Farm Scale Biodiesel/SVO Research

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Fueling the Future:
The Role of Woody and Agriculture Biomass for Energy Workshop

February 18, 2009
Roosevelt

Sponsored by:
University of Minnesota Extension, Roseau and Lake of the Wood Counties; Minnesota Department of Natural Resources

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Farm Scale Biodiesel/SVO Research

Paul Aakre ASM Program U of M, Crookston  2-18-09
CERTS award

• *Project Description*

• The Farm Scale Biodiesel project explores opportunities for energy independence for farm scale or multi-farm scale operations.
UMC Research Project

• Jade Estling, ASM, Agronomy student receives research grant from UMC
A research project using Canola seed

• Oil
  – Biodiesel
  – SVO

• Meal from seed
  – Livestock feed
  – Biomass heat source
Bio-diesel facility at UMC
German Komet twin-screw press, retail price about $18,000
Oil seed extrusion
Oil yield from Canola seed, 60 lbs/hour yields 32% oil
Oil for Fuel (methyl ester of canola oil)

Fuel Meister Kit  $3000

Steps

• Add methanol and lye, allow for about 10 hrs of reaction time.
• Glycerin separates out by gravity.
• Produces bio-diesel if it meets ASTM D6751 (official tests may cost up to $1000)
• Adds up to $1.00/gal
SVO (Straight Vegetable Oil)
Tom Haarstick, UMC UROP
Meal pellets...the byproduct of pressing.

Feed
- Pellets were analyzed by several labs including:
  - NDSU, Fargo, ND
  - Dairyland Laboratories, Sauk Center, Mn
- 38% crude protein
- 15 to 18% fat content
- 90% value of SOM

Source of heat
- Test conducted at Northwest Manufacturing in Red Lake Falls, Mn showed canola pellets comparable to wood pellets and corn as a fuel source
Fuel Testing at NW Manufacturing

Test furnace

Clean emissions
### Pellet Fuel Analysis

#### Pretest Data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilution Tunnel Diam in Inches</td>
<td>12.00</td>
</tr>
<tr>
<td>Fuel Type Pellet</td>
<td>Canola</td>
</tr>
<tr>
<td>Heating Value in BTU/# (HHV)</td>
<td>8766</td>
</tr>
<tr>
<td>Heating Value in BTU/# (LHV)</td>
<td></td>
</tr>
<tr>
<td>Fuel Moisture (Dry Basis) (%)</td>
<td>9.32%</td>
</tr>
<tr>
<td>H2O Density at meter (60 °F) (lb/gal)</td>
<td>8.3342</td>
</tr>
<tr>
<td>Appliance only Weight (dry) (lb)</td>
<td>940</td>
</tr>
<tr>
<td>Appliance Water Capacity (gal)</td>
<td>60</td>
</tr>
<tr>
<td>Avg Stove Temp at Start (°F)</td>
<td>160.62</td>
</tr>
<tr>
<td>Load Cell Reading (lbs)</td>
<td>1617</td>
</tr>
</tbody>
</table>

#### Post Test Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat transferred BTU</td>
<td>370,538</td>
</tr>
<tr>
<td>Heat transferred Kilojoules</td>
<td>390,938</td>
</tr>
<tr>
<td>Fuel Consumed - lbs</td>
<td>53</td>
</tr>
<tr>
<td>Fuel Consumed - lbs (dry)</td>
<td>48.48</td>
</tr>
<tr>
<td>Energy Input to system (BTU)</td>
<td>424,989</td>
</tr>
<tr>
<td>Overall Delivered Efficiency</td>
<td>87.19%</td>
</tr>
</tbody>
</table>
SVO Equipment

SVO tank installed on test tractor.

CNH tractor on SVO test at Penn State (over 250 hrs since spring 08).
Potential Problems to avoid!

2590 Case Tractor piston, with 616 hrs on 50% Diesel/SF blend (NDSU Graduate research 1981)
More potential problems to avoid

7020 AC tractor intake port with 700 hrs on 50% Diesel/Sunflower

4440 JD tractor exhaust valve with 665 hrs on 25% Diesel/Sunflower
Even greater potential problems

Broken rings on AC 8550 with 503 hrs on 50% Diesel/Sunflower

Same tractor with bad bearing and crankshaft.
Fuel Filtering for SVO

- A good job of filtering is essential, this setup will clean oil down to 2 micron.
Two tank Elsbett conversion unit

Conversion unit heater

Fox fuel tank heater
Fuel Injection System Requirements

Inline Bosch Models

Common Rail Fuels Systems

In-line fuel-injection pump
Current challenge

• Find a cooperator for spring and summer operation with a tractor that meets the recommendations of Elsbett.

• Find a cooperator interested in testing an unknown commodity verses $1.75 diesel fuel.