Development of Engineered Biopolymers for the Wood Composite Market

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Global Product Manager

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We are a chemical company that transforms industries toward sustainability by offering a range of engineered biopolymers for targeted markets which enable profitable growth for our customers.
OUR VISION

To be one of the world’s leading technology and market developers of bio-based materials.

Through value-added substitution of ageing fossil-based materials our enterprise will benefit society as a result of our sustainable technology, created from green chemistry and delivering a reduced carbon footprint.
A Growth-oriented Company

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>Enhancing Nature’s Best</td>
<td>Adding functionality - tailored to overcome the challenges of fossil fuel based materials</td>
</tr>
<tr>
<td>Viable and practical</td>
<td>Compatible with incumbent technologies, economically positive</td>
</tr>
<tr>
<td>Global Reach</td>
<td>Manufacturing, distribution, customer support in over 20 countries</td>
</tr>
<tr>
<td>Experienced Team</td>
<td>Global and local experienced industry team</td>
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**ECOSYNTHETIX**

Sustainable Polymers for Planet Earth™
Environmentally Biobased Products Require Compelling Value Proposition
Applying Green Chemistry to Match or Exceed Performance in Many Products

Transitioning from SB Latex in Paper & Board

**Consumer Benefit:** Sustainable Packaging

**Manufacturer Benefit:** Safer Chemicals, Sustainability & Economics

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Transitioning from Formaldehyde & pMDI in Wood Composites

**Consumer Benefit:** Low to zero VOC

**Manufacturer Benefit:** Safer Chemicals, C2C & Sustainability

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Transitioning from Formaldehyde in Building Insulation

**Consumer Benefit:** Low to zero VOC

**Manufacturer Benefit:** Safer Chemicals & Sustainability

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Transitioning from Glass-filled PP in Automotive

**Consumer Benefit:** Natural Ingredients

**Manufacturer Benefit:** Sustainability & C2C

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Transitioning from synthetic binders in Nonwovens

**Consumer Benefit:** Natural Ingredients, Biodegradability

**Manufacturer Benefit:** Sustainability & C2C
Unique Processes and Technologies

Source Feedstocks + Chemicals

Proprietary Continuous Manufacturing Process

Engineered Biopolymer

Patented Formula

Patented Process

Patented Product
EcoSynthetix® Engineered Biopolymers

<table>
<thead>
<tr>
<th>Biopolymers</th>
<th>ENGINEERED Biopolymers</th>
<th>Critical To Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteins</td>
<td>New chemical architecture</td>
<td>Mechanical</td>
</tr>
<tr>
<td>Sugars</td>
<td>Similar to synthetic polymers</td>
<td>Moisture</td>
</tr>
<tr>
<td>Starches</td>
<td>Example: DuraBind™</td>
<td>Emissions</td>
</tr>
<tr>
<td>Cellulose</td>
<td></td>
<td>Economics</td>
</tr>
<tr>
<td>Tannins</td>
<td></td>
<td>Supply</td>
</tr>
<tr>
<td>Other Carbohydrates</td>
<td></td>
<td>Processing</td>
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Engineered biopolymers are tailored for specific applications and replace many synthetic chemistries.
• One litre of aqueous dispersion contains roughly $1 \times 10^{18}$ particles which translates to a surface area ~40,000 m².
• This expansive surface potential translates to greater coating efficiency and increased binding mechanics.
The Challenge in Wood Composites

- Formaldehyde is inherent in wood but added formaldehyde can be a challenge
  - The majority of binder systems employed today are based on formaldehyde emitting resins
  - Increasingly, legislation is being implemented that greatly restricts the addition of formaldehyde
  - Balancing cost and meeting tough new legislation is a major challenge to our industry

- EcoSynthetix® Durabind™ NAF system delivers cost savings and performance that meets the challenge!
• **DuraBind™ Bio-Urethane Chemistry**
  – Tailored mixture of Engineered Biopolymer and Cross-linker
  – Targeted to be cost neutral versus UF System
  – Lower cost versus pMDI

• **DuraBind™ Process Enhancements**
  – Application technology
  – Process stability

• **DuraBind™ Renew technology**
  – Enabling technology to reuse “squeeze” and other excess process water
  – Empowering scavenger to allow recycling of wood from any binder source
### Successful Industrial Trials Validate DuraBind™ Value Proposition

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<th>Compelling value proposition</th>
<th>Saving money</th>
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<td>Chemistry is easy to handle and safer than alternatives</td>
<td>No new regulatory</td>
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<td>No issues getting the binder into the process</td>
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<td>Make boards</td>
<td>Multiple extended trials with multiple customers</td>
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<td>At the same processing conditions</td>
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<td>With no visual defects</td>
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<td>Confirmation that DuraBind boards are being sold through customer’s normal process</td>
<td>Meeting specifications</td>
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- Compelling value proposition:
  - Saving money
- Chemistry is easy to handle and safer than alternatives:
  - No new regulatory
- No issues getting the binder into the process:
  - Used existing equipment
- Make boards:
  - Multiple extended trials with multiple customers
  - At the same processing conditions
  - With no visual defects
- Confirmation that DuraBind boards are being sold through customer’s normal process:
  - Meeting specifications
The DuraBind™ Renew Technology—Added Value

- **DuraBind™ Renew technology**
  - Enabling technology to reuse “squeeze” and other excess process water/waste water

- **Tailored solution for each individual plants**

- **Benefits:**
  - Cost saving
  - Sustainability
Compelling Value for UF users

- Million dollars savings potential on an annual basis

- **Binder cost comparison:**
  - DuraBind™ binder is targeted to be cost neutral versus a typical UF system - **10% UF loading = 3% DuraBind Bio-Urethane**

- **Reduction of UF systems added cost**
  - Emission testing
  - Internal plant environment testing
  - External emissions
  - Waste water disposal
  - Yield loss for out of specification

- **Lower transport cost**
  - 1/3 of current shipping

Independent industry report shows cost at $0.5 to over $1.0 million annual cost to manage towards CARB II
Compelling value for pMDI users

• Million dollars savings potential on an annual basis

Internal Benefit:
– Improved economics versus pMDI
– Reduced release agent use
– Lower process contamination and clean up
– Significant additional savings
  • Reuse of “squeeze” water or wood

Customer Benefit:
– Improved machining quality at customer
– Less tool and press wear at customer
– Lower claims and rejects at customer
DuraBind™ - Summary

Performance:
Equal Performance

Sustainability:
Environmentally friendly, Bio-based

Economics:
Cost Effective

Engage Thought Leaders

Global Delivery

Bio-based Solutions

DuraBind™
The Road to Success
Thank you
Push for Formaldehyde Free binders

• Lumber Liquidators Big Lawsuit


• Front page of *The New York Times* includes an article titled “The Uphill Battle to Better Regulate Formaldehyde”