Production of Densified Biomass

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Biomass Challenges

Multiple sources or types
- Corn stover
- Prairie grass or legumes
- Straw

Multiple uses
- Heat (small, medium, large) applications
- Power
- Fuels and chemicals

Generally low density when harvested
Often harvested once per year, usually in late summer or fall
Agricultural to Industrial System

Agricultural – One harvest per year

Industrial – Requires supply throughout the year
Potential Biomass Resource
Million Dry Tons per Year

- Forest Resources
- Agricultural Resources
- Total Potential Resource

DOE/USDA 2005
Challenges with Stover, Grasses and Straw

Collection
Handling
Storage
Transportation
Densification
Utilization
Corn stover
Corn stover
Biomass Feedstock System

- Harvesting/collection
- Storage near the field
- Transport to preprocessing/densification facility
- Preprocessing/densification
- Storage after densification
- Transport/delivery to user
Harvesting/Collection

- Corn stover – fall
- Native grass or switchgrass – fall
- Straw – late summer
- Alfalfa for fuel – mid summer and early fall
Storage Near the Field

Store as round bales near the field or a farmstead close to several fields
Transport to Densification Facility

Tub grind and transport as coarsely ground material
Operate year around, grinding the wettest material (corn stover) during the November through March period
If bales lose quality or shape in the initial storage this approach should reduce problems with transportation
Equipment or vehicles to transport ground material may need development
Preprocessing/Densification

Facility operates year around drawing from a 15 to 25 mile? radius

Preprocessing includes further size reduction, drying or mixing to achieve desired moisture

Densification includes pelleting or briquetting to achieve a bulk density of 25 to 35 lbs/ft$^3$ at 12 to 15% moisture
Roll Press Briquetting

Screw feeder and rolls
Bepex International LLC, Minneapolis, MN

Briquetting Process

Almond shaped pockets
Briquettes

Briquette shape = large almond

Length = 29.0 mm (1.2 in.)
Width = 22.0 mm (0.9 in.)
Depth = 16.6 mm (0.7 in.)
Pelleting Mill

40 HP pelleting mill at AURI, Waseca, MN

Die and Rolls

Pelleting - extrusion
Pelleting/Briquetting
Storage after Densification

Storage of pellets or briquettes until delivery to the user
Storage could be at the densification facility or at the end user
Transport/Delivery to User

Transport by truck at 25 to 35 lb per cubic foot (pellets or briquettes)
## Biomass Bulk Densities

<table>
<thead>
<tr>
<th>Material</th>
<th>Bulk Density, lb/ft(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bales</td>
<td>6 to 12</td>
</tr>
<tr>
<td>Briquettes</td>
<td>28 to 33</td>
</tr>
<tr>
<td>Pellets</td>
<td>32 to 38</td>
</tr>
<tr>
<td>Corncobs</td>
<td>15</td>
</tr>
<tr>
<td>Shelled corn</td>
<td>45</td>
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</tbody>
</table>
Biomass for Heat and Power at a Corn Ethanol Plant
Heat and Power using Stover

- 50 million gallons ethanol per year
- 400 to 500 tons per day of stover
- 20 to 25 truckloads (20 tons each) of briquettes per day
- 800 to 1000 bales (1000 lbs each)
Home Heating

Shelled corn
Wood pellets
Corn stover pellets

Need high quality pellets or briquettes
Densification Facility

Produce a mix of products
- Briquettes for large (industrial) scale users
- Briquettes or pellets for intermediate (commercial, institutional) scale users
- Pellets for small (home heating) scale users
Summary

Densification offers an opportunity to make biomass easier to handle and transport.

Cost is a challenge.

Need to consider a system that operates year around with several biomass materials.
Questions?

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