Size Reduction with Selective Material Orientation

This presentation is based upon research and development that was supported in-part by the U.S. Department of Energy Office of Biomass Programs Small Business Innovation Research Program Contract No. DE-SC-0002291.
Agenda

- Design Objectives and Constraints
- Taking Advantage of Natural Modes of Failure
- The Forest Concepts Comminution process
- Final Thoughts
Objectives and Constraints

• Maximize transport and storage density
  – Convert logs to industrial veneer

• Ensure flowability similar to grains
  – Produce uniform sheared cubic particles

• Minimize comminution energy
  – Cutting parallel to grain minimizes energy
  – Single-pass shearing minimizes frictional heat

• Produce particles optimized for conversion
Natural Modes of Failure

• Fibrous biological materials can fail in seven unique ways
  – Compression, brittle, shear,…

• Plants are very weak perpendicular to grain
Pathways to Precision Particles

- Log
  - Crush
  - Scrim 20-50 MJ/ODt
- Veneer 2 MJ/ODt
  - Shred
  - Sort 350 – 500 MJ/ODt
  - Chip 30 – 100 MJ/ODt
- Wood
  - Bark, etc.
  - Munch 20 – 70 MJ/ODt
  - Screen
  - Partial Dry
  - Screen
- Hammer Mill 350 – 500 MJ/ODt
  - Screen
- Fiberized Particle
- Precision Particle

- Sort
- Sort
- Bark, etc.
Why Industrial Veneer?

- High transport density
- Controls thickness dimension
- Enables separation of heartwood, sapwood and bark
- Enables orientation with grain for next processing operation
Veneer Making Video
Rotary Shear WoodMuncher™

- Low energy comminution method
- Orient parallel to grain or cross-grain
Does Length Matter?

Longer particles take less energy to make
Final Thoughts

• Work with natural modes of failure
• Veneer offers high density transport
• Single pass shearing minimizes energy
• Resulting particles have high surface area, high uniformity, high yield
• Crumbles™ particles are flowable
• Same design principles probably work in herbaceous crops
This presentation is based upon research and development that was supported in-part by the U.S. Department of Energy Office of Biomass Programs Small Business Innovation Research Program Contract No. DE-SC-0002291.