 „Smart Corrugations“
 rollDetect™ & Roll Service
 IAOM Delhi / Bangalore India
 03. – 07. December 2018 | Roman Inauen MSCS
Basic‘s - Know How ?
How to get best mill performance?
Highest yields and flour extraction

Through a direct product flow along the whole milling flow sheet including Purifier- and Bran Finisher machines!
Grading of first Break
Perfect grading e.g. of first break is key for highest mill performance!
Why rollDetect & -Service?
Wear impact on various parameters

**Throughput capacity**
- Due to wear and tear capacity drops over time

**Energy consumption**
- Due to wear and tear energy consumption / input increases over time

**Product quality**
- Due to wear and tear product quality (granulation, ash contend……etc) will change = product shift.

**Yield loss**
- Due to wear and tear yield / flour extraction will drop over time

**Moisture loss**
- Due to wear and tear more energy input = extra heat development = additional moisture loss !

**Stability / production safety**
- Due to unwanted product shifts caused by the wear and tear instable run

*BUHLER*
Why rollDetect & -Service?
How you evaluate wear today?

Visual check (subjective observation)
- Optical check with magnifying glass / lens

Break release (objective measurement)
- Check for granulation and particle size distribution

Energy consumption (objective measurement)
- Power measurements or tracking if available

Yield / extraction loss (objective measurement)
- Check and track yield calculator

Moisture loss (objective measurement)
- Check and track moisture loss in lab

Ash curve or color = Minolta (objective measurement)
- Check and track ash curve in lab
Why and when shall I make a refurbishment?
Business case e.g. Ø 1’500 Kg/h grinding capacity

Main action crushing & cutting
average specific power consumption = 4.5 kWh/t

Δ 8.5 KWh/t = 200%

Main action grinding & pulverize
average specific power consumption = 13 kWh/t
Real life example of measuring the specific grinding parameters
Energy consumption of a Break 1 passage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before Roll Refurbishment / Change</th>
<th>After Roll Refurbishment / Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Consumption</td>
<td>17.60 kW</td>
<td>15.75 kW</td>
</tr>
<tr>
<td>Throughput Capacity</td>
<td>3.78 t/h</td>
<td>3.83 t/h</td>
</tr>
<tr>
<td>Specific Grinding Power required</td>
<td>4.70 kWh/t</td>
<td>4.10 kWh/t</td>
</tr>
</tbody>
</table>

\[ \Delta P = 2.2\text{kW} \]
Smart Corrugations
Corrugation basics
Facts & Figures

Example:

- $h = \text{Back angle} - \text{Dull angle}$
- $i = \text{Front angle} - \text{Sharp angle}$
- $k = \text{Flute profile} - \text{Flute angle}$
## Corrugation basics

Typical flutes for various passages used today

<table>
<thead>
<tr>
<th>Passage</th>
<th>Flutes / Circumference</th>
<th>Flutes / cm</th>
<th>Flutes / Circumference</th>
<th>Flutes / cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 1</td>
<td>250 – 300</td>
<td>3,2 – 3,8</td>
<td>250 – 275</td>
<td>3,2 – 3,5</td>
</tr>
<tr>
<td>B 2</td>
<td>425</td>
<td>5,4</td>
<td>375 – 425</td>
<td>4,8 – 5,4</td>
</tr>
<tr>
<td>B 3 gr.</td>
<td>625</td>
<td>8,0</td>
<td>500 – 550</td>
<td>6,4 – 7,0</td>
</tr>
<tr>
<td>B 3 f.</td>
<td>675</td>
<td>8,6</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>B 4 gr.</td>
<td>800</td>
<td>10,2</td>
<td>675</td>
<td>8,6</td>
</tr>
<tr>
<td>B 4 f.</td>
<td>850</td>
<td>10,8</td>
<td>750</td>
<td>9,6</td>
</tr>
<tr>
<td>B 5 gr.</td>
<td>-----</td>
<td>-----</td>
<td>800</td>
<td>10,2</td>
</tr>
<tr>
<td>B 5 f.</td>
<td>-----</td>
<td>-----</td>
<td>850</td>
<td>10,8</td>
</tr>
<tr>
<td>Kl.M.</td>
<td>950</td>
<td>12,1</td>
<td>950</td>
<td>12,1</td>
</tr>
<tr>
<td>D 1</td>
<td>650</td>
<td>8,3</td>
<td>650</td>
<td>8,3</td>
</tr>
<tr>
<td>C 10</td>
<td>1100</td>
<td>14,0</td>
<td>1100</td>
<td>14,0</td>
</tr>
</tbody>
</table>
# Corrugation basics

rollDetect tool can verify all kind of corrugation style!

Corrugation Selection – Be organized.

<table>
<thead>
<tr>
<th>01</th>
<th>09</th>
<th>17</th>
<th>25</th>
<th>33</th>
<th>41</th>
<th>49</th>
<th>57</th>
<th>65</th>
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<tbody>
<tr>
<td>02</td>
<td>10</td>
<td>18</td>
<td>26</td>
<td>34</td>
<td>42</td>
<td>50</td>
<td>58</td>
<td>66</td>
<td>74</td>
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<tr>
<td>03</td>
<td>11</td>
<td>19</td>
<td>27</td>
<td>35</td>
<td>43</td>
<td>51</td>
<td>59</td>
<td>67</td>
<td>75</td>
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<tr>
<td>04</td>
<td>12</td>
<td>20</td>
<td>28</td>
<td>36</td>
<td>44</td>
<td>52</td>
<td>60</td>
<td>68</td>
<td>76</td>
</tr>
<tr>
<td>05</td>
<td>13</td>
<td>21</td>
<td>29</td>
<td>37</td>
<td>45</td>
<td>53</td>
<td>61</td>
<td>69</td>
<td>77</td>
</tr>
<tr>
<td>06</td>
<td>14</td>
<td>22</td>
<td>30</td>
<td>38</td>
<td>46</td>
<td>54</td>
<td>62</td>
<td>70</td>
<td>78</td>
</tr>
<tr>
<td>07</td>
<td>15</td>
<td>23</td>
<td>31</td>
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<td>47</td>
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<td>63</td>
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<td>79</td>
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<tr>
<td>08</td>
<td>16</td>
<td>24</td>
<td>32</td>
<td>40</td>
<td>48</td>
<td>56</td>
<td>64</td>
<td>72</td>
<td>80</td>
</tr>
</tbody>
</table>
rollDetect Service

Preparation

Measurement

Report
rollDetect
Solution for optimal use of rollers

The right time for a roller service or roller change is crucial for a consistent high product quality and cost optimization. Therefore, the condition and wear of rollers needs to be measured and objectively evaluated.

Bühler rollDetect service enables optimal use of rollers offering:

- **contour measurements** for corrugated rollers

![Contour Measurement](image)

- **roughness measurements** for smooth rollers

![Roughness Measurement](image)
Collecting data from the rolls - something else that is new – ecoReport
rollDetect
Services at a glance

rollReport for corrugated rollers @ Workshop
- quality report and service transparency after revision
- target value, actual value and tolerances of corrugation

detectReport for corrugated passages @ Customer
- economically optimal time for a roller revision
- based on measurements tecReports and customer-specific operation data

tecReport for corrugated rollers @ Customer
- graphic representation of target and actual corrugation profiles
- wear prediction & recommendation for next roller revision

tecReport for smooth rollers @ Customer
- recommended date for next roller revision
- measurement of roller roughness Ra along the product flow
Corrugated rollers
Contour measurement

For several years, Bühler has been offering the rollDetect service for contour measurement on corrugated rollers. The measuring device allows reliable data to be taken, so that the condition of a roller and the point of time for a roller change are not anymore determined at the operator’s own discretion.

Contour stylus

The current contour stylus shows the profile of corrugated rollers. This procedure allows the state of a corrugated roller to be detected and from that, the optimum time for changing it.
Corrugated rollers

**Customer benefits**
- quality report and service transparency
- target value, actual value and tolerances of the corrugated roller profile

**rollReport**
- measuring of corrugated rollers after revision
- information about target value, actual value and tolerances of the corrugated profile
- graph with measurement curve
- measurement at Bühler workshops
- rollReport is generated and given to customers
Corrugated rollers tecReport

Customer benefits
- interpretation of the wear pattern and possible optimization
- wear prediction
- recommended date for next roller change

tecReport
- graphic representation of target and actual corrugation profiles
- visual determination of the condition of the roller surface and corrugation edge
- current condition of the corrugated rollers (as a percentage)
- measurement at the customer’s site by Bühler process engineers
- initial consulting according to measured values
- generation and e-mailing of the tecReport
Corrugated rollers

Customer benefits

- all selected roller measurements at a glance
- recommendation for maintenance action

summaryReport

- summary of the tecReports for corrugated rollers
- wear out status of each corrugated roller (OK, WATCH, CRITICAL)
- recommendation for action (good, exchange)

Quality Roll Report Summary

<table>
<thead>
<tr>
<th>Mill Identifier</th>
<th>Passage</th>
<th>Corrugation Area Reduction</th>
<th>Edge Condition</th>
<th>Wear out Status</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>M</td>
<td>R</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>M1127 3rd 3rd Break</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>Sharp</td>
</tr>
<tr>
<td>2</td>
<td>M3102 3rd 3rd Break</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>Sharp</td>
</tr>
<tr>
<td>3</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
<tr>
<td>4</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
<tr>
<td>5</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
<tr>
<td>6</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
<tr>
<td>7</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
<tr>
<td>8</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
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<td>9</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
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<tr>
<td>10</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
<tr>
<td>11</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
<tr>
<td>12</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
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<tr>
<td>13</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
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<tr>
<td>14</td>
<td>M3102 3rd 3rd Break</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Sharp</td>
</tr>
</tbody>
</table>

3rd Break through 5th Break
Corrugated rollers
ecoReport

Customer benefits

- the ecoReport indicates the economically optimal time for revising or changing a roller

ecoReport

- based on measurements and customer-specific operation data:
  - preparation of a profitability analysis (break-even)
- shows the customer’s service costs, energy loss due to non-optimal maintenance as well as resulting lost yield and calculates savings potential on that basis
- graphical visualization of results
- measurement at the customer’s site
- customer-specific data needed
- ecoReport is generated and given to customers
Being profitable in the mill – selecting rolls that make the most profit.

<table>
<thead>
<tr>
<th>Outcome</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>ecoReport Date</td>
<td>12.10.2017</td>
</tr>
<tr>
<td>Service costs [$]</td>
<td>5'000</td>
</tr>
<tr>
<td>Lost Energy [$]</td>
<td>1'405</td>
</tr>
<tr>
<td>Lost Yield [$]</td>
<td>22'526</td>
</tr>
<tr>
<td>Total Saving Potential [$]</td>
<td>18'931</td>
</tr>
</tbody>
</table>

*Using roll wear data to select the rolls that make the most money to change out.*
Smooth rollers
Roughness measurement

To determine wear on both corrugated and smooth rollers, we have developed a new stylus that can be used for roughness measurements.

Roughness stylus

The roughness stylus has a very fine and sensitive diamond tip that allows precise recordings of roughness on smooth rollers. This profile data can be technically interpreted so that the maintenance date for smooth rollers can be optimized in the future.
Smooth rollers tecReport

Customer benefits

- **recommended date** for next maintenance

tecReport

- measurement of roller along the **product flow**
- **surface structure** display
- representation of the **roughness value** in Ra (average roughness) to DIN EN ISO 4287
- condition of the roughness (OK, WATCH, CRITICAL)

- roughness measurement **at the customer’s site** by Bühler process engineers
- initial consulting according to measured values
- generation and e-mailing of the tecReport
Roll Technology & Know How
Smooth Rolls what is important?

Correct matting of the rolls:

Reduction set-up, smooth rolls need a correct roll surface roughness of Ra 2.5 (micron) micron to Ra 3.5 (micron).

Completely blank rolls will not grind but only press semolina particles resulting in poor flour yield.

Influence factors smooth vs. fluted rolls

- Polished roll (shiny) < 1.0 Ra
  - Flour less
  - Ash low

- Light matting roll > 1.0 – 2.5 Ra

- Strong matting roll > 2.5 – 3.5 Ra

- Fine fluted > 14 flutes / cm
  - more
  - high
Practice examples I.
4 x 1\textsuperscript{st} BK rolls in the same milling line.

How does this effect the performance of the mill?
Practice examples II. What are these rolls telling us? What can we see from this corrugation profile?

- **Dull to Dull configuration with -42% wear.**
  ![Graph](image)

- **Dull to Sharp configuration with -16% wear.**
  ![Graph](image)

- **Sharp to Sharp configuration with -27% wear.**
  ![Graph](image)

- **Sharp to Sharp configuration with -5% wear.**
  ![Graph](image)
Roll Service
Bühler Roll Service World Wide available!
Roll Service

1. Delivery
2. Removal of bearings, seals and quick packs
3. Inspection of your rolls
4. Grinding or fluting of your rolls
5. Roll report and quality report
6. Fitting of bearings, seals and quick packs
7. Packaging and transport
8. Service with a smile!
Roll Refluting / -Regrinding

- Longer service life
- High flute quality
- Optimal set up of parameters
- Stock rolls available
Fluting Service

Our service includes:

- Collection of your rolls to our workshop
- Inspection of rolls and shafts-journals
- Fluting or grinding
- Sandblasting of smooth rolls
- Check quality of rolls using rollDetect with before and after results
- Packaging and transport of rolls
Other Services

- **Assembly of bearings**
  - We assemble new or old bearings including new seals

- **Overhauling Quickpacks**
  - We overhaul your entire quick packs
  - Including bushings, pins, seals, grease and repair air cylinders

- **New Rolls**
  - Right rolls with correct surface characteristic for all applications

<table>
<thead>
<tr>
<th>Typ</th>
<th>Surface</th>
<th>Hardness - Brinell</th>
<th>Case - Hardening</th>
<th>Lifetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>FERAN</td>
<td>Fluted</td>
<td>490 - 530</td>
<td>15mm +/- 5</td>
<td>100%</td>
</tr>
<tr>
<td>TITAN</td>
<td>Fluted</td>
<td>530 - 570</td>
<td>15mm +/- 5</td>
<td>Min. +30%</td>
</tr>
<tr>
<td>FERAN</td>
<td>Smooth</td>
<td>420 - 490</td>
<td>15mm +/- 5</td>
<td>100%</td>
</tr>
</tbody>
</table>
Thank you very much for your attention.

Milling Solutions Customer Service