BIOINSPIRATION AND BIOMIMICRY: POSSIBILITIES FOR COTTON BYPRODUCTS

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**ABSTRACT**

The byproducts from cotton gins have commonly been referred to as cotton gin trash or cotton gin waste primarily because the lint and seed were the main focus of the operation and the byproducts were a financial liability that did not have a consistent market. Even though the byproducts were called “trash” or “waste” they are comprised of cotton plant materials such as lint, leaf, sticks and stems, and carpel. Over the past several years, there have been numerous research endeavors to find markets for or add value to the byproducts to enhance revenue to the processing facility and/or the producer. This presentation focuses on several products produced from cotton byproducts and discusses the pros and cons of their implementation. The presentation ends with a new bio-composite, which has been successfully implemented in industry utilizing fungus mycelium to integrate a plant fiber matrix to create a product for a variety of uses. The idea for the new biocomposite was born from observation of the natural world and encourages bioinspiration and/or biomimicry as a platform for utilizing natural fibers for future composites. Current and potential uses of the mycelium/natural fiber biocomposite will be discussed.
Bioinspiration and Biomimicry: Possibilities for Cotton Byproducts

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33rd International Cotton Conference Bremen
March 16-18, 2016
Cotton Production and Processing Research Unit
2014
Active Cotton Gins by State
Total Gins: 601

SOURCE: USDA NASS 5/15
Cotton Provides Fiber, Food, Feed, Fuel and Material Feedstocks
Gin Waste → Fuel & Material Feedstocks

- Gin waste
- Fiber
- Fuzzy seed
- Feed
- Composites
- Fuel
- Turf

Field → Gin
Global Cotton Biomass Production
75 Million Metric Tons/Year
80% remains in the Field
10 to 15 MMT Used in Value-Added Products
Waste Fiber

Raw

Semi-Processed

Re-ginned
Segregation is Key
Applications for Cotton Byproducts

- Feed
- Fuel
- Soil & Turf - Geotextiles, Mulch/Compost (soil nutrients, fertilizer, erosion control)
- Composites (packaging, acoustic absorbers, furniture cores, etc.)
- Other (???)
Feed for Livestock

- Agricultural residues can be processed into a high energy roughage for ruminant livestock
Fuel Source

- Agricultural residues can be made into a fuel source for residential and industrial applications.
Soil & Turf Products

- Agricultural residues can be made into products for erosion control & grass seed establishment.
Composites

- Agricultural residues can be used as raw materials for various composite materials.
Primary Substrate - Ag. Biomass
The Fungal Mycelium

Fungal cell wall is a chitinous polymer

- water insoluble
- dimitic hyphae
- grown matrix
Benefits of Mycelium Composite
Reference Sound Levels

- Threshold of hearing - 0 dB
- Threshold of pain - 120 dB
- Rusting leaves - 10 dB
- Mosquito buzzing - 40 dB
- Normal conversation - 50 dB
- Busy traffic @ 10m - 80 to 90 dB
- Jack hammer @ 1m - 100 dB
Biomedical Application?
GROWN, NOT GLUED

Myco Board

Myco Board combines the benefits of homogenous and particleboard into one more functional product. This one interior wall panel can be produced at several densities and at any amount to fit the program at a given, with superior strength. By using Myco Board's unique technology, it provides the strength, stability, and beauty of a wood panel, a wall, or a floor almost any color and style. Myco Board is easy to install and ideal for use where durable, long-lasting and aesthetically pleasing surfaces are needed.

Flat Myco Board

Molded Shapes

Myco Board is molded at high temperature and pressure to form any desired shape. This process creates panels that are stronger, safer, and more efficient to handle than traditional wood products. Myco Board can be cut, routed, and shaped to any desired size and shape, providing flexibility and versatility for various applications.

Performance Specifications

<table>
<thead>
<tr>
<th>Property</th>
<th>Standard</th>
<th>Myco Board</th>
<th>Ecological</th>
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</thead>
<tbody>
<tr>
<td>Panel Density</td>
<td>40 lb/cu ft</td>
<td>40 lb/cu ft</td>
<td>40 lb/cu ft</td>
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<tr>
<td>Formaldehyde</td>
<td>0.01%</td>
<td>0.00%</td>
<td>0.00%</td>
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<tr>
<td>Water Absorption</td>
<td>8%</td>
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<tr>
<td>Flexural Strength</td>
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<tr>
<td>Flammability</td>
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<tr>
<td>Greenhouse Gas</td>
<td>Low</td>
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<td>Low</td>
</tr>
<tr>
<td>Fire Resistance</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Formaldehyde Emission</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Myco Board is environmentally friendly and offers a sustainable alternative to traditional wood products. It is ideal for use in applications where durability, strength, and a natural look are important.
Other...

- Interior décor...
Takeaway

- Look at both the whole and the individual components
- Blends can result in better performance since one substrate can make up for the short-coming of another
- Observe the world around you for solutions (bioinspiration or biomimicry)
- Don’t be afraid to think beyond the traditional. New uses, new ways of looking at raw materials and applications.