FOG RECEIVING, PRETREATMENT AND ANAEROBIC CODIGESTION
DERRY TOWNSHIP MUNICIPAL AUTHORITY CLEARWATER WWTP, HERSHEY, PA

PRESENTED TO THE VWEA COLLABORATIVE BIOSOLIDS: FUEL FOR THOUGHT WORKSHOP

Wayne A. Schutz
Derry Township Municipal Authority
May 11, 2017
A. DTMA Organization & WWTP Facilities Overview
B. Hauled Wastewater [Septage] Receiving
C. Evolution & Current Handling of FOGW
D. FOGW Codigestion
E. BioGas Utilization
   1. Steam Biosolids Dryer
   2. Combined Heat & Power (CHP) Facilities
F. Future Plans
ORGANIZATION & FACILITIES

- Operating Authority – Staff of 36
- Two Wastewater Treatment Facilities
  - Clearwater WWTP - 5.02 MGD
  - Southwest WWTP - 0.6 MGD (“Unmanned” Satellite WWTP)
- Fourteen Pumping Stations
- 150+ Miles of Sanitary Sewer (6” to 48” DIA)
- NEW FOR 2017 – STORMWATER MANAGEMENT
  (Another whole presentation!!)

VWEA
Virginia Water Environment Association
FIGURE 1
PROCESS FLOW DIAGRAM
DERRY TOWNSHIP MUNICIPAL AUTHORITY
CLEARWATER ROAD WASTEWATER TREATMENT FACILITY
AERIAL VIEW
MAJOR LIQUID STREAM COMPONENTS

- 5.02 MGD Activated Sludge
  - Septage Receiving
    - **FOG PRETREATMENT**
  - Preliminary Treatment
    - Screening & Grit Removal
  - Primary Clarification
MAJOR LIQUID STREAM COMPONENTS

- Activated Sludge
- Mechanical Aeration (Flexible Control)
- Biological Nitrogen Removal (Chesapeake Bay compliant)
  - \((A_2O: \text{anoxic} \sim \text{oxic} \sim \text{anoxic} \sim \text{re-aeration})\)
- Ferric Chloride \((\text{FeCl}_3)\) Addition for “P” Removal
- Enhanced Final Clarification (EDIs & Stamford Baffles)
- UV Disinfection
• Sludge / Biosolids Processing Facilities
  • Gravity Thickening - Primary Sludge
  • DAF – WAS
  • Hershey IPF Sludge
  • Anaerobic Sludge Digestion (two stage + storage)
  • Centrifuge Dewatering
  • Indirect Paddle Dryer
  • Class A – “EQ” Beneficial Reuse
  • Storage & Sale
## 2016 Sludge Production

<table>
<thead>
<tr>
<th>Source</th>
<th>Volume (DT/D)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Sludge</td>
<td>4.75</td>
<td>54</td>
</tr>
<tr>
<td>Was</td>
<td>2.86</td>
<td>32</td>
</tr>
<tr>
<td>IPF Sludge</td>
<td>1.02</td>
<td>11</td>
</tr>
<tr>
<td>DTMA SW WWTP</td>
<td>0.24</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8.87</strong> (3,238 DT/Y)</td>
<td></td>
</tr>
</tbody>
</table>

(Includes estimated 1.2 DT/D (~14%) from Septage / FOG Pretreatment)

### Anaerobic Digestion

<table>
<thead>
<tr>
<th>Digested Biosolids</th>
<th>4.13 (1,512 DT/Y)</th>
<th>53</th>
</tr>
</thead>
</table>
HAULED WASTEWATER RECEIVING

- Septage Receiving
  - Started in August 1991
  - “If you build it they will come!”
- Current Receiving Station
  - Completed in 2000
  - Two Lane, Hauler Kiosk & DTMA Operator Station
  - Lime addition to settle load in primaries
  - Screening & Grit Removal via WWTP Headworks
• Originally Refused FOG Wastewaters (FOGW)
  • Grease was loosely define as 750 mg/l FOG
• FOGW Acceptance “Evolution”
  • Accepted FOGW from Derry Restaurants
  • Requested FOGW be diluted
• Problems, Problems, & PROBLEMS
  • Build up of Grease on Primary Clarifier baffles, weirs, beaches & in the PC center wells.
  • 30 – 40 CY removed from each PC every 3 months
  • Plugging Primary Sludge Line
  • Tear down & flush line every month
  • Visible grease “specks” in digested BFP cake
FOGW PRETREATMENT - GENESIS

• Accumulation in Primary Clarifier Scum Pit
  • Genesis of pretreatment idea
  • Pilot “Digestion” in Scum Pits
  • Bugs, soda ash, & mixing/aeration

• Design Concept for Aerobic Grease Pretreatment
  • KISS
  • Incorporate into existing septage receiving station
  • Provide 48-72 hours of detention (40,000 gal tank)
  • Computer controlled fill & draw
    • Decant MLSS to WWTP Headworks
FOGW PRETREATMENT DESIGN

• Final Design
  • Chopper Pumps (2)
    • **Aeration** (Venturi w/ draft tube)
    • **Mixing** (floor mounted mixing nozzles)
    • MLSS removal via tank level controlled wasting valve
• Addition of Bacteria Delivery System
  • ECOBIONICS™ Biogenerator
BioGenerator$^1$ System Fact Sheet

Operation at the DTMA AGPD

- Four BioGenerators
- 24 Hour incubation cycle
- Daily dose of approximately 30 trillion microbes per BioGenerator
- Dose at 6 AM, 12 noon, 6 PM & 12 midnight

MICROBE SELECTION

- All Class 1 Organisms (no pathogens)
- High Enzyme producers

1. Information Courtesy of Ecobionics, a division of NCH Corporation
# FOGW PRETREATMENT BACTERIA

## SUMMARY OF MICROBES

1. Information Courtesy of Ecobionics, a division of NCH Corporation

<table>
<thead>
<tr>
<th>GENUS SPECIES</th>
<th>CAS #</th>
<th>CLASS</th>
<th>ENZYMES/FOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomonas fluorescens</td>
<td>68332-93-4</td>
<td>Aerobic</td>
<td>Lipase - Multiple Enzyme Sys.</td>
</tr>
<tr>
<td>Pseudomonas putida</td>
<td>68332-91-4</td>
<td>Aerobic</td>
<td>Lipase - Multiple Enzyme Sys.</td>
</tr>
<tr>
<td>Bacillus subtilis</td>
<td>68038-70-0</td>
<td>Aerobic</td>
<td>Protease – Amylase</td>
</tr>
<tr>
<td>Bacillus licheniformis</td>
<td>68038-66-4</td>
<td>Facultatively Anaerobic</td>
<td>Protease – Amylase Cellulose</td>
</tr>
<tr>
<td>Bacillus thuringiensis</td>
<td>68038-71-1</td>
<td>Facultatively Anaerobic</td>
<td>Protease – Amylase Lipase</td>
</tr>
</tbody>
</table>
• FOGW Pretreatment Facility
  • Completed in 2005
  • Aerated & Mixed “Batch Reactor” Tank
  • Fill & Draw
  • Lime addition for pH Control
  • Screening & Grit Removal via WWTP Headworks
• BUT it was/is a work in progress.....
• Post Construction Improvements
  • Grinder/macerator on truck discharge to FOGW discharge connection.
  • Rock trap in front of macerator.
  • Mixing Nozzles Modifications
  • Scum / Foam Control
    • At optimal conditions of pH = 7 and D.O. >1.0, the foam/scum becomes problematic.
• pH Adjustment required due to VFA
  • Original
    • Lime addition; manual control (litmus pH paper)
    • Too much settling
  • Current
    • Magnesium Hydroxide addition; automatic control (pH probe)
2016 Totals – 20.17 MG (~70,500 GPD)
- Septage & Other - 16.11 MG (~56,300 GPD)
- FOGW - 3.27 MG (~11,400 GPD)
- Misc. Sludges - 0.79 MG (~2,800 GPD)
HAULED WASTEWATER FACILITY LAYOUT

- Headworks Building
- Lime Silo
- Septage Valve Vault
- Grinder & Grease Unloading Connection
- Septage Receiving Pads
- Kiosk
- Chemical Building for MgOH
- Grease Digester
- Grease Digester Control Building
HAULED WASTEWATER OVERVIEW
FOGW PRETREATMENT TANK

- MAG HYDROXIDE FEED
- VENTURI AERATION DRAFT TUBE
- FOAM SUPPRESSION
- BACTERIA FEED
- CHOPPER PUMPS (2)
- FOG FEED
- MIXING NOZZLES (BELOW)
FOGW UNLOADING STATION DETAILS
Immediate & Dramatic Results throughout WWTP
- Within a few weeks grease buildup throughout the WWTP was gone.
- Within a few months grease “specks” in biosolids cake disappeared.

Change in delivery philosophy
- Requested concentrated and if possible dedicated grease trap loads.
- “Adjusted” rates to enhance cooperation
• No Digestion in Reactor but, pretreatment & transformation into a non-sticking, high FOG, high VFA, MLSS

• FOGW MLSS discharged into headworks with Plant Influent for Screening & Grit Removal

• Settles out as Primary Sludge
  • Now “CoDigestion”
• Anaerobic digester feed stock
  • High Volatiles
  • Very good alkalinity
• Impact of Biogas Production
  • Because of all the variables involved in the digestion of sludge and the subsequent generation of methane, it is very difficult, to establish a quantitative relationship between the amount of grease wastes received and the volume of methane produce, but clearly a relationship exists.
## CO-DIGESTION BIOGAS PRODUCTION

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>GAS PRODUCED (Ft³ / Lb Digested)</th>
<th>METHANE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fats</td>
<td>20 – 25</td>
<td>62-72</td>
</tr>
<tr>
<td>Scum</td>
<td>15 – 17</td>
<td>70 -75</td>
</tr>
<tr>
<td>Grease</td>
<td>18</td>
<td>68</td>
</tr>
<tr>
<td>Crude Fiber</td>
<td>13 – 14</td>
<td>45 – 50</td>
</tr>
<tr>
<td>Protein</td>
<td>11 – 12</td>
<td>73</td>
</tr>
</tbody>
</table>

Reference: Buswell and Neave, 1939
IMPACT OF CODIGESTION - PRE-FOG PRETREATMENT

BIOGAS PRODUCTION vs. FOGW VOLUME ACCEPTED

SCALE AS NOTED

MONTH

BIOGAS x 10 CF

FOGW GALLONS

2003

2004

2005
IMPACT OF CODIGESTION - CURRENT FOGW PRETREATMENT

BIOGAS PRODUCTION vs. FOGW VOLUME

- BIOGAS x 10 CF
- FOG GALLONS

SCALE AS NOTED

MONTH
BIOGAS UTILIZATION BACKGROUND

- 2000 - ES Anaerobic Digester On-line
- 2003 – BioGas Utilization
  - BioGas used to produce steam and dry biosolids into Class A, EQ Product for sale
  - Some BioGas still wasted
- 2007 – Centrifuge
  - Increased cake solids (18% -> 22%) = 50% reduction in biogas use
  - Increased biogas production from grease acceptance
• 2009 – Cogen & Gas Conditioning Design & Bid
  • Award Contract ($2,200,000)
  • $500,000 PA Green Energy Works (ARRA/DOE) Grant
• 2010 - Unit start-up June
• 2011 - Unit destroyed September flood
• 2012 - Unit replaced March
BIOGAS CONDITIONING
CHP FACILITIES COGENERATION ENGINE
CHP FACILITIES - INSIDE THE ENGINE “BOX”
Heat Recovery Connections

Waste Heat Radiator
CHP FACILITIES - SYSTEM PERFORMANCE

• Electric Power (2016*)
  • 937,100 kWh Power Production
  • Approximately 16% of WWTP consumption
  • ~$72,000 savings @ $0.0768 / kWh
    [*~8 weeks downtime for major service ]

• Recovered Heat (2016)
  • Waste Heat recovered to heat three buildings
  • ~18,000 gallons of #2 fuel oil saved
  • $45,000 savings (@ $2.50 / G)
FUTURE PLANS

- Cell Lysis
  - Pilot Testing
- More Food (Trucked-In)
  - Bulk Food & Off Spec Food Waste
  - PTP DAF Sludges
- Second CoGeneration Unit
  - Sufficient Gas
  - Insufficient ROI (dropping power costs - $0.059/kWH)
CONVERTING FOGW INTO BIOGAS FOR ELECTRIC POWER & HEAT

THE FINAL OBJECTIVE
DOGBERT THE GREEN CONSULTANT

YOUR COWORKERS HAVE IDENTIFIED YOU AS A SOURCE OF METHANE.

IF WE CAPTURE THIS FREE SOURCE OF ENERGY WE CAN POWER A SMALL OFFICE BUILDING.

I GIVE AND I GIVE.