Reactor-Ready Biochar Feedstocks from Forest Biomass

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Design functionality into your biochar products through control of feedstock size, shape, species, and surface character

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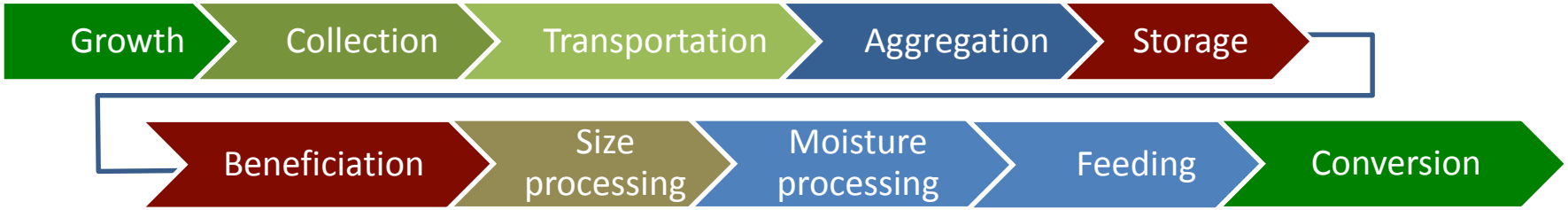
Abstract

- 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



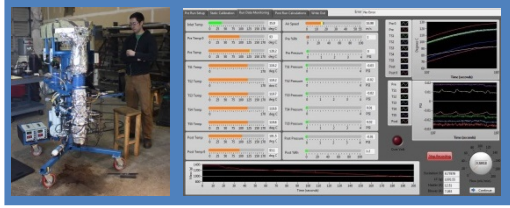
Related Forest Concepts' technologies

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 → 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?

Biorefinery/Biochar Producer	Biomass Feedstock Producer
• Shift capital off-site (CAPEX) • Reduce biorefinery footprint (acres) • Reduce staffing • Reduce truck traffic and receiving • Reduce fire risks from onsite storage, drying, and milling • Reduce waste & soil disposal issues/cost • Make variability someone else's problem	

Why the Interest?

Biorefinery/Biochar Producer	Biomass Feedstock Producer
	• Increase revenue and gross margins • Return screenings, leachates, etc. to the landscape as nutrients/amendments • Increase jobs in supplier communities • Profit by simplifying biorefinery operations and management

Crumbles® Industrial Raw Material

Higher yields and lower downstream processing costs from better feedstocks

Raw Wood Chips

Conventional Hammermill

Forest Concepts' Crumbles®

Magnified 4x

Forest Concepts' Crumbles®

Raw Corn Stover Bale

Crumbles® Switchgrass Bedding

Crumbles® Wheat Straw

- Reactor-ready size
- High flowability
- Highly uniform

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

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

Screening

- By sieve size
- By length

SBIR Beneficiation Validation Test

Ground Land Clearing Debris - Seattle

Mass	
100%	Pile
67%	Initial Screen
60%	Dry Flail
61%	Wet Flail
	Floatation Tank
57%	Final Screen

Pile
66 % Wood
13 % Bark
21 % Other
12.3 % Ash

Initial Screen
80 % Wood
13 % Bark
7 % Other
2.1 % Ash

Dry Flail
67 % Wood
15 % Bark
18 % Other
1.4 % Ash

Wet Flail
77 % Wood
11 % Bark
13 % Other
1.1 % Ash

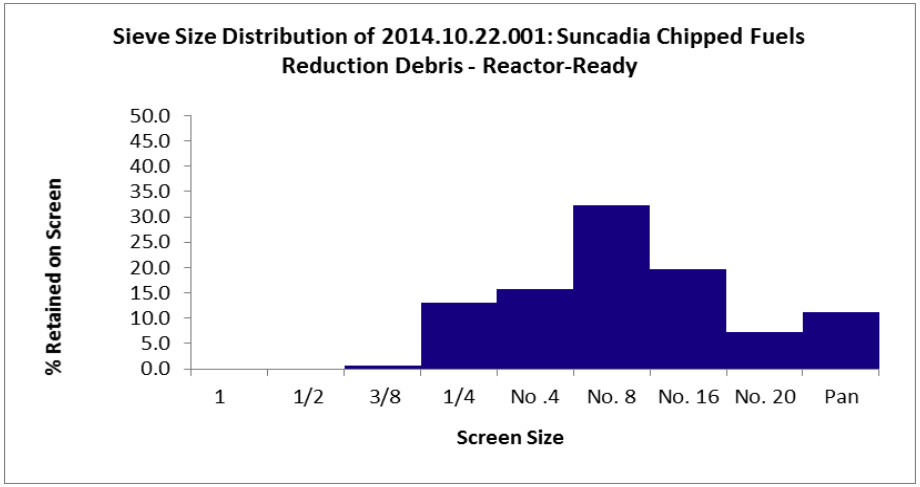
Floatation Tank
79% Wood
18 % Bark
3 % Other
0.6 % Ash

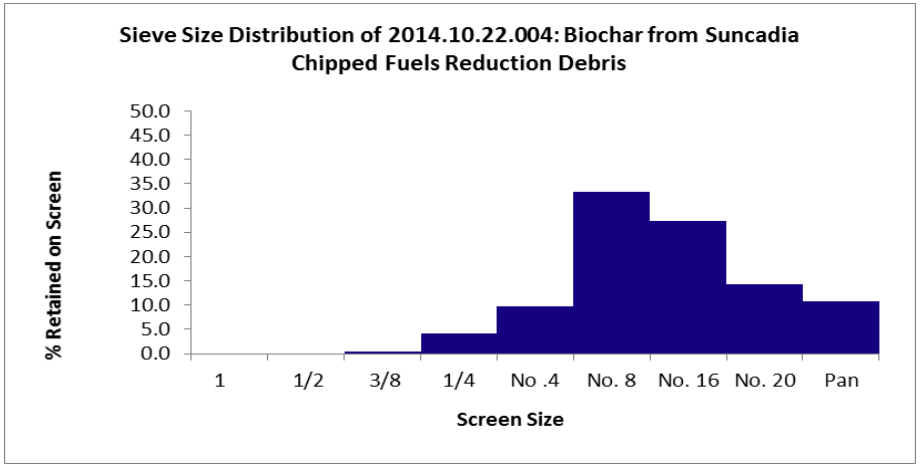
Final Screen

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.

Forest Biomass to Biochar

Amaron Energy & WA DNR (2014)

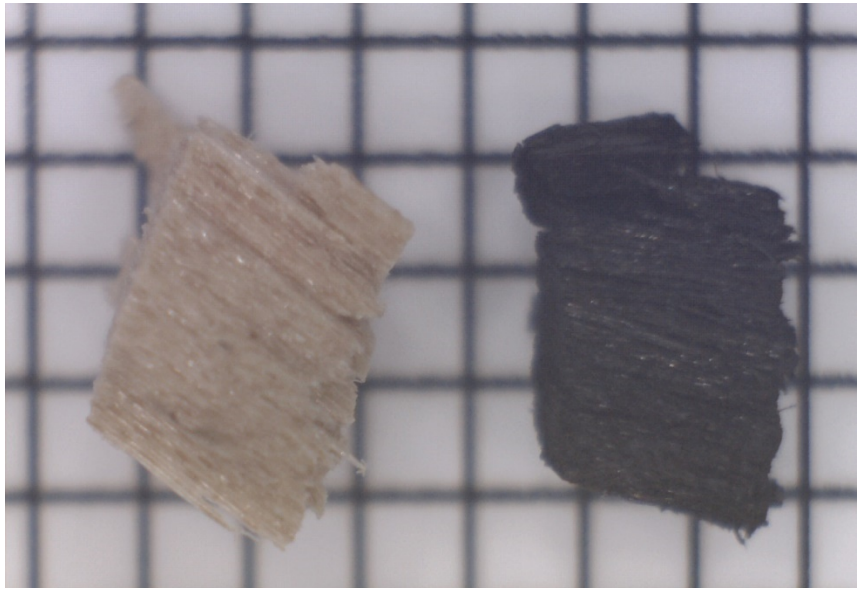




UltraChar™ Biochar Feedstock

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)

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Thank You

Better Products Begin with Better Feedstocks™

www.forestconcepts.com

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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