Case Study of Cost Savings with a New Chemical Mixing System at Mitsubishi Paper Hachinohe Mill PM7

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1. Introduction of Mitsubishi Paper
2. Background
3. Introduction of “Jet Injection” mixing technology
4. Results
5. “Step two”
6. Conclusions
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Outline of Mitsubishi Paper Group

- **Mitsubishi Paper Mills Limited (MPM)**
  - Mills: 5 mills in **Japan**
  - Product: Printing paper, Office use paper,
    Business communication paper,
    White lined board, Photographic paper

- **Mitsubishi HiTec Paper GmbH**
  - Mills: 2 mills in **Germany**
    (Bielefeld and Flensburg)
Outline of Hachinohe Mill

- Hachinohe Mill
  - Production: 0.9 million t/year
  - Machines: 7 paper machines and 3 off-coaters
Outline of PM7 in Hachinohe mill

PM7

- Build: 1997
- Base weight: 48-157gsm
- Speed: 1,300m/min
- Production: 13,000t/month
- Wire width: 5,800mm
- HeadBox: ModuleJet
- Former: DuoFormer-D
- Press: TNT+TF+ENP-C
- Grade: Base paper, Fine paper, Book paper, LWC
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Decrease in FPR

➢ ‘Optimization of wet-end’ at PM7 since 2005
   ➢ New retention system (Dual polymers)

➢ Decrease in FPR after ECF of pulp process
   ➢ Because of increase in PCD of LBKP

(*) LBKP = Laubholz Bleached Kraft Pulp

➢ Increase in the consumption of retention aids
Change in dosing rate of retention aids

(Dosing rate of retention aids (Set 'Before ECF' = 100)

<table>
<thead>
<tr>
<th></th>
<th>Before ECF</th>
<th>After ECF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dosing rate</td>
<td>100</td>
<td>110</td>
</tr>
</tbody>
</table>
Necessity of new chemical mixing system

- Request to new chemical mixing system
  - Reduction in retention aids
  - Improvement of FPR
  - No scale and dirt
  - No sheet formation problem

- Examination of installation “Jet Injection” mixing technology
Previous machine flow

- Stock Box
- DC
- Cleaner
- CFP
- MFP
- MS
- HeadBox

C-PAM: Before CFP (Quill nozzle)
A-PAM: Before MFP (Quill nozzle)
With New Jet Injection Mixing, machine flow

Stock Box

DC

Cleaner

C-PAM : Before MS (Quill nozzle)
A-PAM : After MS (TrumpJet)

HeadBox

CFP  MFP

MS
Simulation of conventional mixing points

- C-PAM before cleaner fan pump
- A-PAM before machine fan pump

Simulation of new chemical mixing points

- C-PAM before machine screen
- A-PAM after machine screen

Agitator setting

- High shear
- Medium shear
- Low shear

(*) Tested at Mütec DFS retention analyzer
Result of laboratory test

- **TOTAL FPR [%]**
  - Simulation of new chemical mixing points
  - Simulation of conventional chemical mixing points

- **ASH FPR [%]**
  - Simulation of new chemical mixing points
  - Simulation of conventional chemical mixing points
TrumpJet® Flash Mixing = Jet Injection Mixing for papermaking additives

Wetend Technologies Ltd is a Finland based corporation.

City of Savonlinna
**TrumpJet® Flash Mixing for papermaking additives**

- Transverse injection exploits circulated headbox feed stock.
- Use of fresh water or filtrate is completely eliminated.

- Flash mixing takes place in time of two seconds.

**PATENTED Flash-Injection mixing technology**
Jet Injection Mixing for papermaking additives

- Fast mixing makes it possible to bring the most important additives close to the headbox to increase efficiency.

- Two or more additives can be mixed simultaneously in groups.

- Additional delay time to slice +0.5...2.5 s with average 1.5 s.
Jet Injection Mixing for papermaking additives

250 installation in 20 countries:

Typical results:
- quality and process improvements
- reduced additive consumption
- total elimination of fresh water in dilution
- reduced energy consumption
- reduction of $\text{CO}_2$ emission
Jet Injection Mixing for papermaking additives

Total Annual Water and Energy Saving with 250 installations:
35 million m³ (9 billion gal) of fresh water with 1,5 million MWh (5000 billion BTU) energy saving corresponding to more than 800,000 oil barrels

7+ hours

No energy needed to heat post-dilution water:

This gives 1,5 million MWh potential to reduce energy consumption and approx 1000.000 tons of CO₂ emissions per annum

PATENTED Jet Injection mixing technology
1. Introduction of Mitsubishi Paper
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Content 4. Result

1) Reduction of retention aids and improvement of FPR

2) Saving energy by reduction of dilution water

3) Extending shut down cycle for prolonged lifetime of wires and felts
Content 4. Result

1) Reduction of retention aids and improvement of FPR

2) Saving energy by reduction of dilution water

3) Extending shut down cycle for prolonged lifetime of wires and felts
Reduction of retention aids

Dosing rate of retention aids (Set 'Before ECF' = 100)

Before ECF: 100
After ECF: 110
With new "Jet Injection mixing": 71

Reduction of retention aids: -35%
Improvement of Total FPR
Improvement of Ash FPR

ASH FPR [%]

- Before
- With TrumpJet

Coat Base Paper
Fine Paper
Book Paper
SLWC
LWC
Average

ASH FPR Before:
- Coat Base Paper: 20%
- Fine Paper: 30%
- Book Paper: 40%
- SLWC: 30%
- LWC: 42%
- Average: 42%

ASH FPR With TrumpJet:
- Coat Base Paper: 42%
- Fine Paper: 30%
- Book Paper: 30%
- SLWC: 30%
- LWC: 30%
- Average: 30%
Content 4. Result

1) Reduction of retention aids and improvement of FPR

2) Saving energy by reduction of dilution water

3) Extending shut down cycle for prolonged lifetime of wires and felts
Saving energy by reduction of dilution water

- **Reduction of dilution water of A-PAM line**
  - 90 L/min → 30 L/min
  - (24 GPM → 8 GPM)

**Energy savings**

\[
25.2^\circ C \times 60\text{L/min} \times 4.2\text{kJ/kg}^\circ C = 2,540\text{kWh/day}
\]

(*) Fresh water temperature = 11.8 C
Warm water temperature = 37.0 C
Content 4. Result

1) Reduction of retention aids and improvement of FPR

2) Saving energy by reduction of dilution water

3) Extending shut down cycle for prolonged lifetime of wires and felts
Ash consistency of white water

Before
Jet Injection mixing

Ash consistency of No.1 white water tank [%]

Coat Base Paper
Fine Paper
Book Paper
SLWC
LWC
Average

0.16
0.09
Ash flow rate passing through wire

Before
Jet Injection mixing

-44%
Wire wearing rate

**TOP.W**
-16%

**BOT.W**
-19%

Wire wearing rate [%/day]
## Improvement of AKD dirt on top wire

<table>
<thead>
<tr>
<th>After 60days</th>
<th>Untouched</th>
<th>Scratched</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before</strong></td>
<td><img src="image1" alt="Untouched Before" /></td>
<td><img src="image2" alt="Scratched Before" /></td>
</tr>
<tr>
<td><strong>With Jet Injection mixing</strong></td>
<td><img src="image3" alt="Untouched After" /></td>
<td><img src="image4" alt="Scratched After" /></td>
</tr>
</tbody>
</table>
Prolonged lifetime of wires

➢ Wire lifetime :

90 days ➞ 120 days

➢ Annual requirement of wire :

4 pieces/year ➞ 3 pieces/year

(*) Both top wire and bottom wire
Total consistency of press white water

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>Jet Injection mixing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coat Base Paper</td>
<td>0.08</td>
<td>0.05</td>
</tr>
<tr>
<td>Fine Paper</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>Book Paper</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>SLWC LWC</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Average</td>
<td>0.00</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Felt wearing rate

PuF

-23%

4PF

-47%

(*) ‘FPR improvement’ + ‘optimization of felt conditioner’
Prolonged lifetime of felts

- Felt lifetime:
  - 60 days → 80 days

- Annual requirement of felt:
  - 6.0 pieces/year → 4.5 pieces/year

(*) All 5 parts (PuF / 1PBF / 3PF / 4PF / TF)
Extending shut down cycle

- Shut down cycle: 30 days → 40 days
- Number of annual shut downs: 12 times/year → 9 times/year

(*) Each shut down time remains the same.
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C-PAM + AKD with Jet Injection mixing after the screen
Present machine flow, PM7

Stock Box

DC

C-PAM : Before MS (Quill nozzle)

AKD : Stock Box

Cleaner

HeadBox

C-PAM

A-PAM

MS

CFP

MFP
With new Jet Injection Mixing, machine flow, PM7

Stock Box → DC → Cleaner

C-PAM + AKD : After MS (Jet Injection Mixing)

A-PAM

C-PAM + AKD

MS → CFP → MFP

HeadBox
Concept of laboratory test, PM7

Simulation of present mixing points
- AKD at stock box
- C-PAM before machine screen
- C-PAM + AKD after machine screen

Simulation of new chemical mixing points
- A-PAM after machine screen

Agitator setting:
- High shear
- Medium shear
- Low shear

0 sec 35 sec 40 sec 60 sec

(*) Tested at Mütec DFS retention analyzer
Result of laboratory test, PM7

Result of laboratory simulation

Stöckigt sizing degree [sec]

AKD at stock box
AKD+C-PAM after machine screen
Conclusion of installation in PM7

- Possibility to reduce AKD by Jet Injection Mixing
- Possibility to reduce retention aids still more because of success in the first Jet Injection Mixing
- Decision to install TrumpJet Chord for CPAM and AKD
- Installation in October, 2008.
Conclusion of installation in PM7 for CPAM & AKD

- **Results:** PM7, additive savings after flash injection installed also for CPAM and AKD

<table>
<thead>
<tr>
<th>Filler content</th>
<th>CPAM</th>
<th>APAM</th>
<th>AKD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low - under 10%</td>
<td>10%*</td>
<td>10%*</td>
<td>20%</td>
</tr>
<tr>
<td>Middle</td>
<td>10%*</td>
<td>10%*</td>
<td>10%</td>
</tr>
<tr>
<td>High 20 – 30%</td>
<td>10%*</td>
<td>10%*</td>
<td>0%</td>
</tr>
</tbody>
</table>

***Filler retention before 30.2% after 41.9%, if old retention is kept, the saving of CPAM is 40%***

***Mitsubishi Paper is now investigating the effect of dosing locations of filler and AKD to optimize sizing degree***
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Optimization of wet-end at PM7

- Optimization of wet-end at PM7 since 2005
  A) Optimization of retention system
  B) Stabilization of electric charge of white water
  C) Optimization of biocide
  D) Optimization of felt conditioner

- Encounter with sudden drop in FPR

- Investigation cause ➔ Installation Jet Injection Mixing stations
Conclusions

- By “Jet Injection Mixing” (and optimization of wet-end),
  - Great reduction in production cost
  - Increase in productivity by 3.5%
- Planning to adapt Jet Injection technology to other chemicals
- One of THE solutions of ‘optimization of wet-end’
  - ‘Change chemicals’ + ‘Improved equipment’
    - More effective result
Thank you