**Hydrothermal Pretreatment**

Biomass feedstocks include a wide variety of materials with significant differences in handling characteristics, energy content and recalcitrance to conversion -- all factors that must be accommodated within a biorefinery context.

**Figure 2. Hydrothermal Pretreatment Process**

Hydrothermal pretreatment transforms lignocellulosic biomass into a more friable solid with less mass and higher energy density that can be easily fed for pyrolysis or gasification.

**Approach:** Treat biomass in water at temperatures around 260°C and equilibrium pressures (~680 psig) for 2-5 minutes to produce a solid that is easily dried and pelletized.

**Technical Accomplishments:**
- The O content is lowered, but the C content is increased.
- The process takes less time than conventional torrefaction.
- The mass of the feedstock decreases while its energy content is mostly retained.

**PROCESS OPTIMIZATION**

DRI is collecting all products of the HP process including:
- The pre-treated biomass or “bio-char”
- The condensed liquid
- Gases

**Table 1: Ultimate analysis of three feedstocks shows a decrease in O and increase in C and energy content of three different feedstocks.**

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Raw</th>
<th>Pre-treated</th>
<th>Bio-char</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinus</td>
<td>66.3</td>
<td>43.1</td>
<td>46.7</td>
</tr>
<tr>
<td>Loblolly Pine</td>
<td>68.7</td>
<td>49.0</td>
<td>45.3</td>
</tr>
<tr>
<td>Corn Stover</td>
<td>72.0</td>
<td>54.0</td>
<td>48.4</td>
</tr>
<tr>
<td>Rice Hulls</td>
<td>74.1</td>
<td>57.1</td>
<td>51.4</td>
</tr>
<tr>
<td>Loblolly Pine</td>
<td>30.7</td>
<td>15.7</td>
<td>15.0</td>
</tr>
<tr>
<td>Corn Stover</td>
<td>14.7</td>
<td>7.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Rice Hulls</td>
<td>10.9</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Ash</td>
<td>0.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Figure 4: Lobolly pine chips before and after pre-treatment**

Through a comprehensive set of laboratory analysis, we will perform complete mass and energy balances of the pre-treatment process.

**Gasification and Deployment in Nevada**

To demonstrate the viability of the pre-treatment process, we intend to use the bio-char to run a gasifier. DRI is partnering with UNR’s College of Agriculture, which has acquired a Biomax 15, a commercial gasifier/ power generation system.

**BIOMAX 15**

The Biomax 15, manufactured by Community Power Corporation (CPC), produces syngas by gasification of wood-chips. The syngas is then combusted in an engine/generator set to produce 15 kW of power and provide available heat. We intend to run the Biomax using pre-treated, Nevada-specific biomass.

**SYNGAS CHARACTERIZATION**

Dilution sampling will be used to collect syngas from:
- raw wood feedstock
- hydrothermally pre-treated feedstock
- conventionally torrefied feedstock

**Techno-economic Assessment**

A techno-economic analysis of the pre-treatment process is being conducted to determine the viability of building a full-scale facility in Nevada.

- This analysis incorporates results of the resource assessment, and the mass and energy balances of the pre-treatment process.
- Hydrothermal pre-treatment will be coupled with gasification (for syngas production) or pyrolysis (for bio-oil production).
- Based upon results of the Nevada biomass resource assessment, the facility would be located in Eastern Nevada.