**CASE STUDY:** Kenosha Water Utility Energy Optimization Resource Recovery Project

*Kenosha Water Utility*

# Energy Optimization Resource Recovery Project

## Project Roles

The Kenosha Water Utility elected to use a design-build approach due to the complex and varied technologies associated with this project. Centrisys/CNP Technology Water & Biosolids, a dewatering/thickening equipment manufacturer and nutrient recovery/sludge optimization provider, served as the design-build developer. Donohue & Associates served as the engineer of record.

## Project Summary

The Kenosha Water Utility completed the Energy Optimization Resource Recovery Project in 2015. The project reduced energy and solids handling costs by 20%, reduced dependence on fossil fuel energy by 40%, removed 10,000 tons annually from landfills and produced a Class A EQ biosolids product that produces the annual reuse of 500 tons of nitrogen and 250 tons of phosphorus.

The project delivered a cost-effective and eco-friendly solution to biosolids handling, processing and disposal. This design integrated equipment and processes never used in North America, while incorporating the technologies into existing buildings and a 1980s infrastructure. Goals included:

- Increase biogas generation from the sludge anaerobic digestion
- Generate electricity from the biogas to produce over 500 kW of continuous power for the facility
- Use electricity generated to offset peak energy pricing during high-demand periods
- Use electric and thermal energy to dry the biosolids and reduce the volume of biosolids cakes to 90%
- Eliminate the volume and cost of landfilled biosolids
- Produce high-quality biosolids that meet Class A biosolids criteria
- Recover and use waste heat as the main thermal energy supply for the facility

At the same time, the new process and individual technologies had to maintain the existing effluent quality and not increase ambient noise level, odor or particulates beyond the facility area.

## Project Goals

- Increase Biogas Production
- Generate Electricity from Biogas
- Use Waste Heat as the Main Thermal Energy Supply
- Achieve 90% Dry Cake and Class A Biosolids
- Eliminate Landfill Disposal and Reuse Nutrients

# Original or Innovative Application of New or Existing Techniques

## Thermal Hydrolysis Process (THP)

**CNPs PONDUS** uses caustic soda and heated water to break down waste-activated sludge and enhance biogas production. The thermal energy, required for the hydrolysis process, transfers and heats the digesters. This process breaks down the cell membranes of the thickened waste-activated sludge, releasing organic acids which are consumed quicker in the anaerobic digestion process.

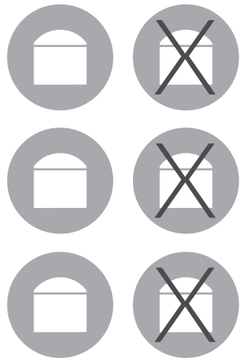
**30%** Biogas Increase

Following installation, Kenosha achieved a 30% increase in biogas production. Minimal digester foaming has been experienced since the upgrade, attributed to PONDUS.

## Thickening Improvements

**Centrisys' THK200** sludge thickener for primary sludge reduces the amount of water fed to the anaerobic digestion process. The benefit is significant, as it serves to:

- Increase digestion time
- Enhance digestion performance
- Enhance biogas production
- Reduce the amount of biogas required to heat the digesters



The THK200 doubled the solids concentration and cut in half the amount of water sent to the digestion process.

## Digester Improvements

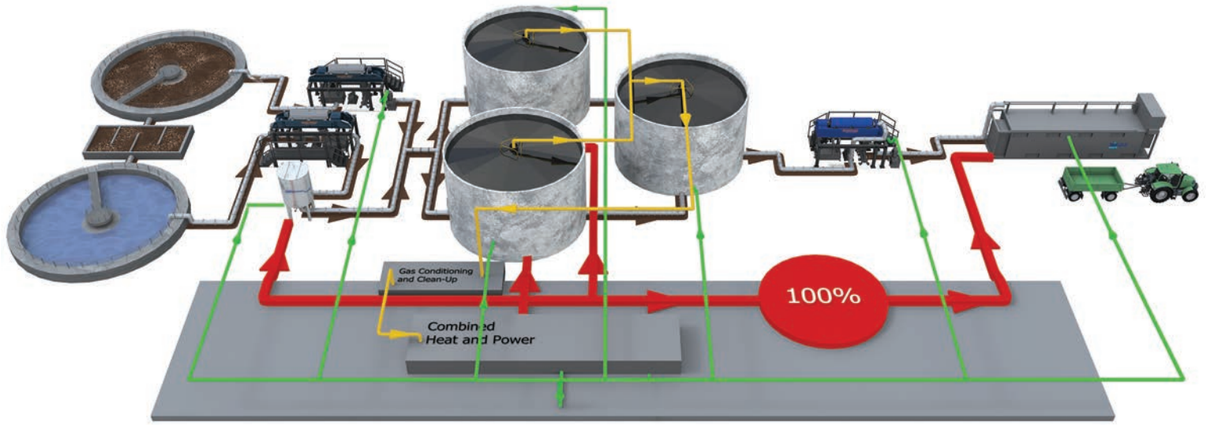
Donohue designed the digester mixing system to perform at solids loading rates that far exceed conventional loading rates, almost double the recommended 10 States Standards and WDNR requirements. Pre-thickening the sludge with the THK200, along with the robust digester mixing system, allows the digestion process to perform with half of the original digester volume. Kenosha effectively operates with half the number of digesters in service, reducing from six to three.

## CHP Units

A pair of combined heat and power (CHP) cogeneration units are powered entirely by biogas, providing supplemental power to the plant. They also supply heat for the dryer, PONDUS, anaerobic digesters and central plant-heating loop. Each CHP unit is capable of producing 330 kW of electrical energy and 422 kW of thermal energy.

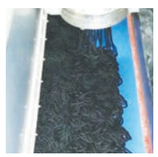
## Biogas Conditioning System

A biogas conditioning system was designed to reduce maintenance and increase the longevity of the CHP units.




## Sludge Dryer

**SÜZLE KLEIN Compact-Dry** is a dual belt, low temperature belt dryer using waste heat from the CHP units to evaporate water from the digested solids, reducing the biosolids volume by a third and converting the biosolids to Class A EQ. The dryer achieves all requirements for Class A, including temperature, duration and moisture content. Class A EQ biosolids can be used as a soil amendment, eliminating the high cost of landfill disposal.



## Pre-Energy Optimization Project Improvements

**2009: Centrisys' CS21-4HC** dewatering centrifuge replaced three plate and frame presses, reducing the dewatering footprint, chemical usage (lime and ferric), disposal and operation costs. The ROI was 1.5 years.

**2011: Centrisys THK200** for WAS replaced four DAFT units. The THK200 operated 24/7, used no polymer, achieved 5% TS cake and 95% capture. Kenosha also avoided $100k in DAFT repairs. In 2015, for the Energy Optimization Project, the THK200 (WAS) was slightly modified to currently use a low polymer dosage to extend the operating range to 6-7% TS thickened solids for PONDUS.

## Exceeding Client/Owner Needs

**$750k** Annual Savings

The Kenosha Water Utility project represented a collaborative design-build partnership that brought together Donohue & Associates (engineers), Centrisys/CNP (project developer), contractors, subcontractors and Kenosha Water Utility officials to successfully complete the project on schedule and within budget. The design-build team was able to successfully design, build and operate the new facilities in 13 months. A typical approach normally takes two years or more. Today, the Kenosha Water Utility stands to save $750,000 annually.

Original Total Budget Estimate = $10,000,000
*(Includes $2,500,000 for Existing Building Modifications)*

Final Total Project Cost = $9,312,957
**Final Process Cost = $6,812,957**

Scheduled Completion 11/30/15
**Actual Completion 11/30/15**

## 2017 ACEC Grand Award Winner

Left to right: Ed St. Peter (Kenosha Water Utility), John Martin Antaramian (Mayor of Kenosha), Michael Kopper (Centrisys/CNP), G. John Ruffolo (4th District Kenosha Alderman), and Mike Gerbitz (Donohue & Associates)

**1st** North American Installation of PONDUS TCHP

PONDUS **Optimizes** Your Sludge Treatment Process

More biogas, lower biosolids treatment and disposal costs, PONDUS TCHP is **simple** and **effective** without the use of steam.

- Reduce Viscosity of Thickened WAS up to **80%**
- Reduce Anaerobic Digestion Volume up to **50%**
- Improve Biosolids Dewatering up to **5%**
- Increase Biogas Production up to **30%**
- Reduce Polymer Consumption at Dewatering up to **20%**
- Reduce Digester Foaming

> *While the technologies each individually bring value, it is their holistic approach, as well as the collaboration of partners involved, that make this project special. The key for this successful initiative is trust among partners – Kenosha Water Utility and Centrisys/CNP leaders – and trust from the City of Kenosha in these leaders to deliver.*

**Ed St. Peter**
Kenosha Water Utility General Manager

> *In one year's time, the utility's biosolids facilities were transformed to a state-of-the art biosolids and energy showpiece. Complete cooperation of all project partners was integral to achieving success on this challenging project.*

**Ed Nevers**
Donohue & Associates Senior Vice President &
Kenosha Water Utility Project Manager

9586 58th Place | Kenosha, WI 53144 USA | +1 (262) 654-6006 | info@centrisys-cnp.com
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