Excellence in Engineering Since 1946
Kankakee River Metropolitan Agency
Digester Improvements

October 8, 2015

Wisconsin Wastewater Operators’ Association:
49th Annual Conference

Presented By:
Kevin Hopkins, P.E.
Strand Associates, Inc.

Co Authored:
Troy Larson, Strand Associates, Inc.
Art Strother, KRMA
Today’s Outline

• Operations and Planning
• Incident
• Planning/Design
• Construction
• Commissioning
• Operation
Influent Pumping, Screening, and Grit Removal

Primary Clarification

Activated Sludge

Secondary Clarification

DAF/Blended Sludge Tanks

Anaerobic Digestion

Combined Heat and Power

Disinfection

Primary Clarification

Digested Sludge Thickening/Storage

Influent Pumping, Screening, and Grit Removal

Excess Flow Equalization

Plant Aerial
Digester Foaming a Persistent Issue
Foam Troubleshooting

- Temperature Control
- Feed Strategies
- Mixing Time/Energy
- Hauled/Industrial Wastes
- Diagnostics – e.g. Foam Potential (pictured)
Foam Troubleshooting

Foam Volume mls

<table>
<thead>
<tr>
<th></th>
<th>Effluent</th>
<th>Influent</th>
<th>Mixed Liquor</th>
<th>TRS</th>
<th>Dig 3</th>
<th>Dig 4</th>
<th>Dig 5</th>
<th>Dig 3 Dup</th>
<th>Dig 4 Dup</th>
<th>Dig 5 Dup</th>
<th>Hauler X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foam Volume mls</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>190</td>
<td>90</td>
<td>160</td>
<td>165</td>
<td>115</td>
<td>165</td>
<td>90</td>
</tr>
</tbody>
</table>
Operations Impacted By Age and Condition of Equipment
Operations Impacted By Age and Condition of Equipment
Old System: Pumped Mixing
Improvements Planned – Status Prior to December 27, 2010

- Projects that were shovel ready included
  - Gas conditioning and cogeneration
  - Dissolved air flotation thickening
  - SCADA Improvements
- Gas piping and conveyance improvements were being considered in house.
- Foam and treatment considerations were being further evaluated, however all considerations were operational at this time.
Explosion destroys Kankakee water treatment building

No one was injured when an explosion demolished a water treatment building Monday morning in far south Kankakee.

Emergency crews were notified of the explosion at 8:49 a.m. at the Kankakee River Metropolitan Agency treatment facility, Kankakee Fire Department Chief Ron Young said. The building is just west of Bradley between Bradley and the Kankakee River.

The digester building — which produces methane gas for use as energy — was demolished in the explosion, although no employees were inside at the time and no injuries have been reported, Young said.

The scene was secured Monday morning and the plant is considered operational, Young said.

Nicor, ComEd and the Illinois Environmental Protection Agency were notified and were responding to the scene, Young said.

The cause of the explosion remained under investigation Monday afternoon.
Short Term Response

- Emergency Response/Site Security
- Develop Operational Strategies To Minimize Forward Flow Disruptions
  - Blended Sludge Tank Storage
  - Mobile Dewatering
  - Landfill Disposal

Net Impact on Operating Budget ~ $1,500,000 or $125,000 per month
KRMA Post-Incident Schematic

Influent Pumping → Screening → Grit Removal → Primary Split → AT → Final Clarifier → CCT → Pump → Kankakee River

- Influent Pumping
- Screening
- Grit Removal
- Primary Split
- AT
- Final Clarifier
- CCT
- Pump
- Kankakee River

- PRS
- WAS Blend Tanks
- DAFT
- TWAS

- TRS Wetwell

- Dig. 1
- Dig. 2
- Dig. 3
- Dig. 4
- Dig. 5

- Mobile Dewatering
- Landfill

- Land Application
- Sludge Storage Tanks
Many Factors Influence the Evaluation of the “Best” Solution

- Capital Costs
  - Use existing digester structures? Equipment needs?
- Operating Costs
  - Appropriate evaluation timeframe – 20 yrs? 40 yrs?
  - Availability of land for disposal
  - Landfill tipping fees and trucking costs
  - Electrical costs
  - Degree of solids reduction
  - Labor
- Non-monetary Issues
  - Reliability
  - Foaming mitigation
  - Class “A” movement in US
  - Carbon footprint
  - Future flexibility
## Planning - Cost Evaluations (20-Year Basis)

<table>
<thead>
<tr>
<th>Alteration</th>
<th>Type of Process</th>
<th>Capital Cost</th>
<th>Opinion of Capital Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt. B-1</td>
<td>Conventional Mesophilic Anaerobic Digestion</td>
<td>$15,080,000</td>
<td></td>
</tr>
<tr>
<td>Alt. B-2</td>
<td>Acid-Gas Mesophilic Anaerobic Digestion</td>
<td>$19,575,000</td>
<td></td>
</tr>
<tr>
<td>Alt. B-3</td>
<td>Class A Solids Acid-Gas Anaerobic Digestion</td>
<td>$22,623,000</td>
<td></td>
</tr>
<tr>
<td>Alt. B-4</td>
<td>Class A TPAD</td>
<td>$21,262,000</td>
<td></td>
</tr>
<tr>
<td>Alt. B-5</td>
<td>Class A TPAD-Second Configuration</td>
<td>$23,278,000</td>
<td></td>
</tr>
<tr>
<td>Alt. B-6</td>
<td>ATAD</td>
<td>$20,501,000</td>
<td></td>
</tr>
<tr>
<td>Alt. B-7</td>
<td>Raw Sludge Dewatering and Landfilling</td>
<td>$8,788,000</td>
<td></td>
</tr>
</tbody>
</table>
## Planning - Cost Evaluations (40-Year Basis)

<table>
<thead>
<tr>
<th>Alt. B-1</th>
<th>Conventional Mesophilic Anaerobic Digestion</th>
<th>Opinion of Capital Costs</th>
<th>Opinion of Annual O&amp;M</th>
<th>Opinion of Present Worth (40-Year)</th>
<th>% of Lowest (40-Year Present Worth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt. B-2</td>
<td>Acid-Gas Mesophilic Anaerobic Digestion</td>
<td>$15,080,000</td>
<td>$484,000</td>
<td>$24,160,000</td>
<td>100%</td>
</tr>
<tr>
<td>Alt. B-3</td>
<td>Class A Solids Acid-Gas Anaerobic Digestion</td>
<td>$19,575,000</td>
<td>$448,000</td>
<td>$28,114,000</td>
<td>116%</td>
</tr>
<tr>
<td>Alt. B-4</td>
<td>Class A TPAD</td>
<td>$22,623,000</td>
<td>$450,000</td>
<td>$31,074,000</td>
<td>129%</td>
</tr>
<tr>
<td>Alt. B-5</td>
<td>Class A TPAD-Second Configuration</td>
<td>$21,262,000</td>
<td>$457,000</td>
<td>$30,716,000</td>
<td>127%</td>
</tr>
<tr>
<td>Alt. B-6</td>
<td>ATAD</td>
<td>$23,278,000</td>
<td>$471,000</td>
<td>$32,991,000</td>
<td>137%</td>
</tr>
<tr>
<td>Alt. B-7</td>
<td>Raw Sludge Dewatering and Landfilling</td>
<td>$20,501,000</td>
<td>$996,000</td>
<td>$40,147,000</td>
<td>166%</td>
</tr>
</tbody>
</table>

###的意见 italiana
## Planning – Non-Cost Issues

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Opinion of Capital Costs</th>
<th>Present Worth Rank</th>
<th>Class A or B Biosolids</th>
<th>Foaming Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt. B-1</td>
<td>Conventional Mesophilic Anaerobic Digestion</td>
<td>$15,080,000</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Alt. B-2</td>
<td>Acid-Gas Mesophilic Anaerobic Digestion</td>
<td>$19,575,000</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Alt. B-3</td>
<td>Class A Solids Acid-Gas Anaerobic Digestion</td>
<td>$22,623,000</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Alt. B-4</td>
<td>Class A TPAD</td>
<td>$21,262,000</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Alt. B-5</td>
<td>Class A TPAD-Second Configuration</td>
<td>$23,278,000</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Alt. B-6</td>
<td>ATAD</td>
<td>$20,501,000</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Alt. B-7</td>
<td>Raw Sludge Dewatering and Landfilling</td>
<td>$8,788,000</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
Design Considerations

- Meet Current Code
- Deal with Multiple Funding Sources (IEPA, Owner, Insurance Co.)
- Minimize Foam Impact
- Maximize Gas Production and Utilization
Overview of Upgraded System

- Blend TWAS + PS
- Pump/Grind TRS
- Heat/Distribute
- Digest

Thickened Sludge Storage Level (LIT-12-11-1) 0.0 IN
Thickened Sludge Storage Level (LIT-12-11-2) 0.0 IN

主管部门

Pump/Grind TRS
Blend TWAS + PS

DAFT Unit 1 Flow 0 gpm
DAFT Building

Digest
Heat/Distribute

Digest

Thickened Sludge Wetwell Level 1.0 FT
Digester Level 0.0 FT

Digester Level 0.0 FT

Digester Level 0.0 FT

Digester Level 0.0 FT

Outdoor Temp 0 Deg F

Kankakee River
Gas System

Create Gas (Primary Digester)
Store Gas (Secondary Digester)
Sulfide Removal
Chilling
Compression and Moisture Removal
Beneficial Use
Foam Detection
Chemical Foam Control
Chemical Foam Control – Multiple Options Provide System Flexibility

Foam control includes 8 pumps capable of treating 14 different locations.
Foam Control

- Gas piping equipped with foam separators and large drip traps to encourage uninhibited gas flow.
Draft Tube Mixing Chosen; Reduced Foam Creation Anticipated

- **Draft Tube Mixers**
  - **Digester 3**
    - 3 Draft tub mixers
    - 7,600 gpm each
    - 5 Hp
    - Maintenance Heat (at 2)
      - 200,000 BTU/hr
  - **Digesters 4 and 5**
    - 4 Draft tub mixers/Digester
    - 9,000 gpm each
    - 7.5 Hp
    - Maintenance Heat (at 2 each)
      - 400,000 BTU/hr

VFD drives and SCADA control adds to mixing control.
Operational Flexibility Added

- Parallel Mode (Shown)
- Series Mode
- Split Series Mode
SCADA Feed Control Offers Improved Control

- Improved Control
  - TS Concentration
  - Timing
  - Duration
Operations Workshops Resulted in Start-up Plan

Acclimation schedules were simulated considering plausible seeding and feeding scenarios.

Operator training, construction sequencing and temporary controls were discussed.
### Startup Condition Planning and Communication Critical

#### Start-up Initial Activities

<table>
<thead>
<tr>
<th>Activity Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler System on Natural Gas and In Auto</td>
</tr>
<tr>
<td>One Blend Tank Available for Seed and then Blended Sludge</td>
</tr>
<tr>
<td>Digesters 4 and 5 Filled with PRE</td>
</tr>
<tr>
<td>Temporary Piping In Place to “leap frog” Secondary Digesters</td>
</tr>
</tbody>
</table>

Training targeted communication regarding construction activities, briefings regarding design intent and information related to process understanding.
Start-up Highlights

• Construction Activities “Phase In” Available Tanks
• Winter Impacted Seed Transport
• Surfactant Load Impacts Secondary Treatment…and Then Digestion
• Digesters Healthy – Producing Class B Biosolids
Foam Receding Following Surfactant Record Load

System bent but did not break when recent record surfactant load was imposed on the KRMA facility.
Summary

• Surfactants likely contribute significantly to foaming.
• Problems associated with foaming can vary from aesthetic to impactful.
• Multiple design attributes can keep foaming issues in check.
• Strong leadership from the Owner kept long term interests in focus.
Excellence in Engineering Since 1946