SOOTBLOWERS: Operation, Maintenance and Optimization

Danny S. Tandra
Clyde Industries, Inc
(Formerly known as Clyde Bergemann)

TAPPI Kraft Recovery Operations Course
Sootblower

- A device that is used to blow off and remove “soot” or deposits from tube surfaces
- Helps improve heat transfer efficiency and prevent unscheduled shutdown due to boiler plugging
Sootblower in Action (Animation)
Basic Components

- **Electrical Box**
  - A rotating tube, inserted into the boiler to direct the jets toward boiler tubes

- **Nozzles**
  - Convert high pressure steam into high velocity jets to clean the boiler tubes

- **Lance Tube**
  - The main drive that rotates and moves the lance tube forward and backward during the cleaning cycle

- **Carriage**
  - A stationary tube connected to the poppet valve. Its main function is to deliver the steam to the lance tube

- **Feed Tube**
  - A valve to open and shut the supply steam and to adjust the blowing pressure of the sootblower

- **Poppet Valve**
  - Enclosure used as housings for sootblower wiring connections

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- **Feed Tube**
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In Canada & USA, many sootblowers are operated well beyond their normal service life.

<table>
<thead>
<tr>
<th>Sootblower</th>
<th>Canada</th>
<th>USA</th>
<th>Brazil</th>
<th>Finland</th>
<th>Sweden + Norway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Age</td>
<td>41</td>
<td>41</td>
<td>18</td>
<td>28</td>
<td>34</td>
</tr>
<tr>
<td>Oldest</td>
<td>71</td>
<td>66</td>
<td>41</td>
<td>59</td>
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Although it is possible to extend the sootblower’s service life, boiler operators need to follow maintenance best practices to ensure safety, reliability, and at the same time, control the maintenance cost.
Challenges facing pulp mills

- Aging sootblower equipment w/ many components require attention
- Retiring experienced personnel
- Lack of trained maintenance team
- Competing budget & resources
OPERATING ISSUES
BLRBAC Incident Report

Electrical Box  Nozzles

Lance Tube  Carriage

Poppet Valve  Feed Tube

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How to emergency retract a stuck sootblower

- When dealing with a stuck sootblower, it is important to first reduce the blowing pressure to a minimum allowable to prevent sootblower-induced-tube erosion while working on retracting a stuck sootblower.

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Make sure the rotation chain is FIRST disconnected to prevent lance rotation while the bent lance is being retracted.
Lance Tube Failure

- A hot topic lately after an incident in Canada in 2017
- A lance tube failed, fell into the furnace, punctured the floor and caused a smelt-water explosion.
Recent Lance Tube Failure Incidents

- 5 incidents reported in 2017
  - Brazil, Poland, Canada, Finland, Austria

- 3 incidents reported in 2018
  - Thailand, USA, Brazil

- Occurred in various countries, SB manufacturers, boiler OEMs, and pulp mills

- Systematic Risk Based Inspection (RBI) to address the issue
Incorrect Poppet Valve Pressure Setting
Excessive Platen Movement

- If high efficiency nozzle is used, avoid setting the poppet valve pressure to a level above 350 psig (24 bar g)

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Imbalanced Nozzles
Causing the lance to hit boiler tubes

- Replace (don’t repair) the nozzles, especially if the mill does not have the proper tools to repair.
- Severe boiler tube damage may occur due to imbalanced nozzles

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MAINTENANCE

Know what to look during a walkdown & visual inspection
Steam & Air Flows in a Sootblower

Cleaning Steam Flows

Steam Purge

Scavenging Air
(protecting SB components against harmful gas)

Scavenging Air
In operation ONLY when the sootblower is in REST position
Scavenging Air

WRONG

CORRECT
What happens if the harmful gas enters sootblowers

- Damaged SB components
  - Check valve corrosion
  - Poppet valve plugging

Salt cake in poppet valve
What happens if the harmful gas enters sootblowers

- Bent canopy due to plugged poppet valve may result in insufficient cooling steam flow and lance tube overheating
What happens if the harmful gas enters sootblowers

- Lance tube corrosion
Rack & Pinion Poor Engagement

Poor Gear Rack & Pinion Engagement

Good Gear Rack & Pinion Engagement
Sootblower Misalignment causes abnormal loading to the lance tube

Normal Loading is Max 12ksi

Misalignment 0.59” 92 ksi stress near flange weld
One of the most common cause of misalignment

- Damaged Progressive Helix Mechanism (PHM)

View from underneath of the sootblower

Right side of PHM

Left side of PHM
At the start of a sootblower operation, the PHM spring will compress to let the lance to rotate but the carriage is not moving forward – causing the sootblower to run on different helical path
Progressive Helix Failure
Stuck on the left side but the right side function properly, causing sootblower misalignment
Uneven wear of Gear Racks

Warning: Do not replace the gear rack without first fixing the misalignment issue as this will increase the risk of lance failure
Another Sign of Misalignment: Feed tube uneven scoring

Uneven worn gear rack and feed tube scoring indicate that a sootblower has been experiencing severe misalignment.
Motor Current Monitoring
One of the methods to detect anomaly

Normal Sootblower Operation is generally ~2.5 Amps
OPTIMIZATION
## Sootblowing / Cleaning Frequency

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**Total** 7639 65
**Sootblowing Frequency**

3-2-1 Rule of Thumb

- Superheater : Generating bank : Economizer = 3 : 2 : 1

- Sootblowing steam consumption is typically 5 – 15% steam production; this can be costly

- For example:
  - 2860 tds/d recovery boiler produces 400 ton/hr steam
  - SB consume 8% MCR (8% x 400 ton/hr = 32 ton/hr)
  - With the cost of steam $10/ton, the annual cost will be around $2.7 million/y
Sootblower Steam Consumption Benchmark

- Benchmark:
  - > 10% of the boiler Maximum Continuous Rating (MCR) steam production
    - HIGH Steam Consumption
  - 5 – 10% of the boiler MCR steam production
    - MODERATE
  - < 5% of the boiler MCR steam production
    - LOW (Best Practice)
Two main variables that we can adjust to optimize the sootblower system and reduce its steam consumption:

- Sootblowing Timing
- Jet Cleaning Force (N or lbf)
Importance of Sootblowing Timing

- Too early !!!
- The deposit is still in the early stage of deposit buildup
- Wasting valuable high pressure steam
Importance of Sootblowing Timing

- Too late !
- Deposit has grown and bridged the space between the platens
- Continuing to increase the jet power at this stage may result in falling clinker.
- Real-time fouling measurement, such as strain gauge, can be used to optimize the sootblowing frequency and prevent over & undercleaning.
Optimizing Sootblower Frequency

The fouling measurement can also be used to determine if a sootblower can be set to one-way blowing to save the steam.
Summary

- It is important to know basic sootblower component and operation.
- Learn *what to look* during regular boiler walkdown to deal with sootblower issues early and prevent safety issue and costly repairs.
- Sootblowing steam is expensive – learn how to optimize your sootblowers.