Installation of High Speed Blowers
Cuts Electrical Costs & Improves Operations
Outline

✓ Background
✓ Evaluation
✓ Blower Features
✓ Blower Project Examples
  - Existing Conditions
  - Design Considerations
  - Proposed Improvements
  - Lessons Learned
✓ Take Away Recap
✓ Questions
Energy Costs for W/WW Industry

- Energy costs are rising
- Stricter treatment regulations are coming
- W/WW 3% of the nation’s energy use (Source-EPA)
- W/WW largest energy user for municipal utilities
- Largest energy use at WWTP is aeration
- Operating budgets stagnant or declining
  - More automation
  - Reduce energy
Background

Aeration System Components

O₂ Transfer
- Diffuser Style
- Operational Conditions
- Bubble Size
- Tank Depth

Control Strategy
- On-line Analyzers
- Operational Philosophy
- Air Flow Measurement
- Air Flow Splitting

Air Production
- Type of Aeration
- Operational Conditions
- Environmental Conditions
- Operational Envelope
Background
Aeration System

“Most Energy Efficient” Operation

✓ Three systems must work together
✓ Improvements to one system will impact the other two systems
✓ Example: Install new diffusers, increase transfer efficiency, reduce air required, blowers may than be oversized
✓ Work on weakest area

M.E.E. – Most Energy Efficient
Focus Today Is…

- O₂ Transfer
- Diffuser Style
- Operational Conditions
- Bubble Size
- Tank Depth

- Control Strategy
- On-line Analyzers
- Operational Philosophy
- Air Flow Measurement
- Air Flow Splitting

Blowers

- Air Production
  - Type of Aeration
  - Operational Conditions
  - Environmental Conditions
  - Operational Envelope
Evaluation

Past Aeration Systems were often Oversized

Designed on static criteria

• Average and maximum loads
• Not transient conditions

Typical results

• Gaps
• Aerobic zones too large
• Too many diffusers per basin
Correct blower sizing – probably the most important detail

Efficient Blower Selection

- Minimum Mixing
- Average vs. Peak
- Site Conditions
- Current vs. Future Loads
- Diurnal Loads
- Turndown/Overlap

Diurnal Loads

Current vs. Future Loads

Minimum Mixing

Average vs. Peak

Site Conditions

Efficient Blower Selection
Evaluation

✓ Examine several operating conditions

✓ Consider mixing requirement based on tank volume

✓ Calculate diffuser minimum airflow (if appropriate)

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Evaluation

Blower Technologies

- Positive Displacement
- Multistage Centrifugal
- Single-Stage Centrifugal
- High-Speed Direct Drive Centrifugal (Turbo)
Motor / blower speed varied with VFD

- More efficient turndown than multistage
- VFD/controls integrated into blower package
- Manufacturers protective of blower controls
- Typically 3 control modes; discharge pressure, airflow, and dissolved oxygen

Blower and motor directly coupled
Evaluation
High Speed Blower Options

✓ Bearings require no lubrication
  • Air foil bearing - inlet air creates air foil around shaft
  • Magnetic bearing - electronic control system continuously monitors and adjusts magnets to position shaft

✓ Limited max size
  • ~6,000 scfm with airfoil bearing (2X with dual core air bearing)
  • ~10,000 scfm with mag bearing

✓ Reduced noise and vibration
  • Noisy during startup/shutdown due to blow-off
Blower Design Considerations

✓ Turndown and avoiding gaps with new blowers
✓ Available manufacturer’s offerings
✓ Site visits and/or references
✓ Equipment and piping layout
✓ Equipment/installation cost plus electrical cost (O&M)
Blower Project 1

Existing

- Four 1500 hp single stage centrifugal blowers
- 28,000 scfm (turndown limited to 18,000 - 20,000 scfm);
- Typical demand 12,000 scfm (70 mgd plant)

Additional Design Considerations

- Size required (400+ hp)
- Made selection, negotiated price for sole source
Blower Project 1

Proposed

- Four 400 hp high speed turbo blowers with magnetic bearings with one master control panel
- 8,000 scfm each
Blower Project 1

Lessons Learned

✓ Site visits always worthwhile, talk to operators
✓ Once you select manufacturer(s), have them review specification to confirm they can meet details.
✓ Require sole source supplier to review/comment on drawings too
✓ For negotiated equipment pricing, address client’s standard payment terms and conditions in negotiation
✓ Beware of long equipment delivery schedules
✓ Consider annual maintenance visit for first 5 yrs
✓ Larger units have separate harmonic filters
Blower Project 2

Existing

✓ Two 200 hp multistage centrifugal blowers
✓ 3,000 scfm each
✓ Typical demand 2,000 scfm (4 mgd plant)
✓ Often mixing limited and over-aerating

Additional Design Considerations

✓ Smaller blowers, more options
✓ Competitively bidding three manufacturers
Blower Project 2

Proposed

- One 150 hp high speed turbo blower
- 1,200 to 2,400 scfm capacity
- Meet existing demand and provide turndown
- Use existing multistage blowers to meet high demand condition
Blower Project 2

Lessons Learned

✓ Challenging to competitively bid high speed blowers; no two blowers have the same features

✓ Manufacturers will not agree with everything in your specification. Decide what features are most important to you.

✓ More experience and options available with smaller turbo blowers (<200 hp)

✓ Prefer to control blower based on discharge header pressure control and control DO using control valves at tanks

✓ Beware of late comments on discharge piping
Blower Project 3

Existing

- Plant with vertical aerators in Oxidation Ditches
- Expanding by adding Aeration Basins with flexibility to meet future nutrient limits at 16 mgd

Additional Design Considerations

- New blower building
- Listed three manufacturers
Blower Project 3

Proposed

7 new high speed turbo blowers (2@150 hp and 5@200 hp) in new blower building
Lessons Learned

✓ Challenging path to lock in blowers
  ✓ Not all manufacturers can meet “Made in USA” provisions; get documentation in writing
  ✓ Consolidation of blower companies during project can have impacts on submittal and delivery process
  ✓ Confirm source of blowers curves early (theoretical vs. actual blower data)

✓ Proprietary blower controls challenging to integrate with “blower system controls”
Take Away Recap

✓ Can lower electrical costs and improve turndown and control of your aeration system…if properly designed.

✓ Consider key air demand points (diurnal, mixing, today, future, min and max) when selecting blowers (number and size)

✓ These installed project examples cut electrical costs by about 20-30%

✓ Blower manufacturers each have different standard features.

✓ Check references and visit installations

✓ Competitively bidding high speed blowers is challenging. Clearly state what is exceptions are acceptable.

✓ Require confirmation of capacity through factory and/or field testing.