Energy Efficiency & Wastewater Optimization

Supporting Agency Climate Initiatives &
Making a Visible Difference

Walter Higgins
Office of Infrastructure & Assistance
Water Protection Division
EPA Region 3
**FACTOID**

- Providing Drinking Water and Wastewater Treatment:
  - 3-4 percent of national electricity consumption
  - 56 billion kilowatts (kW)
  - $4 billion
- PWS & STPs most energy-intensive facilities operated by local governments

Energy accounts for 35 percent of energy used by municipalities!

A lot of $$!!
2012-2013 PA
- Train staff
- Partner with PADEP
- Conduct Training for W&WW Operators

2014 DE
- Partner with DNREC, DHSS, DSEU
- Conduct Training for W&WW Operators
- Conduct Several Energy Assessments

2015-2016 MD
- Partner with MDE
- Conduct Training for WW Operators
- Develop Energy Course training material anywhere
- Optimization – Nutrient Removal

2016-2017 VA
- Partner with VADEQ
- Conduct Training for WW Operators
- Conduct 10 Energy Audits
- Optimization – Nutrient Removal

2017 WV
- Partner with WVDEP
- Conduct Training for WW Operators
- Conduct 10 Energy Audits
- Optimization – Nutrient Removal

Energy Training:
- Understand Your Electric Bill
- Energy Saving Projects and Case Studies
- Math Behind the Savings
- DIY Energy Audit
Partners

- EPA National Sustainable Infrastructure Team
- DOE/Industrial Assessment Centers
- Rural Water Associations
- States’ Infrastructure Funding Agency
- States’ Technical Assistance Providers
- State Water/Environment Assoc.
- Engineering Firms
- Technology/Equipment Reps
- Network of Water Utility Staff and Management
Communication

- 3 Articles Published
- Blogs and Salients
- Website
- WPD Progress Stories
- Local Gov’t Newsletters
- SRF All-State Meeting Presentation
- Trainings and Presentations

"Too Much Air!"

We seek to implement infrastructures and processes that are energy-saving, using fewer chemicals, and gaining better control of their activated sludge processes by splitting them into smaller units, including anaerobic digestion.

The section on the activated sludge process describes the key steps in the treatment process. The process involves feeding a waste sludge to a reactor containing mixed bacterial cultures. The sludge is then passed through a series of stages, each designed to remove different forms of pollution. The process is managed by controlling the temperature, pH, and nutrient concentrations to optimize the biological activity of the bacteria.

The text emphasizes the importance of maintaining the proper balance of nutrients and avoid overloading the system, which can lead to decreased efficiency and increased operational costs. The section also highlights the environmental benefits of the process, such as reduced greenhouse gas emissions and improved water quality.

"Minimum acceptable DO (dissolved oxygen) concentration should range between 2 and 3 mg/L (for nitrification). Nitrification appears to be inhibited when the oxygen concentration is lower than 1 mg/L."
Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants

November 5, 2015

Victor D’Amato
Not Necessarily New

• Retrofitting POTWs (EPA 1989)

• Optimization Guidance Manual for Sewage Works (WEF of Ontario)

• Case Studies on Implementing Low-cost Modification to Improve POTW Nutrient Reduction-DRAFT (EPA 2015)
Enhanced Nutrient Removal

• Generally, this is outside the scope of optimization.
Purpose of Optimization

• Improve effluent quality
  • Better removal efficiencies of nutrients, etc.

• Minimize costs of operations
  • Save energy, chemicals, man power

• Alternatives to capital upgrades
  • Do more with what you have
  • Remove additional pollutants, i.e. TN and TP
Operator Training Required

• Most optimization projects fail due to a lack of training operators to maintain new processes.

• Requires basic training on new processes.

• Needs to develop a new process control strategy based on the facility.

• Several weeks of follow-up to insure correct decisions are made.
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<th>State</th>
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<th>Projected Savings $</th>
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<p>| Total  |                                      |                                                               | 4,516,041               | $370,094            |                                  | 3,432                |         |      |</p>
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<th>State</th>
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</table>

1. Assuming 0.5mg/l is a reliable level of treatment with chemical addition.
2. 2014 DMRs show levels achieved below 0.5mg/l
3. WG has experimented with chemical removal with minimal success.
Best Candidates for Optimization

• Extended aeration activated sludge to BNR levels.
• When actual flows are significantly less than design.
• Potential exists to add new zones to aeration tanks.
• Aeration systems are generally over designed.
• Sufficient nutrients in the influent.
Nitrogen Removal – good potential

• Requirements to remove ammonia is generally well known.
• Going next step to remove total nitrogen is not well understood by the operators.

\[
\text{Aerate} \Rightarrow 2\text{NH}_4^+ + 3\text{O}_2 \rightarrow 2\text{NO}_3^- \\
\text{NO Air} \Rightarrow 6\text{NO}_3^- + 5\text{CH}_3\text{OH} \rightarrow 5\text{CO}_2 + 3\text{N}_2 + 7\text{H}_2\text{O} + 6\text{OH}^- 
\]
Phosphorus

- Chemical addition has been around for a long time and the principles are understood by the operators.
- Fine tuning chemical addition is an art.
- Biological removal is not well understood by the operators.
  - I.e., VFA’s role, required ORP/O₂ levels,
- Side-stream impacts makes things complicated.
  - Aerobic digestions – shut off to decant, release P
  - Anaerobic digestions – release P

BUGS eat BUGS + O₂ => CO₂ + H₂O + PO₄ + NH₃ + ...
Bryn Athyn

- Needed to meet a new Total Nitrogen limit of 10 mg/L.
- Plant is a small extended aeration facility.
- Actual flows is about half of the design with very low influent BOD.
- Past technical assistance shut off one of the two aeration tanks.
- New superintendent asked for help!
Too much sludge! Dilution test.
Before Baffle
After Baffle: Create an Anoxic Reactor

With Internal RAS
Clean Diffusers
Waste Sugar/Water Mix
Hi Everyone,

I am happy to report that when I read Marc's Nitrate instrumentation this morning - IT WAS AT 7.33!

I do know that there are now other things we have to take into consideration - such as maintaining this! However, I am very encouraged by it!

We have our first of our twice monthly sampling going to our lab tomorrow. I want to see all of our numbers.

Thanks to all of you for your help, assistance and expertise!

Sincerely,
Reid Heinrichs

Sewer Operations Manager
Borough of Bryn Athyn
2835 Buck Road
Bryn Athyn, PA 19009
reidh@brynathynboro.org
cell: (267) 358-0970

NO3-N dropped from over 50mg/l to around 5mg/l
Pottstown, PA

- On/Off Aeration
- Establishes an anoxic period
- Total N removal
- Saves energy
- Saves chemicals
- 269,000kWh/yr
- $21,000/yr
Selbyville, DE – Timed Digester Aerators

- Total project cost: $2,000
- Annual energy savings: 480,000 kWh
- $$ savings: $38,000
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<th>runtime (hr)</th>
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Exeter Township
WWTP, PA

Total project cost: $227,069
Total incentive: $70,458
Savings: 640,530 kWh/yr
Payback of 3.5 years.
Questions?

Walter Higgins

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215-814-5476