City of Portland
Columbia Boulevard Wastewater Treatment Facility
120kW Microturbine Application

FACT SHEET

Microtubines

Digester Gas for Fuel

Project Overview

Columbia Boulevard Wastewater Treatment Plant (CBWTP), the largest wastewater plant in Oregon, is operated by the Portland Bureau of Environmental Services (BES). The facility is the collection point for about 1,800 miles of wastewater sewer pipes and includes 92 pumping stations. CBWTP treats 80-90 million gallons of sewage and wastewater each day.

CBWTP's wastewater treatment process produces about one million cubic feet of anaerobic digester gas each day and about 55 percent of the gas is methane. The plant has investigated several technologies over the years to reclaim this "biogas" for electrical power generation to reduce utility costs and has installed a number of these advanced systems.

CBWTP installed a 200 kW anaerobic digester gas fuel cell power generation project in 1999, but it was decommissioned in 2005. In addition to the four 30 kW microturbines, CBWTP also operates two 850 kW I/C Engine-Generators installed in June 2008.

Typically, treatment plants like CBWTP flare or burn excess biogas. Using this fuel source to generate power provides the facility with a free, renewable energy source that displaces local utility electricity (likely generated from natural gas or coal fuels).

Quick Facts

- **Location:**
  Portland, Oregon
- **Wastewater Treatment:**
  80 – 90 MGD Wastewater
- **Biogas Usage:**
  Digester Gas Composition
  - **Methane – 50-62%**
  - **CO_2 – 38-50%**
  - **H_2S – 350 ppm**
  - **Siloxane – 25 ppmv**

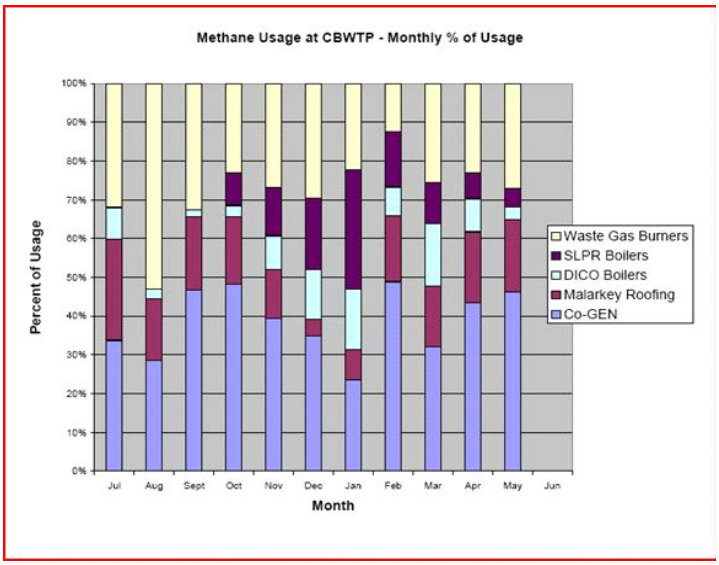
  Pressure Boost – 75 psi
  Approximate Usage – 750 SCF/Hr/Unit
- **Project Equipment:**
  Four 30kW Capstone Microturbines
  - 96,000 RPM
- **Thermal Heat Recovered:**
  0.29 MBtu/Hr Heat Recovery
- **Equipment Cost:**
  Turbines/Electrical Switchgear and gas treatment = $300,000
  Installation = $ 46,000
  Total Cost = $346,000
  ($2,883/kW)
- **Approximate Usage – 750 SCF/Hr/Unit**
  Cost reduced by BETC credit – (slightly > 10%)
- **Final Cost = $309,000**
  ($2,575/kW)
- **Annual Savings:**
  Electricity = $61,000
- **System Online: April 2003**

September 2009

Operating Strategy

This system, with the other BES use of digester gas for CHP projects, has resulted in significant environmental benefits because instead of flaring a large portion of the methane (one of the most powerful greenhouse gases), most of the gas is now used for power generation on-site. Although CO_2 is still released from burning biogas in the turbines, it offsets the CO_2 that would be emitted by the electric utility serving the treatment plant. The portion of biogas used beneficially to save utility costs is shown in the chart below (the amount used in the Microturbines is included in the Co-Gen amount).

In addition to reducing the treatment plant electricity demand and cost, the Microturbines incorporate a heat recovery subsystem. The reclaimed heat from the turbines heats digesters to further convert process biosolids into soil enhancement material sold and trucked to farming operations in Eastern Oregon.



Lessons Learned

The CBWTP Microturbine project encountered problems with the manufacturer's subsystem for treating the gas from the digester before compressing the feed gas and then expanding it through the Microturbines to generate electricity: Gas treatment issues and other specific lessons learned include:

- **Water in the microturbines is a common source of equipment shut-down**
- **A rigorous gas pre-treatment approach is needed for specific applications – thorough gas analysis and possible gas scrubbing may be required**
- **Higher than expected costs for fuel preparation and maintenance**
- **Proper training of plant maintenance personnel is essential**
- **Manufacturers and distributors must be more responsive to individual plant equipment problems**
- **Need to be aware of problems with highly corrosive siloxane deposits**

"The Microturbine project needs more changes to the digester gas fuel system to attain more consistent performance and ensure reliable operation. The technology was considered in 2005 when BES analyzed other options for generating more electricity on-site, but was not chosen due to scaling up factors and maintenance costs."

Garry Ott
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