PROJECT PROFILE

Northwest Regional Water Reclamation Facility

150 kW Biogas CHP System

Site Description

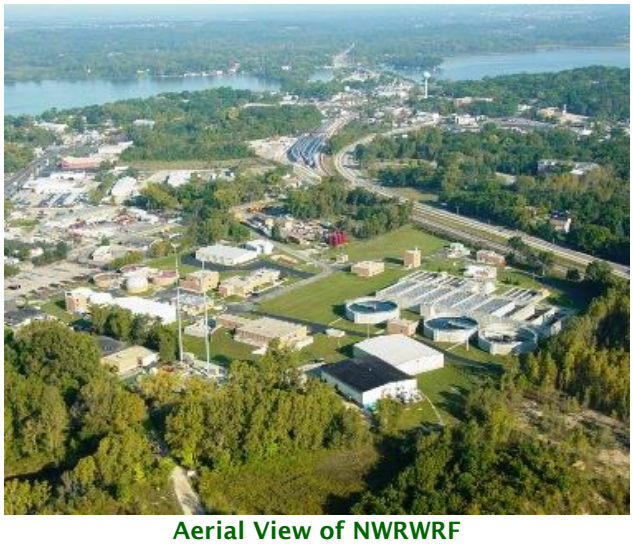
The Northwest Regional Water Reclamation Facility (NWRWRF) provides wastewater treatment services for the communities of the northwest region of Lake County, Illinois. The NWRWRF is owned and operated by the Village of Fox Lake, a northwest suburb of Chicago. In the mid-1970s the NWRWRF was created to extend sanitary sewer services in order to protect the environment from contamination caused by high water tables disrupting septic disposal systems. Today the NWRWRF serves a population of over 85,000 people. Due to increasing flows at the facility, the Village was interested in expanding the water reclamation facility from an average design flow of 9 MGD to 12 MGD. The NWRWRF invested significant capital over two construction phases to complete the project. Phase IIB, the "Solids Handling" portion of the expansion, included the addition of a fourth primary digester, biogas conditioning, and a CHP system.

Quick Facts

LOCATION: Fox Lake, Illinois
MARKET SECTOR: Wastewater Treatment Plant (WWTP)
FACILITY SIZE: 12 MGD
PRIME MOVER: Reciprocating Engine
FUEL: Anaerobic Digester Biogas
USE OF THERMAL ENERGY: Digester Heating & Facility Space Heating
OPERATION: ~6,000 hrs/yr
ELECTRIC OUTPUT: 150kW
THERMAL OUTPUT: 415 kBTU/hr
ELECTRICAL SAVINGS: $67,500
INITIAL PROJECT COST: $763,000
BEGAN OPERATION: November, 2012

CHP Project Overview

The water reclamation facility operates a single engine, 150 kW combined heat and power (CHP) system that was installed in 2012 to help meet their energy demands. The engine runs off of biogas produced from four anaerobic digesters. The produced gas is stored in two large flexible membrane covers atop two of the digester tanks. When gas is needed by either the combined heat and power system or the digester's main heating boilers, it is cleaned by the reclamation facility's gas conditioning system and then sent to the proper system. Jacket water from the engine is run through a heat exchanger in order to provide supplemental digester heating to reduce reliance on the main boiler units.

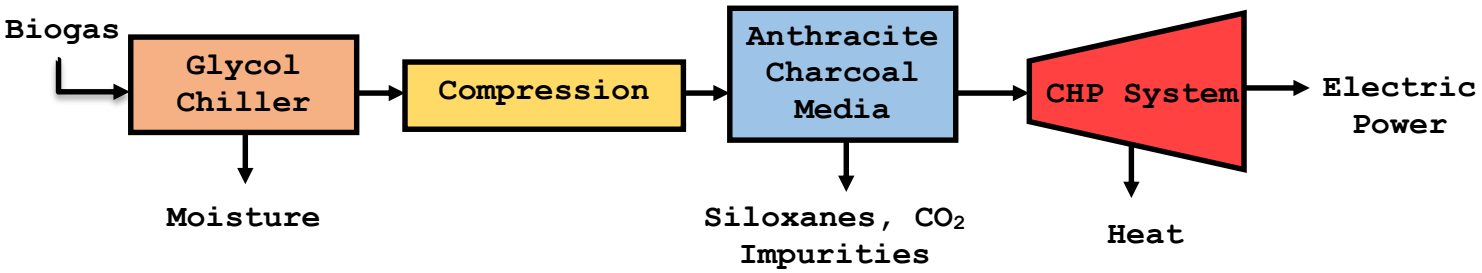


Aerial View of NWRWRF

Motivation and Design of Biogas Fired CHP System

Standard facility operation and wastewater influent conditions provide enough nutrients for the facility's anaerobic digesters to produce approximately 40,000 cubic feet of methane rich gas each day. This biogas had been used to fuel the digesters' original boiler units that reheated the digester sludge and provided space heating to the facility. However, given the large volume of gas, the boiler units could not consume all of the produced biogas. The excess biogas was being flared, equating to lost energy. Staff looked for ways to reduce reliance on the heating units while still effectively using the wasted biogas. The answer was a reciprocating engine combined heat and power system designed to run off of the biogas.

The excess biogas from the boilers is now piped to the installed CHP system, which is composed of a gas conditioning skid and a 150kW reciprocating engine genset. The system uses a hot water heat exchanger to pull waste heat from the engine to supplement the digester boiler operation. The system runs for approximately 70% of the year in accordance with the biogas production rate of the digesters.



Operational Lessons

Gas Conditioning System

A biogas fueled CHP system can be difficult to manage for a wastewater facility, as the biological treatment system can fluctuate depending on weather, influent conditions, and operator decisions, creating inconsistent biogas production. By tweaking operating factors such as proper wasting times and organic loading into the digester, the facility has been able to improve gas production and thereby maximize CHP system activity.

To store the produced biogas, NWRWRF uses a Dystor Digester Gas Holder System that contains two inflatable membranes. The system operates via the pressure differential between the membranes that helps to maintain gas pressure. Through the facility's SCADA system, the differential is also used to determine stored gas volume. However, it has proven difficult to soft-stop the engine – that is, to gradually ramp down generation to prevent excessive engine wear. The CHP system's software was designed to run until the pressure differential between the membranes reaches zero, at which time the engine abruptly stops due to insufficient gas for complete combustion. This can damage the engine components. Together with the CHP system manufacturer, NWRWRF is looking into more efficient ways of measuring the gas flow to know when it is best to either ramp down production or stop combustion altogether. This includes installing a volumetric flow meter to more accurately measure gas consumption.

Reciprocating IC Engine

Additionally, the gas conditioning unit has experienced frozen pipes in the winter, leading to a whole system shut down. Though NWRWRF initially looked at building a structure around the equipment, the option proved to be too expensive. Staff decided to insulate the gas conditioning equipment, which has helped to prevent cold weather issues.

For More Information

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