Design functionality into your biochar products through control of feedstock size, shape, species, and surface character.
Abstract
• Biochar functional performance is affected by feedstock attributes as well as reactor conditions.
• Forest-derived biomass is considered an ideal raw material due to its abundance and relatively low cost.
• The willingness-to-pay price for raw Forest-derived biomass should be a function wood species, primary processing methods (roundwood, grindings, chips, sawdust, etc.), anatomical content, contaminants, and moisture content.
• Secondary processing of woody biomass into “reactor-ready” feedstock can improve the functional performance of resulting biochar products.
  – Secondary processing unit operations may include beneficiation, comminution, screening, and/or leaching.
• Examples and case studies will be presented to show a range of forest-derived biomass materials and resulting biochar feedstocks optimized for various end uses.
Forest Concepts Technologies through the Supply Chain

Related Forest Concepts’ technologies

- Baling Biomass
- Beneficiation
- Crumbles® Particles
- Advanced Drying
- Reactor-Ready Feedstocks
Outline of Talk

• Biomass to Feedstocks
• Reactor-Ready Feedstocks
• Feedstock Knobs that Turn
• Pre-processing Equipment and Operations
• Willingness to pay for functional feedstocks
• Questions?
Biomass  \rightarrow  Feedstock
A Different Paradigm
Industrial Biomass Feedstock Supply Industry

- Separate dirty and clean end of facilities
- Based on well defined commodity feedstocks
- Packaged appropriately for users
- Transported via conventional rail, barge, truck
Why the Interest?

<table>
<thead>
<tr>
<th>Biorefinery/Biochar Producer</th>
<th>Biomass Feedstock Producer</th>
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<tbody>
<tr>
<td>• Shift capital off-site (CAPEX)</td>
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<td>• Reduce biorefinery footprint (acres)</td>
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<td>• Reduce staffing</td>
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<td>• Reduce truck traffic and receiving</td>
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<td>• Reduce fire risks from onsite storage, drying, and milling</td>
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<tr>
<td>• Reduce waste &amp; soil disposal issues/cost</td>
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<td>• Make variability someone else’s problem</td>
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Why the Interest?

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<td>• Increase revenue and gross margins</td>
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<td>• Return screenings, leachates, etc. to the landscape as nutrients/amendments</td>
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<td>• Increase jobs in supplier communities</td>
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<td>• Profit by simplifying biorefinery operations and management</td>
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Crumbles® Industrial Raw Material

Higher yields and lower downstream processing costs from better feedstocks

- 16 US Patents issued with others pending
- 3 US Trademark Registrations:
  - SHREDZ®, US Registered Trademark No. 3,696,332, October 13, 2011
  - CRUMBBLES®, US Registered Trademark No. 4,045,867, October 25, 2011
  - PRECISION FEEDSTOCKS®, US Registered Trademark No. 4,045,904, October 25, 2011

- Reactor-ready size
- High flowability
- Highly uniform

- Absorbents
- Biochemical feedstocks
- Animal bedding
- Solid fuels
- Liquid biofuel feedstocks
- Biochar raw material
Screening

- By sieve size
- By length
Note: This experiment sought to minimize ash while maximizing total biomass retained. Thus, the bark content was higher than we wanted. Removing more bark would reduce the mass yield of clean biomass.
UltraChar™ Biochar Feedstock

*What you put in translates to what you get out!*

- High surface area to volume ratio
- High porosity
- Low bulk density
- Uniform size and shape
- Tunable water filtration flow properties
More Questions than Answers!

• Where to make reactor ready feedstocks?
  – At producer, aggregator (woodyard), depot, end user, ...
• What are best processes and equipment?
  – Comminution, sorting, cleaning, washing...
• What are mass, energy, and LCA balances?
  – How are energy and LCA inventories allocated?
• What are economic benefits?
  – Rural economic development
  – Economies of scale of distributed processing
• What is the willingness to pay for reactor ready feedstocks?
  – How are benefits priced through the supply chain?
Low Cost vs Equitable Cost

Quality is like buying oats - if you want nice, clean oats, you must pay a fair price;

However,

if you're satisfied with oats that have already been through the horse - such oats can be had a little cheaper!!

Anonymous (oats were domesticated ~ 2000 BC)
Thank You

Better Products Begin with Better Feedstocks™

www.forestconcepts.com

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Contact:
Forest Concepts, LLC
3320 W. Valley Hwy. N., Ste D110
Auburn, WA 98001

Jim Dooley
jdooley@forestconcepts.com
Ph: 253.333.9663
Toll Processing (1-2 tph)

Roundwood (via our veneer lathe)
Wood Chips
Ground Hog Fuel
Wood Mill Residuals
Field Chopped Green Crops
Baled Crop Residues
Dedicated Energy Crops