Struvite: The Deer Island Experience

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MWRA Deer Island Treatment Plant
Overview of Deer Island Treatment Process
Deer Island Treatment Plant

- $3.8 Billion Construction Project
- One of the Largest Wastewater Treatment Plants in the United States

- Treatment Capacity:
  - Maximum
    - 1.27 Billion Gal/Day combined sewer system
    - Up to 700 MGD by Secondary Treatment
  - Average Daily Flow:
    - 365 Million Gal/Day

- Built on 200 Acres
  - includes 60 acres of public access area
Primary Treatment Has 48 Stacked Clarifiers

Each Clarifier: 1.369 MGal (15,252 sq ft)

- Five Chain Collector Mechanisms
- Primary Sludge Pumps (1.5 x 15 hp)
- Primary Scum Pumps (14 per battery)
- 20 Field Monitoring Instruments

Process Requires 42 Out Of 48 Always Available

Challenges:
- Covered & Stacked
- Monitored With I&C Remotely
- All Work Is Confined Space Entry
Biological Treatment - Activated Sludge (Pure O2)
Over 900,000 Square Feet Facilities (1/3 Covered)
Pure Oxygen Generation Facility
Odor Control - Carbon Adsorption
Secondary Treatment Has 54 Stacked Clarifiers

Each Clarifier:
1.36 Mgal, 14,350 sqft
Six Collectors
22 Field Instruments
1 x 70HP 3000GPM Return Sludge Pump

Process Requires 50 Out of 54 Always Available

Challenges:
Stacked
Monitored With I&C
Confined Space Entry
Residuals Processing Statistics for Deer Island

- **DITP Influent Solids** – 262 dry TPD (94% captured)

- **Sludge to Digestion** – 246 dry TPD
  - 70% Primary sludge
  - 30% Waste Secondary sludge
  - Time in Anaerobic Digestion:
    - 18 -20 days
  - 62% Volatile Solids destruction
    - (industry avg. is 45-55%)

- **Digas Production** – 189 kscfh
  - 98% beneficially utilized (value: $15-$20 M (heat); & $2.8 M (power))
  - 65% of days Digas meets all DI heating requirements
  - 96.9% of boiler heat attributable to Digas
Methane Utilization At Deer Island

- Deer Island utilizes 98% of the methane generated to power a steam turbine generator and backpressure turbine for plant heat and hot water
- Avoid purchase of about 5MG in fuel oil annually
- Approximately 28M kWh/yr electricity production
- Approximately $3.4M/yr electricity savings and revenue
NEFCO – Dryer Trains and Centrifuges
• 140 ft tall egg-shaped digesters

• 3 million gallon volume

• 18-20 day holding time

• Digesters are fed in a sequence

• Contents “overflow” into a discharge line

• Prime struvite formation conditions during overflow
Struvite in Overflow Pipe
Other Struvite Formation Spots

• Digester Mixers

• Valves downstream of digester

• Digested sludge centrifuges (at fertilizer plant)

• Other points of turbulence in the line
Digester Mixer covered with struvite
Remediation Options

Preventative Measures

- Carbon Dioxide Addition (Stickney Plant)
- Ferric Chloride

Remedial Measures

- Sulfuric Acid
- Proprietary Chemicals
- Manual Removal
• Combines with Ortho-Phosphate to Form Vivianite

• Vivianite is $\text{Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$

• Vivianite is a grit-like substance that is less destructive than struvite

• Large amounts of Vivianite can create problems
Ferrous/Ferric Chloride Feed System (Struvite Control)
Ferric Feed pumps
Monitoring Ferric Chloride Effectiveness

- Monitor Orthophosphate (PO$_4^{3-}$) in digested sludge
- DITP samples sludge from each digester every week day
- Analyze for orthophosphate twice per week using colorimetry technology (EPA 353.2, 365.1)
- Target: 50-75 mg/L orthophosphate
- Challenging target to keep: easy to overshoot or undershoot
Costs and Benefits of Ferric Chloride

- Purchasing ferric chloride is expensive

- 1,600,000 lbs budgeted for next year, at $.55 per pound cost is $870,000.

- Limited space to store on-site, only space for seven days supply

- One added benefit, keeps sulfides down in digester gas
Future

- Work on Minimizing Ferric Chloride dose

- Explore Alternatives:
  - Reconfiguring overflow box in digester
  - Precipitate Struvite in side stream process to reduce overall phosphate levels
Thank you!

Questions?