Maximising Productivity
Condition Monitoring of Drives and Rotating Equipment

The Journey From Reactive to Proactive Maintenance

24 June 2020
12.00 - 12:45
Maximising Productivity

Condition Monitoring of Drives and Rotating Equipment - The Journey from Reactive to Proactive Maintenance

Steve Hughes : Digital Lead - Motion
Rubber and Plastic Industry Segment

Rubber and Plastic Machine Lines

- Injection molding Machines
- Compound process from oil, recycled and bio
- Cables & Wires and Spinning extruders filaments
- Blow molding Machines
- Cast Sheet Lines
- Blow Film Lines
- Profiles & Pipe lines
- Banbury mixer & Rubber open mills

Process Lines & Machinery
Rubber and Plastic Industry Segment

Rubber and Plastic Machine Lines

- Injection molding Machines
- Blow molding Machines
- Cast Sheet Lines
- Calendering
- Cutter
- Extruder
- Fan
- Mixer
- Pump
- Winder / Unwinder
- Wires and Spinning extruders filaments
- Banbury mixer & Rubber open mills
- Profiles & Pipe lines
Whole Life Cost

WLC = £ + ▶ + ▼

Whole life cost = Capital costs + Cost of running + Cost of NOT running
Extrusion

What happens if an extruder drive or motor fails?

**Cost of not running**

- Waste material
- Replacements parts
- Labour
- Crack the barrel?
- Clean up
- Effect on the next stage of the process
- Logistics disruption
- Penalty clauses?
- Process restart costs
Reliability
What makes drives and motors fail?

The majority of failures are fundamentally due to Temperature / Environment

- Blocked filters
- Cooling fan failures (Cabinet Fans or VSD internal Fans)
- Contamination (dust / dirt / chemical)
- Moisture / Condensation
- Motor / Cable faults
- Greasing

Simple, regular visual inspection will help identify some of the above
Aging and Maintenance

Operating Conditions

- **T** thermal
- **E** electrical
- **A** ambient
- **M** mechanical

<table>
<thead>
<tr>
<th>Lifetime</th>
</tr>
</thead>
</table>

Reactive maintenance
Corrective actions taken upon failure or abnormal operation

Scheduled maintenance (preventive)
Maintenance actions schedule based on experience

Condition based maintenance (predictive)
Maintenance actions as consequence of the measurements activities that check the status of components

- Unpredictable stops
- High downtime cost from unplanned stops

- Planned stops
- Predefined spare parts

- Stopover based on findings from condition monitoring
- Minimized downtime

Roadmap to move from reactive to proactive to predictive

1. Run to failure
2. Time based
3. Usage based
4. Condition based
5. Predictive
6. Reliability centered
7. Financial optimization

Benefits: Reduce costs and gain value

Time

Value

- Warranty Period
- Upgrade and Modernization Period
- Replacement & Recycle Period
- Maintenance Period
- Optimized Maintenance Line
- Upgrading/Replacement
- Maintenance
- Aging
- Overhaul
- Repair

Operating Conditions

- **T** mechanical
- **E** electrical
- **A** ambient
- **M** mechanical

Lifetime

©ABB
June 24, 2020
| Slide 8
Predictive vs Preventative vs Corrective Maintenance

**Predictive**
- An attempt to determine when best to perform preventative maintenance activities
- ‘Closed Loop’ – i.e. feedback from the system helps the determination of when it should be done
- Lowest overall cost, potentially higher risk

**Preventative**
- Done in order to prevent potential breakdown
- ‘Open Loop’ – i.e. using manufacturers recommendations
- Lower risk, potentially higher cost (unnecessary cost?)

**Corrective**
- Fix on failure
- High cost (more potential for consequential costs), high risk
Industry Challenges
Asset optimisation

- Realtime
- Days/weeks/months
- Future

ON PREMISE
- Cloud
- On-premises
- Edge
- Device

CONTROL
- Sense
- Act

ASSET OPTIMISATION
- Analyse
- Sense
- Act*
The Data
Mechanical Assets
ABB Ability™ Condition Monitoring
How does it work?

- The ABB Ability™ Smart Sensor transmits data from the motors, mounted bearings and pumps via a smartphone or gateway to a secure cloud service.

- Algorithms analyze the data and convert it into meaningful information, which is sent to the user’s smartphone and customer portal.

- The ability to gather and analyse the data can reveal information on the status and condition of the equipment, to intelligently maintain and manage the performance of the powertrain.
## ABB Ability™ Smart Sensor

### What does it monitor?

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compatibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Induction motors</td>
<td>Frame sizes: 140-440 (NEMA), 56-450 (IEC)</td>
<td>●</td>
</tr>
<tr>
<td>Permanent magnet/synchronous reluctance motors</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Safe area motors</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Hazardous area motors</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Continuous and intermittent duty</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Fixed speed and variable speed</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Old and new motors</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>ABB and non-ABB motors</td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

● = AVAILABLE
● = AVAILABLE IN FUTURE RELEASE (2019)
Smart Sensor
Analytical dashboard and smartphone app view
Imagine that you have a pump and motor in dry well with restricted access

**Without sensor**

Nobody ever goes near that motor.
When it fails you will be surprised, then…
- Pull the spare motor out of your warehouse
- Find an electrician and beg them to come
- Get lifting gear in place
It will take at least a day to replace, even if you have a spare on stock.
If the process or the driven equipment was damaged by the unexpected motor failure all times and cost can be multiplied by ten.

**With sensor**

Nobody ever goes near that motor.
You will get a warning before anything has happened, then …
- Order a new motor from your nearest supplier
- Get lifting gear in place
- Planned engineer visit comes Tuesday with motor
- Run down and run up in an orderly fashion
Within two hours it is replaced.
Without a spare motor on stock, without an electrician on standby.
The Data
Variable Speed Drives
Ageing of critical components

Each component has specific quality characteristics, which must be understood and managed.

Preventive Maintenance is based on statistical methods, predictive maintenance is aiming to detect signals of potential problems from individual devices.

Unlike motors or many other devices with moving parts – drives are ‘silent’. Straight forward wear-out detection is challenging.

Main aging components:
- Semi conductors (IGBT’s)
- Power capacitors
- Cooling Fans

<table>
<thead>
<tr>
<th></th>
<th>Preventive Maintenance</th>
<th>Predictive Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aging components</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ambient conditions</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Usage patterns</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
New features
Condition based maintenance

![Diagram showing electrical components and their connections.]

- DC link
- Rectifier
- Control electronics
- Control, monitoring and communication
- Inverter
- Motor
- Monitoring
- Control
- Supply
- L1, L2, L3
- Cooling system
- Fans, air filters
- Cooling system
- Fans, air filters
- Fan life time
- Inverter IGBT case thermal cycle counter
- Inverter IGBT junction temperature cycle counter
- DC link capacitor expected life time
Maintenance based on insight
Turning knowledge into actions

Data & Analytics

Knowledge & Actions

Remote Condition Monitoring

Remote Support

Predictive Maintenance

Optimization Services
Delivery concept: Cloud based Condition Monitoring Services for Drives
Condition Monitoring and Assistance: End User Solution, permanent connection
Screen capture - Dashboard
Screen capture - Operational Data Trends
Screen capture - Condition Based Maintenance

Condition-Based Maintenance

Condition-based maintenance provides you with the current condition of drive components. You can find the analysis in details below.

Annual aging status

- Standard aging
- Estimated aging before monitoring
- Actual aging
- Average prediction
- Current month
- Commissioning day
- Start planning component replacement
- Replace the component
ABB Ability™
Digital Power Train

A digital advantage that accelerates efficiency, predictability and safety
Why is it important to monitor the complete Powertrain?

The weakest element limits the uptime

**Individual component condition KPIs**

The condition of the most degraded component determines the condition of the powertrain!

**Powertrain condition**

Devices are logically grouped as powertrains

<table>
<thead>
<tr>
<th>Powertrain Name</th>
<th>Hannover Messe 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected Components</td>
<td>Bearings</td>
</tr>
<tr>
<td>Dodge P28510-1SN-045MLR</td>
<td>ACS880 demo 1</td>
</tr>
<tr>
<td>Dodge P28-GTM-4SM</td>
<td></td>
</tr>
</tbody>
</table>

PT = PT

The condition of the most degraded component determines the condition of the powertrain!
Maintenance Manager

Energy Manager

Production Manager

Safety Manager
Maximising Productivity
Condition Monitoring of Drives and Rotating Equipment-The Journey from Reactive to Proactive Maintenance

Summary

- Find the right maintenance strategy
- Reduced “unplanned” down time
- Increase productivity
- New or existing plant?
- Where to start?
- Marathon not a sprint
- Rolling plan

- Identify pain points
- Identify critical assets
  - Effect of failure
  - Value
  - Spares availability
  - Difficulty in change over or repair
- Optimise maintenance costs
- Increase overall value
- Reliability centred
- Financially optimised
Thank You

Steve Hughes
Digital Lead – Motion
ABB Ltd
+44 (0)1925 741111  steve.hughes@gb.abb.com  www.abb.co.uk/energy

BPF Webinars: Lunch and Learn
https://bpf.co.uk/events/webinars/lunch-and-learn