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Biodigester Enterprises at UW Oshkosh

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Legend
- Four-Year Campuses
- UW Colleges
THE BIOFERM™ PLANT AT THE UWO CAMPUS

The First Commercial Scale Dry Fermentation System in the Nation!
UW Oshkosh Biodigester II
Renewable Energy Facility

UWO partners in second dynamic biodigester project

Wisconsin's largest dairy farm will be home to one of Wisconsin's most dynamic research, renewable energy production and public education facilities as part of an initiative involving the University of Wisconsin Oshkosh's College of Letters and Science and UW Oshkosh Foundation.

On Aug. 24, the UW Oshkosh Foundation Board of Directors unanimously endorsed a proposal to pursue an innovative partnership with Milk Source's Rosendale Dairy and renewable energy companies Viessmann Group and BIOForm Energy Systems of Madison.
State, UWO Foundation, partners rally around small-farm biodigester project

Biodigesters already come in dry, wet, big and bigger varieties as envisioned and built by the University of Wisconsin Oshkosh Foundation, its College of Letters and Science and engineering partners Veissmann Group and BIOFerm Energy Systems.

However, the latest incarnation of this sustainable energy generation technology is getting smaller – family-farm sized. And that is prompting the state of Wisconsin to get behind the technology in a new way.

On March 6, Wisconsin Department of Administration (DOA) Secretary Mike Huebsch announced support through the DOA and State Energy Program for a feasibility study to install anaerobic digestion units on family farms with fewer than 500 head of dairy cattle. The “EUCLino” (OY-co-lino) project conducted by BIOFerm™ Energy Systems and the University of Wisconsin Oshkosh, through the UW Oshkosh Foundation, involves the first small-scale biodigester unit in Wisconsin. The feasibility study and test project will be located on the Allen Farm, about six miles northwest of Oshkosh.

“Wisconsin is the national leader for installed anaerobic digestion, and we have the leading minds in the nation working to advance on-farm energy solutions,” Huebsch said. “Under the Walker Administration’s leadership, the collaborative relationship built by the Allen’s, BIOFerm, the University of Wisconsin Oshkosh
Supply of Biomass

<table>
<thead>
<tr>
<th>Biogas yield [m$^3$/t FM]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agricultural Wastes</strong></td>
</tr>
<tr>
<td>25 Cow manure</td>
</tr>
<tr>
<td>30 Pig manure</td>
</tr>
<tr>
<td><strong>Agricultural Raw Materials</strong></td>
</tr>
<tr>
<td>102 Grass</td>
</tr>
<tr>
<td>110 Fodder beets</td>
</tr>
<tr>
<td>125 Sudan grass</td>
</tr>
<tr>
<td>200 Maize</td>
</tr>
<tr>
<td>630 Wheat corn</td>
</tr>
<tr>
<td><strong>Non-Agricultural Wastes</strong></td>
</tr>
<tr>
<td>120 Biowaste</td>
</tr>
<tr>
<td>240 Food residues</td>
</tr>
<tr>
<td>400 Fat trap</td>
</tr>
<tr>
<td>800 Used grease</td>
</tr>
</tbody>
</table>

Weiland, 2010
Hypothetical Feedstock Source Profile

Year (Note: Facility lifetime is >20 yrs)
Community Involvement

Can’t clean your plate? No problem: UWO, Sanimax help community feed the Biodigester

A front-end loader delivers compostable material into one of the chambers of the UW Oshkosh Biodigester, first of its kind in the western hemisphere.
2 Main Substrates used at UW-O
Ultimate Goal for Dry Digesters

Waste to Energy
Organic Waste + Microorganism

= Biogas + Digestate → Energy
Dry Fermentation Overview

- Uses moisture from organic input to facilitate AD, additional required liquid is the percolate housing bacteria
- Microbes within percolate are sprayed to inoculate the organic material and stimulate decomposition
- Generated biogas is collected above the fermentors and routed to utilization room (CHP)
- Residual organic material up to level 4 compost
  - Can be used as fertilizer for soil enrichment or further composting
- Percolate is recycled and used again in a closed loop system eliminating risk of groundwater contamination
Dry Fermentation Process

- **Batch Approach**
  - At 28 days – portion of digested material is extracted and mixed with new material and mixed
  - Mixed batch reloaded into chamber for new cycle
    - Composition = 50% fresh
    - = 50% partially digested material
  - Why mix?
    - Neutralization of pH of the fresh inputs and inoculates fresh material
  - In floor heating system maintains temperature at 38°C
### Dry Fermentation

- Dry Fermentation eliminates waste water
- Dry Fermentation does not require pre-treatment of organic material because it is stationary
- Dry Fermentation has reduced energy load due to reduced electrical/mechanical needs and mesophilic working range
- Biomass input remains stationary in dry fermentation while bacteria flows through the biomass, resulting in significant cost and energy savings

### Wet Fermentation

- Wet Fermentation increases waste water
- Requires pre-treatment of organic material due to pulping
- Needs more energy because of mechanical inputs for stirring of sludge
- Requires continual biomass input increasing cost and energy

**Advantages of Dry Fermentation**
The BIOFerm™ plant at the UWO campus

A 4-fermenter plant with additional biomass storage capacity.

- Total Building Footprint: 19,000 ft²
- Fermenter: 70 ft x 23 ft x 16.7 ft
- Total Fermenter Volume: 26,887 ft³
- Storage Area: 2,000 ft²
- Mixing Area: 7,800 ft²
- Installed Electric Capacity: 350 kW
Storage of Biomass

- 28 day cycle
- Partially digested material is extracted and mixed in a 1:1 ratio with new material
Loading of Biomass
Electricity and Heat are generated...

Solid “digestate” → aerobic composter site (can be custom batched – e.g. organic)
UW Oshkosh Renewable Energy Facility

- CHP Generator: 370 kW
- Annual Electric: 3,000 MWh (ca. 10% of UWO)
- Annual Heat: 3,400 MWh (ca. 10% of UWO)

- Oshkosh Wastewater Treatment Plant
- UWO Campus
- Dairy Farms (bedding)
- Food Processing Plants
- Food Waste Collectors
- City of Oshkosh Yard Waste Site
- Commercial Composter
- Oshkosh Senior Center
- Fox Valley Technical College
Laboratory Testing
Need for Laboratory and Pilot Testing

- As a consumer of feedstock, one needs to know the composition and biogas potential of each feedstock (and digestate).
- Dry fermentation and wet fermentation are different – lack of information.
- Must also know the limitations of each feedstock and microbial biochemistry can often be limited by micronutrients.
Need for Laboratory and Pilot Testing

- Ability to blend feedstock to achieve optimal performance is key to maximizing biogas potential.
- Maximizing biogas potential is key to rapid payback of facilities.
- Odor mitigation studies
Need for Laboratory, Pilot, and Full-Scale Testing

- UW Oshkosh has noticed a significant difference in biogas potential from a wide-array of feedstocks that are locally available.
- Ability to blend feedstock
- Ability to build upon for simple lab data and test in pilot-scale units to demonstrate efficacy.
- Ability to place feedstock in full-scale application for proof of concept in industrial-scale unit.
- Cradle to grave approach to simple testing through proof of concepts.
- Development of additives and microbial augmentations to maximize biogas generation in customized feedstock blends.
Questions!