Linear Motion (LM) Mixing of Digesters
Linear Motion Mixing of a Digester

- Overview of the City of Sidney’s WWTP
- Selection of the OVIVO (Eimco) LM Mixer
- Planning for the installation
- Installation
- Lessons learned
- Operational observations
Sidney WWTP

- Staffing (8 full time staff)
  - Administration (2)
  - Operations (3) 1 Operator position vacant
  - Maintenance (1)
  - Laboratory (1)
  - Industrial Pre-treatment (1)
  - OTCO Intern (1)
- Storm Water Monitoring (1) – Stormwater Phase II
Sidney WWTP

- Staffing
  - Normally staffed 7:00 am – 3:30 pm Mon-Fri
  - Weekends are staff 3-4 hrs through overtime
  - SCADA system provides continuous monitoring and call out capability

- Staff
  - Highly capable staff
    - Class IV – 1
    - Class III – 4 (Brian Clark Chief Operator 2010 recipient of the Dean Stewart award)
    - Class II - 1
Sidney WWTP

- 7.0 MGD Design ADF
  - 13.5 MGD Peak
- 20,500 people served
  - Population Equivalent of 52,000 based on flow & 35,000 based on loading
- 700 – 800 dry tons of biosolids land applied annually
  - Class B – table 3 (clean sludge)
- Significant Industrial Base
  - 45% of WWTP flow & 65% of WWTP loading from IUs
- 16th largest IPP in Ohio
  - 16 Significant Industrial Users
  - 33 Control Documents in effect
Sidney WWTP
ENERGY EFFICIENCY EFFORTS

Energy Efficiency efforts Include

• Centrifuge operation moved to weekends to avoid peak demand and place centrate on plant during typically lower flow/loading periods

• Programming a “Blower Hold” function in the SCADA that prevents additional blower from coming on-line during peak demand times unless approved by the Operator

• Significantly increased use of VFD on motors <30 HP

• Aeration basin diffuser replacement

• Energy efficiency is considered when replacing equipment
Sidney WWTP
ENERGY EFFICIENCY EFFORTS

ELECTRIC USAGE

KWH

Months

2006
2007
2008
2009
2010
Sidney WWTP
ENRY EFFICIENCY EFFORTS

ELECTRIC COSTS

<table>
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<tr>
<th>Costs</th>
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Months:
1 2 3 4 5 6 7 8 9 10 11 12
Repair/Replace existing mixers

- Existing Eimco RDT mixers were installed during 1989 expansion
- Fall 2009 - lower bearing failure caused one mixer to be removed from service
- Staff began researching options to repair or replace
  - cost estimates obtained to ship and repair existing mixers
  - quotes obtained to replace existing with similar new mixers
  - quotes obtained to replace existing with LM mixer
Repair or Replace?

- All options were evaluated based on the following:
  - lead times to implement repair or replacement
  - cost to repair or purchase and removal/installation
  - estimated O&M costs
  - performance

- Vendor products considered were:
  - Philadelphia Mixers (replacement mixer utilizing existing draft tubes)
  - Eimco (rebuild of existing or new Linear Motion mixer)
Philadelphia

Pros:
- Reduced HP compared to existing
- Improved access for maintenance
- Lowest initial cost option

Cons:
- Questions regarding deflection with shaft length
- Questions regarding operation (forward/reverse)
- Higher O&M cost compared to LM mixer (less than existing)
EIMCO Rebuild

Pros:
- Direct fit to our lid
- Known performance

Cons:
- Limited access for maintenance
- More expensive than replacement with Philadelphia mixer
- Longest lead time
- Shipping costs
- Least energy efficient
EIMCO (OVIVO) Linear Motion

Pros:
- 1 mixer needed
- 7.5 HP
- Direct fit to our lid
- Easy maintenance
- Lowest O&M costs
- CFD modeling for performance
- B&V evaluation of performance

Cons:
- Limited use
- No redundancy
- Highest initial cost option
CFD Modeling performed by Eimco (OVIVO)
Black & Veatch – Neil Massart

• Location – Ina Road Water Pollution Control Facility, Tucson, Arizona

• Four existing anaerobic digesters (90 foot diameter and 40 feet deep with a cone bottom)

• Existing digester mixing system includes four 20 horsepower draft tube mixers and one 10 horsepower center mixer.

• Existing mixers are ~20 years old. Mixers require significant maintenance and expensive to operate.
# Lithium Test Results

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## Solids Test Results

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Cost Comparison

- **LM Mixer**
  - Mixer Purchase Price $102,978
  - Estimated annual O&M cost $4,875*

- **RDT Rebuild (Eimco)**
  - Rebuild estimate $50,946 (not including shipping and motors)
  - Estimated annual O&M cost $12,400*

- **Philadelphia Mixers**
  - 2 Replacement Mixers w/ motors $46,000 (estimate)
  - Estimated annual O&M cost $8,500*

- **OTI**
  - 2 Replacement Mixers w/ motors $75,000
  - Estimated annual O&M cost $10,100*

* Includes: estimated 20yr rebuild costs, power, lubrication & man hours for scheduled maintenance
Eimco LM Mixer selected

- CFD model of performance
- Black & Veatch’s evaluation of performance
- Direct fit to our digester lid
- Most energy efficient
- Lowest overall O&M costs
- Although the most expensive option, it remained competitive and within budget constraints
- Durability?
• PLANNING FOR THE INSTALLATION

– Staff received a copy of the O&M manual several months before the mixer was installed.
– Staff met weekly for previous two months to discuss operations, installation, procuring needed items, and brainstorming on how to address potential issues.
• PLANNING FOR THE INSTALLATION Cont...
  • Staff would be performing the installation
    • Major concerns were
      • Safety
      • Plant operations
      • Installation Process (schedule of work to be performed)
• PLANNING FOR INSTALLATION

• SAFETY CONCERNS
  • Confined Space
    • OSHA standard (CFR 1910.146)
      • Hazardous atmosphere
      • Entrance/egress
      • Communication
Confined Space

- Hazardous atmosphere
Confined Space
• Entrance/Egress
Confined Space

- Communication
• PLANNING FOR INSTALLATION

• SAFETY CONCERNS
  • Suspended Loads
    • OSHA Standard (CFR 1926.550(a)(19))
• PLANNING FOR INSTALLATION
• SAFETY CONCERNS
  • Personal Protective Equipment
• PLANNING FOR INSTALLATION
• SAFETY CONCERNS
• PLANT OPERATIONAL CONCERNS

• Centrifuge Operations
• PLANT OPERATIONAL CONCERNS
  • Primary Digester Shutdown
  • Venting Digester Gas
  • Transferring Primary Digester Contents
DIGESTER PIPING
• PLANT OPERATIONAL CONCERNS
  • Secondary Sludge (WAS) Handling
  • Primary Sludge Handling
## September 2010

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**Tasks:**
- Transferring Primary Digester
- Purge Digester Gas
- Shutdown Primary Digester
- Transferring Primary Digester
- Transferring Primary Digester
- Demo Draft Tubes
- Clean Digester
- Install LM Mixer
- Transfer Contents back into Primary Digester
- Transfer Contents back into Primary Digester
- LM Mixer Startup

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**Notes:**

- Brian Clark

**Date:** 12/8/2010 12:59 PM
• Installation
  • VFD desired for controlling mixer
    • Output signal for SCADA system
    • Ease of installation
  • Less costly than other motor control methods
    • A panel and gear sized for the motor would have been required
    • Rebate of $300 from DP&L for VFD
      • Cost: $1,300 - $300 rebate = $1,000
  • Potential to reduce speed?
• Installation Lessons Learned
  – Missing hardware not listed on prints caused installation delays.
    • Do a mock installation inspecting each piece carefully
    • Identify where each bolt goes and make sure it was provided and is the right type
  – VFD over-volt on down stroke caused VFD faults
    • VFD vendor recommended DC Buss brake to prevent over-volt condition
• Installation Lessons Learned
  – Verify O&M manual with manufacturer
    • Many parts of the O&M manual did not match our equipment
• OPERATIONAL OBSERVATIONS
  • Mixer performance is as expected
    • slight improvement with volatile solids reduction

![Bar Chart](chart.png)

- 2009 Avg. % Reduction
- 2010 Avg. % Reduction
• OPERATIONAL OBSERVATIONS

• Gas production has increased by 45%
• OPERATIONAL OBSERVATIONS

- Digester temperature is consistent indicating good mixing

- Maintain similar Volatile/Alkalinity Ratios

![Bar chart showing Volatile/Alkalinity Ratios from Sept. to Dec. for 2009 and 2010]
MIXER WEAR ITEMS
Video of LM Mixer
Questions?