Advanced condition monitoring of critical assets with the AVEVA™ PI System™

Deiser Clemens, Harald Piringer
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Enhancing Reliability and Efficiency

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What does MONDI do?
Mondi is a global leader in packaging and paper

- 22,000 employees
- More than 100,000 solutions for our customers
- Group offices in London and Vienna
- Premium listing on the London Stock Exchange for Mondi plc
- Over 100 operations across more than 30 countries
- 2.4M hectares of forest managed
- Secondary listing on the JSE Limited for Mondi plc
- FTSE4Good Index Series, JSE’s Socially Responsible Investment Index
Mondi 2030 sustainability commitments

Integration along the value chain

Efficient Production

• Use resources wisely
• Prevent environmental degradation
• Support a circular economy

We are committed to reducing water use and increase water recycling, as well as to finding alternative solutions for waste by recycling or reuse.

For more details refer to https://www.mondigroup.com/sustainability/map2030-framework/
AVEVA Products in use

Unleashing Potential with AVEVA PI System’s Asset Framework and AVEVA PI Vision™

**Asset Framework**
- Templates according Mondi standards
- Notifications

**AVEVA PI Vision**
- Custom symbols
- Manual inputs and comments
Challenge – Asset Monitoring

Beyond Static Limits and Manufacturer Norms

What has been tried?

- Online calculation of operating points in relation to the characteristic curve provided by supplier
- Monitoring and alarming based on static limits

Why didn’t it work!

- Characteristic curve are outdated after years of operation (i.e. replacement of mechanical components)
- Static limits are not sufficient for the diversity of operating states
Challenge – Heat Exchangers

Recognize plugging based on asset analytics

- Talc
- Resin
- Inorganic Materials

Clogging → Surface Deposition
Traditional monitoring strategies have proven insufficient, leaving critical gaps in our ability to understand and respond to highly dynamic operating conditions.

Utilizing AVEVA PI System technology, including AVEVA PI Server asset framework and AVEVA PI Vision as well as Visplore analytics, to monitor asset health and assist engineers in their decision-making.

Identifying issues early to prevent unplanned downtimes, thereby reducing the workload of maintenance and reliability engineers as well as achieving savings in energy and freshwater consumption.
Unveiling Key Concepts

**Fundamental Concept - Heat Exchanger Monitoring**

\[ \Delta MT = IMT - OMT \]

**Coolant Flow Rate**

**OMT**

**OMT** = Outlet Medium Temperature; **OCT** = Outlet Coolant Temperature

**IMT** = Inlet Medium Temperature; **ICT** = Inlet Coolant Temperature

Fouling

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Anomaly Detection Workflow
Seamless Integration of New Workflow Paradigm

01 Anomaly Definition
Reliability engineer defines what an anomaly is.

02 Online Analytics
Analytics in Visplore, online using Python API.

03 Anomaly Notification
Automatic Email notifications for anomalous conditions.

04 AVEVA PI Vision Monitoring
Check and understand the current situation.

05 RCFA Visplore
Use Visplore to make a deep-dive data analysis and start RCFA.
Anomaly Detection

Setting up detection algorithm with subject-matter expertise (SME)

**Goal**: Early detection of maintenance need

**Algorithm**: Diverging correlations of coolant flow rate and medium temperature difference

**Challenges**:

- Filter time periods (e.g. maintenance periods)
- Determine correlation coefficient range
- Distinction of operating conditions
- Validation of detection results

**Solution**: Algorithm definition using Visplore

- The integrated visual analytics workflow of Visplore yielded an SME-validated solution within very few hours.

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Online Analytics

Flexible automatization via Python

Detection

• Negative correlation of smoothed PI tags "coolant flow rate" and difference of “medium temperature at inlet” and “medium temperature at outlet" exceeds threshold

• Automatically excluding periods of shutdowns, maintenance, very high process variability

Online

• Evaluated every 8 hours
• Send notifications to reliability engineers
• Write detection results back to AVEVA PI System
• Implemented based on Python, Visplore API and AVEVA PI Web API
**Overview of all assets**
**Custom Hit-Rate Symbol**
**Actual state of asset**

### Heat Exchanger Monitoring

<table>
<thead>
<tr>
<th>Name</th>
<th>Beschreibung</th>
<th>Einheiten</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM8_Dichtwasserkuehler</td>
<td>CoolantFlowRate</td>
<td>FW DW-KUEHLER</td>
<td>m³/h</td>
</tr>
<tr>
<td>PM8_Dichtwasserkuehler</td>
<td>InletCoolantTemperature</td>
<td>Einl FW DW-Kuehler</td>
<td>deg C</td>
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<tr>
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<td>OutletCoolantTemperature</td>
<td>Ausl FW DW-Kuehler</td>
<td>deg C</td>
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<tr>
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<td>InletMediumTemperature</td>
<td>EINLAUF DW DW KUEHL</td>
<td>deg C</td>
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<tr>
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<td>MediumFlowRate</td>
<td>DW ZU DW-KUEHLER</td>
<td>L/min</td>
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<tr>
<td>PM8_Dichtwasserkuehler</td>
<td>OutletMediumTemperature</td>
<td>DW KUEHLUNG VAKPPE</td>
<td>deg C</td>
</tr>
</tbody>
</table>

- Detailed view of asset
- Visualization of KPI’s
- Information about operating conditions
- Additional asset information
Root-Cause Failure Analysis with Visplore

Standardized workflows for in-depth investigation

- Analytics and statistics
- Comparison of patterns over long time
- Contextualization by process states
- Filtering irrelevant data
Impact Savings
Pioneering Time, Energy, and Water Savings

Time
Time savings in the maintenance area. Technicians do not have to check manually.

Energy
Energy savings achieved by optimizing asset utilization within the optimal operating range.

Freshwater
Savings in freshwater through the reduction of soiling's.
Conclusion

Reduction of downtime, energy, fresh water, and workload by advanced condition monitoring

Success factor: Use each technology for its strengths

- **AVEVA PI and PI AF**: Reliable data source and management
- **AVEVA PI Vision**: Efficient visual monitoring
- **Visplore**: Robust detection, RCFA by SMEs
- **Python**: Flexible automatization

Success Strategy: Bring data and subject-matter expertise together

Outlook: Continued adoption of advanced condition monitoring for other assets and across plants
Predicting the future is difficult, but shaping it is within reach through vigilant monitoring.
Clemens Deiser
Solution Engineer
• Mondi AG
• clemens.deiser@mondigroup.com

Harald Piringer
CEO at Visplore
• Visplore
• hp@visplore.com

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Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life’s essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

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