



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

Contract Number: RD3-69

Milestone Report Number 7

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(Public)
MILESTONE REPORT

EXECUTIVE SUMMARY: MNVAP is researching the application of a Kinetic Disintegration System (“KDS”) to biomass pellet production. As compared to raw biomass, biomass pellets can then be more efficiently transported, stored and utilized for the generation of power in electric power 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 previous milestones, pellets that were manufactured from biomass processed from the KDS processing method were tested, analyzed and compared to biomass pellets manufactured from MNVAP’s conventional method for processing biomass.

The goal of Milestone 7 was to design, install and operate a KDS specifically modified for biomass processing that can achieve a throughput goal of 5-7 tons per hour. It was discovered that the KDS could not support capacity required for MNVAP’s biomass processing of 5-7 tons of biomass per hour. To optimize the KDS performance for an increased through-put rate of biomass that has an acceptable particle size for pelleting would require a specific moisture and fiber length. These optimization processes would increase production costs from the current processing system. Incorporation of the KDS into MNVAP’s current biomass processing system would be challenging. Findings from the research has resulted in MNVAP’s decision to save labor and capital by not moving forward with full installation and incorporation of the KDS into their current biomass processing system. MNVAP realized it would cost more than \$2 million dollars to incorporate the KDS with MNVAP’s current biomass processing. The KDS process

was slower than the current MNVAP biomass process. It would take a minimum of \$2 million dollars to compete with the current method of MNVAP's processing. The finished product of pellets did not show much durability with the pellets crumbling. With the cost of incorporating the KDS into the current method and the costs of additional KDS's to compete with the current method, MNVAP's board of directors decided it would be in the best interest not to proceed any further incorporating the KDS into the current processing method.

A key component for many agricultural processes is drying technology. Whether it is raw materials going in or coproducts coming out, some form of drying often is necessary, and the quality of the drying technology can have a drastic impact on cost and capacity. Dryer Demonstration Day is an event that describes and demonstrates different drying technologies that can be applied to Minnesota agricultural processors. MNVAP hosted Dryer Demonstration Day on November 4, 2010 (photo 1). The KDS design was one of three drying technologies featured and a focus of the tour.

“Project funding provided by customers of Xcel Energy through a grant from the Renewable Development Fund.”

TECHNICAL PROGRESS: AMEC engineering drafted several schematics focusing on biomass handling from the intake end of the process through the densification and storage requirements. Engineering conducted focused on incorporating the KDS as a companion to their current biomass processing system. However there was an inability to obtain improved throughput from the KDS; the desired goal reaching 5-7 tons per hour throughput was unobtainable.

The KDS processed shredded alfalfa biomass of 15.4% moisture at 1.6 tons per hour. In comparison, MNVAP's current processing system operates at 7.2 tons per hour. A processing rate through the KDS of 2.3 tons per hour at 12.0% moisture was achieved but this required additional grinding. In addition, pellet tests from Milestone #6 showed performance issues with biomass and pellets processed with the KDS. The longer fiber lengths from the KDS processing system resulted in more broken pellets and inconsistencies in fiber lengths passing from the KDS would result in flow-ability and densification issues in the pellet mill.

Changes performed on the KDS were required to meet through-put expectations. Additional changes included five more belt conveyors to feed a bale chopper conveyor with a Variable Frequency Drive (VFD) control, an additional bale chopper for sizing particles before the KDS, and 4 screw augers one being about 100 feet long for moving the biomass from the bale chopper to the KDS and from the KDS to MNVAP's main pellet mill. It was estimated to be about \$2 million dollars and would take about 9 weeks to build a custom conveyor, 9-12 weeks to build a chopper and 3 months to be put together. Although AMEC engineering designs were developed to incorporate the KDS into MNVAP's current biomass processing method, through-put improvement could not be achieved during the testing and optimization of the KDS processing method.

Dryer Demonstration Day was held on November 4, 2010 at the 19th Avenue Grill and Lounge in Willmar, MN with a tour of the MNVAP plant and demonstration of the KDS. Presenters Greg Stover and Bill DeJong from Marion Mixers and John Lundell from Energy Unlimited along with 26 attendees, discussed the Kinetic Disintegration System. No known alternative drying options were discussed.

ADDITIONAL MILESTONES: No additional redesigns were prepared after December 27, 2013.

PROJECT STATUS: Although the target processing rated through the KDS was not achieved, final testing and re-design of the KDS was achieved. MnVAP participated as a host for AURI's Dryer Demonstration Day held November 4, 2011 (Photo 1). The KDS drying and processing method was the focus of this tour.

MNVAP could modify the KDS to achieve throughput goals of 5-7 tons per hour that would address the goal of furthering the biomass industry by exploring economic benefits of the KDS in processing biomass for pelletization (increased throughput potential, lower energy use and improved transportability through pelletization). MNVAP was looking at replacing the current method of processing biomass for pelletization with the KDS. The tons per hour from the KDS did not provide an opportunity for MNVAP to continue modifying the KDS to eventually replace the current method of processing. MNVAP could not invest any more funds to experiment further with getting the KDS to achieve a sufficient through-put goal. MNVAP exceeded its current goal of incorporating the KDS into MNVAP's current processing method with the engineering work, MPCA permissions, and the excess of the electrical and additional labor costs.

Changes performed on the KDS were required to meet throughput expectations for incorporations into MNVAP's biomass and pellet manufacturing process. Although engineering designs were developed to incorporate the KDS into MNVAP's current processing system, throughput improvement could not be achieved. The inability to improve the KDS throughput and drying efficiency along with concerns about fiber length inconsistency after processing led to a 'no go' position from MnVAP investment.

APPENDIX:

Article—The dryer the better from AG news

Photo 1—Attendees discussing dryer technologies at the AURI Dryer Demonstration Day

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From *Ag Innovation News*; Jan-Mar 2011:



The Dryer the Better

AURI holds second dryer technology demonstration day

Originally from: *Ag Innovation News*, Jan-Mar 2011, Vol. 20, No. 1

Willmar, Minn. — Enquiring eyes watched with curious anticipation as the towering Micronex Kinetic Disintegration System growled into gear. The dryer system, recently installed at the Minnesota Valley Alfalfa Producers facility near Willmar, employs a new particle reduction technology that also creates heat to dry a product for processing. In MnVAP's case, it's alfalfa that will be pelleted for feed.

The MnVAP presentation culminated an AURI-sponsored dryer demonstration day on November 4, attended by more than 30 people. Because of the popularity of a similar event in May, AURI held the second demonstration to focus on drying technologies that could help processors increase efficiency and open up new biomass opportunities.

"Some processors are looking at technologies with no heat because it doesn't denature protein in what they're drying," says Kevin Hennessy, AURI scientist and dryer day organizer. "Others are looking at ways to use low-value material to power their drying needs."

Besides reducing processing bottlenecks and drying costs, Hennessy says processors are looking at technologies that could open potential markets. "For example, depending on the technology, dairy digester solids could be used as fuel or fertilizer. New markets could be opened up for processors if their drying was more efficient."

The dryer technology demonstrations also give AURI scientists an opportunity to listen.

"These events help us to identify the needs of the industry," says Alan Doering, AURI scientist. He says building a community of processors, vendors and researchers is a platform for discussing industry hurdles and ways to address them.

<http://www.auri.org/2011/01/the-dryer-the-better/>

Photo 1 – Attendees discussing dryer technologies at the AURI Dryer Demonstration Day

