2011 Waste-To-Energy Excellence Award

NOMINATION FORM

Program/Facility Nominated: University of Wisconsin Oshkosh Anaerobic Biodigester Facility

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Nomination submitted by (if different than information listed above):

Name: ______________________________  Phone #: ____________________________

Email: ______________________________

If selected for an award, how would you like the name of the organization to read on the award
(limit of 50 characters)? University of Wisconsin Oshkosh

*** PLEASE NOTE THAT ENTRY REQUIREMENTS HAVE RECENTLY CHANGED ***

See the attached Entry & Eligibility Requirements sheet for further information

Application Checklist (Please make sure the following items are included in your submittal packet):

- Completed nomination form with signed release statement (this page), to be scanned and included in digital submission
- 1 copy of your award submittal on a CD-ROM OR via the SWANANET FTP site.
- Executive Summary of your nomination (NO more than 200 words)
- At least 2 pictures of your operation (may be included in nomination text)
- Check or credit card payment (made payable to SWANA) for nomination fee (in U.S. dollars)

SWANA

ATTN: Technical Programs Department
1100 Wayne Avenue, Suite 700
Silver Spring, MD 20910

Release Statement: I certify that the information provided in this application is accurate and correct to the best of my knowledge.

SWANA reserves the right to publish the enclosed information. Nominations become the property of SWANA. My signature gives SWANA the right to reprint or make available for purchase any portion of this submittal.

Signature: ______________________________  Date: April 15, 2011
SWANA 2011 Waste-to-Energy Excellence Award

Submission by University of Wisconsin Oshkosh Foundation, Inc. partnered with BIOFerm Energy Systems.

Executive Summary

The University of Wisconsin Oshkosh Foundation, Inc., along with BIOFerm Energy Systems, appreciates the opportunity to present information about their Anaerobic Biodigester facility to be considered for the Waste-to-Energy Excellence Award. This facility will take organic waste from the University, the City of Oshkosh, and local businesses and farms to produce biogas, which will be utilized in a combined heat and power unit (CHP) to generate electricity and heat for the campus. It will be the first dry fermentation anaerobic digestion (AD) facility to be constructed in North America, and will serve as a living, learning laboratory for the University students and faculty.

Engineering Design Systems and Technologies

a. Describe the engineering designs and technologies

BIOFerm™ dry fermentation plants are made up of a series of modular vehicle-accessible fermentation chambers. Once loaded into the chamber, organic input is continually digested and biogas is recovered and converted into heat, electricity or fuel. The modular construction approach allows for the implementation of several chambers. This is important for scalability of the plant in regard to input material available or energy generation required. The
modular approach also has the benefit of creating consistent biogas production and quality by mixing biogas from all chambers. This increased biogas reliability is especially important for obtaining a higher production capacity with the combined heat and power generator (CHP). It also allows the plant to be designed in scale with the amount of organic material available or how much energy production is desired.

BIOFerm™ plants have a rectangular floor plan, made up of individual fermentation chamber units, each with the dimensions of 20m long x 7m wide x 5m tall. All engineering components of a plant are located in a separate technology room adjacent to the building. Biogas is captured from the individual fermentation chambers and routed through a piped ventilation system to a short/medium duration storage gas bag located above the fermentation chambers. Percolate is sprayed on the stationary organic input material at designated intervals, according to the specific requirements of each plant’s input mixture. The percolate that filters through the input material, and additional liquid leachate from the decomposition of the organic material, is collected and stored in a storage unit directly adjacent to the first fermentation chamber. The liquid is recycled and used to inoculate fresh material after a fermentation chamber material exchange. Each concrete fermentation chamber is air- and gas- tight, preventing the infiltration of oxygen (the presence of which would cause the methane-producing bacteria to become inactive) as well as the leakage of biogas.

b. Describe the operational plan design

The plant is designed to handle up to 8,000 tons per year of organic material. There are four concrete chambers into which the material is loaded for a 28-
day cycle via a front end wheel loader. Material will be hauled from the campus cafeteria, the City of Oshkosh yard waste collection, and from a local farm. Truck scales at the facility will allow revenue-generating feedstock collection via waste haulers with institutional, retail, and industrial food waste customers. The process reduces the material volume by up to 40%, and the remaining digestate will be hauled to a commercial compost facility to be turned into high-quality soil amendments.

Environmental Impacts & Regulatory Compliance

a. Discuss the overall impact of the facility on human health and environmental quality

The facility will have minimal impact on human health and environmental quality. The entire building will be enclosed and, to address odor concerns, an enclosed mixing lobby prevents odorous process air from escaping into the environment. The mixing lobby is ventilated with up to 2.6 air exchanges per hour. The process air is released to the atmosphere via a biofilter.

There are many positive environmental impacts as well, such as keeping organics out of landfills where they would be producing methane, a potent greenhouse gas. The facility will also accept biogas from an adjacent City of Oshkosh Wastewater Treatment Plant which is currently flared without energy production. Producing energy from a clean and sustainable source will set an example in reducing dependence on fossil fuels and moving in the direction of energy independence.
In contrast to wet digesters such as sewage or manure treatment systems, the facility will produce little or no wastewater. The system is a closed loop for liquid recirculation. If the feedstock contains high moisture levels (e.g. food waste versus yard waste) then the system may require occasional removal of liquids with trucking to the City of Oshkosh Wastewater Treatment Plant located next door. For the Oshkosh site, the no/low wastewater feature is a considerable environmental advantage, as the Fox River watershed is under strict nutrient management with pending Total Maximum Daily Loads for phosphorus that are challenging for the existing sewage and industrial discharge permit holders.

b. Is the facility in environmental compliance for operating, permit conditions
   Yes, all permits are in place.

c. Have they included any awards, letters, or facility inspection data
   No.

d. Is the system integrated and complementary to other local solid waste management systems
   It will be a complement to the City of Oshkosh yard waste collection by providing an additional method to recycle yard waste. Food waste collected from the university, other institutions and retail operations will be diverted from landfills. The plant will also be connected to the City of Oshkosh waste water treatment plant (WWTP). The WWTP currently uses the biogas it generates to heat the facility during the winter and flares the gas during the summer months. The interconnection will allow for the biogas to be utilized by the CHP
at the dry fermentation plant during the months that it is not used by the WWTP.

Performance

a. Describe the efficiency of the operation

Dry fermentation anaerobic digestion facilities operate more efficiently than the more familiar wet fermentation facilities (e.g. manure digesters). Since there are fewer moving parts and mechanical operations, less overall maintenance is required. Dry fermentation systems also have a lower parasitic load (5 - 8%) required to run the plant.

b. Discuss operational performance – does it equal or exceed the goals and expectations

The plant will be fully operational in summer of 2011, and the performance is projected to equal expectations.

c. Discuss ash management strategies

N/A

d. Discuss emission controls design and applications

The UWO Biodigester has a completely enclosed receiving and mixing area that also includes room for storage of biomass. This ensures that any odors originating from the feedstock materials are contained within the building. The mixing lobby is kept under constant negative air pressure, which is adjusted according to the current need. For example, the ventilation blowers run at full...
speed during fermenter exchanges but at lower speeds when there is no immediate activity in the mixing lobby. The process air from the mixing lobby is vented to a biofilter before it is released to the atmosphere. The biofilter is an enclosed rectangular structure that holds lava rock as a filter media. The media is sprayed with water to keep it moist, which provides ideal conditions for odor consuming bacteria to proliferate. The incoming process air flows horizontally through the biofilter media and then exits the biofilter through a 12’ tall stack on the opposite side. Approximately 5,000 ft³ of lava rock are placed and used as the filter media.

The UWO Biodigester uses a combined heat and power unit (CHP) to generate electricity from the biogas. The exhaust from the combined heat and power unit is another source of emissions. The facility uses a 2G engine which meets all the emission standards set in EPA – Subpart JJJJ of Part 60 (Digester Gas, Biogas, FLG, Natural Gas) lean burn & rich burn Gas Engines (IC Internal Combustion) – 73 FR 3591, Jan. 18, 2008).

Program Planning

a. Description of the special waste management/collection system planning process – does it work?

The organic waste will be collected from the pre-consumer and post-consumer cafeteria food waste on campus and delivered by a commercial waste hauler. The university will collect its own yard waste and pick up chipped yard waste from the City of Oshkosh yard waste site (0.1 miles away) for delivery to the plant. Commercial waste haulers with contracts for pre-consumer retail food
waste and industrial food waste will make deliveries to the plant. Agricultural waste (winter bedding) will be delivered from a local family dairy farm.

b. Discuss the plan for managing special waste
Any special waste that cannot be digested will be separated and recycled and/or disposed of properly. Feedstock sources have been selected based on their ability to provide contaminant-free materials. For example, the feedstock for pre-consumer food waste from supermarkets will come from a waste hauler who has requirements that retailers remove all packaging. Campus food waste is collected from a pulper in a dining hall using all compostable paper products.

c. Discuss how community concerns were addressed and resolved
Meetings were held with the community to address concerns. These included meetings hosted by the City Sustainability Board, Planning Commission, and Common Council. Siting of the facility is in a site zoned for light industry, and community members wanted assurance from the city that the facility fit the zoning definition. The most common concern was the potential for odor problems. Partly, this is a legacy of air quality problems with paper mills, rendering plants and ethanol plants in the region, as well as local issues near the site due to city wastewater treatment and yard waste facilities. The university assured the community members that odor control is a top priority, that the university has a valuable reputation and good community relations to protect, and that the university faculty includes a scientist who is a nationally-recognized expert in design and performance of odor-control biofilters, who had helped design the system. The facility was designed with indoor feedstock storage, and no outdoor storage. The city engineers also assured
the community that they would expect the university to maintain odor control as well or better than the adjacent city wastewater treatment plant.

There were also community concerns about the types of feedstock to be trucked to the site, mostly due to confusion with manure digestion systems. This probably stems from the fact that Wisconsin is the leading state in the use of farm-based manure digesters as energy facilities. The university assured the community that raw manure or human sewage will not be used as a feedstock and that the facility is not designed to use that type of waste.

d. Discuss plans for future expansions or refurbishments
In the early stages of the plant’s operation, the annual throughput will be approximately 6,000 tons per year. As the collection and feedstock recipe is optimized, the plant will process 8,000 tons per year and optimize biogas production by using the highest quality feedstock available.

Use of heat generated by the CHP generators will also be developed over time. The first connection will be to an adjacent university building (a refurbished supermarket now used for facilities management and storage), with hot water piped to heat exchangers. Future customers within range for hot water delivery include a technical college building, a senior center, small factories, and small retail buildings. The university has also generated several ideas to explore adjacent to the facility, including adding greenhouses, co-locating heat-requiring systems (e.g. laundry) and adding a digestate drying/pelletizing facility to prepare fuel for a gasification plant addition to the campus central heating plant.
Worker Health & Safety

a. Describe employee training frequency and safety procedures
All employees are trained according to OSHA safety standards on the proper operation, safety and emergency procedures at the plant. The plant is equipped with a supervisory control and data acquisition system that monitors all plant processes as well as safety systems (e.g. gas and smoke detection system). Employees are trained on utilizing the system to interpret and react to any malfunctions appropriately. Furthermore, the system is equipped with remote monitoring and message and alarm forwarding, so that the plant operator is notified via cell phone of any malfunctions or emergencies at the plant.

b. Describe injury rates
Since the plant is not operating yet, there are no data on injury rates to report, but the highest safety standards will be in place. There have been a limited number of minor injuries reported from similar plants operating in Europe that were designed by the same manufacturer.

Economics and Cost Effectiveness

a. Does the program operate within its budget, are the costs appropriate for a WTE system of comparable size
The program will operate within its budget, and O&M costs should be relatively low compared to other WTE systems of comparable size.
b. Are the economics typical of those found in the industry

Dry fermentation AD systems tend to be more capital intensive than wet AD systems due to the high grade of concrete used. However, depending on the type of waste that is being processed in a wet AD system, the cost can be comparable. For example, if a wet AD system is processing food waste, the material has to be made into a slurry before entering the digesting tank. This requires choppers and grinders, and often contaminant-removal systems. A dry fermentation system like the UWO Biodigester does not require preprocessing of materials or contaminant removal, effectively eliminating the need for preprocessing equipment.

c. Was the facility constructed and operated (and generate revenue) as budgeted and expected

The facility construction was within the budgeted expense and is expected to generate revenue as projected. Agreements for electricity sales, feedstock acquisition and digestate removal are in place, guaranteeing a predictable revenue stream.

In addition to the business plan, a university may have other revenue streams. UW Oshkosh plans to generate revenue by using the facility as a teaching tool and as a draw for educational offerings related to alternative energy and waste management systems. The university will be able to develop research grants that will also contribute revenue. To this end, UW Oshkosh and BioFerm have invested in expanding laboratory facilities and research staff in microbiology and chemistry. UW Oshkosh has also been working through a regional
consortium to discuss educational uses of the facility for technical college programs.

Utilization of Equipment/Systems and Technologies

a. Types of equipment being utilized

Beyond the facility itself, the main pieces of equipment being utilized are the front end wheel loader to stack the organic material into the chambers and remove the digestate at the end of each cycle, and the CHP to generate electricity and heat.

b. Detail efficiency and effectiveness of equipment

The facility itself provides an efficient method to extract biogas from organic waste materials. It is possible to extract between 70 – 90% of the theoretically available biogas from the material at a methane content of 50 – 57%. This is comparable to other biogas technologies that are currently available on the market.

The 2G CHP engine has an electrical efficiency of 37.3% and a thermal efficiency of 50.45%, which is at the upper end of efficiency ratings available from other manufacturers.

The front end wheel loader reflects current industry standards. It is the best possible equipment to use for the loading and unloading of the feedstock material into the chamber.
Public Acceptance, Appearance and Aesthetics

a. Discuss overall appearance of the vehicles, maintenance facility and yard

The facility itself was designed to blend in with the other surrounding buildings in the area. It has the same look as an industrial warehouse or small manufacturing facility. The City of Oshkosh required installation of an evergreen screening hedge on property lines visible from a high-traffic road south of the site. Since waste materials will not be stored outside, it will not be obvious to passers-by that this is a waste processing facility. (see image below)

The front end wheel loader is the only vehicle that will always be at the site, however, it will be kept indoors during normal operating times. Trucks will move in and out to drop off the organic material but won’t be kept on site.

Rendering of the UWO Biodigester at 755 Dempsey Trail, Oshkosh, WI
b. Are facility and vehicles properly maintained for cleanliness
   Yes.

c. Does the program provide public relations measures and public education information
   The planning and construction of the facility has been made public through multiple avenues such as energy conference presentations (e.g. Annual BioCycle Conference On Renewable Energy From Organics Recycling 2008), press releases, newspaper coverage and local TV station reports. UW Oshkosh has made over 40 public presentations on the project, including national conferences, state industry and economic groups, and local civic organizations. The facility will be available for public tours through the University of Wisconsin Oshkosh and will also serve as a training and research facility. The installation of the plant is part of the UWO’s Climate Action Plan, which was developed upon signing the American College & University Presidents’ Climate Commitment.

d. Is the facility a good neighbor
   Yes, there will be minimal impact of noise and odor emissions to the surrounding buildings. Driveways are located off a low-traffic side street that primarily services truck traffic to the city wastewater treatment plant. Truck traffic is estimated at 2-4 vehicles per day.
Innovation and Creativity

a. *Innovation or unique aspects of the program*
   As previously mentioned, this facility will be the first dry fermentation AD plant in North America. The fact that it is on a college campus will provide tremendous opportunity for research, additional curriculum, and learning experiences. A laboratory has also been established to test and study different combinations of organic materials to produce optimal biogas yield.

b. *What makes this program different from the rest*
   A unique partnership between a private company and university to showcase a new technology makes this program different from most. In taking on this project, the University of Wisconsin Oshkosh will be a trailblazer for the future of waste-to-energy technologies.