Experiences of Single Point Morphology Measurements in Mechanical Pulping

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Outline

• Single point online pulp quality measurements
  • What can it be used for
  • Speed of the measurement
  • Brief description of the Instrument

• Two examples
  • TMP Holmen Hallstavik R16 main line
    • High Consistency refining in two stages (Hymac)
  • CTMP Rottneros main refiner line
    • Single Stage HICO followed by 1 stage LOCO refining

• Summary & Discussion
We have known for years

- The Morphology of the pulp has an effect on the final products
- In commercial installations we would like have the pulp quality within a tight specification window all time

Source: Horn, USDA
The pulp morphology impacts the quality of paper or board produced

TMP  CTMP

Very different pulps by design
Different approaches used to improve

• Complete investigations with hand sheets or paper properties
  + Accurate
  + Understand / Compare large systems
  - Expensive and time consuming
  - Snapshots in time

• Independent process measurements
  + Many independent measurements
  + High frequency and relatively in-expensive
  - Coupling between process measurements -> pulp -> paper properties is a challenge

• Online pulp measurements
  + Measures pulp properties
  + Inexpensive
  - Low measurement frequency
  - Coupling between pulp properties -> final product can be difficult
SPM Single Point Morphology Measurement

- Optical single point measurements
  90 high resolution pictures/sec
- No sampling- Continuous measurement
  No pumps, transmitters, solenoid etc.
- Utilizes the inertia of the stock to drive it through the sensor for analysis
- Can be placed in locations from 0-10% consistency
- A vast number of variables are produced
Our focus for Mechanical Pulp installations

- Morphology measurements
  - Provide a robust measurement of relevant parameters
    - Content of fines, fibers, shives
    - For each particle observed
      - Size
      - Shape
      - Appearance
    - All measurements are available as mean, distributions or accumulated values

- High Output frequency of the results > 100 data points/hr.
- Minimal service and maintenance requirements
Single Point Morphology Sensor

Installed on a 2 stage TMP line after a pulper
The inline SPM results were compared with off line laboratory test results
• All SPM results are based on the fiber morphology obtained from the image analysis
• Strong correlation between SPM inline and laboratory results $R^2 = 0.8$
Rapid pulp quality measurements - can it improve the operating efficiency?
Short term response to a “large” change in plate gap

**Applied Specific Energy response to Plate Gap Change**

- Specific Energy
- Ref gap
- Sec gap

**Fiber Length comparison**

- PQM online raw
- SPM raw
- Manual Lab PQM
- Pri
- Sec

**Refiner plate gaps mm**

**Time (Dec 12 2017)**

IMPC 2018
TMP Holmen Hallstavik installation

• Can we gain a better understanding of the different morphology measurements by having high frequency and high resolution data available?

• To find out we decided last year to start with CSF
  • Benefits
    • Reference results produced every 20 min by a conventional CSF tester online
    • Process variables such as plate gaps, SEC etc. impact on both short and long term variations are also available
    • Simple and not cumbersome, large amount of data for very different operating conditions will be covered over time
    • Not snapshots but rather continues measurements
What we are learning from the TMP installations

PQM and SPM Fiber Length

What we are learning from the TMP installation

SPM Fiber Length Distribution


High sampling freq.
Low sampling freq.
SPM CSF from morphology measurements
CTMP Rottneros

SPM installed in the main line

A single stage Hico refiner followed by a Loco refiner
Different grades

• Market pulp mills may benefit from being able to switch grades quickly
  • Run shorter more profitable production runs
  • Reduce the off-specification transition periods
  • More precise and defined “recipes” for the operators
  • Simplified scheduling
Typical switch from one grade to another
The event in terms of a **pulp finger print**

**Grade A is being produced and is within the recipe specifications (light green bars)**

**Grade A has changed to grade B**
**Production is NOT within the recipe specifications (light green bars)**

**Operators are taking actions**

**Grade B is being produced and is within the recipe specifications (light green bars)**
Pulp Finger Print example
• Animation from real data collected
• Starting at 200 ml
• Plate gap is reduced
• Ending at 160 ml
Summary & Discussion

• Single Point Morphology Measurements points out we are ignoring short term variations of the pulp quality in Mechanical Pulping

That cannot be good

Thank you for your attention