Energy Saving Through Intelligent Sootblowing A Case Study

Indian Pulp & Paper Technical Association (IPPTA) Conference

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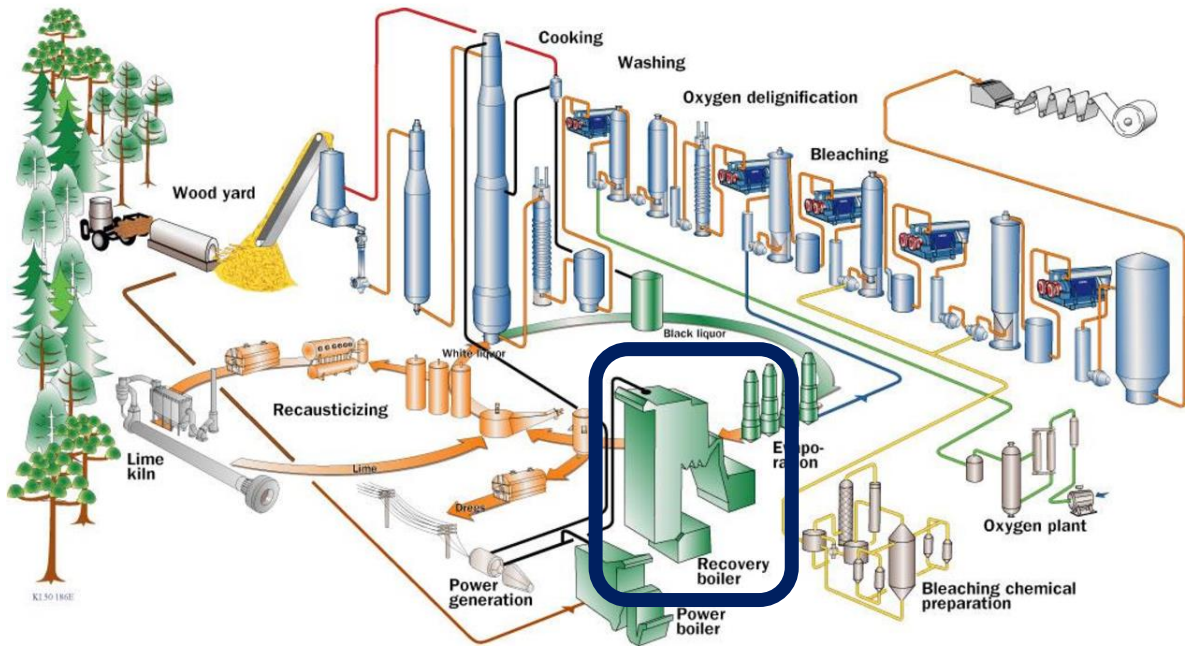
Problem & Opportunity



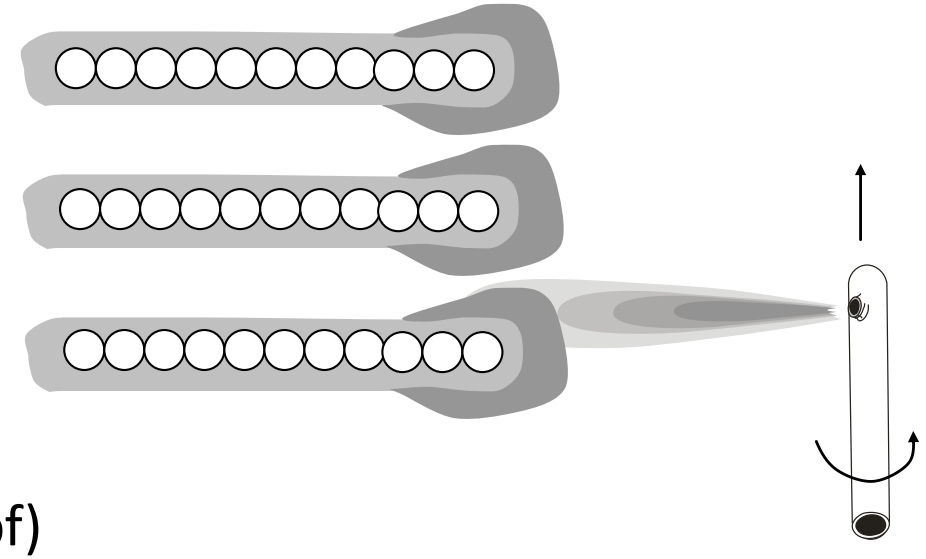
- It is **COSTLY** to operate sootblowers and most mills run them inefficiently
  - 3 Million lb BLDS (Black Liquor Dry Solid) per day
  - 450 KPPH Steam Production at 900 psig
  - SB consume 10% MCR steam
    - 10% * 450 KPPH = 45 KPPH
    - $5/1000lb * 45 KPPH
    - **$1.9 Million / year (Cost of steam ALONE)**

- **Intelligent Sootblowing**
  - Reduce the steam consumption to at least the Benchmark 5% MCR or Best Practice 2.5% MCR
  - Avoid unscheduled downtime due to heavy fouling
  - Great opportunity to save energy and improve boiler runtime

- Many mills are still experiencing **unscheduled downtime** due to heavy fouling w/ the cost of lost production
  - Chill & Blow $100 - $300K/incident
  - Forced outage $500-$750K/incident
  - Plus 5-10% additional costs to deal w/ emergency (i.e., labor, overtime, etc)

Background

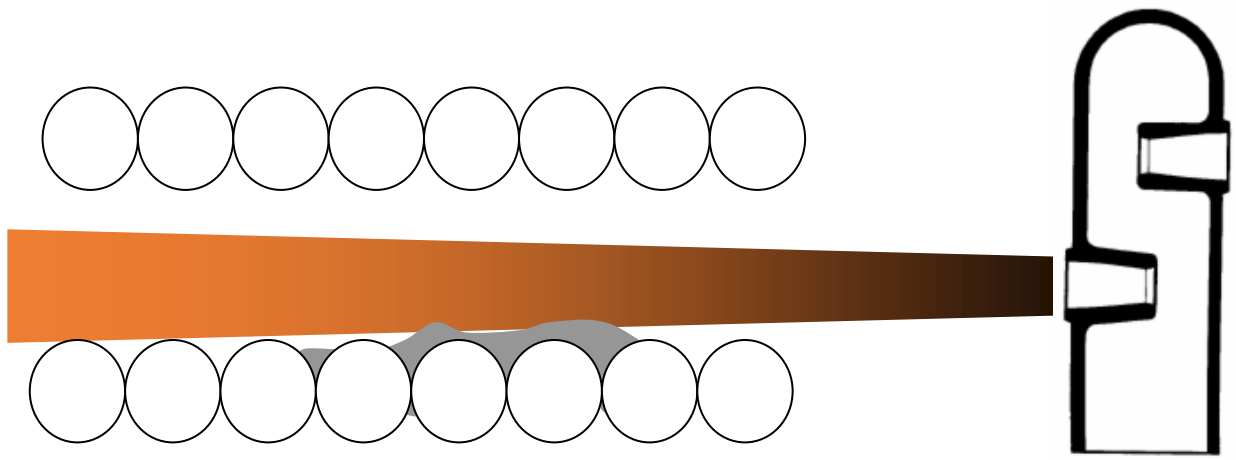
- The success of deposit removal by a sootblower depends on two main important factors:



  - Jet Cleaning Force (lbf)
  - Sootblowing Timing

- Much research has been done how to improve jet cleaning force (i.e., Nozzle Techenology) but little on sootblowing timing

Sootblowing TIMING – TOO EARLY (1 of 2)

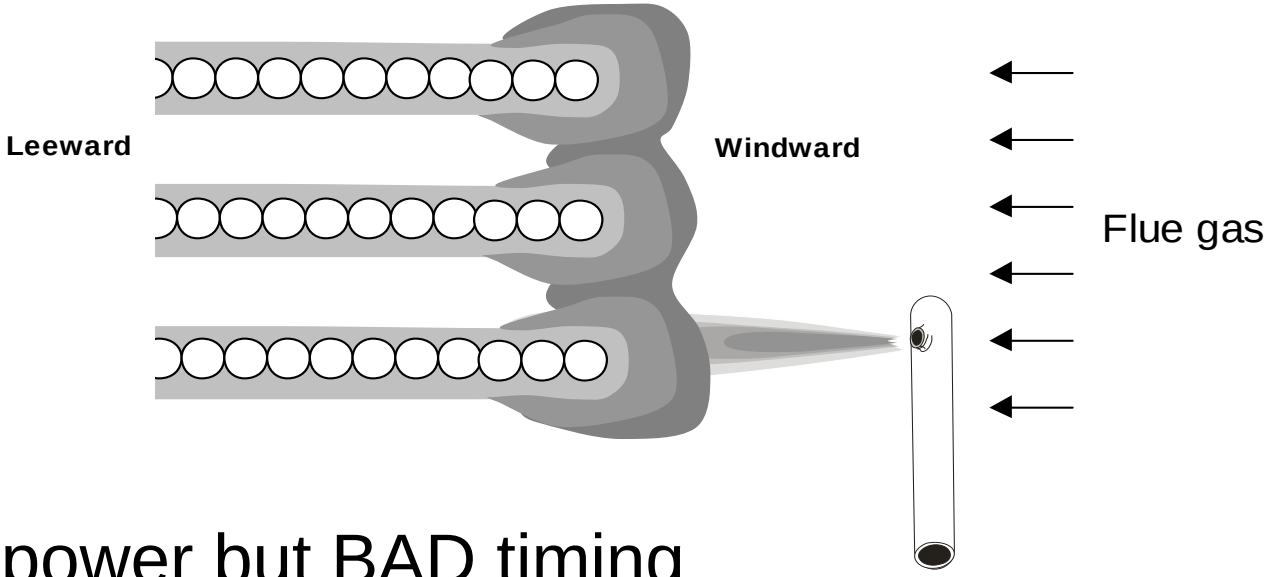


Powerful Jet power but BAD timing

➔ The deposit is still in the very early stage of deposit buildup

➔ Wasting valuable high pressure steam

Sootblowing TIMING – TOO LATE (2 of 2)



Powerful Jet power but BAD timing

- ➔ The deposit has grown to a very large size
- ➔ Increasing jet power to remove may result in falling clinker, damaging boiler floors
- ➔ Wasting valuable high pressure steam
- ➔ Losing boiler efficiency

- Between Too Early and Too Late there is a **sweet spot** where a good sootblowing timing exist.
- Good sootblowing timing will control deposit accumulation without the excessive use of valuable steam.

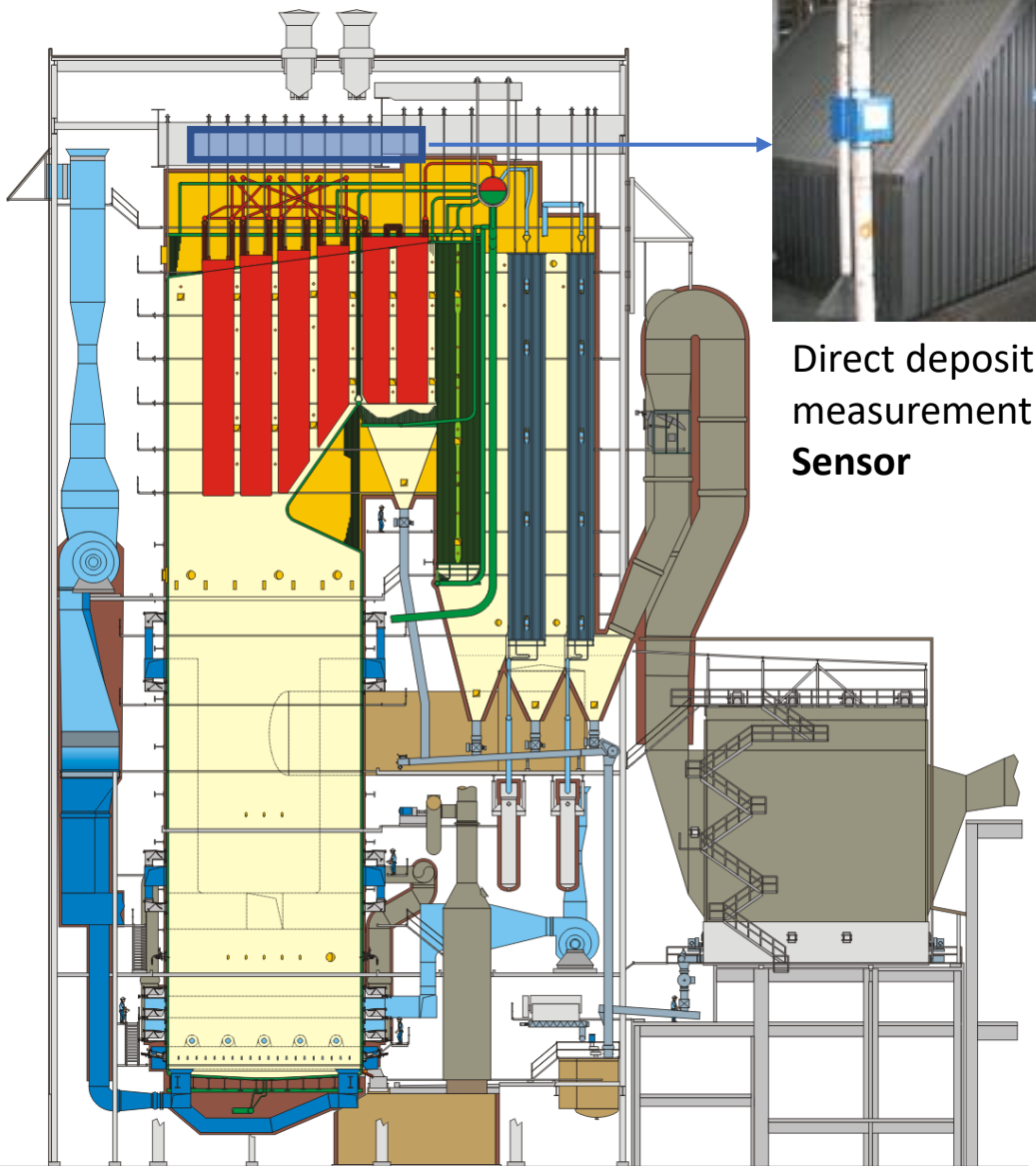
How sootblowing frequency is typically set

- Most pulp mills run their sootblowers based on a **static** predetermined sequence.
- This sequence is generally **pre-tuned** to deal with a fouling condition under the designed black liquor firing load.
- Since the sequence is independent of the real fouling condition inside the boiler (which is a very much dynamic phenomenon based on how the boiler is run), the sootblowers are always in a high risk of over and/or under cleaning.

Over and Under Cleaning

- **Over cleaning** leads to costly excessive steam usage – it might also contribute to premature tube failure.
- **Under cleaning** will lead to interruption in recovery boiler operation, unscheduled shutdown due to heavy fouling / plugging.
- **Best Practice** is to devise a sootblowing strategy that prevents both over and under cleaning.

→ It can only be achieved if we have online fouling feedback information from the boiler



Direct deposit accumulation measurement with **Fouling Sensor**

FS1

FS2

FS40

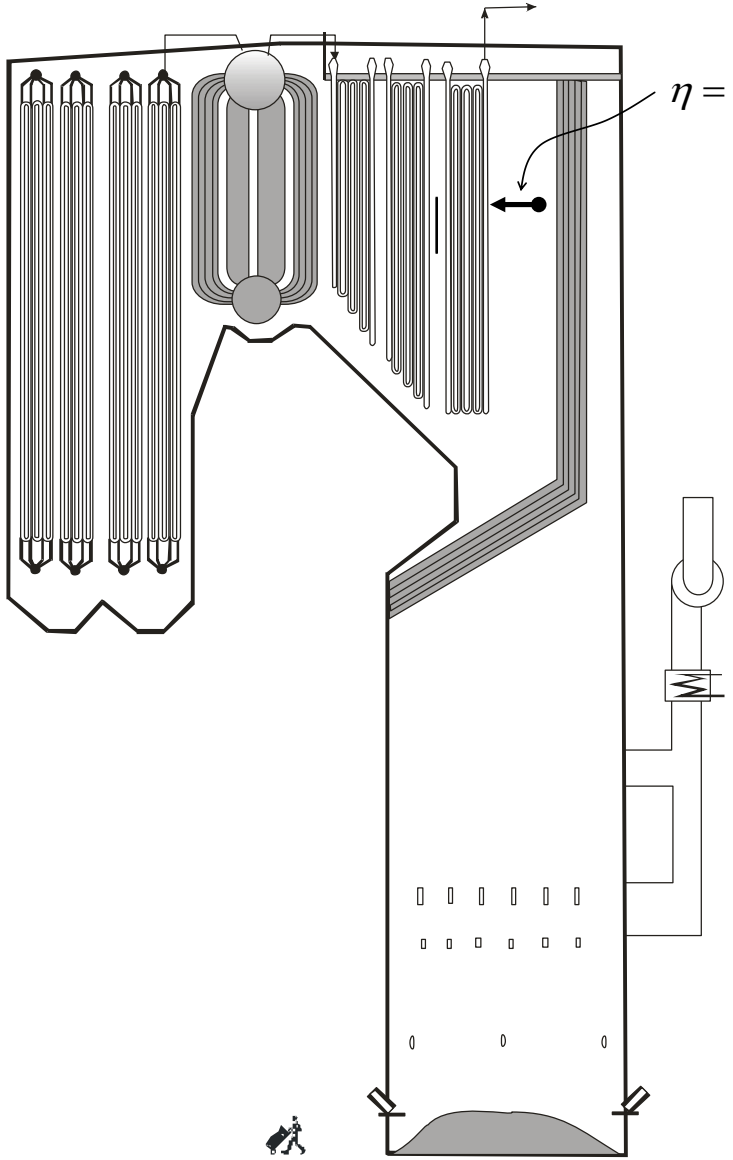
SB

Fouling Feedback

Intelligent Algorithm

Intelligent Cleaning Action

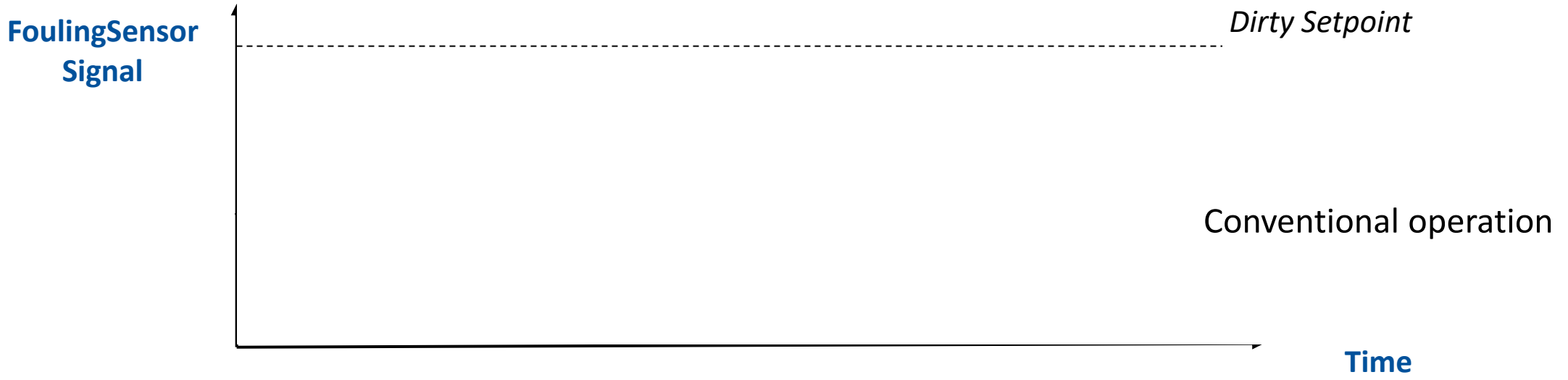
Energy balance around each exchanger



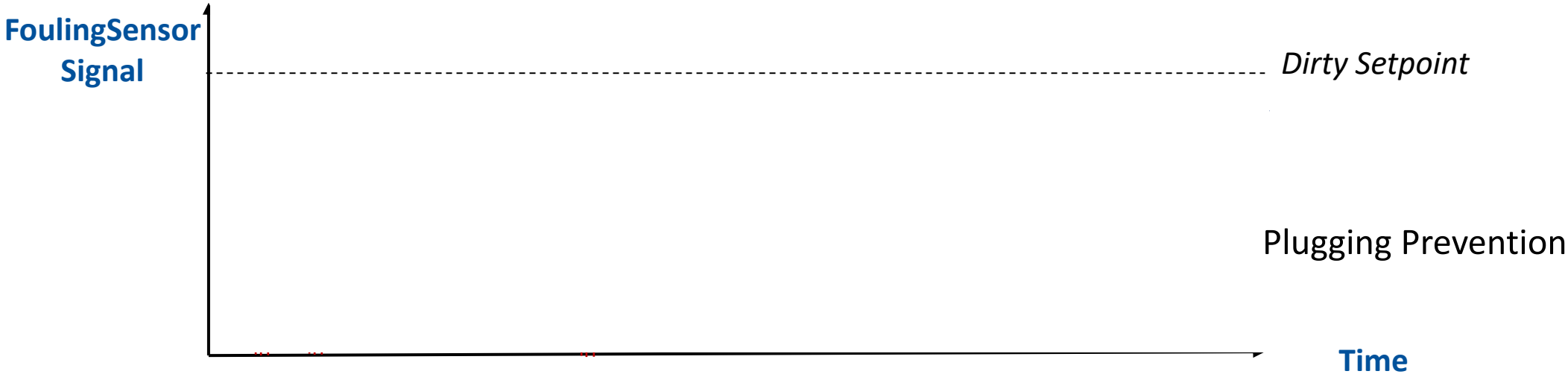
$$\eta = \frac{\text{Actual heat transfer to the water/steam inside the heat exchanger}}{\text{Total available heat input to the heat exchanger}}$$

$$\eta = \frac{Q_{Actual\ Heat\ Absorption}}{Q_{Heat\ Input}}$$

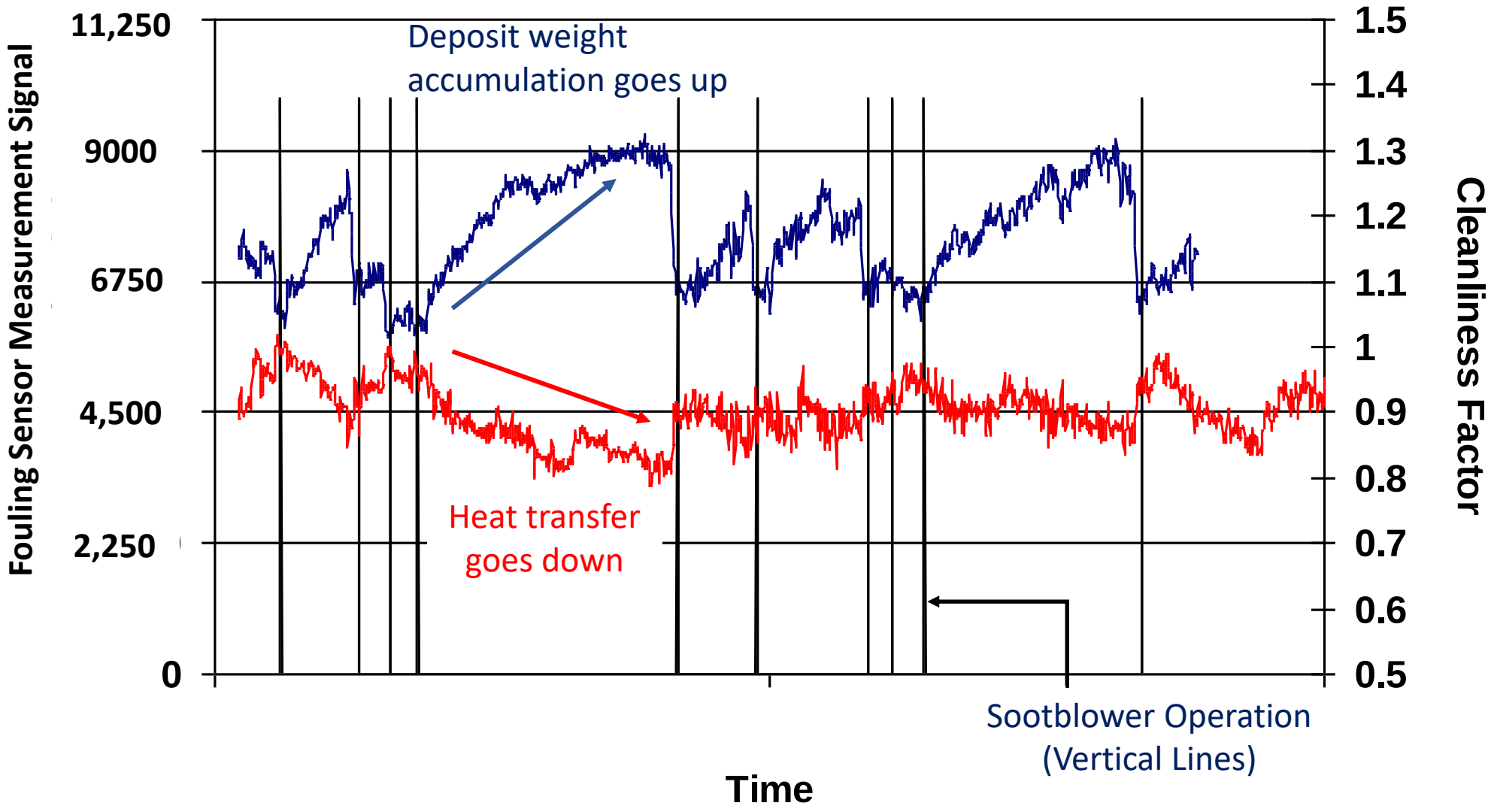
INTELLIGENT CLEANING: How do we save steam & prevent plugging



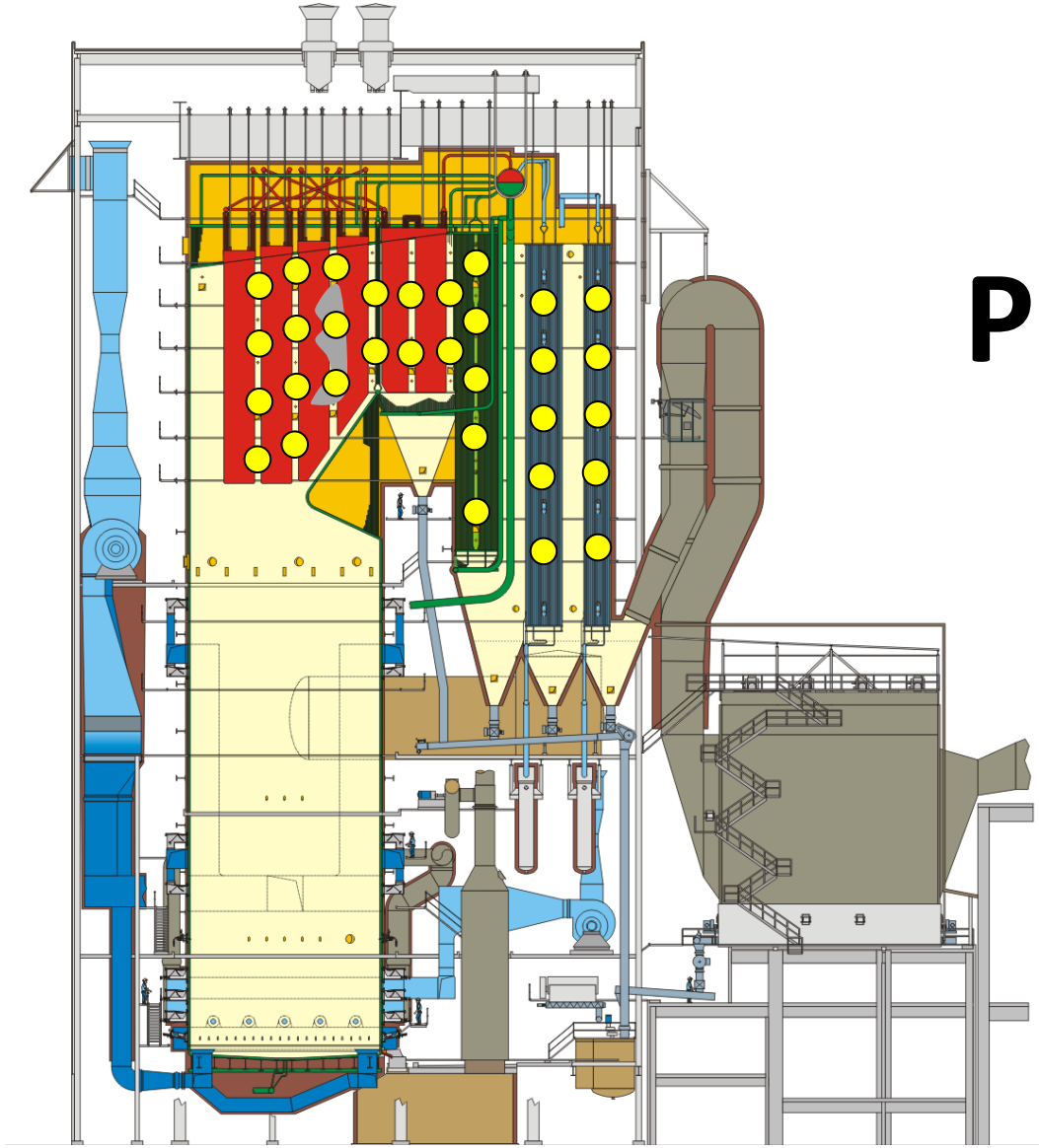
High rate of deposit accumulation is a good indicator that the boiler is about to plug. It requires specific sootblowing strategy to prevent it.



Superheater Section

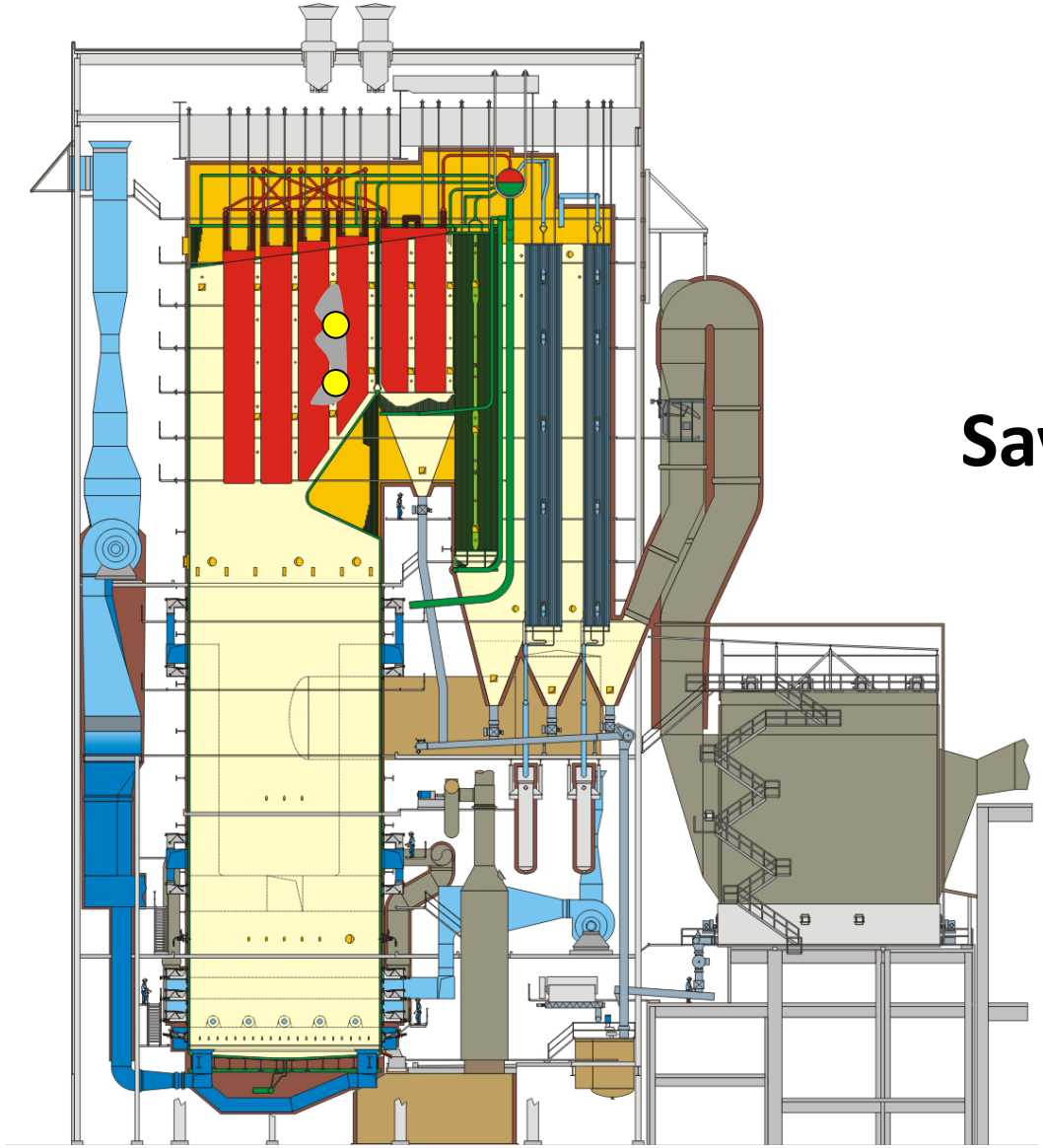


Conventional Timer Based Sootblowing



Plugging !!!

Intelligent Sootblowing



Targeted Cleaning !!!

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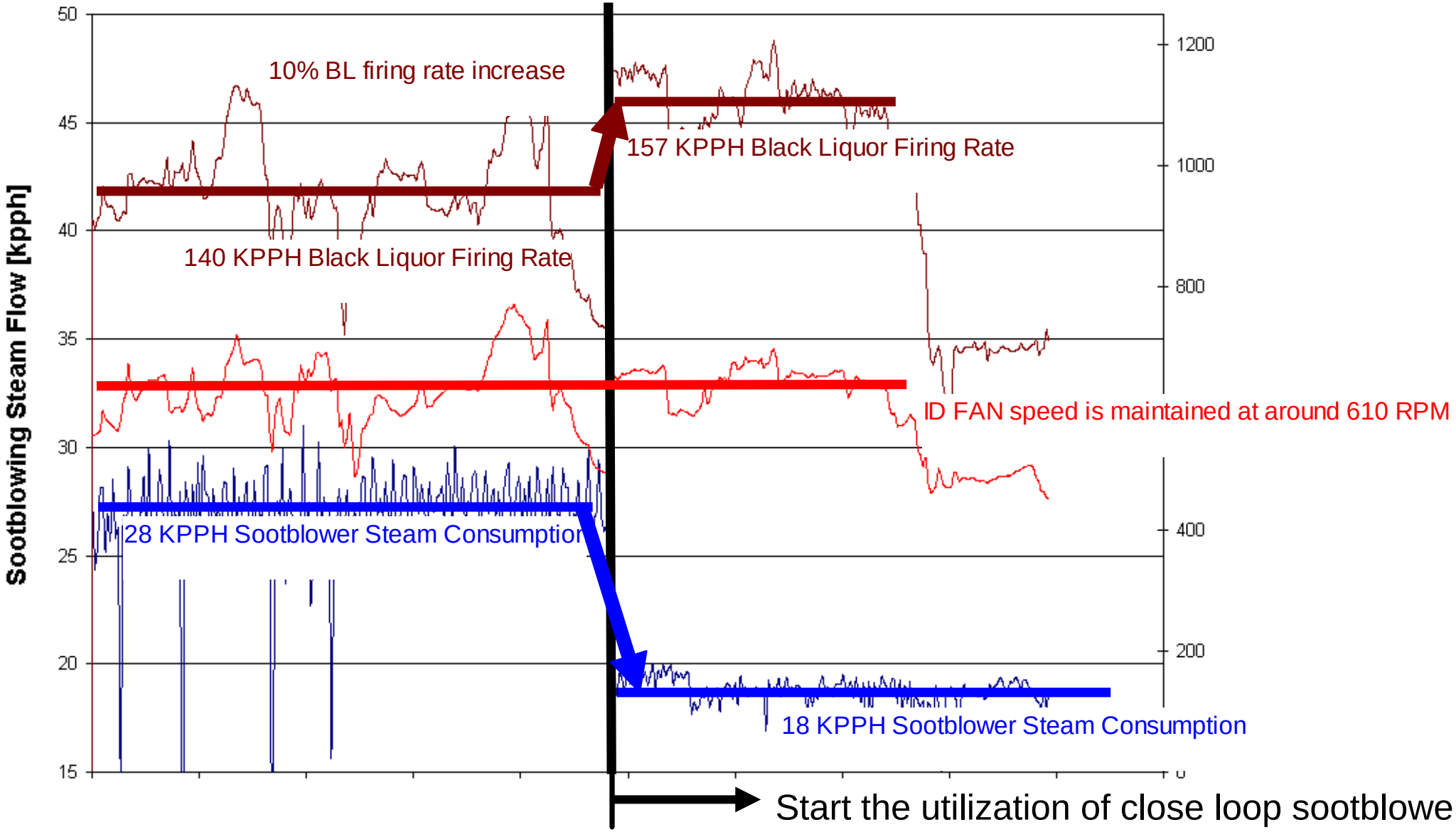
Saving your valuable steam

Case Study:
Recovery Boiler in North-America

Recovery Boiler Spec

- Single Drum Recovery Boiler
- Designed to burn 3.7 Million lb/day Black Liquor Dry Solid (BLDS)
- Current Steam Production
  - 643,000 lb/hr
  - 825 psig & 750 ^{o}F
- High Sootblower Operating Cost
  - Prior to Sootblower Close Loop Control System installation
    - 26 KPPH sootblower steam consumption
    - At cost of steam $8.9/1000lb, the mill spent **$2 Million per year** on sootblowing steam


Sootblowing Steam Flow [kpph]
50
45
40
35
30
25
20
15
1200
1000
800
400
200
0
10% BL firing rate increase
157 KPPH Black Liquor Firing Rate
140 KPPH Black Liquor Firing Rate
ID FAN speed is maintained at around 610 RPM
28 KPPH Sootblower Steam Consumption
18 KPPH Sootblower Steam Consumption
Start the utilization of close loop sootblower control
(Intelligent Sootblowing)

Three Key Takeaways

1. **It is COSTLY to run sootblowers.**
   - The cost of steam alone can reach Million dollars annually.
   - What is your current SB steam consumption? Is it >5%MCR?
2. **It is also COSTLY to have insufficient boiler cleaning**
   - As it may lead to heavy fouling/plugging (Reducing your throughput)
   - Is your recovery boiler having difficult time to run at full capacity due to heavy fouling/plugging?
3. **Best practice is to devise a sootblowing strategy that prevents both over and under cleaning**
   - Manage sootblower operation by means of close loop intelligent control system based on these online fouling detectors (Sensors & Thermo Dynamic Model)

REFERENCES

1. Tandra, D.S., Shah, S., “Extended Recovery Boiler Runtime Using Smart Sootblower”, TAPPI Engineering, Pulping, and Environment Conference, Atlanta, GA, USA (2006)
2. Tran, H.N., “Kraft Recovery Boilers”, edited by T.N. Adams et al, TAPPI Press (2020)

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Thank You IPPTA and Paper Mill Users!

Questions?