Laying the Path from Disposal Challenge to Opportunity

Bioeconomy 2017: Domestic Resources for a Vibrant Future
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Great Lakes Water Authority
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Great Lakes Water Authority

Began Operations January 1, 2016

- Resulted from mediation during the City of Detroit Bankruptcy
- Regional Authority formed to supply wholesale drinking water and wastewater treatment services
- Leases facilities (5 WTP, 1 WWTP and 8 CSO basins) from the City of Detroit for 40 Years for annual payment of $50 Million (term extends as long as debt is outstanding)
- Detroit must use lease payment for City’s water and wastewater capital investments
- Water Residential Assistance Program - 0.5% of revenues - $4.5 M year one

2017 Service Areas
GLWA Water Resources Recovery Facility

- 675 MGD Avg – up to 930 MDG full primary and secondary capacity
- 1.7 Billion wet weather capacity
- 9 CSO facilities
- 450 Dry Tons per day Biosolids
  - 320-1100 dry tons per day wet weather
- Belt Filter Presses & Incineration
- Lime stabilization & Landfill
- Biosolids Drying Facility
Conventional Wastewater Treatment

- Grit
- Landfill
- Scum - Landfill
- Primary
- Secondary
- Secondary Clarification
- To Sludge Thickening
- To Sludge Thickening
- Cl₂
- SO₂
- Land application
- Ash - Landfill
- Lime
- Drying
- Incineration
- Rivers
Feedstocks for Biofuels production

- **Scum**
  - 80 – 100 Tons per month
- **Primary Sludge**
  - 350 dry tons per day
  - 60-65% Volatile (wet weather 50-55%)
  - Thickened 5-6%
- **Secondary Sludge**
  - 100 dry tons Secondary (Waste Activated)
  - 70-75% Volatile
  - Thickened 2 – 2.5%
- **Daily Sludge flow requiring treatment** 2.5 – 3 MGD
Biosolids Disposal Today

Primary Clarifier

Primary

Secondary

Sludge Thickener

Mix with Waste Landfill

Drying Facility

Dried Biosolids

Land Applied

Primary Sludge Thickener

Sludge Thickener

Dewatering

Blend

Lime

Landfill

Incinerator

Ash Landfill

GLWA
Great Lakes Water Authority
Biosolids Disposal Today

**Disadvantages**

- Utility costs (whole plant)
  - Electricity $12 Million annually
  - Natural Gas $6 Million annually
- Biosolids Dryer
  - Roughly $13 M (@ min)*
  - Land applied for nitrogen, phosphorous and root development
- Untapped Opportunities
  - heat recovery
  - anaerobic digestion
  - energy generation

*began operation in 2016 as initial phase of a biosolids disposal plan and Clean Air Act compliance strategy - with significant annual cost avoidance/savings

**Average energy use WWTP national**
Large Opportunity - Anaerobic Digestion (AD) w/ CHP

Based on a 50:50 blend of PS and WAS

**PS**
- 220 ton/day
- 60% VS

**WAS**
- 200 ton/day
- 75% VS

**Anaerobic Digesters**
- Total SRT: 15 d
- VSR: 50%
- 16 scf gas/lb VSR
- 600 Btu/scf gas

**Digester Gas**
- 223,000 scfh
- 134 mmBtu/h

**Dew. Cake**
- 528,000 lb/d
- 22% TS

**Energy Requirement**
- Evap: 77,000 lb H₂O/h
- Energy: 127 mmBtu/h

**Dried Solids**
- 264 dtpd @ 95%TS

**Heat Recovery**
- 49 – 63 mmBtu/h

**Electricity**
- 12 – 17 MW/HR

*1/3 Baseline

*50% Volume Reduction
Investigation and Planning Underway

**Steps**

Minimize Energy use on liquid side
Investment Grade Audit launching shortly

Maximize energy harvest from solids
- Solids have to be brought to the WWTP with minimum retention time in the collection system
- Carbon has to be conserved through liquid processes

**Profile of Potential**

- Primary Solids
  - Inerts: 50%
  - Volatiles - Not Readily Biodegradable: 30%
  - Volatiles - Readily Biodegradable: 20%

- Waste Activated Sludge
  - Inerts: 26%
  - Volatiles - Not Readily Biodegradable: 55%
  - Volatiles - Readily Biodegradable: 20%
Biosolids to Energy Puzzle

Enhanced Primary

Scum
Food Waste
Off Site Sludge

Sludge

HTL

Aqueous

Biofuel

Solids

Gasification → Fuels

Gasification

Drying

Dried Biosolids

Incineration

Anaerobic Digestion

Ash

Biofuel

Biosolids
HTL Puzzle Section

HTL → Biofuel

- Aqueous
- Ammonia
- Methane

Biofuel →

- Refining
- CHP
- BDF

Refining →

- Liquid Fuel
- Waste Heat
- Electricity

其他？

Phosphorous
Known

The basics

- 450 Dry tons per day
- % Volatiles
- % inert
- Geographic locations
- Refinery
- Steel Mills
- Local WWTP biosolids
- Sources of food wastes

Some constraints

- Available space
- Newer Biosolids Drying Facility and 20 year operating contract
- Aging Incinerators
- Existing regulations
- Air permitting
- Sale of electricity
- Risk considerations

Opportunities

- New international bridge
- Utility of the future
- Carbon regulation is coming
- Migrating energy production
- Rapidly advancing technology
## Specifics

- Anaerobic Digestion, HTL, Pyrolysis w/wo co-processing materials
  - Energy production potential
  - Impact of recycle streams on secondary treatment
- Inventories of co-processing materials
- Availability of co-processing materials
- Regulatory requirements if co-processing
- Energy balances for different scenarios
- Markets for products

## Economics

- Cost to construct
- Projected operation and maintenance costs
- Value of carbon credits
- Value of energy recovered
  - electricity, liquid fuels
- Value of other products
  - nitrogen
  - phosphorous
  - bioplastics
  - industrial chemicals
- Potential operational savings
The Path

Research

Elimination of scenarios

Process modeling
As the funnel narrows

Master Planning

Pilot scale testing

Construction