Increase Production in Your Recovery Boiler with LignoBoost

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Outline of the presentation

• Lignin – one of the three main wood components
• Process layout
• Equipment and installation
• Why extract lignin from black liquor?
• Energy situation in a general mill
• Steam saving potential
• Pulp capacity increase
• Impacts on the mill
• What can the lignin be used as?
Lignin – one of three main wood components

Amount of lignin in different black liquors, kg/ton pulp

- Spruce 510
- Birch 340
- Eucalyptus 340
Lignin

Nature's own binding agent

- Polymer (or macromolecule) of phenyl propane units
- High carbon content;
  - 60-65% for Softwoods
  - 56-60% for Hardwoods
- Main energy carrier in wood
  - HHV ~26 MJ/Kg DS
- Huge potential since lignin is a high volume by-product
  - In Sweden:
    - Kraft pulp production ~8 Mt/a
    - About 390 kg lignin/Adt
    - 25% removal rate
    - ~800,000 ton lignin/a → 5.8 TWh

Can supply about 230,000 houses with energy during one year
The LignoBoost process

Lignin lean liquor

Liquor ~40%

CO₂

H₂SO₄

Wash water pH 2.5

Washed Lignin

High pH

Low pH

Liquor from digester

Wash liquid ~2 m³/t lignin

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Equipment and installation

Typical installation

- 2 or 3 VPA pressure filters
- Precipitation equipment
  - $\text{CO}_2$ storage tanks – optional
- Process pumps and tanks
- Piping and valves
- Heat exchangers
- Scrubber, vacuum pump and fan
- Belt conveyors
Why lignin extraction?

1. Increases the pulp production

2. Produce a fuel that can replace oil e.g. in the lime kiln

3. Produce an additional product that can be transported and sold to increase revenue
Energy situation in mill

Consumers

- Evaporation 5.1 GJ/ADT
- Fibre line 4.9 GJ/ADT
- Pulp drying 3.0 GJ/ADT
- Lime kiln 1.4 GJ/ADT
- Others 1.0 GJ/ADT


KAM, report A100, 2003
Energy situation in mill

Producers

- Turbo generator 4 GJ/ADT 2)
- Recovery boiler 15.2 GJ/ADT 1)
- Power boiler 0-2.0 GJ/ADT

1) Low and medium pressure steam
2) High pressure steam

KAM, report A100, 2003

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Energy situation in mill

Summary/Steam balance

Recovery boiler 15.2 GJ/ADT
Evaporation 5.1 GJ/ADT
Fibre line 4.9 GJ/ADT
Pulp drying 3.0 GJ/ADT
Others 1.0 GJ/ADT
Total need 14 GJ/ADT


KAM, report A100, 2003
Energy situation in mill

Steam saving potential

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<tr>
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<th>Average</th>
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<td>1,4</td>
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<tr>
<td>Others</td>
<td>1,0</td>
<td>0,0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15,4</strong></td>
<td><strong>10,8</strong></td>
</tr>
</tbody>
</table>

1. KAM, report A100, 2003
How can the pulp production be increased when lignin is extracted from black liquor?

1. Lignin has a high heating value (about 26 MJ/Kg DS).
2. Lignin stands for approximately 35% of the dry solids content in the recovery boiler.
3. The recovery boiler is limited by the heat load and many mills run their boiler close to the maximum limit.

Consequently, when removing lignin prior to combustion the dry solids content and the overall heating value of the black liquor decreases. This means that at preserved availability the flow of black liquor can be increased and in the end also the pulp production.

The question is: HOW MUCH CAN BE REMOVED??
- Depends on the situation in the mill and also to some extent on the approach
- 2 different approaches
  - To maintain combustion properties (approx 20%)
  - To maintain steam parameters (approx 65%)

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Pulp capacity increase

Case study

• Softwood kraft mill producing 400,000 ADtpa

• Traditionally expansions steps already made (e.g. optimization of air and feed water system).

• Target: increase the pulp production

• Solution: A lignin extraction unit producing 75,000 tpa is installed. Due to the lower heating value in the liquor the recovery boiler will be able to process liquor corresponding a new pulp production of 490,000 tpa.

• Additional advantage: If the lignin is used as fossil fuel replacement in the lime kiln, about 50 liters of oil/t pulp can be saved.

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Pulp capacity increase

Possible pulp production increase
Flue gas limited, constant DS and air excess

Relative pulp production

Lignin extraction t/ADt

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Consequences for the mill

• **The recovery boiler**
  - Lower combustion temperature
    • Increase dry content of black liquor
    • Increase pre-heating of air entering the lower part of the boiler
    • Increase the amount of air entering the lower part of the boiler
  - Lower production of high pressure stem
    • Additional bark or forest residues burnt in the bark or hog fuel boiler
    • Lower the overall steam demand in the mill by steam savings

• **The evaporation**
  - Capacity increase of the evaporation; approx 2 ton water/ton lignin is sent back to evaporators.
    • To some extent counterbalanced because organic material is removed from the black liquor
Lignin – a versatile product

Fuel

• Fuel oil replacement in the lime kiln
  - High heating value
  - Hydrophobic and very easy to dry
  - Successful three day trial at a Swedish mill has been carried out

• Sold as biofuel to an external customer
  - Has been burnt in a CHP-plant in Sweden

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Lignin – a versatile product

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Thank you for our attention
VPA Filter
General economics

1 Mton HW, 25% capacity increase

Pay-back in years

Oil price USD/barrel

Gross profit

- 100USD/Adt
- 150USD/Adt
- 200USD/Adt
- 250USD/Adt
- 300USD/Adt

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Why can’t we wash at high pH?