Waste Carpet Construction Materials

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Wood construction board

- **OSB**
  - Oriented wood strand
- **MDF**
  - Medium density fiberboard
- **Plywood**
  - Wood layers
- **Particle board**
  - Wood particle, sawdust
Application

House
Walls, roof, floor, stairs, etc

Furniture
Tables, chairs, bed, dresser, etc
Potential Problems

Deforestation

Toxicity

Over 90% boards
Our Previous Work

Coconut

Sugarcane

Non-formaldehyde binder

Corn stalk

Agave

Procedure design

Surface chemistry

Designed Process

Surface chemistry

Designed Process

UCONN
Performance is much better than ANSI standard!

H – high density

M – medium density
Waste Carpet

4 Billion pound/year!

General recycle approaches explored previously:

- Pyrolysis
- Fiber extrusion
- Depolymerization & repolymerization

Difficulties with contaminants and economics
Different than soda bottles
Pure Carpet fiber board

**Tuft:** Nylon, PET, PTT.

**Backing:** Polypropylene, latex, inorganic fillers.
## Performance

### Swell Ratio (%)

<table>
<thead>
<tr>
<th>Composition</th>
<th>Swell Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuft/10% Resin</td>
<td>6.5</td>
</tr>
<tr>
<td>Tuft/5% Resin</td>
<td>3.5</td>
</tr>
<tr>
<td>Backing/10% Resin</td>
<td>3.13</td>
</tr>
<tr>
<td>Backing/10% Resin</td>
<td>6.7</td>
</tr>
<tr>
<td>Tuft-Backing/10% Resin</td>
<td>1.79</td>
</tr>
<tr>
<td>Tuft-Backing/5% Resin</td>
<td>--</td>
</tr>
<tr>
<td>ANSI-H</td>
<td>8%</td>
</tr>
<tr>
<td>ANSI-M</td>
<td>8%</td>
</tr>
</tbody>
</table>

### Graphs (10% Resin and 5% Resin)
Carpet/biofiber board

High modulus natural or manmade fibers
Water absorption is regularly addressed using small amounts of additives, per data shown earlier for coconut and bagasse.
Flammability Analysis

- **Standard methods for ignitability/flammability and toxicity**
  - ASTM methods exist for flammability and toxicity
  - Methods are different for different size samples
  - Methods are time consuming and are for validation purposes only
  - Methods require specific equipment

- **TGA and DSC approaches (and Py-GC methods for toxicity tests)**
  - More rapid and repeatable
  - Use reference material to get relative results
  - Provide insights into differences in flammability, ignitability, etc.
TGA-DSC experiments in this work

Instrument: SDT-Q600 TGA-DSC

Experimental method
- Atmosphere: air or argon
- Heat from 15°C to 120°C at 15.00 °C/min
- Remain constant temperature at 120°C for 30 min
- Heat from 120°C to 900°C at 15.00 °C/min
Components of a carpet composite particleboard
TGA-DSC results
The composite material has higher degradation temperature than the original sisal material (and lower than its carpet origin)

Up to 350°C degradation and combustion present the same weight loss profiles (degradation is the mechanism of weight loss of the solid sample for all the materials studied)

The binder is the first to leave the solid/liquid phase (evaporation or degradation; it is uncertain at this point)

Due to the small amount of binder and its possible chemical transformation, the binder is not seen to be lost as early in the composite materials

The multiplicity of DTG peaks in the majority of the samples studied indicates that the Py-GC studies need to be performed for degradation and combustion
The carpet samples contain approximately 20wt% inorganic (incombustible) matter.

Repeatability of the tests is marginal, possibly because of the heterogeneity of the sample.

DSC results indicate exothermic combustion profiles at temperatures in good agreement with the TGA data.

DSC results of the degradation experiments (the Ar group) are not well understood at this point.

**Future work**

- Repeatability tests with new carpet composite samples
- TGA and DSC of reference material (particleboard provide by Parnas)
- Analysis of DSC result of degradation
- Py-GC for toxicity analysis
Product Marketing Research
Summer 2015

• Work with Select Team of UConn Graduate Business Students at UConn Stamford Campus

• Timeframe: June-August

• Begin Detailed Research for New Particleboard Product with Post-consumer Carpet
Marketing Project Elements

1. Create Product Development Strategy
   - Determine Applications for Product and Product Extensions

2. Assess Industry Market Potential
   - Industry Attractiveness
   - Buyer Potential
   - Competitive Landscape
   - Available Substitutes
Marketing Project Elements (cont’d)

3. Segment & Identify Target Market
   - Employ both Primary & Secondary Research
   - Survey Prospects in Target Markets
   - Weight Prospects by Need, Price, and Purchase Preferences

4. Develop Strategic Pricing Plan
   - Analyze Tiered Pricing Scenarios
   - Assess Impact on Market Penetration
   - Positioning in Marketplace
Marketing Project Elements (cont’d)

5. Perform Value Chain Analysis
   - Identify Optimum Distribution Channels
   - Determine Customer Service Levels
   - Provide Suggested Marketing Messaging
Thank you!