Implementing Strategies for Drying and Pressing Wood Without Emissions Controls

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Industry Partners: Georgia-Pacific, Louisiana Pacific, Norbord
Technology description

- Industry problem: Reduce reliance on energy-intensive control devices such as RTOs.

- Project goal:
  - develop strategies for lowering HAPs emissions from dryers & presses through process changes;
    - if HAPs can be reduced to below a regulatory limit, then controls won’t be needed.
  - develop lower-cost control options.

### Potential benefits (AF&PA estimates)

<table>
<thead>
<tr>
<th>Energy savings</th>
<th>Environmental benefits</th>
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<tbody>
<tr>
<td>2.07 million MWH</td>
<td>4.6 million tons CO₂</td>
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<tr>
<td>34.1 trillion BTU gas</td>
<td>49,700 tons SO₂</td>
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<td><strong>Dollars (per mill)</strong></td>
<td><strong>31,000 tons VOC</strong></td>
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<td>~$5MM for RTO</td>
<td>12,900 tons NOₓ</td>
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<td>~$1-2MM natural gas</td>
<td>10,000 tons HAPS</td>
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<tr>
<td>~$1MM electricity</td>
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Results

Previous
- Developed fundamental understanding of the mechanism of VOC & HAPs generation.
- Implemented at OSB & MDF facilities at G-P (>$28 MM savings).

Recent
- Demonstrated that fines were responsible for much of the HAPs emissions from flake drying.
- Identified the size of the fines responsible.
- Reduced flaker fines by matching knife angle to wood temperature. Wood savings at Norbord ($200K annually).
HAPs & dryer inlet temperature

- Full scale results.
- 3 HAPs: formaldehyde, methanol, acetaldehyde.
- HAPs increase with temperature because the wood tissue thermally degrades.
The Aug. 20 runs (full-scale) included fines. Fines lead to high HAPs because they overdry & reach higher temperatures.
Can we reduce fines at the flaker?

Studied fines generation during full-scale strand flaking at a Southeastern mill.

Samples were taken every 30 minutes throughout the knife cycle (30 points), fractionated, & the fines measured.

Fines do not increase over 1,000 strokes.
Knife angle & temperature

- Average ambient temperature of the preceding two days is used.
- Points averaged from 20 samples taken over knife life.
- A 29° knife should be used in the winter; 26° is preferred in the summer.
- Wood savings: $200K/year plus VOC savings.
- G-P is presently trialing at 3 mills.

Full-scale data from a Southeastern mill.
Pilot work at LP, Nashville

- Differences with mill study
  - drum flaker vs disk flaker;
  - log temperature vs air temperature.
- Same trend is observed.
Hypothesis

- When a flake separates the wood is partly cut & partly split.
- Cutting depends on fiber stiffness, which is temperature-dependent. Small angles promote cutting.
- Splitting depends on H-bonding, which is not temperature-dependent.
**Validation of hypothesis**

- We are measuring zero-span wet tensile strength of fibers as a function of temperature (39-90°F).
- The zero-span test pulls the fiber apart, which should mimic splitting.
- The zero-span result does not appear to be temperature dependent.
- But the differences are small & extensive replication is needed. The work should be complete in 3-4 months.
Fines fractionation at G-P Fordyce

- Fines are defined as material that falls through a 1/8” screen. They produce large amounts of HAPs.
- Screening out fines will reduce HAPs substantially. But fines are also used as fuel & we cannot screen them all out.
- If we knew the exact size fraction that generates HAPs, we could screen out only this fraction.
- Fines were obtained from the dryer at Fordyce, size-fractionated, & examined under a microscope.
Problem fines are somewhere between samples 12 & 13. No dependence on dryer inlet temperature in the 1130-1270°F range.

Pan fines (#12) correspond to a 0.5-mm opening. A theoretical calculation gives similar results.

Application: only green-screen out these fines.
HAPs from fines

- Lab activation energy measurements for the breakdown of wood tissue into methanol and formaldehyde: ~17 kcal/mole.

- Field measurements gave ~45 kcal/mole, which means that there are more HAPs than expected. This is an artifact caused by the “pan-fraction” fines that are exposed to high temperatures.

- Solution: Green screening the pan fraction will reduce HAPs. Under consideration by G-P.
Determine what fraction of the fines is
- removed by the secondary cleaners,
- ends up in the RTO media,
- the ESP catch, &
- leaves with the furnish.

Will be done through modeling & field validation.
Urea & formaldehyde

- Adding urea to flakes during resin blending reduces press formaldehyde emissions. But this adds water to the flakes.

- Treating green flakes with urea (in the flaker cooling water) might be a better strategy, since these flakes would need to be dried anyway.

- The urea-treated flakes would then go through the dryer, which would leave a thin layer of urea on the flake surface.
Urea & formaldehyde (cont.)

- Green pine flakes were immersed in 0.1 or 1% urea solution for 1 minute & then dried at 105°C to 7% MC.
- Flakes pressed with 2.5% GP 145C48 OSB core resin.
- Formaldehyde in press emissions reduced by 20% (0.1% urea) & 46% (1% urea).
- These reductions may not be enough given that urea can thermally degrade in the dryer.
New chemical for formaldehyde control

- We have identified a cheap polymer that ties up a large amount of formaldehyde from the gas phase.
- We are studying the effect of this in reducing formaldehyde in the ESP wash & in press post-treatment.
What’s left

Complete

– work on the theory behind the knife angle relationship,
– fines balance across the dryer,
– suppression of formaldehyde emissions with urea or polymer.
Industry cofunding

- Georgia-Pacific: ongoing cash, mill support.
- Louisiana-Pacific: pilot equipment, time.
- Norbord: cash, mill time & support.