Project Title:  
Research to Apply Kinetic Disintegration System to Process Various Biomass Feedstocks for Pelletization

Contract Number: RD3-69

Milestone Report Number 6

Report Date: May 25, 2013

Reporting Period: November 27, 2012 to May 25, 2013

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MILESTONE REPORT

EXECUTIVE SUMMARY: MNVAP is researching the application of a Kinetic Disintegration System (“KDS”) to biomass pellet production. The biomass pellets can then be more efficiently transported, stored and utilized for the generation of power in facilities that cannot accommodate raw biomass as a feedstock. The KDS technology is capable of handling a wide variety of feedstocks that have varying levels of moisture. In Milestone 6 pellets were produced from feedstock from the KDS process and analyzed. An assessment of the KDS manufacturing process was also conducted.

The goal of this milestone was to compare and analyze feedstock obtained from MNVAP’s current biomass processing stream and from a biomass processing stream that incorporated the KDS. The Agriculture Utilization Research Institute (AURI) conducted densification testing to assess and identify characteristics of KDS processed fiber compared to MNVAP’s current processing system. Densification trials results showed the two processing streams result in similar pellet durability and density; however through-put efficiency is limited due to the different fiber structure of material processed through the KDS. Inconsistency in fiber length passing from the KDS results in flowability and densification issues with the pellet mill.

“Project funding provided by customers of Xcel Energy through a grant from the Renewable Development Fund.”
**TECHNICAL PROGRESS:** AURI conducted pelleting trials on ground alfalfa from MnVAP’s current biomass processing stream and biomass from the KDS processing stream at AURI’s Co-Product Pilot Lab facility in Waseca, Minnesota. A tote of approximately 400 pounds of material from each process was collected for densification research.

All pellet tests were produced on a 60 hp California Pellet Mill, Model 1112-4 (Photo 1), using a 1/4 inch diameter hole die with a 7:1 compression ratio (1.75 inches effective). Compression ratio is the effective length of the die divided by width of pellet. Pelleting throughput and energy utilization from the two processing systems for alfalfa were evaluated during pelleting.

During the pelleting trials, an attempt was made to keep pellet mill amperage operation at a constant level to eliminate variability in determining throughput between products. Pelleting was initially conducted on product produced from MNVAP’s current process which pelleted very easily without complications. However, during the pelleting trials with material produced on the KDS, the process had to be stopped several times due to plugging of ground material in the pellet mill conditioner outlet and the chute to the feeder cone. Although the pre-pellet bulk densities were similar between the two processes, with their current processing having a 13.5 pound per cubic foot bulk density compared to the 13.0 pound per cubic foot bulk density of the KDS produced material, the material from the KDS has a small percentage of stringy texture which causes plugging and difficulty in handling.

Pellet durability testing was conducted on a Kansas State Pellet Durability Tester. This test involves cutting off a 500 gram sample, tumbling it for 10 minutes at 50 RPM and sieving the test sample on a screen specific for the pellet diameter. Sieving conducted to identify yield involved a Tyler #3.5 screen that is standard for sieving 1/4 inch diameter pellets. Results of all pellet development and pellet durability results are displayed in Table A.

No additional moisture was added through water or steam during the pelleting process due to adequate moisture levels in the alfalfa processed material from the current processing stream which contained 12.65% moisture and alfalfa material from the KDS process containing 11.24% moisture.

AURI also conducted densification testing to aid in the assessment of identifying characteristics of KDS processed fiber compared to MnVAP’s current system. The KDS observed a 41.5 lb. per cubic foot density and MNVAP’s current biomass system was observing a 41.0 lb. per cubic foot density. The two densities were very comparable to each other. AURI observed that the limited throughput with larger particles caused plugging. The KDS operated at 1.6 tons per hour with 15.4% moisture alfalfa compared to MNVAP’s current process at 7.2 ton per hour of pre-pelleted material. Total energy cost during the control trial was $6.58 per ton for the KDS compared to $5.10 per ton on MNVAP’s current system. Energy efficiency for the KDS process was 3,526 Btu per pound of moisture removed compared to MNVAP’s current system of 3,414 Btu per pound of moisture removed.

**ADDITIONAL MILESTONES:** none
PROJECT STATUS: Feedstock testing and evaluation addressed the questions focused on similar pellet production from material that was processed with the KDS compared to their current biomass processing system. However, it also brought attention to the hurdles that could be encountered related to fiber length inconsistency from the KDS unit and the affect it has on pelleting efficiency.

Densification trials resulted in similar pellet durability and density; however throughput efficiency is limited due to fiber structure of material processed through the KDS system. Inconsistency in fiber length passing from the KDS system could result in flow-ability and densification issues within the pellet mill.

APPENDIX:

Photo 1- 1112-4 Model California Pellet Mill in AURI’s Pilot Lab
Table A - Pellet Development Testing (efficiency, durability, density)

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Table A- Pellet Development Testing (efficiency, durability, density)

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<tbody>
<tr>
<td>Test A – Control Alfalfa From Current Process</td>
<td>75 F</td>
<td>166 F</td>
<td>34 Amps</td>
<td>727</td>
<td>9.8%</td>
<td>97.2%</td>
<td>41.0</td>
<td>¼” X 7:1</td>
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<td></td>
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<td>12% feeder speed</td>
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<tr>
<td>Test B – Control Alfalfa From Current Process</td>
<td>75 F</td>
<td>166 F</td>
<td>40 Amps</td>
<td>1,200</td>
<td>9.8%</td>
<td>97.2%</td>
<td>41.0</td>
<td>¼” X 7:1</td>
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<td>20% feeder speed</td>
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<tr>
<td>Test C – Control Alfalfa From KDS Process</td>
<td>70 F</td>
<td>164 F</td>
<td>32 Amps (17% feeder speed without plugging)</td>
<td>708</td>
<td>9.3%</td>
<td>98.8%</td>
<td>41.5</td>
<td>¼” X 7:1</td>
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MNVAP process particle size before and pelleted after.

KDS process particle size before and pelleted after.