Not Your Typical Turbo Blower

New Holstein Utilities’ Blower Improvements

Don Lintner (NHU)
Eric Lynne (Donohue)
Background

- New Holstein Utilities
  - Population (~3200)
  - Design
    - Flow (1.33 mgd)
    - Load (1600 ppd BOD)
- Current
  - Flow (0.5 mgd)
  - Load (680 ppd BOD)
Background

- Permit Requirements
  - BOD (20/30 mg/L)
  - TSS (20/30 mg/L)
  - TP (1.0 mg/L)
  - No disinfection

- Operational Practices
  - Extended Air (Nitrification)
  - Septage Receiving (Slugs)
Background

- Aeration Blowers
  - Type - Rotary Lobe
  - Function - Aeration and Digester
  - Condition - End of Useful Life
  - Reliability Concerns
  - Inefficient
Aeration Blowers
  - Operational Limitations
    - Constant Speed
    - 40HP / 30HP
  - Age
    - 2 Failed
    - 2 Used Units

Typically run 70 / 100 HP for 1600 scfm / 2300 scfm (mixing limited)
Facilities Plan

- Blower Replacement
- Ancillary Systems
  - Building
  - Decant Tanks
  - WAS Control
  - Sludge Pumps
  - Standby Generator
  - DO Control
  - Lab Temperature
  - Workshop/Garage Bay
Facilities Plan

- **Blower Replacement Alternatives**
  - Replace In-Kind - Rotary Lobe Blowers
  - Single Stage Centrifugal (Turbo) Blowers

- **Efficiency**
  - Life Cycle Cost Evaluation

- **Upgrade Electrical Service**
  - 230V vs. 480V Power

- **Recommended Further Consideration**
Facilities Plan / Preliminary Design

- Single Stage Centrifugal Blowers
  - High Speed Turbo (Sulzer/APG-Neuros)
    - Specialized Electronics
    - Cost
  - Integrally Geared with Sliding Vane (Turblex)
    - High Capacity / Cost
  - Integrally Geared with VFD (Inovair)
    - New
Inovair Blower

- **Concept**
- **Advantages**
  - Moderate Cost / Efficiency
  - Basic Components
- **Disadvantages**
  - Not Best Efficiency
  - Limited Installations and Experience
    - Milwaukee Industrial Application
    - Rib Mountain (eternally almost complete)
    - Unclear lifespan
Design Concepts

Design:
A. Evaluated Blower Bid
B. D.O. Control
C. Modulating Valve
D. 3-D Model
A) Blower Evaluation

- Evaluated Bid:
  - Rotary Lobe Blowers
  - Inovair

- Early Adopter=Attractive Pricing (and random issues...)

Assumed $0.10/kwh for two blowers operated 24 hours per day, total of 2000 scfm.
B) Dissolved Oxygen Control
C) Modulating Digester Valve

- Concept
  - Throttle digester header when liquid levels are lower to balance airflows
  - Less overall horsepower
    (Note: can’t pinch both ends)

- Allow flexibility to run a dedicated blower(s) to each side
D) 3-D Models

- Design:
  - 3-D Model
  - Pump Gallery - Operator Input allowed ability to pull/push flow every direction
Funding

**BIDS**

Low Bidder:
- $2,149,000

**GRANTS**

Aeration Blower:
- Projected Energy Savings ($16,500)

Building Heat:
- Electric Heat → Gas Heat Savings ($7,500)

Grant Value
- $33,976 WPPI
- $68,165 Focus on Energy
- $364,382 CWF Principal Forgiveness

$466,523 Total (22%) → $1,682,477 (net cost)
Construction and Startup Photos
Construction and Startup Photos
Construction and Startup Photos
Construction and Startup Photos
Construction and Startup Photos
Construction and Startup Photos
Construction and Startup Photos

(No trees were harmed on this portion of the project)
Construction and Startup Photos
Valved Flexibility

- Design:
  - Eliminated 1 pump
  - Some flowpaths can flow by gravity or pump
  - Rotary lobe pumps allow multi-use
  - All three can really move some sludge
  - Sacrificed Automation
Operation

- Startup Plan
  - How to sequence blower demo/startup to prove new units are fully functional?
    (...Very Carefully)
Operation

- The Blowers Work!*
  - Designed to typically need 2 blowers

- Now to Optimize
  - Reduce DO
  - Reduce Mixing Limited
  - Reduce Digester Airflow

- Limitations:
  - Blower Turndown (Range 70-100%)
  - Inovair now offers wider-range units, consider varying sizes (or rpms?)
Operation

- Blower PLC Programming
  - Surge Protection Feature
    - Manual reset
    - Head rise to surge worse at VFDmin
    - Ramps up VFD, fights valve PID
Operation

- Blower PLC Programming
  - Mass Airflow - Winter Operation
  - Adjusted PLC Temp Setting
Operation

► Current
  ► Operating smooth now
  ► Maintenance Items:
    ► Expensive Oil
    ► Belt Tensioning
    ► Air Filter
  ► Observed Energy Savings
    ► Average
    ► Peak

![Electric Utility Graph]

3-YRS BEFORE

AFTER
Operation

- Benchmarking
See Focus at Booth #136
Download Guide @
www.focusonenergy.com/guidebooks

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Flow Range (MGD)</th>
<th>Average Energy Use (kWh/MG)</th>
<th>Top Performance Quartile (kWh/MG)</th>
<th>Best Practice Benchmark (kWh/MG)</th>
<th>Average Potential Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activated Sludge**</td>
<td>0 - 1</td>
<td>5,440</td>
<td>&lt; 3,280</td>
<td>3,060</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td>1 - 5</td>
<td>2,503</td>
<td>&lt; 1,510</td>
<td>1,650</td>
<td>34%</td>
</tr>
<tr>
<td></td>
<td>&gt; 5</td>
<td>2,288</td>
<td>&lt; 1,350</td>
<td>1,760</td>
<td>23%</td>
</tr>
<tr>
<td>Aerated Lagoon</td>
<td>&lt; 1</td>
<td>7,288</td>
<td>&lt; 4,000</td>
<td>3,540</td>
<td>51%</td>
</tr>
<tr>
<td>Oxidation Ditch</td>
<td>&lt; 1.2</td>
<td>6,895</td>
<td>&lt; 4,000</td>
<td>4,320</td>
<td>37%</td>
</tr>
</tbody>
</table>
Operation

- Benchmarking
  - How does it compare?
  - Data Crunch
  - Keep Updated

- Benchmark - Activated Sludge
  - 5.4 MWh/MGD (average)
  - 3.3 MWh/MGD (Top 25%)
  - 3.0 MWh/MGD (Best Practice)
Operation

- Normalized for Loading
- Heating Impact
  - Summer vs
  - Winter
- Benchmark - Extended Air
  2.9 MWh/MGD

**Electric Utility**

- 3-YRS BEFORE
- AFTER

**kWh / lb BOD**
Operation

- Heating Improvements
  - Cost: $40,000
  - Benefit:
    - Reduced OPEX
    - Lab temp control
  - 2-10 year payback without grants
  - Demand charge reductions

Electric and Natural Gas

Heating Degree Days (deg F)

Cost:
$40,000

Benefit:
Reduced OPEX
Lab temp control
2-10 year payback without grants
Demand charge reductions
Operation

- Normalize for BOD and Heating

Blower System Efficiency

34.6 % Reduction
Operation

- Minimized Electric Heat
  (some areas still have electric heat)
Summary

- More than Just a Blower Replacement Project
  - Blowers
    - Continued Optimization
  - Control System
  - Heating System

- Come Visit!