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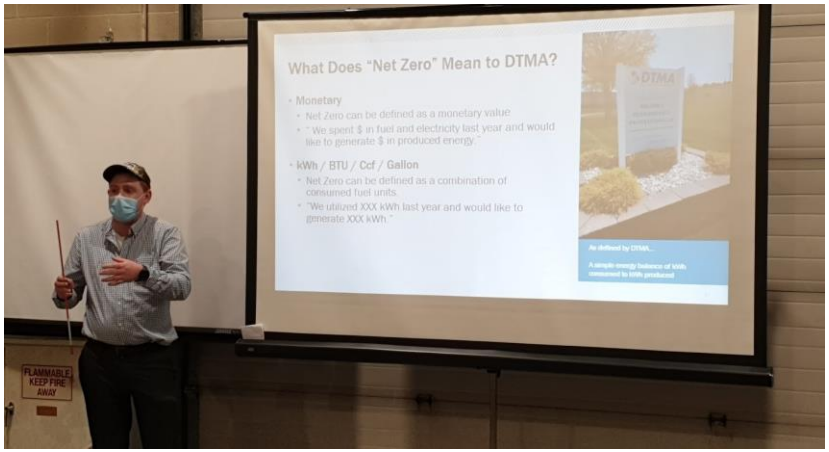
New England Water Environment Association, Virtual Spring Meeting and Exhibit 2021

A New Look at Digester Gas Conditioning, Regenerative Siloxane Removal System Makes Cents

June 9, 2021

Presentation Agenda

- Speaker Intro
- Importance of conditioning digester gas
- Case Study
  - Implementing an Innovative Technology
  - Hands on Approach
- Lessons Learned
- Questions



Today's Speaker

A New Look at Digester Gas Conditioning, Regenerative Siloxane Removal System Makes Cents

- Colin O'Brien
- 6 years of industry experience
- Biosolids, Energy, CSO/Wet Weather, Stormwater, Secondary Process Treatment (BNR), Permitting, Master Planning, Feasibility studies and Business Case Evaluations, High Strength Waste Receiving Facilities
- Current NEWEA Outreach Council Director

NEW ENGLAND WATER ENVIRONMENT ASSOCIATION
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Why condition Digester Gas?

- Conditioned (improved) digester gas is required for different end uses
- H2S (Hydrogen Sulfide) is traditionally removed for corrosion protection
- Siloxanes impacts on ends use equipment
- Moisture is removed through the process of removing H2S and Siloxane
- Other constituents removed for pipeline (RNG – Renewable Natural Gas) pending utility requirements

BENEFITS

- Reduces O&M requirements
- Extends the lifetime of equipment
- Allows for complete combustion of digester gas
- Conditions digester gas for beneficial reuse

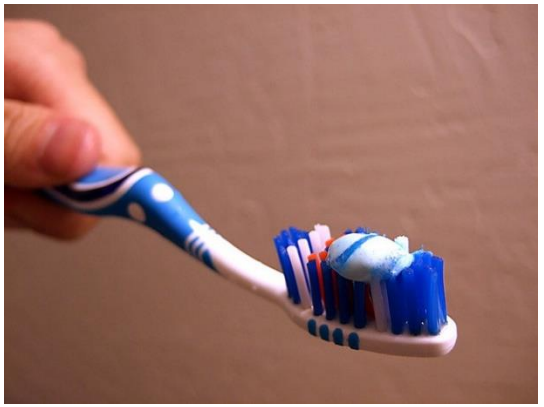
Todays focus..... Siloxane Removal

Some Historical Issues with Siloxanes in Digester Gas

- Depending on end use; boiler tube fouling, piston, valve, pipe, engine block fouling and/or destruction
- More stringent regulations as part of AQMs requiring better siloxane removal to accommodate performance and efficiencies
- Difficult to remove in digester gas with high moisture content
- Frequent media replacement required for traditional treatment technologies
- Variable waste streams with variable siloxane content

Where do Siloxanes come from?

- Found in significant quantities in a wide and varied range of household products, such as detergents, shampoos, deodorants, toothpastes and cosmetics
- Manufactured in a range of types, including high and low viscosity fluids



Regenerative Siloxane Removal Technology Evaluation - Derry Township Municipal Authority (Hershey, PA)

Who is *DTMA*?

- **Operating Authority formed in 1972**
- **Current Staff of 40**
- **Serves 6 Municipalities**
- **Two Wastewater Treatment Facilities**
  - Clearwater Road WWTF – 5.02 MGD
    - Operational since 1977
    - Serves the Townships of Derry, Conewago, South Hanover, and a portion of Hummelstown Borough
  - Southwest WWTF – 0.6 MGD ("Unmanned" Satellite WWTF)
    - Operational since 1993
    - Serves Southwest corner of Township of Derry. Northwest corner of Londonderry Township, and Lower Swatara Township
- **Collection & Conveyance System**
  - **14 Pumping Stations**
  - **150+ Miles of Sanitary Sewer**

Providing a cost-effective public service to protect and enhance the water, environment, and quality of life for our local and regional community.

CLEARWATER WWTP - AERIAL

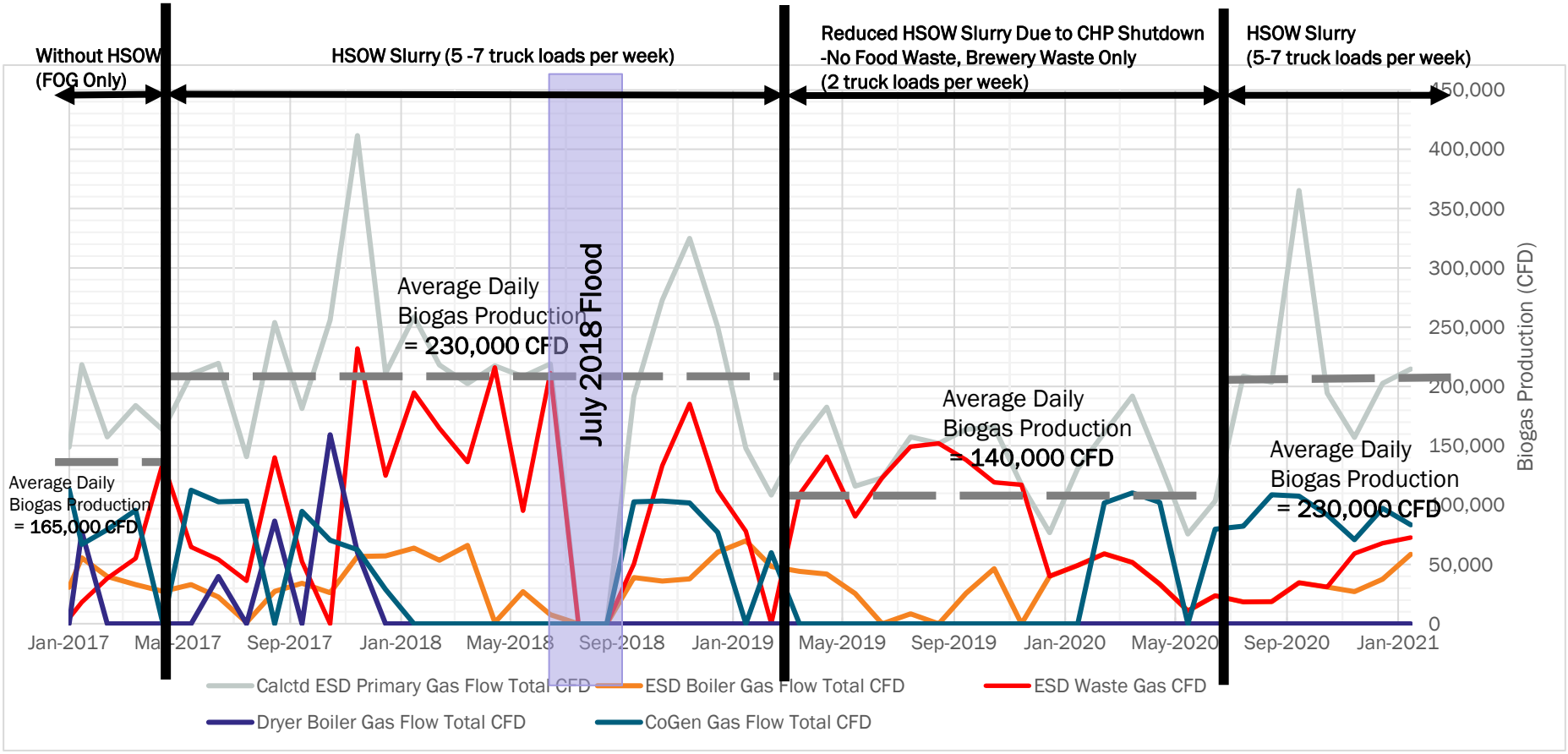
HISTORY OF HAULED-IN WASTE PROGRAM

- Hershey Chocolate Co. Waste Sludge – Since 1978
  - Direct connection from Hershey's PTP to Clearwater WWTP
  - Avg. 115k Gallons/Month, 5% TS, 88% VS
- Septage Receiving – Since 1991
  - Two Lane Receiving Station Constructed in 2000
  - Screening / Grit Removal via Headworks Facility
  - Avg. 60,000 GPD, M-F
- FOG Waste Acceptance – Since 1995
  - Aerobic Grease Pretreatment Since February 2005
  - Avg. 10,000 GPD, M-F
- High Strength Organic Waste (HSOW) – Since 2017
  - Food waste slurry, brewery yeast waste, vegetable oil
  - Avg. 12,000 GPD, M-F
  - 10-15% TS, 90-95% VS

Biogas Utilization Background

- **2001 – ESD Heating**
  - Fuel hot water boiler for heating digester contents
- **2008 – Thermal Dryer**
  - Steam boiler fueled by biogas, dryer heat source
  - *Decommissioned as of July 2018*
- **2010 – 280 kW Cogen & Gas Conditioning (300 SCFM)**
  - Annual Electric Savings – Offsets an average of 21% of total WWTP electric consumption per year
  - Engine Heat Recovery: Heat three (3) WWTP buildings during cold weather season
- **2021 – Ongoing Energy Enhancements Improvements**
  - Two (2) new 1 MW Cummins GenSet units
  - Secondary Digester Membrane Cover
  - Heating loop improvements

BIOGAS ON-SITE UTILIZATION



Existing Asset Concerns

- Impact on CHP uptime
- Siloxane breakthrough potential
- O&M costs and labor
- Inadequate moisture removal
- Inadequate freeze protection
- Lacking redundancy for all treatment trains

Implementing an Innovative solution

DTMA
Derry Township Municipal Authority

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Evaluate Traditional versus Emerging Technology

Why are we looking at an emerging technology? (defined by DTMA)

A. Cost Savings
B. O&M reductions
C. Benefit to the industry

What do we as Engineers need to do for due diligence?

A. Appropriately vet the technology and its application
B. Visit the installs with the Owner
C. Condensate issues
D. Maintenance and operational costs
E. Freeze protection issues

See it in action.....

Clarkson Wastewater Treatment Plant (Mississauga, ON)

- Operational since March 2019
- 625 scfm system capacity serving two (2) GE Jenbacher 400 kW GenSets

Greencastle, PA

- Operational since January 2018
- 1800 scfm system (landfill gas) capacity serving 1.2 MW of combustion engines

Lifecycle Cost Analysis

Comparison of Siloxane Removal Alternatives		
Parameter	Units	Value
Number of vessels	2 (lead/lag)	2 (duty/standby)
Vessel diameter	6 ft	7 ft
Vessel height	10 ft	10 ft
Pressure drop	<1 psig	<4 psig (larger upstream blower) required)
WGB or thermal oxidizer required	No	Likely not (Existing regen system at Greencastle, PA does not have WGB and it has higher VOCs than projected at DTMA).
Compressed air required	No	Yes (80 - 120 psig, 2 cfm consumption)
Control panel required	No	Yes
Electrical supply required	No	Yes
Breakthrough concern	Yes, if media not replaced in timely manner	No
System heat protection / Insulation required	No	Yes
Vendors	Unison, Biospark, MV, Varec	Granite Fuel-DCL, Venture
Expected media lifetime (both vessels)	124 days [b, c]	10 years
Approximate annual media cost[c], $	$146,770	$9,733[a]
Approximate annual electrical and fuel cost[d], $	$0	$30,000
Vendor supplied equipment cost	$0.8M	$1.1M
Vendor supplied equipment footprint	20' x 10'	29.5' x 21'

Make a team decision

A. BC developed a TM to document technical aspects, provided a technology recommendation.

   Regenerative System 20 year LCA cost: $2.0 MM

   Traditional System 20 year LCA cost: $3.7MM

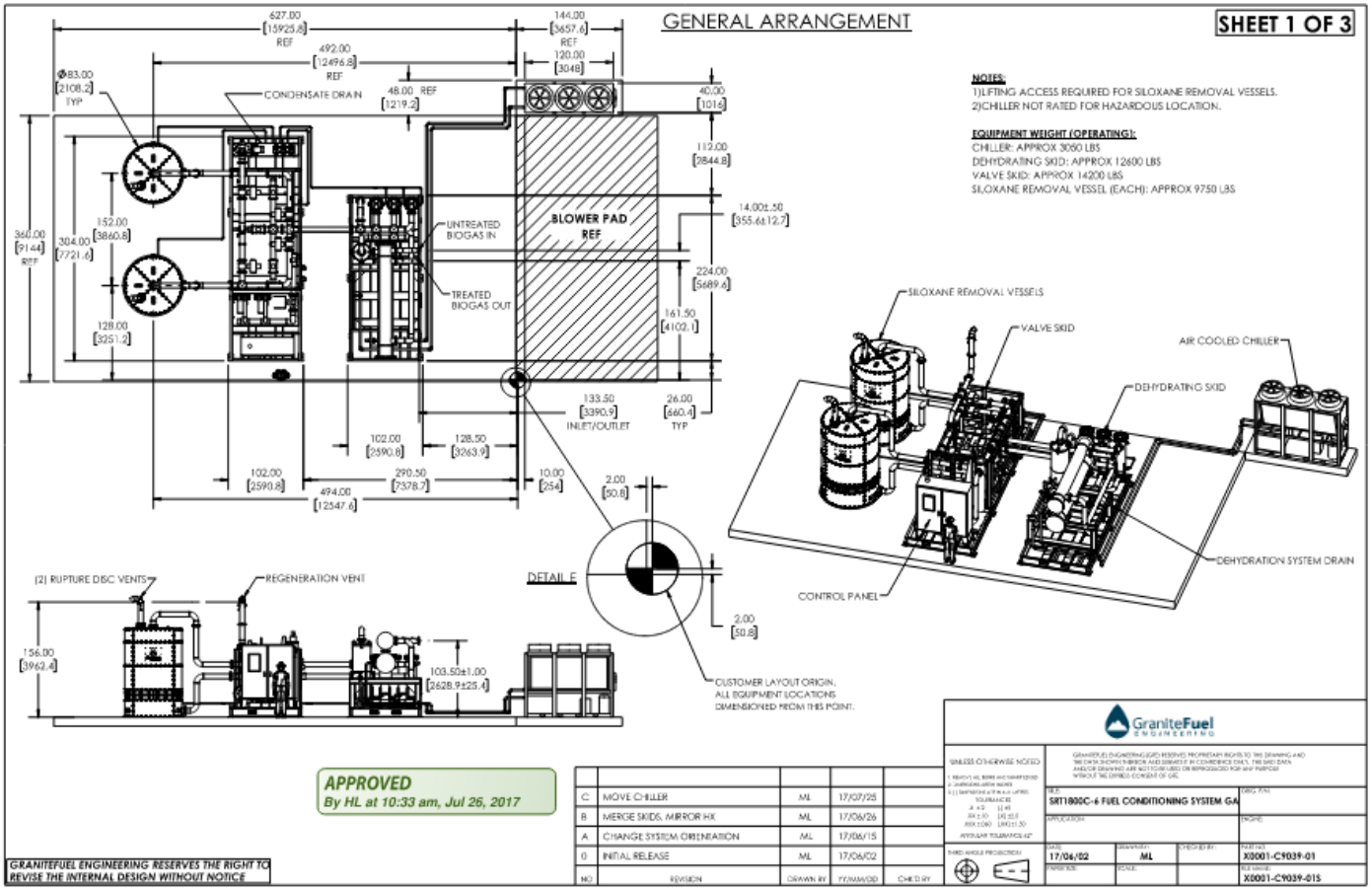
B. DTMA attended many phone calls with the design team and manufacturer to stay engaged with the fine details

C. Lifecycle analysis was comprehensive of O&M, utility, and capital costs. Adjusted based on DTMA experience

   Regenerative system benefits: Operational flexibility in regenerative cycles

D. Engage manufactures on logic for decision making process. Transparency is key.

Current Project Status



- Shop drawing and submittal phase nearing completion
- Delivery and install Fall 2021

Innovation does not come without challenges…

- Different business practices
- Providing additional details to clarify install requirements
- Barriers to understanding Municipal Wastewater workflow
- Maintaining confidence in the team
- Additional effort to vet technologies
- Can be limited competition on different scale of capabilities

Lessons Learned and Conclusion

Early Engagement is Key

- Working with Subject Matter Experts early in the projects allows for full vetting of the technology (site visits, workshops with the Owner, coordination with design team)
- Developing a strong relationship with vendors, manufacturers, and current Owners to create an outreach network
- Reliable Service allows for successful uptime, confirm the manufacturers/vendors ability to assist with maintenance
- Be transparent with concerns/issues brought up by the Operators and Engineering team

Innovation….Be Creative!!!

- Leverage industry relationships
- Optimize project savings early on
- Innovation is not monumental or hard to find, our industry is constantly evolving
- Take pride in being part of the process
- Make it fun

Questions?

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