The Value of Benchmarking: Wastewater Treatment

Jon Vanyo C.E.M.
Minnesota Technical Assistance Program
Overview

MnTAP Background

Value of Benchmarking

Types of Benchmarks

Energy Savings Strategies
MnTAP Background
Minnesota Technical Assistance Program

• State-wide, non-regulatory, no-cost, confidential technical assistance to Minnesota industrial businesses
  • waste, water, energy assessments
  • source reduction opportunities
  • grant project scoping
  • confidential regulatory questions

• Technical staff with backgrounds in engineering, science and industry with a passion for efficiency and the environment
Special Project - Wastewater Facilities

Objective: Improve WWTP energy efficiency through

- Benchmarking
- Site assessments
- Implementation
- Intern projects
- Renewable energy assessments (CHP)

http://www.mntap.umn.edu/POTW/wwtp.html
Value of Benchmarking
Benchmarking makes energy efficiency known.
Benchmarking makes energy efficiency **visible**.
High benchmark scores are deserving of recognition.
Low scores can justify efficiency improvements.
High or low...

You can leverage your score to benefit your facility.
Benchmarking results in cost savings;

MnTAP’s energy assessments averaged implemented savings of $13,000 per plant per year.
Benchmark scores help, but plant operators and managers are the efficiency champions.
Value Summary

Find energy efficiency relative to your peers.

Leverage that number into projects and upgrades that will make your plant more efficient and more effective.
Types of Benchmarks
Types of Benchmarks

Hydraulic Flow Benchmark

BOD Load Benchmark

ENERGY STAR Portfolio Manager Benchmark
Hydraulic Flow Benchmarking (kWh/MG)

Plant energy consumption per unit flow
Hydraulic Flow Benchmarking (kWh/MG)

Hydraulic Flow Score Range

5000 kWh/MG  1500 kWh/MG
BOD Benchmarking (kWh / kg BOD)

Plant energy consumption per unit BOD removed
BOD Benchmarking (kWh / kg BOD)

BOD Load Score Range

5 kWh / kg BOD  1.5 kWh / kg BOD
ENERGY STAR® Portfolio Manager (ESPM)

Energy Efficiency as a Percentile Rank

- Energy Consumption
- Fuel Consumption
- Flow
- BOD Removal
- Climate
- Nutrient Removal
- Trickle Filter
ENERGY STAR® Portfolio Manager (ESPM)

ENERGY STAR Score Range

1 100
ENERGY STAR® Portfolio Manager (ESPM)

ENERGY STAR scores were developed using data from plants with flows over .6 MGD.

Smaller plants can calculate unofficial scores which are useful, but less accurate.
Electric Costs and ENERGY STAR (ESPM) Scores
MN Wastewater Treatment Plants with Similar Hydraulic/BOD Loads

![Bar chart showing annual electric cost at $0.10/kWh for different hydraulic flow ranges.](chart)

- 0.37-0.41 MGD: 94, 11
- 1.2-1.6 MGD: 79, 4
- 3.8-5 MGD: 63, 12

Hydraulic Flow Range for Plant Comparison

Annual Electric Cost at $0.10/kWh

$0, $100,000, $200,000, $300,000, $400,000, $500,000, $600,000, $700,000, $800,000, $900,000
Energy Savings Strategies
MnTAP Project Background

• 11 Wastewater Plants
• $450,000 in recommended annual energy cost savings
• $150,000 in annual energy savings implemented to date
• $13,000 per site average
Secondary Aeration DO

Is your secondary aeration basin running at over 2 ppm DO?
Secondary Aeration DO

Aeration Energy Costs at DO Levels

<table>
<thead>
<tr>
<th>DO concentration (ppm)</th>
<th>Electrical cost ($/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 ppm</td>
<td>$12,100</td>
</tr>
<tr>
<td>7 ppm</td>
<td>$11,500</td>
</tr>
<tr>
<td>6 ppm</td>
<td>$10,900</td>
</tr>
<tr>
<td>5 ppm</td>
<td>$10,300</td>
</tr>
<tr>
<td>4 ppm</td>
<td>$9,700</td>
</tr>
<tr>
<td>3 ppm</td>
<td>$9,100</td>
</tr>
<tr>
<td>2 ppm</td>
<td>$8,500</td>
</tr>
</tbody>
</table>

$12,100 - $600
Secondary Aeration DO

Reduce blower speed by reducing VFD frequency (if possible).

Cycle equipment on and off to reduce average aeration (using mixers during off time as needed).

Get a smaller blower that can efficiently maintain lower DO.
Aerobic Digester Aeration

Is there opportunity to reduce aerobic digester aeration?
Aerobic Digester Aeration

The Ten State Standards recommends
30 scfm / 1000 ft$^3$.

Many sites can run even lower.
Aerobic Digester Aeration

Reduce blower speed by reducing VFD frequency (if possible).

Cycle equipment on and off to reduce average aeration.

Get a smaller blower that can efficiently meet air requirements.
Aerobic Digester Detention Time

Is there opportunity to reduce aerobic digester detention time?
Aerobic Digester Detention Time

Ten State Standards mentions a 27 day detention time basis.

Some sites can run lower than this.
Aerobic Digester Detention Time

Ensure waste is stabilized with SOUR testing.

Reducing detention time will also reduce aeration requirements, allowing you to use less energy.
Anaerobic Digester

Consider Combined Heat and Power (CHP)

This study found simple payback periods ranging from 4-10 years.
Case Study Examples

http://www.mntap.umn.edu/industries/facility/potw/energy/

Share the benefits of these successful projects.
The magnitude of these opportunities is expected to **correlate with benchmark score**.
Benchmarking is the first step towards efficient wastewater infrastructure.