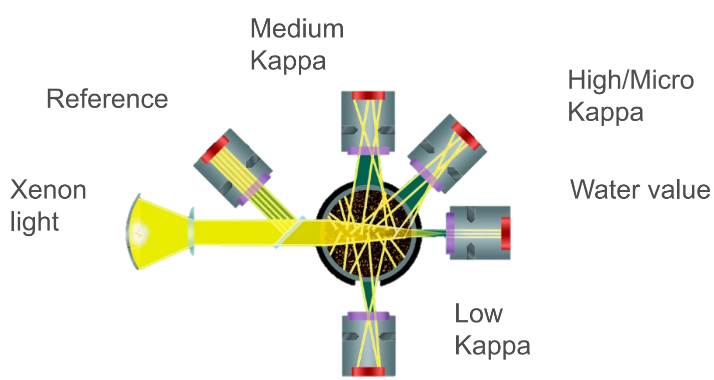
Control must tackle all chemicals consuming substances

Air bubbles scatter the light, the measurement is not accurate.

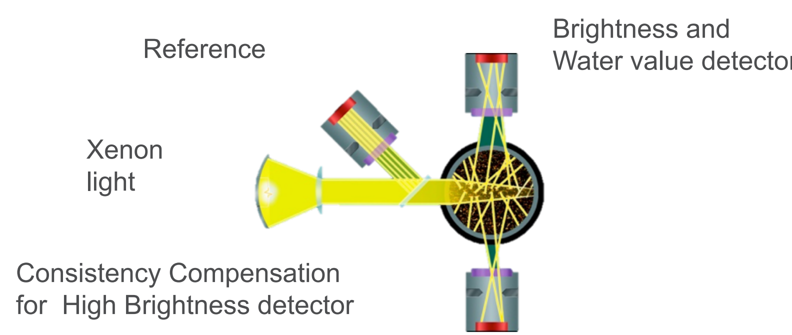


The pressurized measurement principle totally eliminates the air bubble effect

Kappa & Hex-A (from 0 to 120)

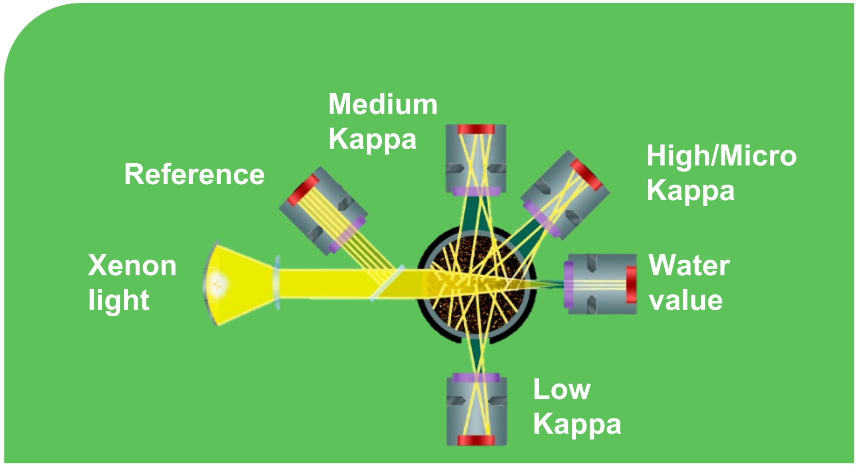


Brightness (up to 95 ISO)



Kappa Analyzer Measurement Principle

- **The analyzer uses an optical measurement principle.**
- **The sample is led through the measurement cell and illuminated with a xenon light.**
- **The analyzer measures the light scattering/absorption of the sample at different wavelengths.**
- **The measurement is made in a preset consistency range dependent on the kappa level of the pulp being measured.**



Kappa Analyzer Lab Sample Collection

Lab Sample Collector

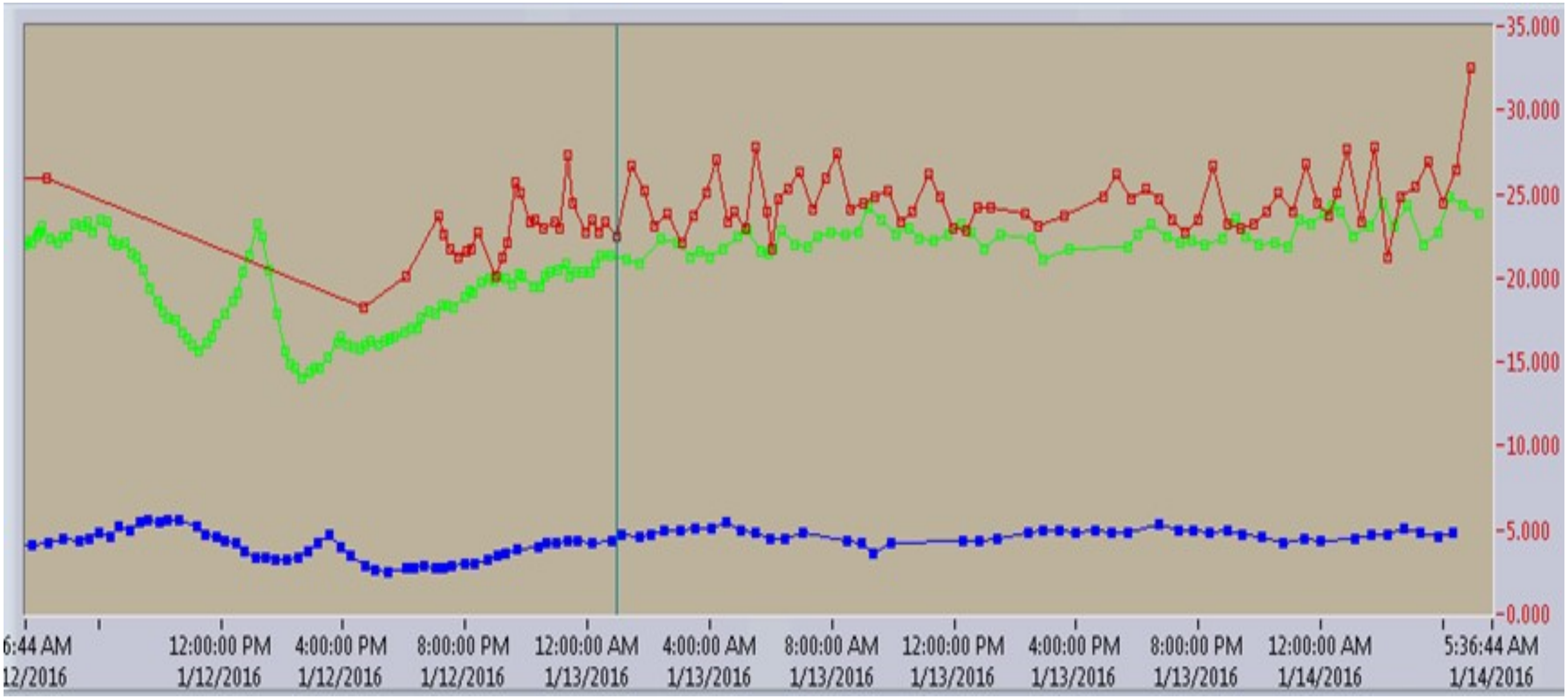
Adapting automatic sampling to the mill's procedures and standards

- Weekly analyzer accuracy verification
- No shift laboratory tests needed – a member of the quality team
- Analyzer lab sample test results follow-up through a communicator or Kajaani interface via Ethernet

Three operating modes:

- Manually initiated
- Collection timer 24/7
- Lo/Hi limit trigger

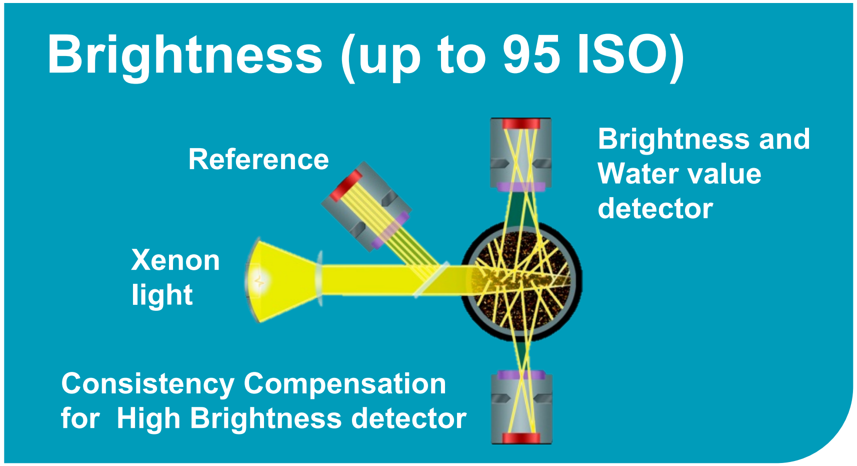
Fiberline Kappa Profile



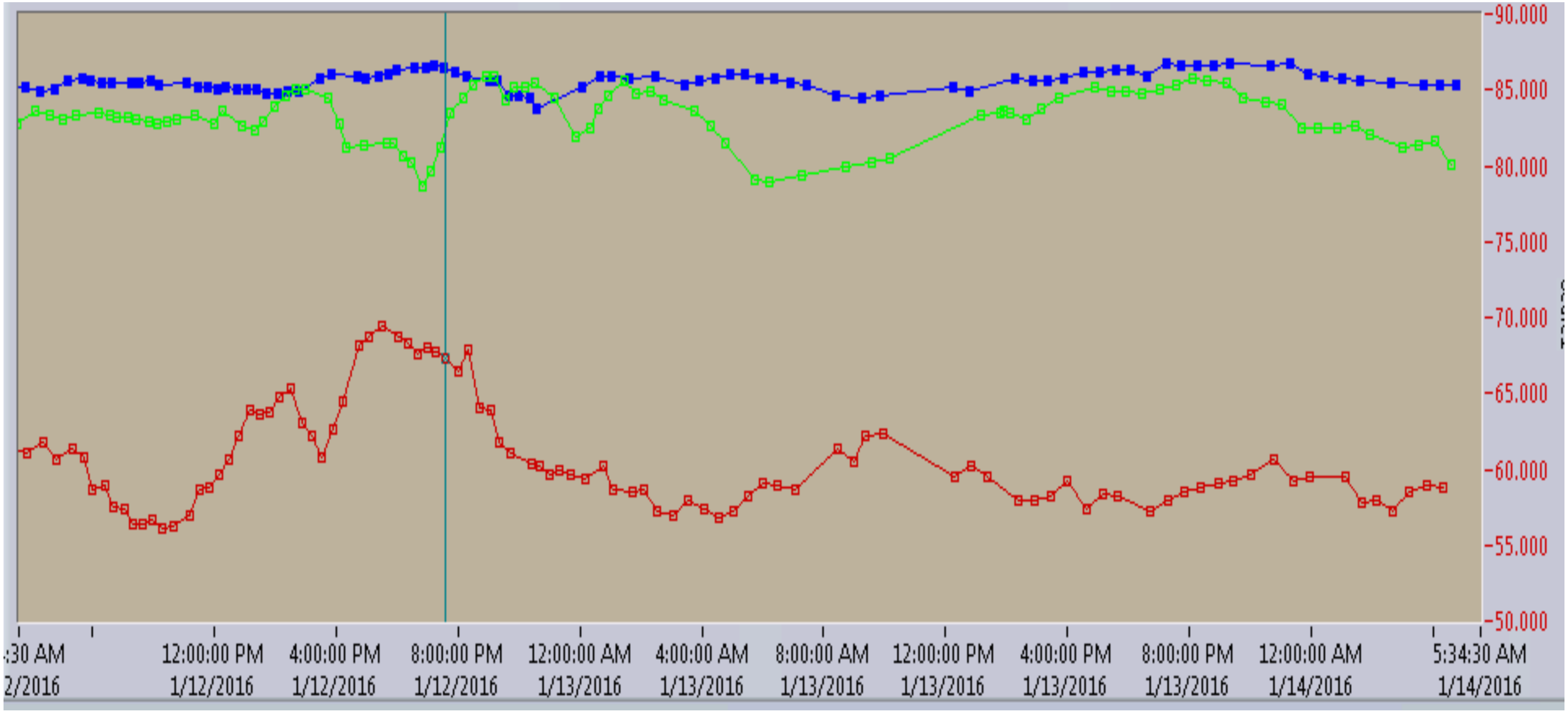
- Blowline Kappa
- D0 Pre-Stage Kappa
- Eop Post-Stage Kappa

Analyzer Brightness Measurement Principle

- Incoming sample is washed and neutralized, and the brightness of the pulp fiber is measured
- For this measurement, the entire sample is pumped through the measurement loop and the optical properties are measured from detectors measuring the reflectance of a xenon light at a certain consistency
- Variations in lamp intensity are detected and compensated for using the reference detector
- Cell contamination and variations in water color is measured by light transmitted through clean water in the measuring cell.



Bleach Plant Brightness Profile

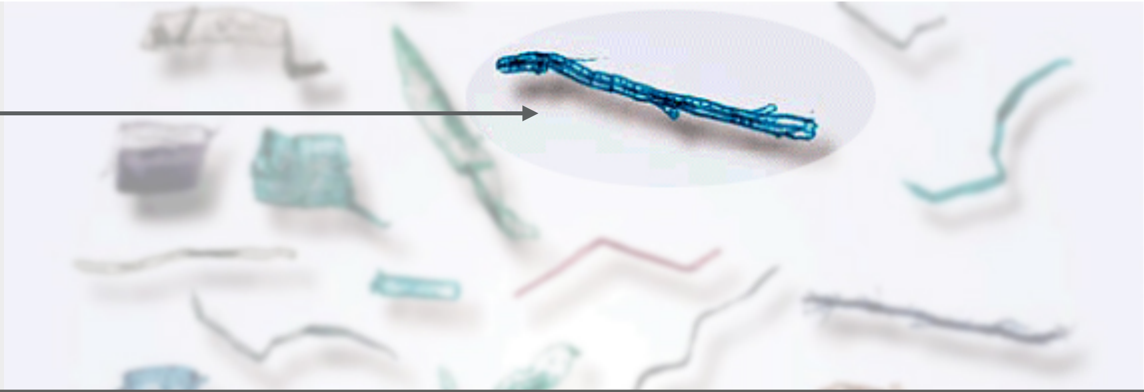


- Eop Post-Stage Brightness
- Post D1 Stage Brightness
- Post D2 Stage Brightness

Fiber-Shive Module Overview

Relationship Between Fiber and Paper Properties

Target is to keep the fiber quality consistent through the pulping process



Fiber property	Interdependency
Length	Tear strength, folding endurance, formation, light scattering, bonding
Width	Flexibility, bonding (area), bulk
Coarseness	Bulk
Curl	Strength of fiber network, formation, bulk
Fines	Freeness, bonding, light scattering, tensile strength, bulk, smoothness
Kink	Tearing strength
Vessels	Print picking, dust, coating problems

Fiber-Shive Module Overview

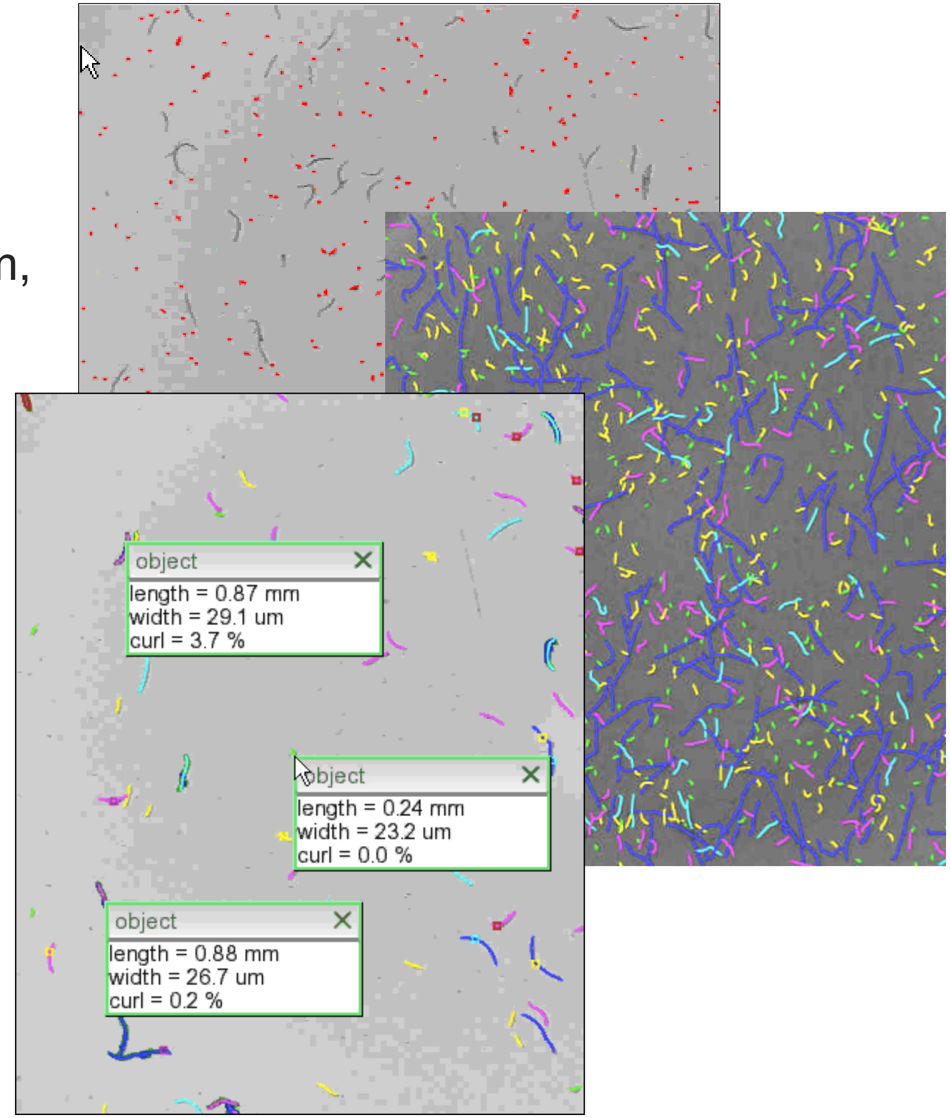
Measurements

Shive measurement

- [% (of weight), n/mg, n/g, n]
- Measuring range, width 75–2000 µm, length 0.3–20 mm

Fiber measurement

- Measuring range, width 2–500 µm, length 0.01–7.6 mm
- Averages, distributions and matrix presentations available
  - Length (Lc)
  - Curl
  - HW/SW ratio
  - Fines content
  - Width
  - Kink
  - Vessels



Fiber-Shive Module Overview

Measurement Principal

- A high resolution camera is used to take digital photos of a very dilute sample, at two different dilution levels for fiber and shive analysis.
- The digital images are then analyzed to determine various properties of the sample.
- The Fiber analysis is done at the lowest consistency to better capture individual fiber properties. It is looking at fiber length, width, curl, coarseness, kink, fines content, vessels, etc.
- The Shive analysis is run at a slightly higher consistency to allow it to look at more sample overall. It is looking at fiber bundles and various sized shives based on a classification matrix that sets the size requirements for each class of shive.

Fiber-Shive Module Components

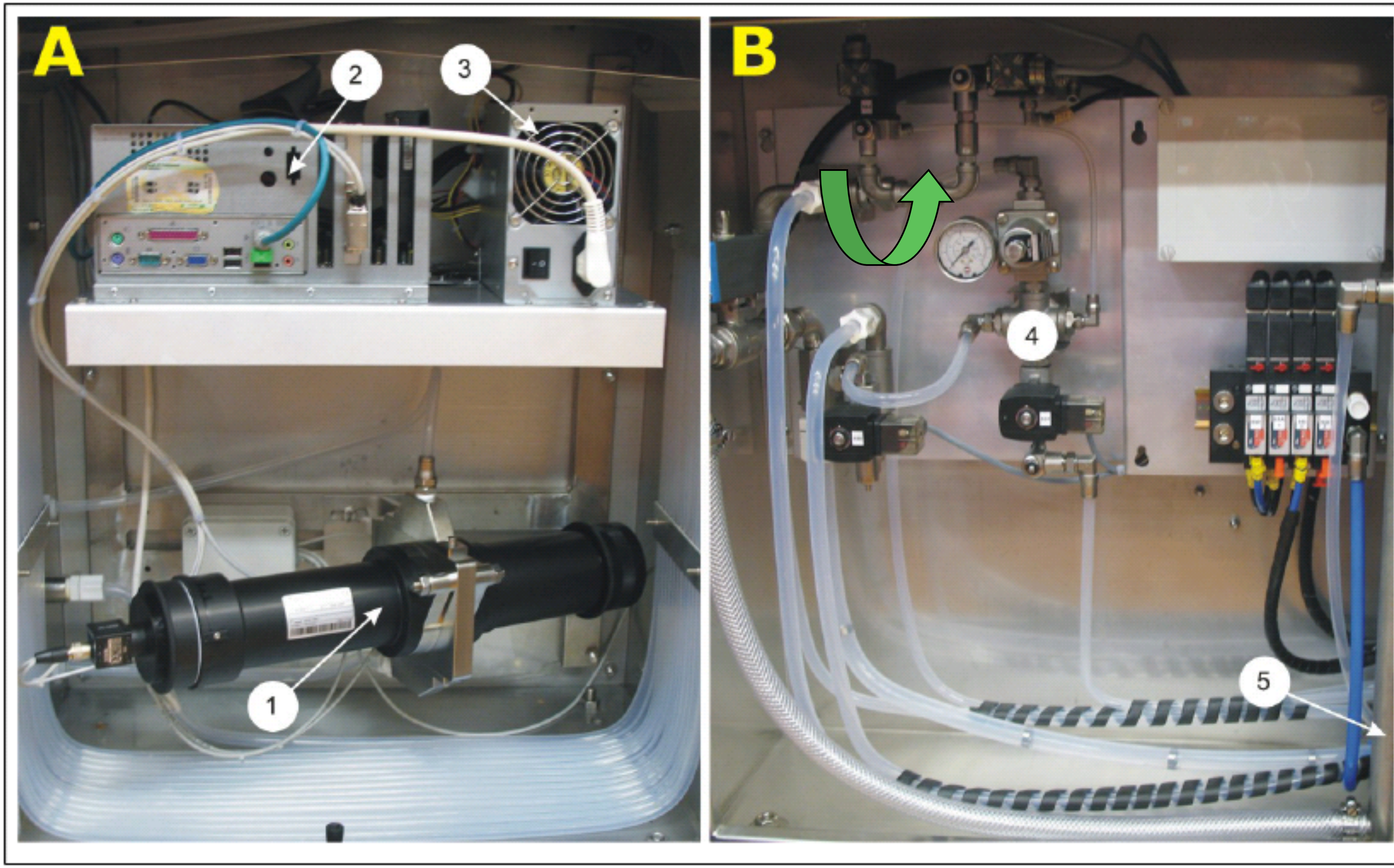
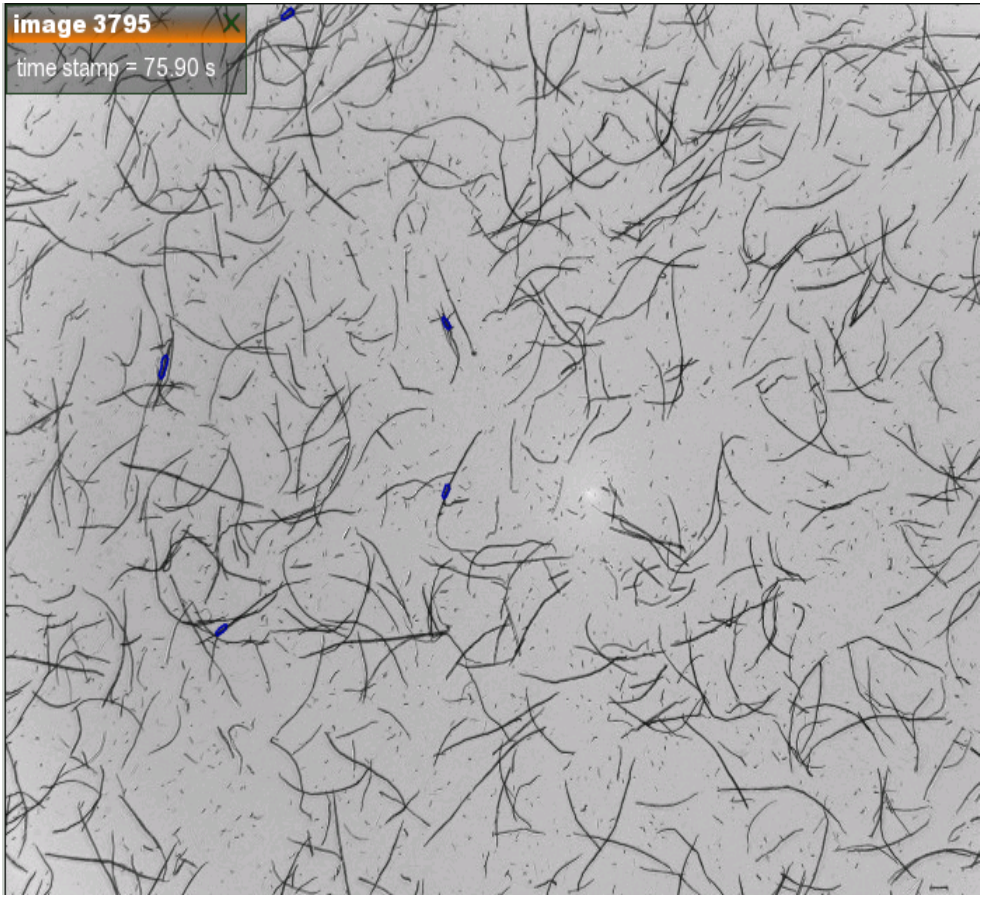


Fig. 2. Fiber-Shive module: A. 1 - measurement loop, 2 - computer unit, 3 - power; B. 4 - valve assemblies, 5 - discharge.

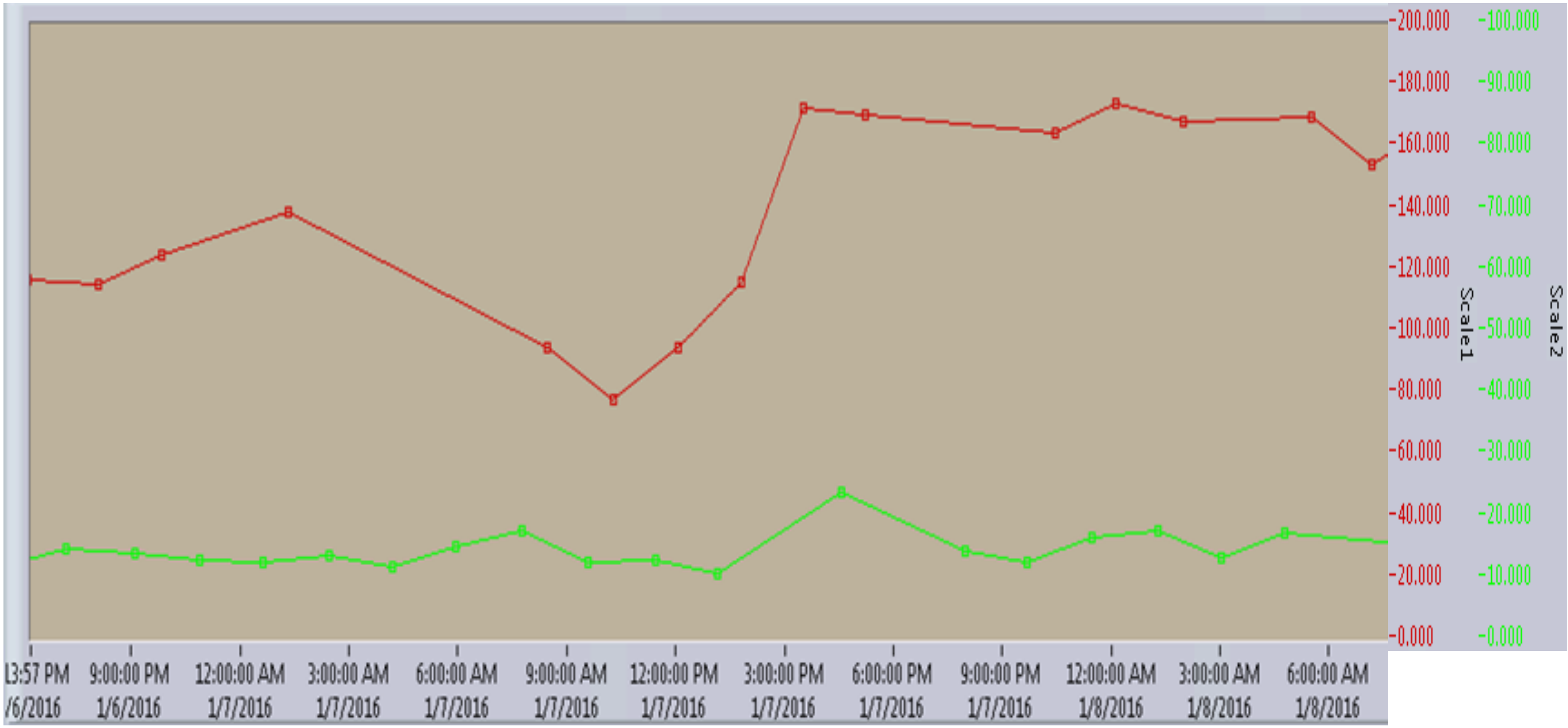
Shive Module Measurements



Shive measurement

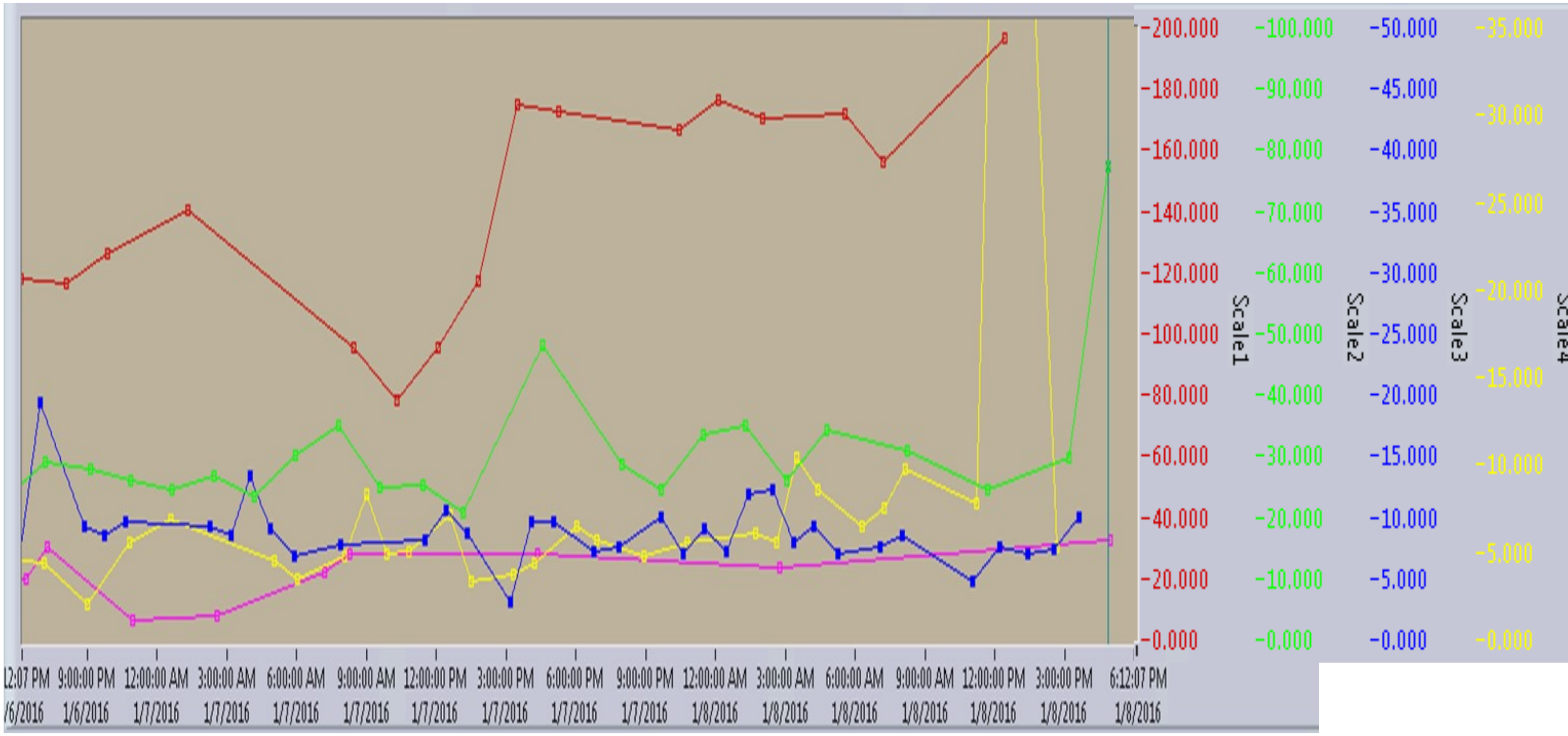
- Camera view of measurement
- Measuring range, width 75–2000 µm, length 0.3–20 mm
- Preset shive classes – mini, wide, long, and course
- Preset units available - %, shives/gram, number of shives

Shive Module Measurements



- Blowline Shive Count
- D0 Stage Shive Count

Fiberline Shive Profile



- Blowline Shive Count
- D0 Stage Shive Count
- Post-Eop Shive Count
- Post-D1 Shive Count
- Post-D2 Shive Count

Shive Profile Measurements

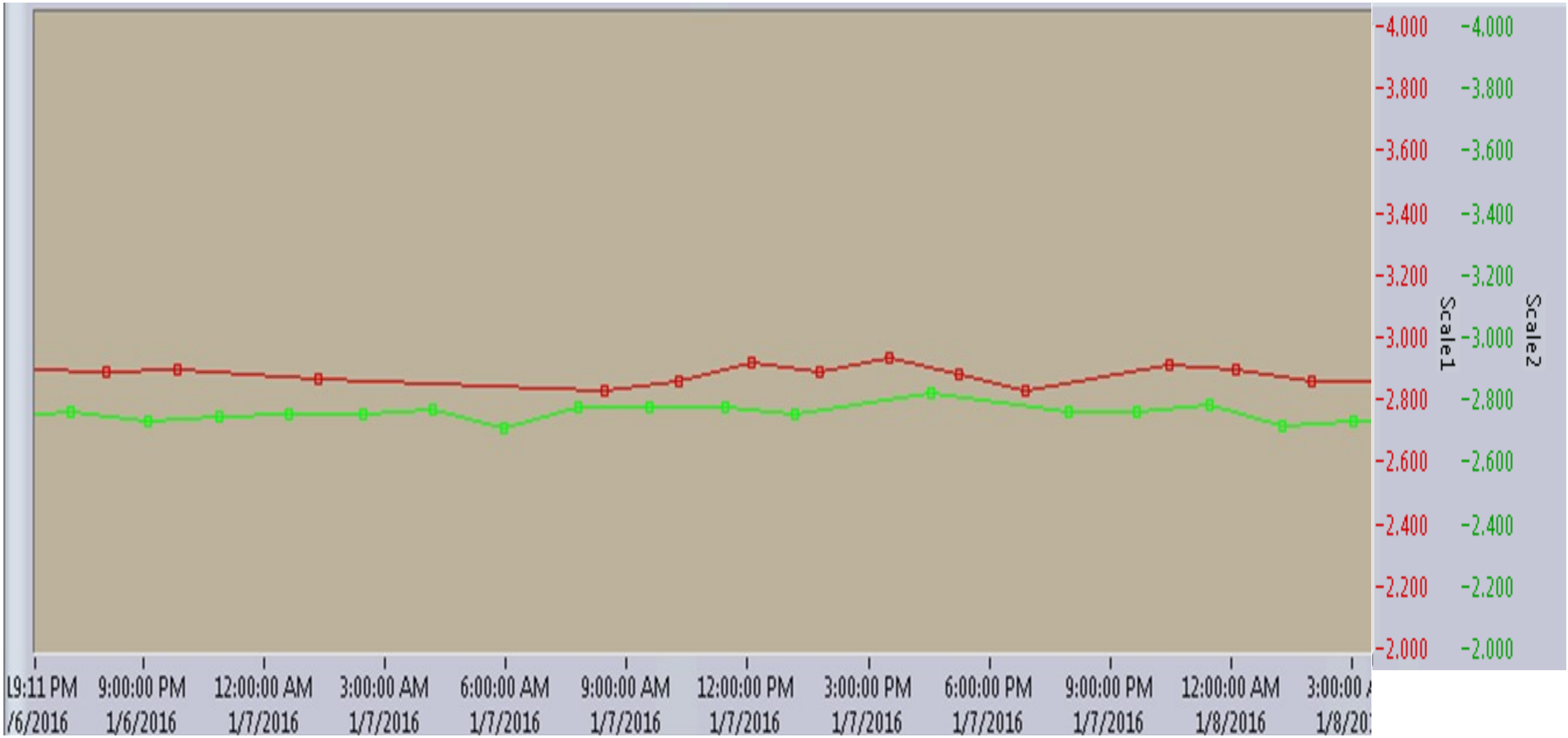
- The shive content from different sample locations can be very helpful in troubleshooting your process
  - Digester shive issue – correct liquor impregnation issues
  - Bleach feed shive issue – correct stock screens
  - Eop shive issue – modify D1 bleaching stage conditions to bleach shives better

Kappa Analyzer Fiber Property Measurements

- After the shive measurement the sample is diluted even further for fiber length measurements
- This give definitive species recognition if you have a swing line
- Several other paper properties can be determined from these measurements as shown below

- Length (Lc)
- Curl
- HW/SW ratio
- Fines content
- Width
- Kink
- Vessels

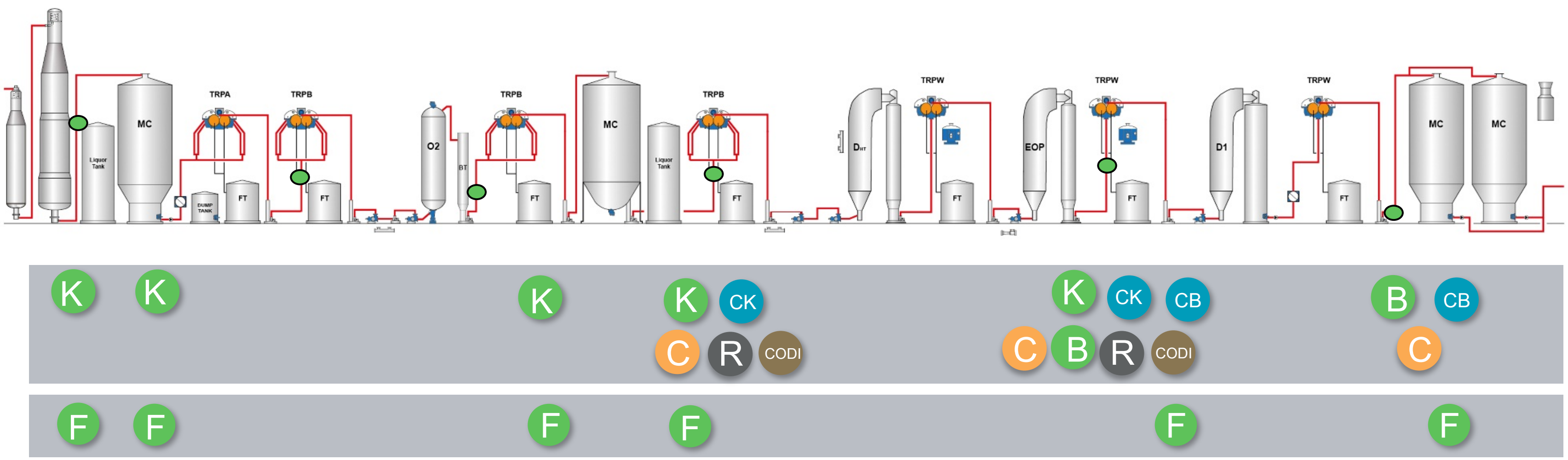
Fiber Module Measurements



- Blowline Fiber Length
- D0 Stage Fiber Length

Combining Measurements Provides Beneficial Results

Combining inline brightness and residual measurements to online absolute kappa and brightness measurements provides continuous process response into pulp quality & enhances process control



- K – Kappa (fiber lignin)
- B – Brightness
- F – Fiber Properties and Shives
- C – Inline Brightness
- R – Chemical Residual
- CK – Continuous Kappa
- CB – Continuous Brightness
- CODI – Continuous COD Index (Chemical oxygen demand index)

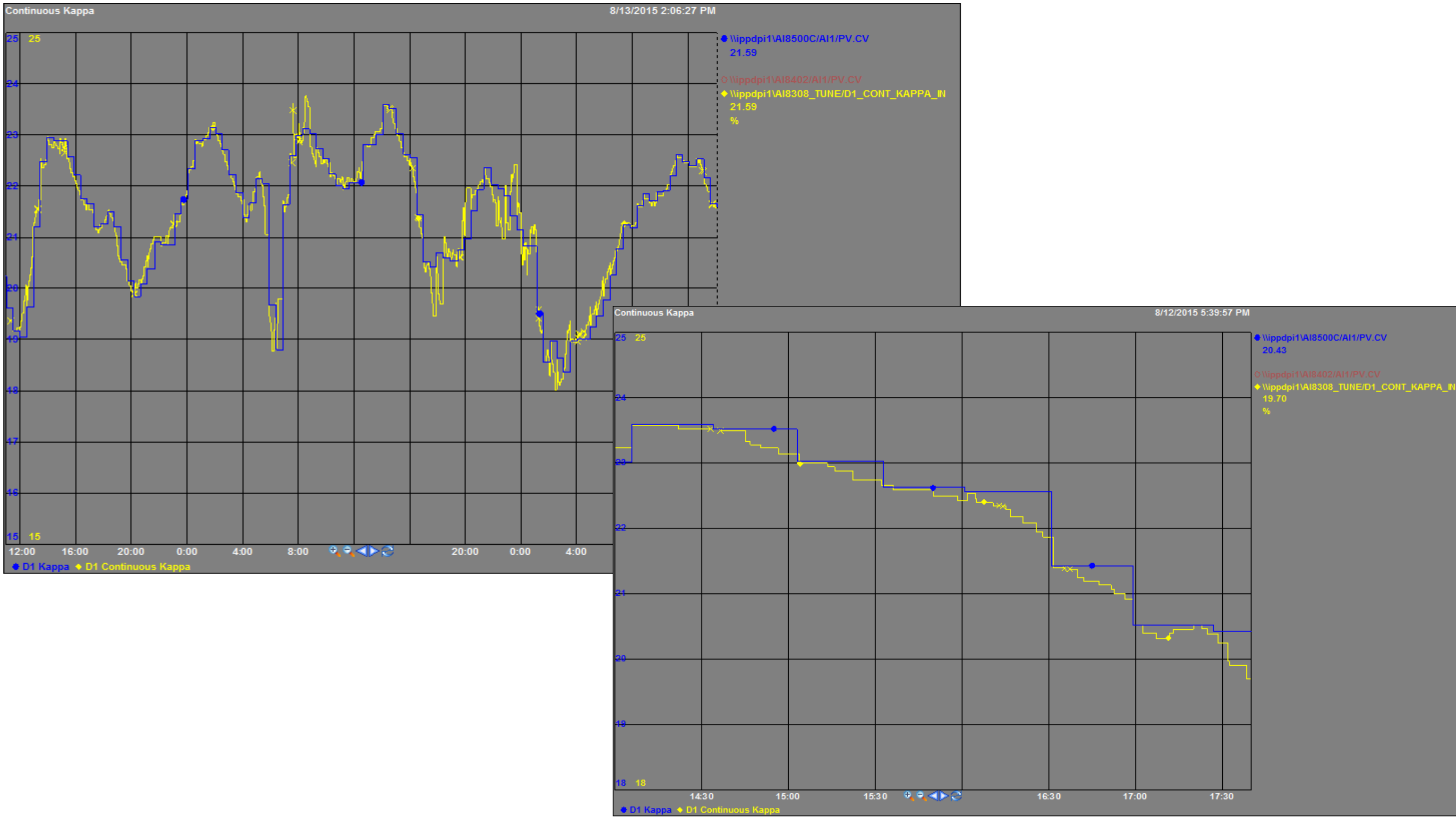
Cormec5 Brightness Sensor

- Provides a broad online window to the process by continuous relative brightness measurement
- Sampling points:
  - D0 inlet
  - D1 inlet
  - D2/P inlet
- Benefits:
  - Continuous measurement
  - D2C-application composes continuous absolute brightness or continuous absolute kappa information from this measurement and from the kappa analyzer for control purposes

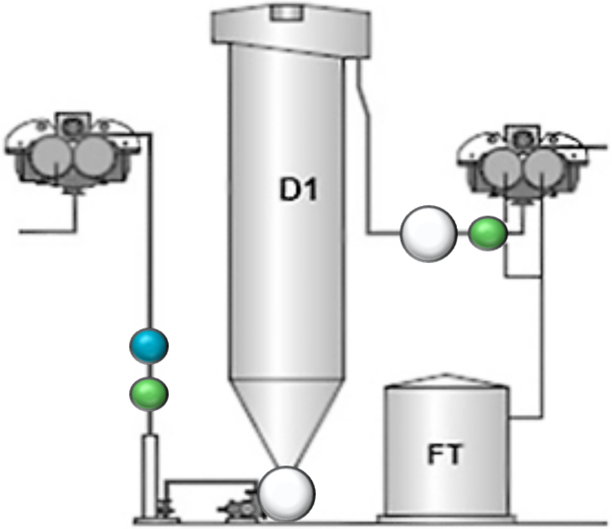
- Along with the Polarox residual sensor it compensates for changes in the process that a washed kappa sample would not see
  - Carryover
  - Consistency
  - pH
  - bleachability

Continuous Kappa measurement

Combines Kappa Analzyer and Cormec5 brightness measurement



Continuous brightness signal for D-stages

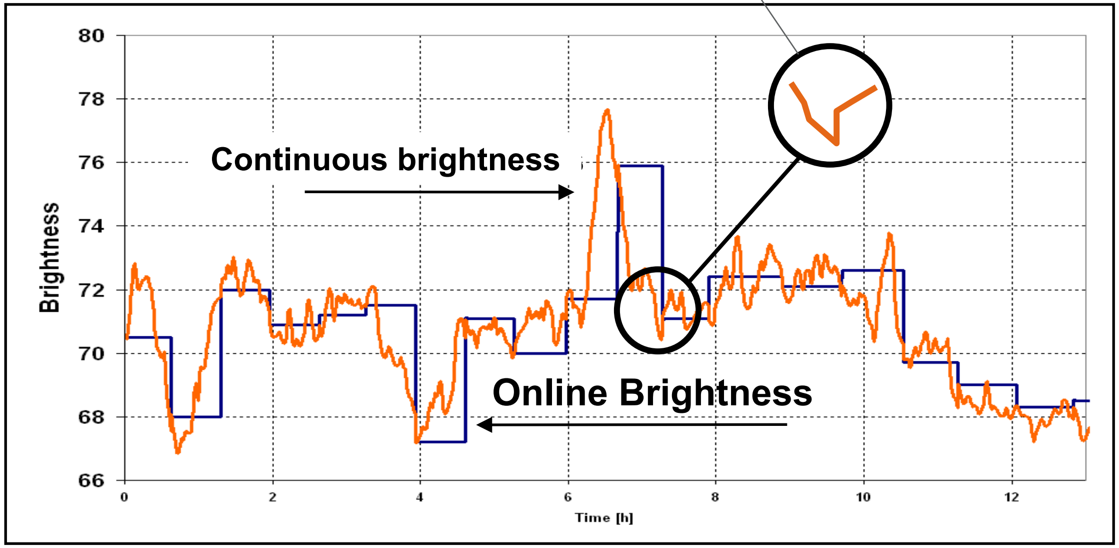


Cormec Brightness Sensor

Kappa Analyzer Kappa Sample

Kappa Analyzer Brightness Sample

Continuous brightness signal auto tunes after each new measurement from online analyzer



Polarox5 Residual Measurement

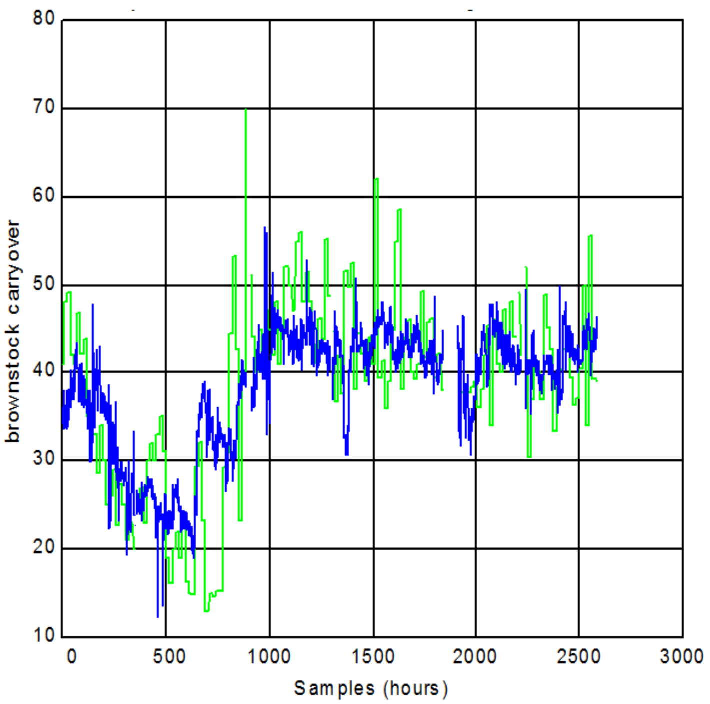
- Provides a broad online window to the process by continuous relative residual measurement
- Sampling points:
  - D0 inlet
  - D1 inlet
  - D2 inlet
- Benefits:
  - Provides continuous, timely information of washer losses and optimal chemical charge for Bleaching Chemical Controls
  - After tower residual measurement for antichlor control to safe guard process equipment and minimize pulp brightness reversion

- Chemical pulping:
  - ClO2
  - Peroxide
  - Cl2
  - SO2
  - Sodium Bisulphite
- Mechanical pulping:
  - Peroxide
  - Sodium Hydrosulphite
- RCF/DIP:
  - Peroxide
  - Sodium Hydrosulphite

CODIndex – Measures overall chemical demand relative to the absolute kappa and brightness level

- Continuous Kappa signal combines fast pulp lignin variation measured by the inline brightness sensor and discrete fiber bound lignin variation measured by Kappa analyzer
  - Continuous inline brightness also responds to pulp bleachability variations
  - Chemical residual signal responds to washing efficiency and bleaching chemical strength variations as well as chemical reaction speed with lignin

CODIndex (Chemical oxygen demand index) based on
Fiber lignin /Brightness /Chemical residual measurements as an individual signal



Conclusions

- The fiberline process is very dynamic and challenging to monitor and control
- Good measurements are the first key to understanding the process. Once the measurements are in place and proven to be reliable and accurate, you can begin to optimize your fiberline
- Optimizing your fiberline is a step by step process that must be done correctly with a systematic and sustainable approach
- Frequent, reliable, and accurate process measurements are the first and most important step in the process. Without this step any hope of optimizing a fiberline to operate at its most efficient stage and sustain the results is futile.
- If a proper control strategy is developed based on accurate and reliable lab quality or better measurements, then the savings in wood and chemical cost should be substantial enough to more than cover the cost and effort required to add and maintain these measurements
- This approach should also lead to reduced variation in the process that results in improved final product quality

Valmet

FORWARD