Energy Resources Center

Technical Education and Analysis for Community Hauling and Anaerobic Digesters

TEACH AD

Project Profile

University of Wisconsin–Oshkosh

Small Wet Anaerobic Biogas System

Allen Farms Resource Recovery and Renewable Energy System

ALLEN FARM AND ANAEROBIC DIGESTION

The Allen family farm is located in Oshkosh, WI about 12 miles northwest of the University of Wisconsin Oshkosh (UWO) campus, and has around 175 head of cattle among milking cows, non-milking cows, and calves. The collaboration between the farm and the University first started in 2011 when all the bedding waste from the farm was being brought to the campus dry digester that was beginning its operation. The farm in return was receiving back some raw digestate from the digester that was much more broken down and more bioavailable for plant uptake. The UWO biogas program wanted to expand and it was decided to develop another project to demonstrate small-scale anaerobic digestion technology. In 2012 the digester equipment, provided by the only small-scale AD technology provider available at that time, was shipped directly from Europe to the Allen Farm. In 2013 the digester began its operation with some ups and down due mostly to the freezing Winsconsin winter and in 2015 the farmer decided to add technology to his farm with the addittion of a new freestall barn and a robotic milking system. More than 80% of the organic material for the digester currently is collected from this new barn. The digester is used as a "living learning laboratory" for faculty and students where many educational, research opportunities, and technology demonstrations are developed.

THE PROCESS: HOW IT WORKS

Three types of organic material are fed into the digester: manure scrape from milking cows, bedding pack and manure from non milking cows, and industrial food waste from various sources. The last two are collected together and trucked from the original barn of the farm to the feedstock transfer building adjacent to the digester. Inside this building, there is a feed hopper system with three augers that mix and feed the material into the digester. The liquid manure from the milking cows is collected in the more recent freestall barn through a scraping system and pumped directly into the digester.

Inside the digester vessels (two containerized steel tanks sitting on a concrete pad, each with a capacity of 40,000 gallons) a large shaft mixes the organic material and keeps it uniform.

HIGHLIGHTS

LOCATION: Oshkosh, Wisconsin

SECTOR: Agriculture

FEEDSTOCK PROCESSED: 6,600 tons/yr. - Manure Scrape-82% (12.5% TS), Bedpack/Manure-12% (21.6% TS), industrial food waste-6% (20.6% TS)

FOOD WASTE: 400 tons/year of food-processing waste from various food-processing facilities

DIGESTER TYPE: Small-scale liquid plug flow digester

BIOGAS YELD: 18 SCFM (31 m3/hr)

BIOGAS USE: Cogeneration (CHP)

CHP size: 64 kW

ELECTRICITY PRODUCTION: 560,640 kWh/year

IMPLEMENTATION COST: $1.2 Million capital investment

- Wisconsin State Energy Office grant: $125,000
- Focus on Energy (WI) grant: $125,000

O&M COST: $80k-90k/year

THERMAL APPLICATION: 2,680 MMBTU of thermal energy/year can be transferred to different areas including the digester, some of the farmer's equipment, the farmer's house and workshop

General view of the site: two fermentation vessels, biogas storage pump room, feedstock transfer building, technology research lab, control room, CHP unit

The retention time of the material inside the digester is 18 days. Inside the pumping room, the pump system can pull the liquid material from both tanks and recirculate it through the tanks or send it to the final storage lagoon. Generally, all the material is fed to tank 1, passes through this tank and then it's pumped to tank 2 and finally to the storage lagoon where it gets temporarily stored and then land applied by the farmer. A certain amount of material is always pumped back from tank 2 to the beginning of tank 1 to keep beneficial bacteria and increase biogas production. The biogas from the digestion process is burned into a Combined Heat and Power (CHP) unit that generates electricity and thermal energy.

Mixing inside the fermentation vessel

Open barn with non-milking cows where the more solid bedding waste, manure and food waste is collected

A LIVING-LEARNING LABORATORY

Part of the goal of the UWO biogas program is to demonstrate new technologies. Allen farm is the first small-scale biogas system in Wisconsin and it shows how this technology could be available to small rural farmers. The digester provides also hands-on education, research, and training opportunities to UWO students. The site includes a technology research lab and a control room and classroom. These are some of the research and learning activities:

- ✓ Understand, refine and optimize the process of producing electricity from methane derived from manure
- ✓ Liquid synthetic fuel generation from dairy manure to replace diesel fuel, jet fuel and gasoline
- ✓ Generation of clean water in dairy farms
- ✓ Solid-Liquid Separation of Animal Manure
- ✓ Use of SCADA system for digester operation
- ✓ Composting

BENEFITS FOR EVERYONE

- ✓ Manure management
- ✓ Odor control
- ✓ Nutrient management
- ✓ Free heat for the farmer
- ✓ Industrial food waste recycled, reducing landfill volume
- ✓ R&D opportunity
- ✓ Renewable Electric power generated goes to the grid via a PPA

"It has been very rewarding being part of building the biogas program here at UW Oshkosh over the past 12 years. Not only are we helping achieve our campus sustainability goals but we are a resource to our community and a living-learning laboratory for our students to learn about the many advantages of incorporating biogas systems into our everyday lives."

Brian Langolf, Biogas Program Director

LESSONS LEARNED

- ✓ "Be cognizant of the feedstock and have a good relationship with your supplier, especially for food waste. If you put garbage into your digester, you will get garbage out. If you want to develop a good soil amendment product from your digestate you need to ensure no contamination is present".
- ✓ More effort is needed to get a better value for the many benefits AD systems bring to waste management in a more sustainable cycle and to the value of the renewable form of methane gas for energy usage.
- ✓ Chemicals in the wash water from the farm can cause inhibition and foaming in the digester.
- ✓ Needed to modify the system so that it was robust enough to operate continuously through the Wisconsin winter

FOR MORE INFORMATION

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