Lifting the Fog from FOG Receiving

AZ Water Association

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Rashi Gupta, P.E.
Carollo Engineers

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Acknowledgements

• Co-Authors:
  – Daniel Meacham (Carollo, CA)
  – Phil Parkins (Carollo, AZ)
  – Travis A. Peacock (Albuquerque Bernalillo County Water Utility Authority, NM)
  – Anthony L. Montoya (Albuquerque Bernalillo County Water Utility Authority, NM)

• Review:
  – Gary Deis (Carollo, CA)
Understanding the whole picture is necessary for informed decision-making

- Water Authority knew that when it’s digested, FOG has many benefits
  - Reduces clogs in collection system
  - Decreases energy demand for treatment
  - Produces energy
    ... but, what issues do we have to consider?
    ... have facilities seen the expected benefits?
    ... and how do we make it successful?

- Site visits and a detailed survey of existing facilities helped answer these questions
A real-life perspective from operational systems provides a fuller picture.
Facility investigations were comprehensive

- Facility background and drivers
- FOG characteristics and quality control
- FOG receiving station equipment and cost
- FOG receiving station materials of construction
- O&M issues and requirements
- Impacts on digester gas production and revenue from tipping fees
Facility Facts

• Plant Average Dry Weather Flow (ADWF) Capacity: 12.5 – 450 mgd

• FOG Receiving Station Capacity: 12,000 – 175,000 gpd

• FOG Receiving Station Storage Capacity: 5,000 – 60,000 gallons

• Years of FOG Receiving Station Operation: 3 – 11 years
Specific drivers initiated FOG projects

- Reduced utility costs through increased digester gas production
- Reduced clogging and impacts on collection system
- Improved sustainability and reduced greenhouse gas emissions
- Revenue generation
FOG sources determine characteristics

• FOG is “brown grease” from restaurant grease traps
  – Concrete, flatware, bones, etc.

• FOG typically delivered by private grease haulers (beware septage!)
# FOG characteristics illustrate variability

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of Facilities Regularly Monitoring</th>
<th>Typical Frequency of Measurement(^a)</th>
<th>Range of Reported Values(^b), (median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of FOG Received</td>
<td>9</td>
<td>With delivery or daily</td>
<td>1,500 – 105,000 gpd, (18,500 gpd)</td>
</tr>
<tr>
<td>pH</td>
<td>5</td>
<td>With delivery or daily composite</td>
<td>2 – 6 (4)</td>
</tr>
<tr>
<td>Total Solids (TS)</td>
<td>5</td>
<td>With delivery or daily composite</td>
<td>0.5% - 20%, (8.6%)</td>
</tr>
<tr>
<td>Volatile Solids (VS)</td>
<td>5</td>
<td>With delivery or daily composite</td>
<td>Less than 20% to 100%, (79%)</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>2</td>
<td>With delivery or daily composite</td>
<td>5,000 – 202,000 mg/L, (50,000 mg/L)</td>
</tr>
</tbody>
</table>

\(^a\) Frequency of testing is based only on facilities that reported testing intervals and regularly monitored parameters.

\(^b\) Some facilities indicated that they test for these parameters, but did not report measured values.
FOG quality control is essential, but difficult

- Several facilities contract with single hauler
  - Hauler provides consistent and prescreened material

- Seven of the surveyed facilities require haulers to apply for a permit
The Generic Process
Debris removal is the first line of defense

Bar Screen

Basket Strainer
Macerators/grinders chew up debris and rock traps allow heavy materials to drop out

Inline Grinder

Rock Trap/Macerator
Offloading pumps control tanker discharge

- Rotary Lobe
- Centrifugal Chopper
- Peristaltic Hose
FOG tanks provide short term storage (and “inadvertent” grit removal!)

- Steel Horizontal
- Vertical FRP
- Vertical Steel – Cone Bottom
- Vertical Stainless Steel
Recirculation pumps can provide multiple functions

Centrifugal Chopper

Rotary Lobe
Heating systems keep material flowing and reduce clogs/mats

- Heat Exchangers
- Heat Tracing
- Insulation
- Preheated FOG
- Steam Injection
Digester feed pumps meter FOG into digesters, typically with VFDs
Odor control requirements driven by area and neighbors

- Bioreactor
- Carbon Canister
- Scrubber
Materials tell a “tale of two cities”

Stainless Steel

Glass-Lined Ductile Iron

NBR (Buna-N) Hose

PVC
Isolation valves critical for O&M but subject to extremely severe duty

<table>
<thead>
<tr>
<th>Ductile Iron Plug Valves with Buna-N</th>
<th>Full Port PVC Ball Valves</th>
<th>Full Port SST Ball Valves</th>
</tr>
</thead>
</table>

[Images of the valves shown in the slide]
Reported construction costs follow size, but also redundancy, complexity, automation.
System changes frequent post-startup

• Reasons for equipment changes:
  – Increase service life
  – Reduce maintenance needs
  – Combat abrasive and corrosive nature of FOG
• Add screening/straining
• Add heating
• Replace steel components with stainless steel
• Try various elastomers for pumps and valves
O&M issues are real and significant

- Facilities agreed that FOG is a difficult material to handle

  Abrasive • Acidic • Variable • Odorous • Labor intensive

- In most cases, labor required was higher than anticipated
FOG delivery control can reduce staff time OR improve quality/consistency

• Key card system
  – Allows delivery during non-staffed hours
  – Restricts delivery to permitted haulers
  – Difficult to implement sample testing
  – No operator assistance/control

• Operator presence required
  – Operator controls/oversees offloading
  – Operators can sample each delivery
  – More staff time required
  – Haulers are time-limited for delivery
## O&M Issues: Screens, Strainers, and Macerators

<table>
<thead>
<tr>
<th>Clogging</th>
<th>Corrosion</th>
<th>Abrasion</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Clogging Image" /></td>
<td><img src="image2.jpg" alt="Corrosion Image" /></td>
<td><img src="image3.jpg" alt="Abrasion Image" /></td>
</tr>
</tbody>
</table>
O&M Issues: Pumps

- Damage/wear of elastomers (replacement: 3 – 6 months)
- Damage/wear of pump housings (replacement: 6 – 36 months)
- Damage/wear to internal components (replacement: as needed)

Maintenance and replacement more frequent than same pumps for sludge
O&M Issues: Valves, Piping, and Storage

- Grit, Debris, and Rocks
- Grease Clogging and Mat Formation
- Damage to Elastomers in Valves
Staff time required for more than just O&M

- In addition to O&M of FOG system, staff required for:
  - Permitting haulers and monitoring for compliance
  - Inspecting FOG loads, sample collection and analysis
  - Monitoring digester performance and troubleshooting
  - Determination and collection of tipping fees
  - Management of contracts, if any, with FOG haulers
Reported staffing requirements must be considered in economics

<table>
<thead>
<tr>
<th>Facility</th>
<th>No. Full Time Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>1 - 2</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
</tr>
<tr>
<td>E</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Digester stability paramount, but no standard feed control (yet)

- Multiple methods used:
  - Empty FOG tank over setpoint time
  - FOG tank level control
  - FOG slowly fed in increasing amounts for acclimation
  - Maintain total or volatile solids loading to digester
  - Specific FOG:sludge feed ratio by volume
  - Specific volume per day
  - Vary to optimize gas production
Changes in gas production are significant

FOG digestion played a key role in energy neutrality for two facilities.
Variation in delivery impacts gas production – mitigate through FOG and/or gas storage
Tipping fees and revenue often drive system economics – but are not guaranteed

- Two agencies reported $300,000/year of revenue from tipping fees
- Highly dependent on local market, which may change over time
The evolution of HSW receiving offers some solutions to screening and contaminant removal

- Flo-Beast at SVCW
- Modified system for FOG applications
  - U-shaped inlet flush header
  - Auxiliary hot water connection
  - Booster pumps
- 7 US Installations on FOG or food waste
The evolution of HSW receiving offers some solutions to screening and contaminant removal

- Strainpress at Napa
- 22 HSW installations in Europe on up to 15% solids
- May require heating and dilution
Proper planning, stakeholder buy-in, and design based on lessons-learned critical to success

- FOG receiving offers multiple benefits, including a path towards energy independence

- Before embarking, consider:
  - Drivers and operational goals
  - Quantity and quality of material available
  - FOG market in area/realistic tipping fees

- Economics specific to each case

- Other goals may supersede economics for some facilities
Proper planning, stakeholder buy-in, and design based on lessons-learned critical to success

• FOG receiving is O&M intensive

• Successful, sustainable operations possible through:
  – System design based on lessons-learned
  – Strong, preventative O&M program
  – Early consensus from all stakeholders

• Two plants have achieved energy neutrality/net positive status, partly due to FOG receiving and digestion
We would like to thank all facilities that participated in the survey and shared their experiences.

AND THANK YOU FOR LISTENING!

Questions?

rgupta@carollo.com