Energy Efficiency in Wastewater Treatment

October 09, 2012
3pm Eastern

Moderators:
Joel Rogers, Center on Wisconsin Strategy (COWS)
James Irwin, Center on Wisconsin Strategy (COWS)
Agenda

• Welcome
• Introduction
• Presentation
  • Joseph Cantwell, Focus on Energy
  • Dale Doerr, Sheboygan Regional Wastewater Treatment
• Questions and discussion
• Close
Wastewater Energy Efficiency and Renewable Energy for Efficiency Cities Network

Joseph Cantwell P.E.
Focus on Energy
Oct. 9, 2012
The Wastewater Picture

• W wastewater and water systems consume 3% of the total energy consumed by the U.S.
• Municipal wastewater and water systems use approximately 35% of the energy consumed by a municipality.
• There are approximately 17,000 Publicly Owned Treatment Works (POTW’s) in the U.S.

*WEFTEC 2012 - Workshop 208 - Barriers to Biogas Use For Renewable Energy
Why do utilities have an “edge”? 

- Single shift = 8 hours/day x 5 days/week x 52 weeks/year = 2,080 hours/year 
- Continuous = 24 hours/day x 365 days/year = 8,760 hours/year 
- 8,760 hours/year / 2,080 hours/year = 4.2
Energy Awareness

Operators who **DO NOT** see energy bills

Operators who see energy bills

J. Cantwell, SAIC
Understanding Energy Use

1% Operators who see AND understand energy bills
99% Others
Focus on Energy

- Energy efficiency and renewable energy program for State of Wisconsin.
- Created through a partnership of WI utilities.
- Provides technical and financial resources to customers of participating utilities.
W/WW Facilities in Focus on Energy

- Serviced by Focus on Energy Advisors through the Large Energy Users and Business Incentives programs.
- Special outreach targets energy intensive facilities.
- Water/wastewater facilities for public and private owners are eligible.
Program Success Metrics

• Projects implemented (completed)
• Energy consumption savings (kWh/year, therms/year)
• Demand reduction (kW)
• Engineering verification (ensuring that measures perform)
Assessing W/WW Facilities

• Engage the entire W/WW industry
• Identify & partner with proactive facilities
• Perform energy surveys & provide recommendations report
• Meet with Facility personnel to review report
• Identify grant to provide incentive for implementation
Focus on Energy Assessment Report

- Description of proposed modification
- Estimate of modification cost
- Forecast of probable yearly energy reduction
- Simple payback period
Creating Value for Customers

- Industry advised and accepted
- Proactive approach
- Energy efficiency not in design codes
- Simple presentation of value
- Independent third party assessments
- Emphasis on implementation
Reaching out to Customers

Focus on Energy contacts facilities through:

• Facility representative direct contact
• Trade allies (equipment representatives)
• Educational and training programs
• Focus on Energy staff at conferences and events
• Managers at other W/WW facilities
• Government and/or trade organizations
Energy Management Best Practices

Energy Conservation in Water and Wastewater Treatment Facilities

WEF Manual of Practice No. 32

Prepared by the Energy Conservation in Water and Wastewater Treatment Facilities Task Force of the Water Environment Federation

WEF Press

Water Environment Federation

Alexandria, Virginia

Characteristics of Wisconsin Wastewater Treatment Facilities Served by Focus on Energy

Focus on Energy © 2006

Provided By:

focus on energy

The power is within you.

Funding for this guidebook was provided by Focus on Energy. Focus on Energy is a public-private partnership offering energy information and services to energy utility customers throughout Wisconsin. The goals of this program are to encourage energy efficiency, use of renewable energy, enhance the environment and ensure the future supply of energy for Wisconsin.

Prepared by:

Science Applications International Corporation (SAIC)

December 2006
Opportunities to Save

- Operation adjustments
- Equipment adjustments/modifications
- Process modifications
- Incorporation of controls
Wastewater Energy Baseline

Electricity requirement for typical activated sludge facilities (WEF)

Data derived from the Water Environment Energy Conservation Task Force *Energy Conservation in Wastewater Treatment*
General Operation Status

• System partially utilized (loaded) – not at design conditions
• Equipment selection provides limited operational flexibility
• Limited application and utilization of automatic controls
• Limited monitoring and recording of energy consumption
Solids Management

- Anaerobic system partially utilized (loaded)
- Capital cost invested
- Maximize biogas generation
- Utilize all biogas generated
- Maximize utilization of resource
Energy Efficiency Opportunities

- Install flexible membrane diffusers
- Reduce blower size
- Update blower technology
- Check sheave sizes on positive displacement blower
- Install dissolved oxygen monitoring, controls
- Enhance primary treatment
Energy Efficiency Opportunities

- Thicken waste solids
- Beneficially utilize generated biogas
- Improve equipment size selection
- Fine-bubble technology – applicable in aerated lagoons
- Variable speed drives, DO control in oxidation ditches
- Assess modular systems
- Recycle “used” water
- Flexible treatment process design
Energy Efficiency Opportunities

- Manage on-peak electric demand
- Rotate lead-lag blowers, pumps
- Switch ultraviolet banks
- Change time for pump (equipment) maintenance
- ‘Bump’ aeration diffusers
- Operate sludge tank mixers
- Turn on blower to raise DO concentration
Energy Benchmarking

Current Energy Use and Potential Savings
for Surveyed Wisconsin Activated Sludge Facilities

0 - 1 MGD
Average Potential Savings = 44%

1 - 5 MGD
Average Potential Savings = 34%

>5 MGD
Average Potential Savings = 23%

MGD = million gallons per day

Facility # (from lowest flow to highest flow)

- Benchmark Energy Use
- Potential Savings

The blue and yellow horizontal lines represent average energy use for each group, where yellow = current use and blue = benchmarked use after best practices.
Implemented Projects

• Reduced energy consumption...
  - Up to 70% aeration system
  - Up to 40% oxidation ditch
  - Up to 40% aerated lagoon
  - Up to 20% fixed growth system
  - Facilities in entire county

*Water & Wastewater Industry Energy Best Practice Guidebook- Focus on Energy
Improvements Beyond Energy

- Improved effluent quality
- Reduced polymer dosage
- Increased operational awareness
- Increased awareness of energy consumption & expenditures
Energy Neutrality

Utilize the energy generation capability of your WWTF to move toward energy neutrality and community sustainability.
What We Learned With Focus on Energy

• Energy awareness – management
• Energy use knowledge is critical
• Energy efficiency without impact to effluent limits
• Significant savings available
• System assessment necessary
• Long-term savings
• Publicize need for energy efficiency
If you have any questions, please contact:

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SHEBOYGAN REGIONAL WWTP’S JOURNEY TO ENERGY INDEPENDENCE.

Dale Doerr, Superintendent
Sheboygan Regional Wastewater Treatment Plant

Efficiencies Cities Network – Oct 9, 2012
Agenda

Sheboygan Regional WWTP
Liquid Treatment
Solids Treatment
Sustainability Project Descriptions
Summary
Questions
Sheboygan Regional WWTP

- Built 1982
- 18.4 MGD Permitted Flow
- 11.0 MGD Average Flow
- Serves 68,000 People
  - City of Sheboygan
  - City of Sheboygan Falls
  - Village of Kohler
  - Town of Lima
  - Town of Sheboygan
  - Town of Sheboygan Falls
  - Town of Wilson
- 2011 Actual
  - Operating Budget $3.780 M
  - Debt Service $602 K
  - Capital Outlay $600 K
  - Energy Costs $340 K
  - Tipping Fee Revenue $1.013M
Liquid Treatment

- Preliminary Treatment
  - Screening
  - Grit Removal
- Primary Clarifiers
- Two Treatment Trains
  - BNR
  - Activated Sludge
    - Fine Bubble Diffused Air
    - High Efficiency Blowers
- Secondary Clarifiers
- Chlorination
- De-chlorination
Solids Treatment

- Anaerobic Digestion
  - Co-Digestion of HSW and Primary-Waste Activated Sludge
- Methane Gas Recovery for Building Heat and Co-Generation Facility
- Gravity Belt Thickening
- Liquid Biosolids Storage
- Liquid Biosolids are Land Applied
- Biosolids Drying (Future)
  - Class “A” Bio-solids
May 5, 2011:
Energy Independence Day

When the red line is below the green line, the WWTF is pushing electricity to the grid.
Made Possible by Energy Projects and High Strength Waste Program

- RWW Pumping Motors VFDs
- Aeration Blower Project
- Heat Utilization Project
- CHP Project Phase I
- Aeration Automation Project
- Digester & CHP Project Phase II

High-Strength Waste Program

- 2004
- 2006
- 2012
RWW Pumping Motors VFDs

200 HP Premium Efficiency Motors with VFDs
Replace 250 HP Motors with Eddie-Current Drives

SCADA System Improvements
Aeration Blower Project

Replaced 2 - Gardner Denver®
Positive Displacement Blower

With 2 - Turblex® High Efficiency Centrifugal Blowers
Heat Utilization Project

With 2 - 3.8 MBTU Hurst® Boilers

Replaced 3 – 2.3 MBTU Ray® Boilers

and Hot Water Recirculation Pumps
Combined Heat & Power (CHP) Phase I

Biogas Gas Conditioning

10 - 30 kW Capstone® Micro-turbines

Heat Recovery - Cain® Heat Exchangers
Aeration Automation Project

AUMA® Electric Valve Operators and Air Header Piping Modifications to Allow for Better D.O. Control
Digester & CHP Phase II

- **OVIVO® Linear Motion Mixers Installed**
  - D7 = Dec 2010
  - D5 = Sep 2011
  - D8 = Nov 2011
Digester & CHP Phase II

Gas Conditioning

Hot Water Recirculation Pumps

C 200 Capstone® Micro-turbines & Cain® Heat Exchangers
Sheboygan Micro-Turbines

700-kW Capacity

Phase I - 2006

Phase II - 2010
WWTF Producing More than 80% of Required Electricity

When the red line is below the green line, the WWTF is pushing electricity to the grid.
Exceeds Best-Practices Benchmark

RWW Pumping Motors VFDs
Aeration Blower Project
Heat Utilization Project
CHP Project
Aeration Automation Project
Digester & CHP Project

High-Strength Waste Program

2004 - 2012

Purchased Electricity, kWh/Mgal
Projects and HSW Program Reduces Energy Costs and Provides Revenue

- Electrical Savings
  - $400,000/yr ($0.0876/kWh)
- Natural Gas Savings
  - $135,000/yr ($0.54/therm)
- HSW Revenue
  - $400,000/yr
- Net = $1M/yr
Summary

- Sustainability in wastewater treatment is attainable.
- When improvements are needed, think energy efficiency.
- Look for the low hanging fruit.
- Take baby steps, you don’t have to do everything at once.
- Think outside the box, anything is possible.

Thank You
Web Links to Additional Information

- [http://www.wefnet.org/nbp/September%202010/](http://www.wefnet.org/nbp/September%202010/)
SHEBOYGAN REGIONAL WWTP’S JOURNEY TO ENERGY INDEPENDENCE.

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Efficiencies Cities Network – Oct 9, 2012
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To Join - www.efficiencycities.org/join-us