Hog Pile Management
Charles Friesen
FPInnovations Quick Reference Guide

In development for winter publication

- Summary of published literature
- Focusses on characteristics and management of comminuted forest residues
- Incorporates observations from past and current FPInnovations’ studies, and from hog pile managers
Ideal practice for minimum expenditure

- Store on paved surfaces, in windrow piles less than 7-8 m high and 14-16 m wide
- Pile oriented parallel to prevailing winds
- Piles spaced to allow access
- Minimize storage time
- Monitor internal temperature so preventative actions can be taken
Why hog piles catch fire or rot?

- Pile size
- Moisture content
- Poor ventilation
- Contamination (rocks, metal, foliage)
- Compaction
- Timing – temperature peaks 3 to 4 weeks after pile creation
The mechanism of spontaneous combustion

- Stage 1 – wood digesters
- Stage 2 – chemical reactions
- Material losses
  - Microbial respiration or rot
  - Pyrolysis
  - Fire
Basic pile management techniques - preventative

Four basic actions to virtually eliminate pile fires

- Make small piles or windrows
  - More exterior surface area for volume
- Monitor pile temperature
  - 80-90°C – risk of breakaway reaction
  - 150°C – ignition
- DO NOT ADD WATER to cool
- Reduce storage time
  - Keep pile fresh
  - Promote ventilation
  - Delay hogging – store as residue (tops, branches)
Basic pile management techniques - preventative

Monitoring Pile Temperature

- FPInnovations has developed a detailed pile monitoring protocol. Sylvain Volpe has more details.

- Once piles reach 80 °C or more, emergency action should be taken to ventilate the pile by carefully spreading it out while irrigating the hot spot. This needs to be done slowly because if hot spots at near flammable temperatures (150 °C) are encountered, exposing them to air may briefly fan the flames, so proceed slowly.

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>Monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50°C</td>
<td>Every 2 weeks</td>
</tr>
<tr>
<td>50-60°C</td>
<td>Every week</td>
</tr>
<tr>
<td>60-70°C</td>
<td>Every 2 days</td>
</tr>
<tr>
<td>70-80°C</td>
<td>Daily</td>
</tr>
<tr>
<td>&gt; 80°C</td>
<td>Hourly</td>
</tr>
</tbody>
</table>
Basic pile management techniques - preventative

Other measures to reduce dry matter loss and the likelihood of fire

- Ventilate piles – orient piles parallel to wind to promote ventilation
- Build piles under open-sided roofs in areas of heavy rainfall
- Build piles on concrete slabs or clean floors
- Fan-dry hog piles
What if a hog pile catches fire?

Emergency response

- Follow emergency response plan
- Remove people and equipment
- Douse with water or flame retardant and pull apart burning area
- Spread out hog pile to allow cooling and drying
Any questions?

Questions & Answers
Thank you!

Contact

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Residual Wood Conference
October 28 2011

Gurminder Minhas
Director Technology Deployment
Lignol Innovations
Introduction to Lignol

- Technology company deploying the Biorefinery concept
  - Key products areas include fuels, chemicals and advanced materials
- Burnaby BC based, public company (LEC:TSX-V)
- Investment in Biorefining Technology Development Centre
  - $50M over the last 6 years on R&D, Engineering, Operations
  - 40+ employees, most with technical backgrounds
  - Scientists, Engineers, Technologists, Technicians, Operators
- Developing potential commercial projects in Canada and US
Lignol’s Flexible Biorefinery

Biomass Extraction

- Biomass Feedstock
- Process Chemicals
- Utilities

Cellulose
- Cellulose Processing
- Bio-processing & Distillation
- Washing and Delignification
- Post-treatment

Lignin
- Lignin Processing
- Washing and drying
- Chemical treatment

Mixed Sugars
- Mixed Sugar Processing
- Bioprocessing & Distillation
- Chemical treatment

Fuel Ethanol
- Industrial Sugars
- Biofuels
- Biochemicals

Specialty Pulps
- Lignin Derivatives
- HP-L™ Lignin

Cellulose derivatives
- Industrial Sugars
Lignol’s Flexible Biorefinery

Biomass Feedstock

Process Chemicals

Utilities

Biomass Extraction

Solvent Recovery

Lignin Processing
- Washing and drying
- Chemical treatment

Lignin Derivatives

HP-L™ Lignin

HP-L Lignin Based Biorefinery Products
Development of Lignin Based Bio-Chemical Products
Lignol Produces a Unique High Value Chemical

- Understanding the chemical composition and characteristics is key in developing applications.

- Lignol measures and correlated key properties against production parameters and performance
  - Molecular weight and distribution
  - Functional groups
  - Thermal properties
  - Chemical performance
  - Melt flow, glass transition, rheological performance

- Production and quality control points include
  - Feedstock - Hardwoods, softwoods, non wood materials
  - Processing conditions
  - Post process forward chemical derivatization
    - Sulfonation, amino-methylation, oxidation
Lignol’s Approach to Product Development

• Substitute HP-L Lignin for petrochemicals with similar structure/function
• Develop new applications where HP-L lignins are key ingredients or feedstocks
• Focus on performance and cost effectiveness
  – A green or renewable is not enough
• Demonstrate performance with a product that is:
  – Consistent
  – Reproducible
  – Cost effective
  – Commercial quantities available in reasonable time frame
• Focused on delivering both a cost advantage and a market differentiation tool to the end user
Current HP-L Lignin Application Development

- Wide range of applications in development for high purity lignin as a substitute for petrochemicals with large scale industrial customers

<table>
<thead>
<tr>
<th>Petrochemical Substituted</th>
<th>Uses</th>
<th>End Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenol formaldehyde, Isocyanate Resins</td>
<td>Wood adhesives, foam insulation</td>
<td>Residential construction, friction materials, shipping, industrial equipment, utilities</td>
</tr>
<tr>
<td>Furfuryl alcohol</td>
<td>Foundry resins</td>
<td>Automotive pats, oil &amp; gas, industrial equipment, shipping, manufacturing, utilities</td>
</tr>
<tr>
<td>Polyurethanes and Polyol’s</td>
<td>Structural foam and insulation, adhesives</td>
<td>Automotive, construction, industrial equipment, footwear, sports equipment</td>
</tr>
<tr>
<td>Petroleum wax</td>
<td>Wood panel products</td>
<td>Construction, household products, packaging</td>
</tr>
<tr>
<td>Bisphenol A</td>
<td>Epoxy coatings and resins</td>
<td>Automotive, marine, architectural coatings, digital media &amp; equipment, food containers</td>
</tr>
<tr>
<td>Propylene and ethylene based plastics</td>
<td>Incorporation into thermoplastics</td>
<td>Range of markets associated with large volume plastics.</td>
</tr>
<tr>
<td>Polyacrylonitrile (PAN) Carbon fibre</td>
<td>Intermediate for “low cost carbon fibre”</td>
<td>Structural and functional applications primarily in automotive, process industry etc.</td>
</tr>
</tbody>
</table>
Customized HP-L Lignin For Wood Adhesives

- Pilot scale manufacturing of OSB and MDF wood panels containing HP-L at >30% resin substitution in core
- Lignol’s approach was to incorporate HP-L into the resin

Successfully met APA and CSA specifications
- Continue on work on evaluating L-PF systems in the face layer and as wax emulsifier, U-F and Isocyanates resin systems
HP-L Lignin in Thermoplastics

• Recently trials with NRC Industrial Materials Institute
  – Canada’s leading R&D Center focused on materials, formulation and forming, and manufacturing processes.

• Evaluate incorporating HP-L Lignin into thermoplastic blends as a functional ingredient
  – Initial screening indicates multiple potential applications, including polyethylene, polypropylene, polyvinyl chloride (PVC), polystyrene (PS)
  – Narrow molecular weight range, glass transition point and low ash content identified as key functional parameters
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www.lignol.ca
Altentech bioVertiDryers

Alternative energetechnologies
alternative energy is cool

yah... like way cool man!
Maximizing the resource
Maximizing the resource!
Maximizing the resource

HOW?
Mmmmm... Lodgepole Pine with a hint of Douglas Fir!

WARNING - DISCLAIMER
I am NOT an engineer

maximizing the resource...
TO DRY OR NOT TO DRY

THAT... IS THE QUESTION!

maximizing the resource...
FIRE GOOD
WATER GOOD
WATER IN FIRE
NOT GOOD

maximizing the resource...

Altentech
www.altentech.com
Golly Mr. Wilson, should I wet down the wood again?

Hey that's a swell idea Dennis!
...but what has the research revealed?

maximizing the resource...
Drying biomass fuel improves combustion efficiency, increases steam production, usually reduces net air emissions, and improves boiler operation...

A biomass-fired **boiler will perform better** when fuel has an optimum dryness... without supplementary use of fossil fuels... **air emissions are reduced**... More complete combustion results in lower quantities of volatile organic compounds and ash produced...

**Reduced fuel requirements**... **smaller fuel handling equipment**... **drying reduces transportation costs**

Biomass Drying and Dewatering for Clean Heat & Power
Carolyn J. Roos, Ph.D. WSU Extension Energy Program
“Using dry fuel in a direct combustion boiler results in: improved efficiency, increased steam production, reduced ancillary power requirements, reduced fuel use, lower emissions and improved boiler operation...”

Report on Biomass Drying Technology
National Renewable Energy Laboratory
“Drying... is an important part of the conversion process from fuel to the useful end products of power and heat... Dry fuel contributes to:

- boiler efficiency and the steam generation are raised
- volume of flue gas is reduced
- more flexible and stable boiler operation
- using less or no support fuel
- increased thermal output or steam generation
- smaller size and cost for a new boiler of same thermal output
- lower furnace emissions of particulate matter and volatile organic compounds ...

Thermal Drying of Wet Fuels: Opportunities and Technology - a report prepared by H.A. SIMONS LTD.
“In combustion systems any water content in the fuel must be driven off before the first stage of combustion can occur... High moisture content biomass has a much lower net energy density by mass.”

The Biomass Energy Centre of the UK
but we've got one of those “wet burning” boilers

Don't worry... I know some experts!

maximizing the resource...
REAL BENEFITS

Removing moisture before combustion can lead to:

- Increased plant efficiencies
- Increased power production
- Lower fuel costs
- Lower operating costs
- Reduced particulate pollution

maximizing the resource...

Altentech bioVertidryers
www.altentech.com
hmmmmmmm...

maximizing the resource...

Altentech bioVertidryers
www.altentech.com
maximizing the resource...
“energy balance” aka: is the juice worth the squeeze?

INCUMBENT (OLD) TECH

NEW TECH

maximizing the resource...
NEW-TECH

maximizing the resource...

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OLD(er)-TECH

maximizing the resource...

NEW-TECH

Altentech bioVertIdryers
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a significantly different technology

( in patent process in over 48 counties and counting )
a significantly different technology
...a fraction of the size / footprint

maximizing the resource...
a significantly different technology...

half or less electric energy consumption

maximizing the resource...
a significantly different technology

...approximately 55% of the thermal energy required

maximizing the resource...

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a significantly different technology...
engineered to give you unparalleled control & consistency
maximizing the resource...
a significantly different technology

...inherently reduced chance of explosions or fire

maximizing the resource...

Altentech biOVertidryers

www.altentech.com
a significantly different technology... reduced emissions
(1.) moisture reduction... really?

(2.) those experts pointed out some serious benefits

(3.) if we're going to do this we should use the best technology

maximizing the resource...

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Maximizing the resource!

maximizing the resource...

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thank you for your time and attention!

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