Agenda

• Thermal Hydrolysis Background
• Blue Plains Background
• Design Issues
• Current Status at Blue Plains
• Upcoming and ongoing research
• Summary
Thermal Hydrolysis Background

Thermal Hydrolysis is a process by which sludge is heated and pressurized with the purpose of reducing organic solids to make them more readily biodegradable.
Thermal Hydrolysis Background

- Manufacturers
  - Cambi Systems (>30 facilities)
  - Veolia/Kruger (Exelys – 2 facilities + 1 demonstration)
  - SH&E Group (Lysotherm 2 demonstration 1 facility in design)
Blue Plains Advanced Wastewater Treatment Plant

- Operated by DC Water
- 391mgd (ADWF capacity)
- ~160 acre site
- Largest Advanced WWTP in the world
DC Water has an Extensive Wastewater Collection Area

- 2.2 million pop served (4 million “Population Equivalent”)  
- Includes all of the District of Columbia and portions of Virginia and Maryland suburbs  
- A portion of the service area has combined sewers

Source: DCWater.com
Blue Plains AWTP Current Processing System

- NPDES Permit
  \(~4.2\text{ mg/l TN}\)
  (Mass-based Limits)

- P-removal
  NPDES limit < 0.18 mg/l
Major Programs are Using Most of Remaining Footprint at Blue Plains

- **BP Tunnel Dewatering Pump Station & Enhanced Clarification Facility**
  - $300 million

- **New Filtrate Treatment Process**
  - $84 million

- **Upgrade & expansion of the Nit/ Denit system**

- **Enhanced Nutrient Removal Facilities**
  - $340 million

- **Upgrade of the Secondary High Rate System**
  - $26 million

- **New Biosolids Management Program**
  - $460 million

- **Dual Purpose Sed Basins Upgrade**
  - $18 million

- **Overview of Projects and Costs**
Determined that TH/Digestion was Best for DC Water

- Anaerobic Digestion remains the cornerstone of BMP
- Least reactor volume and small footprint
- TH by Cambi proven at large-scale and can be implemented in USA
- Produces well-dewatered and high quality product
- Class A product (diversification) needed long-term for sustainable program
- Produces best energy scenario and GHG reduction
- Board of Directors of DC Water approved recommendation in 2008
Main Process Train Design Build

- Pre-Dewatering Building
- Thermal Hydrolysis (Cambi) Process
- Digesters
- Screenings Building
Selected Design Issues

- Sludge Conditioning for THP
- Control and Transfer of Sludge to THP
- Sludge Viscosity post-THP
- Biosolids Cooling
- Rapid Rise Event Contingencies
- Gas Production
- Condensate Control
Sludge Conditioning

- Screening required to 5 mm
  - Reduces wear on THP components
  - Reduces risk of pressure vessel failure
  - Increased life of pump stators

- Dewatering to 15% to 18% DS (>16.5% avg)
  - Design basis for Cambi throughput is 16.5% DS
  - Optimize processing time
Control and Transfer of Sludge

• Control of inlet solids concentration is critical
  – Based upon concentration vs. headloss curves created during startup
  – Will change as equipment ages
  – Inlet solids concentrations should be monitored daily
Sludge Viscosity

- Preliminary work done by Dr. Matt Higgins
- Thermal hydrolysis greatly reduces apparent viscosity
- Digestion after THP further reduces apparent viscosity
- Rheology similar to sludges at 1.7 to 1.9x concentrations
Comparison of Mesophilic Anaerobic Digestion (MAD) and Cambi-MAD Viscosities

![Graph showing the comparison of apparent viscosities between MAD and Cambi-MAD at different concentrations.](chart.png)

- **2.0% MAD**
- **2.9% MAD**
- **3.6% MAD**
- **3.9% MAD**
- **3.9% Cambi-MAD**
- **5.5% Cambi-MAD**
- **6.1% Cambi-MAD**
Biosolids Cooling Design Parameters

- Cooling water max inlet T = 81°F
- Max cooling water flow = 7,000 gpm (total all HEX’s)
- Sludge Discharge T = 100°F
- Sludge Velocity = 6.5 fps
- Cooling HEX - 9.6 MMBtu/Hr per digester
- Tuning HEX - 1.3 MMBtu/hr per digester
Biosolids Cooling

- Hydrolyzed biosolids exit THP at up to 194°
- Cooling sources
  - Dilution water
  - Solids blending
  - Tube-in-tube heat exchangers
- Sludge max inlet T = 112.7°F
- Viscosity = 20 cP to 35 cP
Rapid Rise Contingencies

- Freeboard in each digester
- Overflow wetwell (shared between each pair of digesters)
- Total storage is 400,000 gallons each digester
- Additional standpipe storage allows overflow rate of 24,000 gpm
- Mixers are bi-directional
- Considering standby power for digester mixers
Biogas Production

- Hydrolyzed sludge biodegrades at a higher rate
- Expect 55% to 59% VS removal
- No gas storage other than headspace
- Digester gas pressure 50% higher than typical (18” w.c. vs. 12” w.c.)
- Significant H₂S not expected due to high ferric dosing in liquids train
Condensate Control

• Condensate collection for each digester
  – Higher gas production
  – Reduces risk of plugging

• Sideline condensate collection
  – Lower headloss
  – Minimizes plugging from foam
Project Status

• Design – Completed July 2012
• Construction Permits obtained – Foundation January 2012, Final Permits August 2012
• Construction –
  – Site Preparation completed December 2011
  – MPT Mobilization January 2012
  – Pile installation completed June 2012
  – Concrete installation completed June 2013
  – Mechanical Completion 1st Train– scheduled for May 2014 (seeding of digesters)
  – Final Completion November 2014
Upcoming and Ongoing Research

• Led by Dr. Sudhir Murthy – DC Water
  – Investigation Team: Ahmed Al-Omari (DC Water), Dr. Matt Higgins (Bucknell Univ.), Josh Mah and Trung Lee (VA Tech)

• Studies
  – Digestion start-up
  – Digestion and Thermal Hydrolysis Process Control (TH temperature range of 130°C to 170°C)
  – Digestion – Rapid Rise
  – Dewatering – polymer dose and cake solids
  – Permit – rDON production and removal
Summary

- First US THP Plant and will be largest in the world
- THP Successfully implemented at plants of varying size
- THP Requires significant sludge pre-conditioning
- Sludge cooling requirements must be considered
- Ongoing research into effects of THP on digester operations and sidestream impacts