Retrofitting Digestion Facilities with An Egg Shaped Digester

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Outline

- Consideration of alternative digesters
- Economic and non-economic factors
- Digestion improvements at Waukesha WWTP
- Preliminary construction at Waukesha WWTP
- Lessons learned throughout planning, design, and preliminary construction
Consideration of Alternative Digesters

- Facilities planning should include evaluation of alternatives to traditional “pancake” digesters including:

  - Silo-Shaped Digester
  - Egg-Shaped Digester
Silo-Shaped Digesters

- Tall concrete cylinder
- Advantages
  - Minimize footprint
  - Efficient mixing
  - Not proprietary
- Disadvantages
  - More difficult to construct
Egg-Shaped Digesters

- **Welded steel vessel**
- **Advantages**
  - Better foam control
  - Minimize footprint
  - Efficient mixing
- **Disadvantages**
  - Only one supplier
Components of CB&I’s System

- CB&I’s scope may be tailored to project
  - Steel vessel
  - Recirculation pumps
  - Heat exchanger
  - Internal piping
  - Stairways
  - Controls
  - Start-up services

CB&I-Supplied Tube Heat Exchanger
Comparison to Traditional Digesters

- Alternative digesters may be the best choice for some facilities
  - Higher mixing efficiency
  - Greater gas production & foam control
  - Smaller footprint

Waukesha WWTP Digester No. 4

CB&I Egg-Shaped Digester (Grandville, MI)
Economic and Non-Economic Factors

- Both economic and non-economic factors require evaluation
- List all feasible alternatives
  - Type of new digesters
  - Quantity of new digesters
  - Retrofitting old digesters
  - Reuse or add new support facilities
Economic Considerations

- Capital costs
- Operation & maintenance costs
  - Heating/mixing
  - Cleaning
  - Painting
  - Foam control
  - Gas production
- Total present worth
Non-Economic Considerations

- Performance
- Ease of operation
- Aesthetics
- Constructability
Example - Waukesha WWTP

- Digestion improvement alternatives

- Refurbish Existing Digesters
- One new conventional digester

- One New Egg-Shaped Digester

- Two new conventional digesters
- Two new egg-shaped digesters

- Two silo-shaped digesters
Waukesha WWTP Selected Alternative

- Advantages of the selected alternative
  - Makes maximum use of existing digestion infrastructure
  - Relatively low cost with only one new digester
  - Relatively low maintenance cost with only two digesters requiring routine maintenance (excluding egg-shaped digester)
  - Relatively low energy cost for mixing (one egg-shaped and one conventional digester)
  - Improved foam management
  - Can be configured for co-digestion of high strength wastes in the future – gas production
The current Waukesha WWTP digestion system will be completely upgraded:

- Past construction
- Current operation
- Past heating/mixing concerns
- Maintenance issues
Waukesha WWTP Digestion Upgrades

New ESD (Dig. 1)
- Mixing / Recirc pumps
- Drain pump
- Heat exchanger
- Foam control

Dig. 2
- Steel cover to remain
- Pump mix
- Spiral heat exchanger
- Foam control

Dig. 3
- Dual membrane cover
- Pump mix
- Spiral heat exchanger
- Foam control

Digester Rooms
- New Roof
- Centrifuge feed pumps

Gas Handling
- Sediment traps
- Foam separator
- SS gas piping
- Relief valve
- Flare

Centrate Storage
- Centrate Return pumps

Hot Water Boilers
- 100% and 50% units
Egg-Shaped Digester Details

- 1.1 million gallons
- 82 ft tall, 66 ft wide
- Spiral staircase from existing control building
- 4.5 ft thick foundation
- Pump mix with heat exchanger
- Internal draft tube
Coordination with CB&I

• Design requires close coordination with CB&I
  ▪ Multiple design meetings
  ▪ Coordination of scope (equipment, controls)
  ▪ Discuss bidding strategy early (sole source concerns)

• Visit to project with CB&I digester

CB&I Egg-Shaped Digester (Grandville, MI)
Reconfigure digesters for series operation (existing is parallel)
• TWAS and Primary Sludge pumped to Digester No. 1
Flow out of Digester No. 1 by displacement to Digester No. 2 (steel cover)
Flow out of Digester No. 2 through a telescoping valve to Digester No. 3 by gravity.
Telescoping valve allows lowering of Digester No. 2 level for foam control.
Digestion improvements will provide greater process control, decreased maintenance, and increased capacity:
- SCADA controls
- Reduced foam events
- Reduced digester cleaning
- Increased gas production
- Increased capacity with greater efficiency
Waukesha WWTP Preliminary Construction

- Construction of the digestion improvements is in the early stages
  - Construction began in March 2014
  - Substantial completion: April 2016
Existing Digester No. 4 Demolition
Egg-Shaped Digester Subgrade
Egg-Shaped Digester Foundation
Concrete Ring Wall
Continued Construction

- Construction of the egg-shaped digester will continue through early 2015
  - Steel structure
  - Install stairway
  - Insulation and painting
  - Start-up
Waukesha WWTP Lessons Learned

- Improvements to the Waukesha WWTP digestion system provide valuable lessons for other WWTPs.
Facilities Planning/Design Lessons

• Consider several options to traditional digesters
• Reuse of infrastructure
• Geotechnical impacts
• Coordination with CB&I
  ▪ Develop bidding strategy
  ▪ Evaluate scope of services
Construction Lessons

- Sludge removal from existing digester
Conclusion

- Consider other options to “pancakes”
- Evaluate based on economic/non-economic factors
- ESD was most appropriate for the Waukesha WWTP
- Waukesha project provides example for other facilities
Acknowledgements