Anaerobic Digester Foaming Workshop
Full Scale Case Studies

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MWIE Conference | Kalahari, WI
Outline

- Literature Review
- Surveys and Summary
- Full Scale Testing
  - Identifying plants of interest
  - Gathering operational data
  - Facility review
  - Pilot Testing
    - Operational Changes, Recording Data, Facility Testing, Testing by IIT
- Going Forward
Case Studies

1. City of Marquette, MI
   - High gas production, limited surface area for gas removal, solids handling process

2. City of Elmhurst, IL
   - Overloading, over mixing

3. City of Crystal Lake, IL
   - High proportion of WAS in feed sludge

* East Coast Case Studies*
Marquette, MI
Marquette, MI
Monitoring Foam Levels
Marquette, MI

Operating Data

2010 Organic Loading Rate (OLR) of Digester 1 and Digester 2

OLR for Completely Mixed (0.8 – 1.6)

OLR for Moderately Mixed (0.4)
Marquette, MI

Operating Data

VS Loading and Gas Production in 2010
Marquette, MI

Operating Data

VS Loading and Gas Production during Foam
Marquette, MI

Summary

Organic loading rate

- Within a good range according to literature
- Consistent
- Too low?

Suspected primary cause –

- Unintended pre–digestion (aerobically) results in lower VS load
Marquette, MI

Study Plan

Diagram showing the process flow for waste treatment, including:
- Trucked/Hauled Waste
- Influent
- Headworks/Pretreatment
- Primary Clarifiers 1-4
- Bio-P Tank
- RAS Return Line
- Bypass line to Primary Clarifier
- Mixed Liquor
- Aeration Tanks 1-3
- WAS Line
- Sludge Storage Tanks 1-2
- Digested Sludge from Digester #3 to Storage Tanks
- TWAS + PS Mixing point
- PS Line
- TWAS Well
- GBT
- WAS Tank
- Secondary Clarifier 1-2
- Residuals to Offsite Application

Scenarios:
- Scenario 1 - WAS Tank Bypass
- Scenario 2 - GBT and WAS Tank Bypass
- Scenario 3 - Bypass to Primary for co-thickening
Marquette, MI

Summary

Volatile Solids Reduction around WAS Holding Tank

- VS influent
- VS effluent

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Marquette, MI

Study Plan

- TWAS + PS Mixing point
- PS Line
- TWAS Well
- GBT
- WAS Tank

- WAS Tank Bypass
- WAS Tank & GBT Bypass
- WAS Tank, GBT, & TWAS Tank Bypass
Marquette, MI

Study Plan

1. Eliminate the WAS holding tank
   – Started February 1, 2012
   – Continue through March 1
2. GBT and WAS tank bypass
3. Eliminate the tWAS holding tank
4. Co-settle sludge through the primaries

→ Eliminate foam supression (provide no mixing) when there’s steady operation without foam
Elmhurst, IL
Elmhurst, IL

Study Plan

- 1 foam event from overfeeding
- More persistent (and unreliable) foaming also occurs
  - Expected to be due to thermal shocks
  - Heat exchanger issues in November 2010
  - Digester temperature dropped to 88°F (gradually)
  - After repair, temperature increased to 94°F (quickly) and foaming occurred
- Heat exchanger replaced in 2011
Elmhurst, IL
Elmhurst, IL

Study Plan

Why Elmhurst?

- North Digester foams; South does not
- Feed is the same otherwise
  - Change loading to each digester (more to North, less to South)

Objective 1: Determine the organic loading rate at which the digester begins to foam
Objective 2: Determine the impact of mixing

- In general, if not well mixed the organic loading rate can be non-uniform
  - Conflicting opinions on whether mixing required
- Previous operation: Mix 11 hours / day
- Currently: Mix 3 hours / d
  - 1 hour before feeding in the morning
  - 1 hour at noon
  - 1 hour before leaving for the day
Elmhurst, IL

Status

January 2012 –

✎ Began feeding North digester 2 days in a row, South digester 1 day

Mid-February 2012 –

✎ Increase North digester feed to 3 days, South digester 1 day
Crystal Lake, IL
Crystal Lake, IL

- Crystal Lake has 1 (only!) digester
  - Have the ability to store WAS / aerobically digest WAS

- Intermittent foaming problems

- Major foaming problem April 16, 2011
  - Suspected to have been due to an overfeed event
Crystal Lake, IL

Study Plan

Primary Clarifier 1-3

PS Pumps

PS Line

To BFP or Sludge Storage

Digestor

Digested Sludge Line

TWAS Line

RAS Valve Station

From Secondary Clarifiers

WAS Thickener Tanks (not in use)

Return Sludge to Aeration Tanks

Supernatent to Drain

TWAS Pumps

GBT Pump

GBT

Pump to Digester
Objective 1: Determine the optimal PS: WAS ratio

- Increase the time that PS is pumped to the digesters to control the ratio
  - Start with 65% primary, 35% WAS; hold for 1 SRT
  - Reduce to 60% primary, 40% WAS; hold for 1 SRT
  - Reduce to 55% primary, 45% WAS; hold for 1 SRT
Objective 2: Determine the effect of PS ratio on biogas production; pressure under the cover

- Pressure under the cover be used as an indicator on whether foaming will occur?
  - Ocean County Utilities Authority (Brick, NJ) maintains pressure < 0.16 psi or foaming will occur
  - Des Moines controls foam this way
Crystal Lake, IL

Status

January 2012 – Maintain a steady feed rate of 65% primary sludge; 35% WAS

February 2012 – Increase WAS to 40%
Summary

- Pilot testing expected to be complete in Fall 2012
  - Firm results on the impact of OLR, PS:WAS ratio, mixing, gas pressure
- Foam supression to be tested full-scale
- Testing underway at IIT

- WERF timeline
  - Guidance manual on foam due December 2012
Acknowledgments

The group thanks the facilities who have participated in the study!