



CHP
TECHNICAL ASSISTANCE
PARTNERSHIPS

Missouri River Water Resource Recovery Facility

2,850 kW Biogas CHP System

Project Overview

The Missouri River Water Resource Recovery Facility (WRRF) receives wastewater from domestic, commercial, and industrial sources as well as combined wastewater during wet weather events. The plant serves approximately 125,000 people in Omaha, but its total industrial and domestic flows are more equivalent to that of a city with a population of 600,000, due to the many factories and packing plants served by the facility. Its wastewater processing capacity is 196 Million Gallons per Day (MGD) during wet weather and the average flow is 30 MGD.

WRRF treats the wastewater with several different processes, including screening, grit removal, clarification, two-stage trickling filter biological treatment, disinfection and de-chlorination. Solids are thickened in clarifiers and a dissolved air flotation thickener and stabilized in anaerobic digesters before being dewatered and used as fertilizer in an extensive land application program. The anaerobic digesters produce biogas, a valuable resource that fuels the treatment facility's combined heat and power (CHP) system.



An Aerial View of the Missouri River
Resource Recovery Facility (Source: Google Maps)

Quick Facts

LOCATION: Omaha, Nebraska

MARKET SECTOR: Wastewater Treatment

FACILITY SIZE: 196 million gallons/day

CHP CAPACITY: 2,850 kW

PRIME MOVER: Three reciprocating engines,
950 kW each

FUEL: Biogas

BIOGAS SOURCE: Anaerobic Digester

USE OF THERMAL ENERGY: Heating
Anaerobic Digester and Space Heating

VALUE OF ELECTRICITY PRODUCED: \$1
Million/Year

VALUE OF THERMAL ENERGY: \$150,000
/Year

CHP IN OPERATION SINCE: 1985

CHP System

The biogas produced by anaerobic digestion is sufficient to support 2,850 kW of CHP capacity at the facility. The CHP system consists of three reciprocating engines of 950 kW capacity each. The first two units, 16-cylinder machines that operate at 900 rpm, were installed in 1985. In 2005, the system was upgraded and a third engine added – a 12-cylinder turbocharged machine that also operates at 900 rpm. The three engine generators collectively produce 50% to 60% of the annual electric needs of the facility. The engines also produce up to 9,700,000 Btu/hour of thermal energy that heats the digesters and provides space heating. The annual value of the electricity produced is approximately \$1 million and the value of the useful thermal energy produced is approximately \$150,000.

Anaerobic Digestion at WRRF



Wastewater treatment plants produce a sludge that must be stabilized and made safe to leave the plant. Anaerobic digestion of this sludge is one of the attractive options for stabilizing the sludge. Anaerobic digestion is a biological process for producing methane-containing gas, known as biogas, from organic matter – a process that is carried out in the absence of air. The organic matter in the WRRF sludge is converted to biogas through methanogenic microorganisms that convert the organic acids to methane gas. The digestion process

at WRRF operates at nearly 100°F, a process referred to as mesophilic, as opposed to a higher temperature process known as thermophilic. The Missouri River WRRF has four 2-million gallon capacity mesophilic digesters.

Resource Recovery



The Missouri River WRRF is a full resource recovery facility – using the biogas to generate electricity and useful heat, reusing plant effluent water for non-potable needs, and beneficially reusing the biosolids through an extensive land application program. The installation of the CHP system using the biogas from the digesters is also just one aspect of the Missouri River WRRF's efforts to increase energy efficiency of its operations and also reduce its annual energy costs. The system reduces natural gas consumption and reduces emissions as part of an overall emission control strategy for the treatment facility.

Lessons To Share

While the heat recovery system works well overall, the limited capacity of the digester heat exchangers has caused some problems, particularly during the winter when sludge temperatures are lowest. For example, if a mixing pump happens to be out of service for maintenance on a cold winter day, even though adequate heat is available from the generators, the undersized equipment cannot transfer the heat to the digesters. The plant is currently designing upgrades to augment the existing CHP system with independent spiral heat exchangers and supplemental boilers.

“The CHP system at the Missouri River WRRF has provided three decades of reliable service and offsets more than \$1 million annually in electrical and natural gas energy costs.”

***- Michael Arends
Plant Manager***

Accolades

The Missouri River Water Resource Recovery Facility has received multiple Nebraska Water Environment Association and Water Environment Federation awards and has received recognition from the Environmental Protection Agency for its secondary treatment upgrades and outstanding biosolids programs.

For More Information

U.S. DOE CENTRAL CHP TECHNICAL ASSISTANCE PARTNERSHIP

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