Creating Innovations utilizing renewable resources

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HOW CAN WE HELP POOR FARMERS?

CREATE INNOVATIVE NEW MATERIALS USING ABUNDANT, RENEWABLE RESOURCES THAT ARE UNDER UTILIZED (AGRICULTURAL WASTE) AND OWNED BY POOR FARMERS (<$2/DAY)
A Great Need

How can we speak of God’s love to them?
Coconut Family in Indonesia--
$500/yr income for family
Children of Coconut Farmers, Indonesia
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Approximately **50 BILLION** coconuts fall from the tree every year!
### Worldwide Production of Coconut Oil -- 2008

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Metric Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Indonesia</td>
<td>19,500,000</td>
</tr>
<tr>
<td>2</td>
<td>Philippines</td>
<td>15,300,000</td>
</tr>
<tr>
<td>3</td>
<td>India</td>
<td>10,900,000</td>
</tr>
<tr>
<td>4</td>
<td>Brazil</td>
<td>2,800,000</td>
</tr>
<tr>
<td>5</td>
<td>Sri Lanka</td>
<td>2,200,000</td>
</tr>
<tr>
<td>6</td>
<td>Thailand</td>
<td>1,500,000</td>
</tr>
<tr>
<td>7</td>
<td>Mexico</td>
<td>1,200,000</td>
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<tr>
<td>8</td>
<td>Viet Nam</td>
<td>1,100,000</td>
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<tr>
<td>9</td>
<td>Papua New Guinea</td>
<td>700,000</td>
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<td>10</td>
<td>Malaysia</td>
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<tr>
<td>11</td>
<td>Myanmar</td>
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<tr>
<td>11</td>
<td>U. Rep. of Tanzania</td>
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</tr>
<tr>
<td>13</td>
<td>Ghana</td>
<td>320,000</td>
</tr>
</tbody>
</table>

Source: FAOSTAT 2008
WHAT IS A COCONUT?

- Husk Pith
- Husk Fiber (Coir)
- Shell
- Meat (Copra)
TRIPLE BOTTOM LINE

• Helping impoverished farmers

• Stewardship of renewable resources

• Improving performance
• Reducing cost
• Improving sustainability

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Patent Pending: “NON-WOVEN FABRIC COMPOSITES FROM LIGNIN-RICH LARGE DIAMETER NATURAL FIBERS” BAYU-0027 (208614.00115)

WHOLE TREE IS “BORN”

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Creating innovations utilizing renewable resources

Funding and Applications

Angel Investors

Applications

Automotive Interiors
Building Construction Materials
Consumer Products
Packaging
Coconut fibers (called coir)....Milled and baled....Combined with binder polymeric fibers into needle-punched felt.

Felt compression molded or thermo-formed into parts!
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Thermoformed
Husk’s function in nature
- Help nut survive impact after 60-80 ft drop
- Help nut avoid microbial attack
- Help nut survive forest fires

Physical Properties of Coir Fiber
- Naturally burn resistance (high lignin)
- Excellent ductility (~25%) and formability
- Density ~ 1.2 g/cc; low composite density
- Large diameter fibers (150-250 um)
- Excellent bending stiffness (EI)
- Durable in wet environments
- Resistance to mold and microbial attack
- No problems with odor
- Moderate tensile strength and stiffness
Non-woven Fabric Composite
Coir:PP vs. PET:PP

Flexural modulus vs. density of varying
coir % and PET reinforced PP nonwoven

Rigidity vs. density for varying
coir % and PET reinforced PP nonwoven
Strategic Alliances

• Hobbs Bonded Fibers - Waco, TX
  – Produces advanced textiles
  – Thermoformable composites

• Baylor University
  – Provides ongoing R&D support
What is the unique physical property of coconut shell? High hardness!

Coconut Shell is 4X harder than the hardest maple hardwood!

Coconut Shell is 10X harder than the pine wood!
Coconut Shell Powder (CSP) -- Reinforcement in Polypropylene, Polyethylene or Co-polymer of PP/PE

*Improving neat resin properties while reducing cost*

- Significantly increases tensile and flexural moduli
- Modest increase in tensile strength
- Good retention of ductility and Izod impact toughness
- Good UV resistance; reduces UV degradation in polymers
- High lignin content resists odor development associated with natural materials
- Possible uses of CSP in plastics, cosmetics and other applications

**Automotive**

[Image of automotive interior trim](http://www.geminigroup.net/interior_trim/index.html)

**Construction**

Plastic Lumber / trim / panels

[Images of plastic lumber](austinwholesaledecking.com)

**Decking**

[Image of decking](austinwholesaledecking.com)

**Toys**

[Images of toy tricycles](http://www.123rf.com)

**Consumer goods / Packaging**

[Images of packaging](http://www.123rf.com)
SUMMARY

1. CoirForm non-woven fabric composites made with coir and a polymeric binder fibers offer substantial improvements in properties with significant reductions in cost.

2. Coconut shell power as a reinforcement in polyolefins offers a significantly improved performance at a substantially reduced cost.

3. Both make more environmentally friendly polymeric composites.

POTENTIAL TO HELP POOR COCONUT FARMERS IS HUGE!
Acknowledging those who made major contributions to this work

- Elisa Teipel
- Stanton Greer
- Sean Conroy
- Matt Kirby
- David Fait
- Ben Peterson
- David Hagen
- Ryan Vano
Thank you for your interest?

QUESTIONS?