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Why should the forest products industry consider deploying Biorefinery Technology?

What is the need?

Where is the Pain?

Declining profits are the Pain

Figure 1: Industry Financial Performance: The Top 100 Forest, Paper & Packaging companies’ ROCEs*

What is CALIFORNIA’S Pain

- Forest biomass buildup
- Catastrophic fires
- Degradation of watersheds
  - Siltation of streams
  - Loss of fisheries
  - Loss of wildlife
  - Loss of hydropower
  - Loss of jobs
  - Drinking water compromised
  - Loss of wildflowers/native flora
How will it work?

First we must define: “What is a Biorefinery?” (under the ABS model)
What is a “Biorefinery”?
The Applied Biorefinery Sciences Perspective

Refinery? An industrial plant for purifying a crude substance

The diversity of products from, and economic strength of, a refinery is a function of:

– Feedstock chemical composition
– Capital investment
– Markets
What is a “Biorefinery”?  
The Applied Biorefinery Sciences Perspective

A sugar refinery is an example of a single product refinery
What is a “Biorefinery”?

An oil refinery is a multi-product refinery

- gasoline
- diesel fuel
- asphalt base
- heating oil

- kerosene
- liquefied petroleum gas
- chemicals
So, what is a “Biorefinery”? 

A “Biorefinery” under the ABS model is defined as:

– an industrial plant where crude biomass is processed and refined into more useful products.
How can ABS Process™ Biorefinery Technology ("BT") capture value not currently realized?

By generating an increased or improved variety of products per volume of wood

“More jobs from the same tree”

Pat Curran
President
Seaway Timber Harvesting
Massena, NY, USA
ABS Process™ BT
starts with raw (crude) biomass
that is
cooked in water
SUNY ESF
Hot Water Extraction vessel
Separation of products

After two hours:
- Remove wood/extract mixture from extractor
- Drain hemicellulose extract from wood
Biomass after processing two hours

Extract mixture after processing
Applied Biorefinery Sciences
Integrated Biorefinery – General Process Flow

Biomass Feedstock
Wood Chips

Hot Water Extraction

Hydro-Torrefied™
Wood Chips

Hemicellulose Extract Mixture

Yields two potential product streams instead of just one
micellulose Product Recovery
Using multiple methods and pathways, separate extract mixture components into

- Non-sulfonated Lignin
- Sugars
- Permeate Solution
Potential Hemicellulose Related Products

Hemicellulose Product Recovery

Extract Mixture

- Filtration & Membrane Separation
  - Lignin → adhesives et al.
  - Sugars
  - Permeate Solution

Fermentation

- E.g.,
- Butanol
- Ethanol
- Acetone
- PHAs
- et al.

Various Product Recovery Techniques

- Formic Acid
- Furfural
- Methanol
- Acetic Acid
Hydro-Torrefied™ Wood Uses

Biomass Feedstock Wood Chips

Hot Water Extraction

Hydro-Torrefied™ Wood Chips

Two potential product streams instead of just one

Hemicellulose Extract Mixture
Hydro-Torrefied™
Wood Uses

Raw Chips

Hydro-Torrefied™ Chips
What has happened to the chips?

After extraction:
- darker color
- structure (cellulose & lignin) still intact
- same volume, but
- 20-23% less mass
Hydro-Torrefied™

Wood Uses

After extraction, structural components (cellulose & lignin) remain intact, therefore chips are usable and improved for making:

- Fuel pellets
- Reconstituted wood products
- Pulp
- And other products

Hydro-Torrefied™ Chips
**Hydro-Torrefied™**

Wood Uses

*Hydro-Torrefied™ fuel pellets*

decreased chip bulk density  (due to hemicellulose extraction)

increased Btu content/lb

reduced ash content/lb

increased structural stability

- higher % lignin    (less likely to break)
- decreased hydrophilicity    (less likely to absorb water)
Simplified Business Model
Nature’s Biorefinery
Market potential

- California has largest dairy herd in the country
- Cows & heifers – 2.7 million*
- Potential demand for C-5 Sugars
  - If fed 1 lb/day per cow
  - 1290 T/day
  - 491,000 T/yr

*NASS California Agricultural Statistics 2012
Hydro-Torrefied™
Wood Uses

Hydro-Torrefied™ fuel pellets

increased structural stability
− higher % lignin (less likely to break = fewer “nubs”)
After 1 hour
drain the water

*Hydro-Torrefied™* pellet still intact

Conventional pellet disintegrated
Potential Pellet Market

Ship to Pacific Rim* nations to:
- Blend with coal
- Improve air quality
- Domestic Coal Burning Generators
- Public entities such as Schools, etc.
- Residential Pellet Stoves

* Dr. Thomas Amidon met with Environmental / Energy liaison & China Coal Specialist at US Embassy in Beijing.
Potential feedstocks

Forest biomass:
- Thinnings
- Slash piles
- Fire salvage
- Hardwoods/softwoods
Potential feedstocks

Agricultural by-products:
Almond shells
Peach pits
Prune pits?
Olive pits
Orchard pullouts
Testing California’s ag byproducts

at

USDA Western Regional Lab at Albany, CA
Concluding Statements
ABS Process™ Biorefinery Technology offers a complementary solution to:

- Torrefaction
- Pyrolysis
- Slash pile burning
- Land filling
- Biomass power

...to help solve California’s Forest Health Issues
Recommendation

When developing policy to address California’s forest health issues,

Develop policy that is results driven & technology neutral.