Waste Product to Resource – Biosolids Handling at City of Wisconsin Rapids

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2006 Wastewater Facility

- Screening/Grit Removal
- Primary Clarification
- Conventional Activated Sludge
- Final Clarification
- UV Disinfection
2006 Wastewater Facility
Sludge Handling

- Anaerobic Sludge Digestion – 2 Primary Digesters
- Gravity Belt Thickener for WAS
- Liquid Sludge Storage
- Contract Haul Disposal
2006 WWTP Design Capacity

- **Average Daily Flow**: 5.16 mgd
- **BOD Load**: 8,927 lbs/day
- **TSS Load**: 9,272 lbs/day
2006 WWTP Flows and Loads

- Average Daily Flow: 4.0 mgd
- BOD Load: 11,177 lbs/day
- TSS Load: 7,063 lbs/day
2006 Capacity Limitations

- Limited Activated Sludge Capacity
- Sludge Storage Tank Limited to 132 Days Storage
What Happened?

- Ocean Spray Added Larger Juice Line
- High Strength Cranberry Waste Discharged to Sewer
- No Communication from Ocean Spray
Communication Restored

- Ocean Spray Planned Dried Cranberry Production
- Industrial Agreement Reached
- Second Cranberry Company Requested Annexation for Wastewater Service
Design Conditions

- 5.28 MGD
- BOD Load – 18,386 lbs/day
- TSS Load – 10,994 lbs/day
- TKN – 1,181 lbs/day
- P – 177 lbs/day
City Design Philosophy

- Design for Projected Conditions
- Allow for Expansion on Site and in Structures
- Include Sustainable Features Where Practical
- WWTP to be a Resource to City
  - Attract Industry/Jobs
  - Capture Value in Waste
Sludge Treatment Alternatives

- Expand Mesophilic Anaerobic Digestion
- Convert Anaerobic Digestion Process to Temperature Phased Anaerobic Digestion (TPAD)
- Class A vs. Class B
**Pros**
- Reduce Fecal Coliforms to Class A Level
- Higher VSS Destruction
  - More Biogas
  - Less Sludge for Disposal

**Cons**
- Higher Initial Cost
TPAD

- Design for Class A
  - Convert Existing Mesophilic Digesters to Thermophilic Digesters
  - Use Time/Temperature Criteria to Meet Class A Requirements
  - New Mesophilic Digester
Sludge Handling/Storage Alternatives

- Liquid Sludge Storage
- Dewater Sludge/Cake Storage
- Dewater Sludge/Sludge Drying and Storage
Sludge Handling/Storage Alternatives

- **Liquid Sludge Storage**
  - 4% - 5% Solids
  - Two Large New Tanks Required
  - High Cost Disposal

- **Dewater Sludge/Cake Storage**
  - 18% - 22% Solids
  - Remote Site Required
  - Lower Cost Disposal
Dewater Sludge/Sludge Drying and Storage

- 75% - 90% Solids
- Remote Site – Drying Pad
- Lowest Cost Disposal
- Class A – Use as Soil Conditioner/Landscaping
Sludge Handling

- Dewater and Drying Selected
- Dewater at WWTP
- Store and Drying Pad in Industrial Park
- Class A Sludge to be Used in City Landscaping
  - Reduced Cost
  - Waste to Resource
Biogas Utilization Evaluation

- TPAD Increases VSS Destruction and Biogas Production
- Biogas Production Exceeds the Need for Digester Heating
Biogas Utilization Alternatives

- Digester Heating in Biogas Boiler
- Biogas Engine Driven Equipment (Blowers/Pumps)
- Electrical Generation
- Combined Heat and Power
Biogas Utilization

- Combined Heat and Power Selected
- Engine Generator Selected Based on Efficiency
- Microturbines Evaluated but Had Lower Overall Efficiency
Engine Generator

- Dual Fuel Operation Possible (Biogas and Natural Gas)
- Heat Recovery from Engine Coolant
- Heat Recovery from Engine Exhaust
- Overall Energy Efficiency = 83%
- Biogas Boiler Available as Back-up
TPAD Process Operation

- Volatile Solids Reduction – 63.7%
  - 10% Improvement from Mesophilic Operation
TPAD Design Features

- Two Thermophilic Tanks
- Feed One Tank Each 24 Hours
- Automated Feed System
- Complex Piping
- Simple Operation
- Sludge Feed Small Amounts Each Hour
TPAD Design Features

- Common Feed Tank
  - Primary Sludge
  - Thickened WAS
- Piped to Accept High Strength Waste
- Caustic Feed for pH Control
TPAD Design Features

- Automated Withdrawal Sequence
  - Mesophilic Sludge to Dewatering
  - Thermophilic A Sludge to Mesophilic
  - Fresh Sludge to Thermophilic A
  - Thermophilic B Holds at 131° F.

- Mesophilic Digester Has Cooling Heat Exchanger
Biogas Production

- Biogas Production = 70,000 cubic feet/day
  - 48,000 cubic feet/day From Volatile Solids Destruction
  - 22,000 cubic feet/day From High Strength Cranberry Waste Fed Directly to Digesters
Electrical Generation

- Biogas Engine Provides 29% of Total Electrical Demand
- Biogas Engine Operates During Peak Demand Hours (8 AM to 9 PM)
Hot Water Usage

- Waste Heat from Biogas Engine Used for Process Heat in Building
  - Sludge Heating
  - Building Heat
Sludge Dewatering

- Rotary Press Selected
- Enclosed System – Low Odor
- Low Water Use
- Can be Stopped For Truck Unloading
Sludge Dewatering

- Land Available in Industrial Park for Storing and Air Drying Sludge
- Asphalt Pad Built by City
- Runoff Collected in Basin with Outlet to Sanitary Sewer
- Sludge Stored and Dried in Windrows
Sludge Dewatering

- Dewatered Sludge – 18 – 22% Solids Concentration
- Drying Bed Sludge – 86% Solids
Class A Performance

- **Digester Feed Sludge** – 625,000 MPN Fecal Coliform
- **Dewatered Sludge** - <326 MPN Fecal Coliform
- **Class A Requirement** = <1,000 MPN Fecal
- **Time/Temperature** = 24 hours at 131°F
Summary

Before Project

- Biosolids are Waste Product
- High Cost for Disposal
- Restrictions on Handling
- Sludge Handling Capacity Limited
Summary

- After Project
  - Biosolids are Resource
  - Capacity Available to Attract Customers
  - Fuel to Make Biogas
    - Electricity
    - Hot Water
  - Class A Biosolids
    - Low Volume
    - Soil Amendment
    - Safe to Handle