Energy Resources Center

Technical Education and Analysis for Community Hauling and Anaerobic Digesters
TEACH AD
Project Profile

Kishwaukee Water Reclamation District, Dekalb, Illinois

Energy Neutrality:

Energy neutrality is defined as a facility that produces as much or more renewable energy on-site than they consume on an annual basis. For the Kishwaukee Water Reclamation District (KWRD), reaching energy neutrality at their wastewater treatment plant (WWTP) means long term strategic and financial planning, commitment of resources, and persistence in implementing the necessary plant modifications. Facing increasing energy costs, KWRD initiated one of its most ambitious upgrade projects in 2017 and established the goal of being energy neutral by the year 2025.

The approach implemented by KWRD to reach energy neutrality is a combination of **overall energy consumption reduction** (implementing the most energy efficient technologies in process and plant improvements); **internal resource recovery** (recovering the chemical energy embedded in wastewater influent that produces biogas); **external resource addition** (co-digestion of high strength materials to boost biogas production); **on-site generation** (installing combined heat and power (CHP) to best utilize the renewable biogas).

HIGHLIGHTS

LOCATION: Dekalb, Illinois

SECTOR: Wastewater

FEEDSTOCK: Primary and waste activated sludge; fats, oils and greases (FOG).

REVENUE STREAM: Tipping fees for trucked in FOG, sale of excess electricity back to local utility

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DIGESTER TYPE: Four 55 ft. diameter, 500 k gallon mesophilic anaerobic digesters.

BIOGAS YELD: average 200,000 ft^3/day (max to date 250,000 ft^3/day)

Biogas Cleanup: Remove hydrogen sulfide, moisture and siloxanes.

CHP: Two 375 kW engine generator sets with heat recovery. Total capacity 5,200,000 kWhr/yr (80% availability)

Recovered Heat: Provide heat for digesters

Background:

KWRD is a regional sanitary district that provides sanitary sewer and wastewater treatment services to 45,000 customers in the City of Dekalb, Village of Malta, Northern Illinois University, Kishwaukee College, and unincorporated areas in DeKalb County. Its WWTP operates a sewer system with over 175 miles of sewer main, seven pumping stations, and treats an average of 5 million gallons of wastewater per day (MGD). The wastewater is treated to a tertiary level of purification then, discharged into the Kishwaukee River.

Throughout the treatment process, solids are drawn off and separated from the wastewater. These solids, known as sludge, are gathered and pumped into the digesters where an anaerobic mesophilic digestion process turns the sludge into renewable energy (biogas) and a watery slurry which, when dewatered leaves a nutrient rich fertilizer (biosolids).

Increased Biogas Production:

One of the first and most important steps for KWRD to reach energy neutrality was to demonstrate its ability to substantially increase the on-site generation of clean biogas and utilize the renewable fuel to displace the electricity purchased from their local utility. In 2015, the WWTP began successfully testing the blending of externally provided Fats, Oils and Greases (FOG) from local commercial establishments with their waste water sludge and feeding the combined feedstock into their anaerobic digesters. The results were positive, demonstrating the ability to double their biogas production.

Four 55 Ft Diameter Digesters plus 40 Ft Digested Sludge Storage Tank (source KWRD)

By 2020, KWRD installed a newly designed FOG receiving station capable of receiving up to 50,000 gallons of truck hauled FOG and allowing the WWTP operators to better manage the mixing and loading of the digesters. The present loading of the anaerobic digester tanks is about 20% to 25% FOG, with the remainder being a combination of primary and activated sludge. The existing four 55 ft diameter digester tanks are consistently generating an average of over 200,000 ft^3/day of biogas, with the maximum daily yield achieved at 250,000 ft^3/day. This is a sufficient yield to power the 750 kW engine driven CHP system. Before being injected into the CHP engines, the biogas is cleaned on site, removing hydrogen sulfide (H_2S), moisture, and siloxanes.

New 50,000 gallon FOG Receiving Station (source: KWRD)

On-Site Electric Generation:

KWRD has installed and is operating, two 350 kW engine driven CHP units, which combined are producing approximately 90% of the total electric load (15,000 kWhr/day) of the plant. In addition, the CHP engine-generator sets produce enough recoverable thermal energy to keep all four anaerobic digesters at the proper operating temperature (96° to 98° F) to ensure maximum digester efficiency. The electricity generated on-site utilizing the renewable biogas displaces electricity otherwise purchased from the local electric utility. Any excess electricity generated on-site is sold back to the local utility.

CHP Unit 1 – 375 kW Biogas Fueled Sys

KWRD is well on its way to meeting its 2025 goal of energy neutrality. Today, the total amount of electricity generated by the biogas fueled CHP system (both consumed on-site and sold back to the utility) exceeds the total electricity consumed at the facility. However, KWRD still purchases some natural gas to heat several remote buildings. To fully meet its goal of energy neutrality, KWRD's plans include the addition of a 240 kW solar photovoltaic system (642 solar panels). When implemented, KWRD will then produce more electricity on-site with renewable fuel sources than the total amount of energy consumed at the plant (energy neutrality).

"With what's happening globally, energy prices are increasing rapidly. Creating our own power through onsite renewable sources is becoming more beneficial every day."
Michael Holland
KWRD Technical Services Director

Community Benefits:

- ✓ Area haulers and businesses no longer have to endure the added costs of hauling FOG to out-of-county facilities for processing
- ✓ KWRD provides free for public use, 6 electric vehicle charging stations located in their parking lot
- ✓ The local power grid is no longer the primary source of energy, providing added plant operation reliability during local utility outages
- ✓ By displacing grid power with renewable biogas CHP generated electricity, KWRD is removing over 6 million pounds of CO^2 annually from the atmosphere
- ✓ KWRD has restored over 15 acres of turf grass to native prairie land that has been certified as monarch butterfly waystations

Lessons Learned:

- ✓ One of the largest challenges has been determining the proper quality, consistency, and quantity of FOG to inject into the digesters to maximize biogas production while avoiding digester upsets.
- ✓ Engaging local food waste haulers in the design of the FOG receiving station has resulted in a steady and full booking of quality FOG supply.
- ✓ Partnership with the local utility (ComEd) is essential to ensure smooth installation and operation of the CHP system
- ✓ Experience has shown that most of the down time of the CHP system has been caused by non CHP engine-generator issues (eg: gas clean-up and digester operations), that continue to be assessed, adjusted and improved.

FOR MORE INFORMATION

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