Advanced Control of the TMP Mainline Refiner System

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Overview

• Mill description
• Process analysis
• Control problem definition
• The control solution
• Implementation results
• Benefits
TMP Plant – Elk Falls

• Plant description
  – 1600 adm/day TMP plant
  – TMP I – 3 RLP 54/58 refiner lines
  – TMP III – 4 RLP CD70 refiner lines
  • Produces 80% of total pulp production

• Manual control challenges
  – Based on grab samples (infrequent)
  – TMP I and TMP III each have a single latency chest
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Process Schematic

- Screw speed controller
- Flow controller
- Plate gap controller
- Motor load indicator
- Consistency indicator
- Pulp quality monitor

Presteamer
Dilution water
Motor
Blow-line
Cyclone

Latency chest

PQM - pulp quality monitor
Paper Machine Requirements

- **Reduce kraft consumption**
  - Competitive edge required in the current market

- **Improved paper machine runnability**
  - Reduce paper breaks
  - Increase paper machine efficiency

**Consistent TMP Pulp Quality**
Impact of TMP Pulp

- Analysis of TMP pulp quality
  - CSF, MFL, Shives
  - Impact on hand sheet properties
- Significant pulp quality variability
  - Analysis was useful but not conclusive

Needed to reduce TMP pulp quality variability
TMP III – Process Analysis

- **Motor load variations**
  - Affected by chip bulk density variations

- **Blow-line consistency variations**
  - Implies uneven refining intensity
  - Manual control based on grab samples

- **Pulp quality variations**
  - Affected by all process variables
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Process Dynamics

Feed Screw Speed

Dilution Flow

Plate Gap

Motor Load

Blow-line Consistency

Pulp Quality
Control Problem Definition

- Control refiner motor load
  - Avoid load excursions
- Control blow-line consistency
  - Regulate refining intensity
- Control final pulp quality
  - Define a quality window (CSF, MFL)
- Coordinate multiple refiner lines
The Control Solution

• Development
  – NorskeCanada-Elk Falls & Honeywell joint project

• Controller design
  – Constrained model based control (MPC)
  – Ability to define low and high limits on all variables
  – Ability to define a pulp quality window
  – Accommodates multiple refiner lines
  – Robust MPC Design
    • Insensitive to plate wear
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Control Strategy

Diagram of control strategy with various inputs and outputs:
- PR Screw Speed
- PR Dilution Flow rate
- PR Plate Gap
- SR Dilution Flowrate
- SR Plate Gap
- PR Motor Load
- PR Consistency
- SR Motor Load
- SR Consistency
- Quality Controller
- Stabilization Controller
- Optimizer

Diagram connections and data flow indicate the control strategy for the TMP Mainline Refiner System.
Open Application Architecture

- Mill Information Network
  - Router or Hub
- Process Information Network
  - Application Node
    - Profit Studio
  - Historian
- Operator Interface
- Process Control Network
  - Process I/O
- Process Information Network
  - Operator Interface
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Refiner Line Control Results

![Chart showing time (days) on the x-axis and motor load (MW) and blow-line consistency (%) on the y-axis. The chart compares Primary motor load, Secondary motor load, Primary consistency, and Secondary consistency before and after a certain point in time.](chart.png)
Quality Control Results

![Graph showing quality control results for PQM Freeness (mL) vs. PQM Fiber Length (mm). The graph compares data before and after quality control, with distinct markers for each condition.](image)
Benefits

- Tight regulation of refiner operations
  - Motor load and blow-line consistency
- Improved pulp quality
- Ability to define a pulp quality window
  - Window set to optimize paper machine operations
- Reduced specific energy
- Reduced kraft consumption
Benefits Sustainability

- Average life of APC is about 6 months
  - Lack of operator training
  - Lack of process model update as major physical changes are introduced
  - Lower level regulatory control loop performance deteriorates
Benefits Sustainability - 2

• NorskeCanada - Elk Falls solution to sustainability
  – Each crew was fully trained (hands-on and classroom)
  – Lead operator was assigned to the project
  – Offline TMP simulation package was supplied by Honeywell (Profit Studio)
  – Honeywell Advanced TMP Control course (Vancouver)
  – Automated loop performance assessment – Loop Scout analysis
Conclusions

- Advanced control strategy was successfully implemented in TMP III
- Refiner operation was stabilized
- Pulp quality was improved and variability of quality was reduced
- Significant benefits are being realized
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