The Problem

- 2 of 3 blowers were needed to meet DO demand
  - Microbrewery discharging higher than anticipated loads
- 1 blower failed; no longer operational
- Diffusers experiencing high discharge pressure
  - Potentially caused blower failure and could cause others to fail
- Blowers located in basement
  - prone to flooding and hot in summer
Overview of Dexter WWTP
Key Issues

- Rapid response to address blower and diffusers
- Energy (cost) savings for new aeration system
- Consider future increased loadings
The Solution

- Design-Build project delivery for accelerated response
- Diffusers replaced in initial stage of project
  - Ceramic diffusers replaced in-kind
  - After replacement of diffusers in three tanks, only one blower req’d for typical day
- Added one new, variable speed blower capable of handling entire aeration load
Agenda

1. Project Delivery Method
2. Diffuser Replacement Considerations
3. Blower Replacement Considerations
Common Methods of Project Delivery

1. Design-Bid-Build (traditional approach)

2. Design-Build (DB)
   a. Fixed Price DB
   b. Progressive DB

3. Construction Management At-Risk

Starting in 2015, SRF Project Plans allow Owner to choose most appropriate project delivery method among these four.
Comparison of Project Delivery Methods

Design-Bid-Build

From Design Build Institute of America: “Choosing a Project Delivery Method”
Comparison of Project Delivery Methods

Design-Bid-Build

Design-Build

From Design Build Institute of America: “Choosing a Project Delivery Method”
Comparison of Project Delivery Methods

Design-Bid-Build

Design-Build

CMAR

From Design Build Institute of America: “Choosing a Project Delivery Method”
Key Considerations for Design-Bid-Build

1. Widely accepted and well understood

2. Longer project duration - Construction cannot begin until design phase complete

3. Designer and Contractor work directly with Owner

4. There is no opportunity for collaboration with contractor during design phase
Key Considerations for Design-Build

1. Cost efficiencies can be achieved since the contractor and designer are working together:
   - Fewer changes
   - Earlier knowledge of firm costs

2. DB can deliver project more quickly than conventional DBB

3. One contract, with single point of responsibility

4. If Owner is not familiar with DB, a “mental shift” is required
Major Reasons Dexter Chose Progressive Design-Build

- Time to construction (diffuser and blower replacement) was shortened
- Earlier knowledge of construction costs
- Single point of contact throughout entire project

Method of project delivery is an important consideration for any project and should occur during the planning phase.
Agenda

1. Project Delivery Method
2. Diffuser Replacement Considerations
3. Blower Replacement Considerations
Existing Fine Bubble Diffusers

- Original diffusers were 9-inch ceramic
- Significantly fouled
  - Pressures of >50 inches (DWP) measured at Aeration Tanks (Clean diffusers ~8”)
- Higher than normal airflows & pressures were required to maintain DO
Fine Bubble Diffuser Alternatives

Disc Diffusers
- Ceramic or Membrane
- 7 or 9-inch

Tube Diffusers

Plate Diffusers
Comparison of Membrane & Ceramic Discs

Integrated “check valve” on membrane disc prevents backflow during air shutdown

Illustration of chemical fouling on a ceramic disc
## Comparison of Membrane & Ceramic Discs

<table>
<thead>
<tr>
<th></th>
<th>Membrane</th>
<th>Ceramic</th>
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</thead>
<tbody>
<tr>
<td><strong>Expected Life</strong></td>
<td>5-10 years</td>
<td>20+ years</td>
</tr>
<tr>
<td><strong>O2 Transfer Eff.</strong></td>
<td>Similar</td>
<td></td>
</tr>
<tr>
<td><strong>Fouling Resistance</strong></td>
<td>Better</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>PM Procedures</strong></td>
<td>Clean (flex) in place</td>
<td>Built-in place cleaning system, or clean by hand/power wash</td>
</tr>
<tr>
<td><strong>Aeration Tank</strong></td>
<td>Integrated check valve prevents backflow</td>
<td>Backflow into aeration piping will occur if air not kept on</td>
</tr>
<tr>
<td><strong>Shutdown</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resistance to</strong></td>
<td>Generally good; Test to ensure compatibility with high-strength waters</td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Chemicals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Replacement Cost</strong></td>
<td>$8.50 (disc and PCV subplate)</td>
<td>$16.20</td>
</tr>
</tbody>
</table>
Diffuser Cleaning Tests

3 acid cleaning methods were tested

- “Spray & soak” restored 40-50% of capacity
- “Fumigation” restored 70% of capacity
- “Dexter Method” restored ~100% of capacity
  - Involves scrubbing disc and soaking in muriatic acid for 3 days
  - Cleaning cost is ~ $1.50/disc

Inspection by Xylem Engineer
“The clean diffusers have like-new DWP values. If these were ever in operation, I would like to know the cleaning method.”
Agenda

1. Project Delivery Method
2. Diffuser Replacement Considerations
3. Blower Replacement Considerations
Key Issues for New Blower

- 1 blower failed; no longer operational
- Blowers located in basement
  – prone to flooding and hot in summer
- Nearing end of expected useful life
- Consider variable micro-brewery loadings
Blower Alternatives for Smaller Plants

Positive Displacement

Multi-Stage Centrifugal

Twisted Lobe

High-Speed Turbo
Power and Turndown Comparison for Blowers

Example of Specific Power Comparison for Blowers

![Graph showing specific power comparison for different blower types.]

Specific Power Comparison Delta Hybrid D62S, GM 60S, and K-Turbo TB100-1.0
(Inlet T1=68F, P1=14.5 PSIA, RH=0%) P2=11.6 PSIG

- **D 62S**: SCFM/BHP = 19.1%
- **GM 60S**: SCFM/BHP = 25.8%
- **K-Turbo TB100-1.0**: SCFM/BHP = 23.2%

Flow SCFM: 400, 800, 1200, 1600, 2000

Twisted Lobe PD Turbo

Provided by Aerzen
New Blower Capabilities/Benefits

- Selected Blower: Twisted lobe blower
  - 32% more efficient than old blowers

- Variable frequency drive provides 560 to 1,200 scfm
  40% turndown

- Quiet (<73 dB with enclosure)

- Outside installation

- Rebate of $20,529 from DTE
Reduction in Power Costs

- Reduction in power: 32% measured per blower
- Overall reduction (with new blower and diffusers) = 64%

Comparison of WWTP Monthly Electricity Usage

23% KWH Reduction for Plant or $500 per month
Summary

- Project delivery method is important consideration
  - Address this in the planning stage of every project

- Thorough ceramic disc cleaning can restore original capacity and reduce capital costs

- Dexter realized significant energy savings through blower and diffuser modifications

- Obtain power company rebates