



Minnesota Valley Alfalfa Producers Phone: 320-231-2400 Fax: 320-231-0399 7410 Highway 23 SW Raymond, MN 56282

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

Contract Number: RD3-69

Public
Milestone Report Number 1

Report Date: March 23, 2011

Reporting Period: Feb 23, 2011 – March 23, 2011

Principal Investigator: Keith Poier 320.231.2400
Contract Contact: Keith Poier 320.231.2400

MILESTONE REPORT

EXECUTIVE SUMMARY: MnVAP will research the application of a new technology that is capable of handling a wide variety of feedstocks with varying levels of moisture that can be used in biomass pellet production. MnVAP will utilize the prototypic Kinetic Disintegration System ("KDS") that was invented for use in pulverizing ores and minerals. The Project will apply this technology to processing biomass, gathering information on performance and appropriateness of the KDS for the biomass industry, and introducing the KDS process as a more energy efficient option for processing biomass when compared to the current biomass processing methods.

The resulting biomass pellet product(s) could be used for co-firing with coal, in combined heat and power ("CHP") applications, for gasification and/or for use in biofuels production.

Project Goals:

- Increase revenue flows for farmer-owners.
- Improve rural economies economically and environmentally.
- Further the biomass industry by utilizing KDS technology to process numerous and various feedstocks.
- Further the biomass industry by exploring economic benefits in processing biomass for pelletization.
- Gain knowledge regarding operating specifications of the KDS.

Project performance targets will be set for each milestone to allow evaluation of the success of that step in relationship to the KDS. Primary in these quantifiable goals will be:

- Determination of reduction of utility cost (electricity and gas).
- Better moisture control of the pelletized product.
- Improved product quality.
- Increased feed rates/hour for pelletizing equipment.

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

TECHNICAL PROGRESS: Milestone #1 included preparation of a preliminary flow diagram for the modified KDS system and the establishment of the testing parameters. In addition to the design work, critical project activities were addressed such as permitting and procurement of equipment. A Minnesota Pollution Control Agency air quality permit was needed to conduct the tests and the feedstock needed to be identified.

Project Design and Engineering

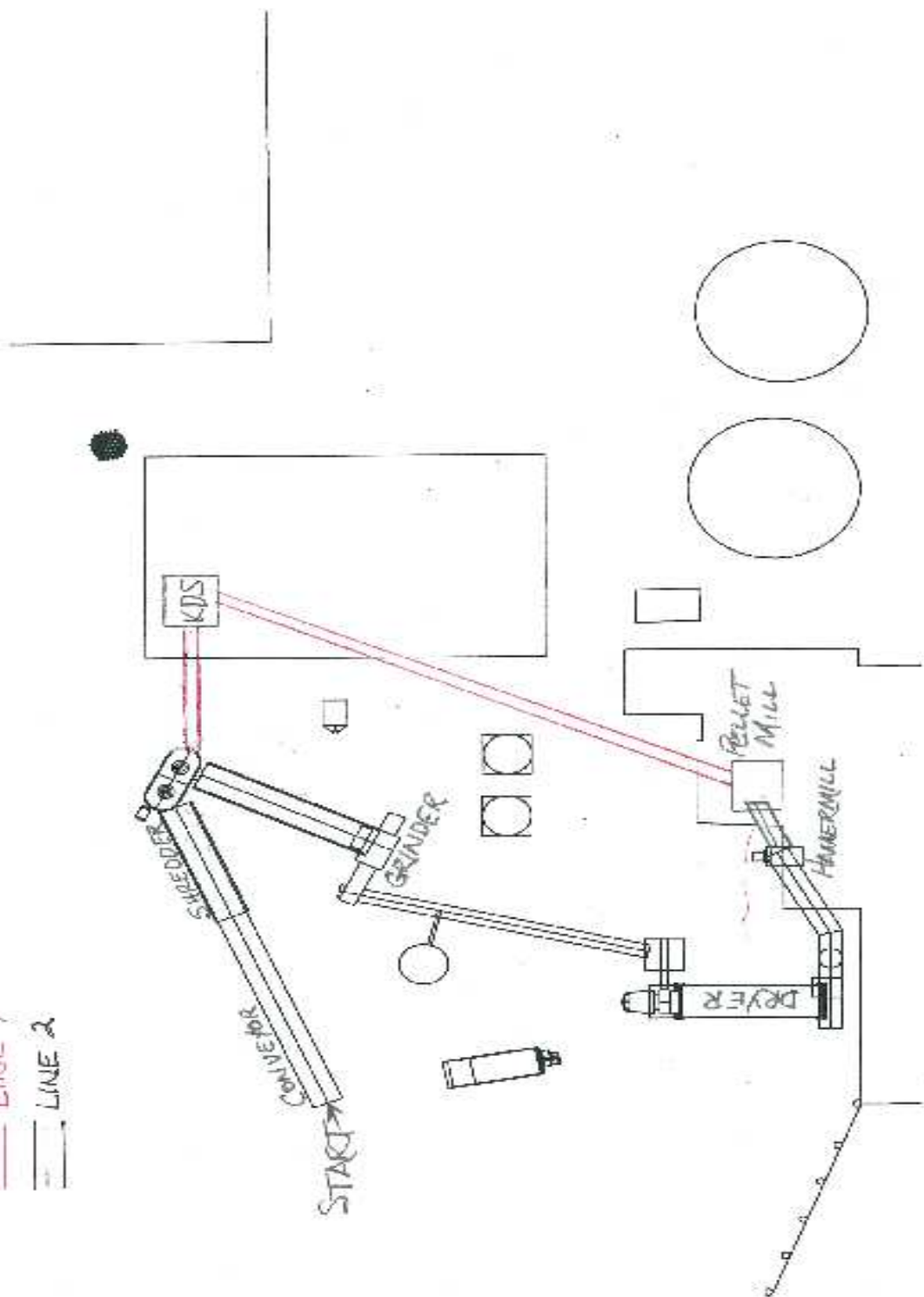
AMEC and Thompson Dehydrating Company have designed the Process Flow Diagram (PFD) for the KDS process line to develop the modifications that will increase the throughput, efficiency, consistency and cost of the KDS. The PFD is a diagram that follows the flow of material as it is processed through the equipment to produce the final product that being a densified biomass pellet. The importance at this point, you have a product that is easy to store, transport and the end user has a consistent product. The process starts with a loading conveyor where the material is placed for transport to the shredder. The shredder breaks the material down to 4” to 6” in size. At this point the process splits into two lines.

Line number 1 goes to the KDS .where the material is dried and ground down to 1/8 minus (this means that all the material is less than 1/8 of an inch). The material is now ready to be densified in the pellet mill.

Line number 2 goes to a grinder, then to a rotary drum dryer and then to the hammer mill where it is ground down to 1/8” minus. The material is now ready to be densified in the pellet mill.

The comparison of this material at this point in the process between the two lines will be evaluated for size, dryness, consistency and cost. See diagram below.

== LINE 1
-- LINE 2



AMEC, with an office in Minneapolis, has been contracted to complete the engineering portion of the project. Marcus Construction, located in Willmar, has been chosen to be the general contractor.

MnVAP has ordered the grinding equipment which has a twenty week delivery time, the longest of the equipment in the project. The upgrades to the dryer have been engineered and MnVAP is placing them out on bids along with conveying equipment and emission control equipment.

Permitting

MnVAP received their MPCA permit on December 18, 2009. The time and expense necessary to obtain the permit was more than expected. The project could not progress until the permit was granted. The KDS machine is an unproven item in the state of Minnesota. MnVAP had to design equipment that would allow the KDS to comply with the Minnesota state statutes on particle emissions. Airlocks on the KDS were replaced to eliminate particle emissions from the KDS to be in compliance with the MPCA. The airlocks were letting air escape the KDS, changing the airflow and the air pressure inside the KDS which affected the throughput.

Feedstock Analysis

Agriculture Utilization Research Institute (AURI) has been contracted to test the feedstocks, the final pellets and to analyze the KDS machine. Preliminary results in the testing show the KDS's ability to produce both a quality and consistent product for pelleting. See picture below.



AURI began some preliminary analysis of the KDS. The following is their report.

Kinetic Disintegration System (KDS), Minnesota Valley Alfalfa Producers, Priam, Minnesota

Dryer Name:	Kinetic Disintegration System	Dryer Type:	Grinder
Company:	First American Scientific Corporation		
Company Address:	201-30758 South Fraser Way, Abbotsford, BC CANADA V2T6L4		
Company Website:	www.fasc.net/		
Company Phone:	(604) 850-8959		

Efficiency:	
Btu/lb water removed tested:	Not tested at MNVAP.
Btu/lb water removed claimed:	See chart in text.

Power requirements:	
Total horsepower:	407 for 6 drive motors including 350 hp main motor (per company representative, single unit)
Horsepower notes:	350 hp motor with 75 hp blower at MNVAP

Maximum throughput (wet tons):	2 with 500 hp motor starting at 20% moisture content
Biomass tested:	Bagasse, animal manure, wood chips/bark, biosolids

Pictures on the following pages (pictures 8 and 9) are from the tour during AURI's Dryer Demo II on November 4, 2011, in Willmar, Minnesota. The KDS is a product of First American Scientific Corporation (FASC), with corporate headquarters in Abbotsford, British Columbia, Canada. The machine is actually a grinder, which through kinetic energy of high speed particle collisions, and the heat produced by the friction of grinding material, dries the material as it grinds.

The KDS internal chamber has a diameter of 1.3 meters and encloses a set of 8 spinning chains with a stationary torus above it. The motion of the chains, moving at a speed at the tips of up to 200 meters/second, not only serves to pulverize material but also heats up the air in the chamber.

The unit at MNVAP has a main motor with 350 hp. A 440 volt line is needed to power the KDS. In addition to the motor there is a 75 hp blower fan motor. At a starting value of 20% moisture they have been able to get approximately 1.5 ton/hour throughput. They have been told that installing a 500 hp motor on the unit would increase throughput by 0.5 ton/hour. The KDS is currently the bottleneck in the overall process throughput. Material up to 2 feet long has been run through the KDS with no ill-effects.

Speaking with a FASC representative, it was disclosed that the KDS uses less energy when reducing the moisture content in a material that starts with lower moisture. The numbers presented to us are listed in table 1.

KDS Energy Numbers	
Range (% moisture)	btu/lb
50-10	683.1
40-10	512.3
30-10	341.5
20-10	256.1

Table 1: KDS energy numbers based on starting moisture and intended drying range.

The company website claims the KDS can dry material up to 70% in moisture and reduce it to as low as 5%. Production rate is listed at 1-4 tons per hour (depending on material characteristics). Particle size can be controlled from less than 45 micron up to 1000 micron (2 mm).

Alfalfa is the standard being used to compare the two processing lines. Corn stover, bean straw, wheat straw are all considered “low hanging fruit” which means that they are byproducts that are readily available in the market today and will be prioritized as the first feedstocks to be tested. Prairie grass and switch grass will also be tested. The feedstocks will be procured from the members of the cooperative. The feedstocks cost will range from \$60-\$90 per ton. Delivery charges will be based on \$3 a running mile.

After the equipment has been installed the testing of different feedstocks will begin.

The KDS will be tested to find the following parameters:

- ◇ The moisture range of the feedstocks that the KDS will dry.
- ◇ The control of particle size with the different feedstocks.
- ◇ The throughput of the KDS.
- ◇ The production cost.

The Pellet Fuel Institute (PFI) standards will be used to test the pellets. MnVAP is producing a standard grade pellet for the commercial market. The PFI standards are in the chart below.

	Residential/Commercial Densified Fuel Standards		
	See Notes 1 & 2		
Fuel Property	PFI Premium	PFI Standard	PFI Utility
Normative Information - Mandatory			
Bulk Density, lb./cubic foot	40.0 - 46.0	38.0 - 46.0	38.0 - 46.0
Diameter, inches	0.230 - 0.285	0.230 - 0.285	0.230 - 0.285
Diameter, mm	5.84 - 7.25	5.84 - 7.25	5.84 - 7.25
Pellet Durability Index	≥ 96.5	≥ 95.0	≥ 95.0
Fines, % (at the mill gate)	≤ 0.50	≤ 1.0	≤ 1.0
Inorganic Ash, %	≤ 1.0	≤ 2.0	≤ 6.0
Length, % greater than 1.50 inches	≤ 1.0	≤ 1.0	≤ 1.0
Moisture, %	≤ 8.0	≤ 10.0	≤ 10.0
Chloride, ppm	≤ 300	≤ 300	≤ 300
Informative Only - Not Mandatory			
Ash Fusion	NA	NA	NA
Heating Value	NA	NA	NA

ADDITIONAL MILESTONES: Milestone 2 includes determination of the baseline performance of the KDS machine which cannot begin until all emission control equipment is in place and operating. This should not delay the project as MnVAP will be working on milestones 3 & 4 during this time which consists of the installation of supporting equipment such as feedstock grinders, conveyors, and dryers. With milestones 3 & 4 completed all emission control equipment will be in place.

PROJECT STATUS: The project looks very good due to many hours of critical analysis by the team members. AMEC has used their engineering expertise and experience to analyze the project and improve the efficiencies of the research line both from a processing and an economical viewpoint.

Marcus Construction experience will make it possible for MnVAP to continue producing alfalfa pellets to facilitate cash flow to completion of the project with the least amount of down time. The contract guarantees that the project will be operational and completed on schedule.

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APPENDIX

1. MPCA Permit



Minnesota Pollution Control Agency

520 Lafayette Road North | St. Paul, MN 55155-4194 | 651-296-6300 | 800-675-3843 | 651-282-5332 TTY | www.pca.state.mn.us

December 18, 2009

Mr. Zayna Eischens
Interim General Manager
Minnesota Valley Alfalfa Producers-MnVAP
7410 Highway 23 Southwest
Raymond, MN 56282

RE: Air Emission Permit No. 06700023-002

Dear Mr. Eischens:

The enclosed permit, Air Emission Permit No. 06700023-002, authorizes modification and operation of your facility located at 7410 Highway 23 Southwest, Raymond, Kandiyohi County, Minnesota.

The permit is effective from the issuance date of the permit until the expiration date of the permit. Please read through the permit and review its conditions and requirements. Distribute the permit to staff members responsible for ensuring compliance with the conditions and limitations in the permit. If appropriate, post the permit at the facility.

We appreciate your cooperation and compliance with environmental laws. If you have questions about the permit, please contact me at 651-757-2497.

Sincerely,

A handwritten signature in black ink, appearing to read "Ben Klismith".

Benjamin Klismith
Engineer
Air Quality Permits Section
Industrial Division

BK:rm

Enclosure

cc: Rachel Studanski, MPCA
AQ File No. 1682



AIR EMISSION PERMIT NO. 06700023- 002
Total Facility Operating Permit - Reissuance

IS ISSUED TO

Minnesota Valley Alfalfa Producers-MnVAP

MINNESOTA VALLEY ALFALFA PRODUCERS-MNVAP

7410 Highway 23 Southwest
Raymond, Kandiyohi County, MN 56282

The emission units, control equipment and emission stacks at the stationary source authorized in this permit reissuance are as described in the Permit Applications Table.

This permit reissuance supersedes Air Emission Permit No. 06700023-001 and authorizes the Permittee to operate and modify the stationary source at the address listed above unless otherwise noted in Table A. The Permittee must comply with all the conditions of the permit. Any changes or modifications to the stationary source must be performed in compliance with Minn. R. 7007.1150 to 7007.1500. Terms used in the permit are as defined in the state air pollution control rules unless the term is explicitly defined in the permit.

Unless otherwise indicated, all the Minnesota rules cited as the origin of the permit terms are incorporated into the SIP under 40 CFR § 52.1220 and as such are enforceable by U.S. Environmental Protection Agency Administrator or citizens under the Clean Air Act.

Permit Type: Federal; Pt 70/Limits to Avoid NSR;
Operating Permit Issue Date: December 18, 2009
Expiration Date: December 18, 2014

All Title I Conditions do not expire.


for Don Smith, P.E., Manager
Air Quality Permits Section
Industrial Division

for Paul Eger
Commissioner
Minnesota Pollution Control Agency