Agenda

• Introduction to Cambi
• What is Thermal Hydrolysis
• Main Benefits
• Cambi THP Plant Configuration
• DC Water Blue Plains Project
• THP O&M
Cambi the Company

• Started late 1980’s in Norway as Kambi
• Technology originally developed for the paper pulping industry
• Company bought by Petrol Holdings in early 1990’s
• Odd Egil Solheim & Per Lillebø
Cambi the Company

Cambio = change *(Spanish masculine noun)*

Currently

- 150 Employees
- Offices in China, USA, UK, Germany, Spain, Singapore and headquartered in Asker, Norway
- Manufacturing facility in Manchester, UK
Cambi THP Systems Worldwide

• 1995 - First full scale facility in Hias, Norway
• Over 55 Installations or contracts worldwide
• 20 Years of continuous operation
• 2015 - First operational installation in United States - the BIGGEST IN THE WORLD!
CAMBI SERVES A POPULATION OF MORE THAN 50 MILLION PEOPLE WORLDWIDE

SEOUL – DUBLIN – OSLO – BRUSSELS – ATHENS
SANTIAGO DE CHILE – EDINBURGH – CARDIFF – AND 20+ OTHER CITIES
What is Cambi Thermal Hydrolysis?

Process for preconditioning biosolids prior to anaerobic digestion

Stage 1: Pressure Cooker

- Dissolves extra-cellular polymetric substances (EPS)
- Increases solubility
- Time/temperature destroys pathogens resulting in Class A Biosolids
Stage 2: Rapid Depressurization

Rapid depressurization results in steam explosion, cellular disintegration and a dramatic decrease in viscosity.

Cells Before Hydrolysis

Cells After Hydrolysis
Dramatic Viscosity Reduction

Dewatered Cake 16.5% tds

Hydrolyzed Sludge 14% tds

Digester Feed 10.5% tds

Digested Sludge 5 - 6% tds

Dewatered Cake 30 - 35% tds
Thermal Hydrolysis Main Benefits

- Highly digestable solids
  - Accelerates Volatile Solids Reduction (VSR) and methane production
  - Lowers required Digester Hydraulic Retention Time (HRT)
  - Increase in high quality methane gas production

- Maximizes use of existing infrastructure
  - Reduces or eliminates the need for expansion

- Great end produce
  - Class A, highly dewaterable end product
  - Lower quantity for disposal = cost savings
Thermal Hydrolysis Plant Configuration

Feed sludge (18% solids)

Pulper Tank

Reactor #1

Reactor #2

Reactor #3

Reactor #4

Flash Tank

Recycled Steam

Flash Line

steam 150 psi

Hydrolysed sludge to digestion (10–16% solids)
Cambi THP Animation
Blue Plains Overview

• 391 mgd average day capacity
• ~160 acres
• Serves DC, plus areas of MD and VA
• Advanced secondary treatment – filtration, N and P removal
• Discharges to Potomac River and Chesapeake Bay
Planning and Research Spanned 10 Years

Quality Research

Technology Research
Class B Bio Solids Land Application

1200 wet tons/day of lime stabilized biosolids

- Agriculture – 39 counties in MD and VA
- Silviculture – 40,000 acres permitted in 8 Virginia counties
- Poplar plantation on a gravel mine
- Reclamation projects – three sites to date
Project Drivers and Objectives

1. Biosolids planning goals
   • Produce Class A Biosolids
   • Reduce final quantity
   • Enhance long term reliability

2. Generate electricity to meet one third of Blue Plains needs

3. Reduce project costs
   • Higher loaded, smaller digesters
   • Smaller project footprint
THP Project Design & Delivery

• Four independent Cambi THP trains each rated at 112.5dtpd. Whole system rated at 450dtpd.

• Design based on standard B12 linear train layout with six reactors per train.

• Manufactured in the US and UK.

• 20 month site installation started August 2012.

• Control system by Emerson – Ovation PCS.
THP Overview – Emerson PCS
Feed Loop Overview – Emerson PCS

- TH solids fed at 10.5% tds to four 3.8 million gallon digesters
- Increased feeding flexibility of the loop design
**THP Commissioning & Start-up**

Commissioning

- Thorough control system testwork with Emerson carried out both off and on site.
- Systems integration, including surrounding support systems.
- THP trains functionally tested using water.
- Full Automatic operation with water.
THP Pressure Trends

- Heat and pressure are generated via steam from CHP facility.
- Approx. 1 pound of steam per pound of solids is required.
THP Commissioning & Start-up

MPT Seeding: 1st Truck
THP Commissioning & Start-up

Plant Start-up

• A very cautious approach was taken, one train operating intermittently feeding approx. 20,000lbs of VS into digester 1 on day 1 (around 7% of the existing VS in the digester)

• THP throughout ramped up 3-5% each day.

• All THP trains started up over the following three months.

• Processing all of DC Water’s sludge by March 2015.
The “Intensified Cambi Digester”

DC Water Digester Loadings
Digester #1 of 4
Project Summary

Process Performance

Operational targets:
- Cambi feed sludge TS – 16.5%
- Digester feed TS – 10.5%
- Cambi reactor – 87 psi, 330°F

Digester conditions:
- Temperature = 100°F
- TS = 5.5 %
- Ammonia-N = 2800 mg/L
- pH = 7.6
- Bicarbonate alk = 8,000 mg/L +/-
- Approx. 65% VSR

Reached Class A February 2015
Project Summary

Beltpress Performance

- Loading rate:
  - 1000 lbs/m/hr avg
  - 1500 lbs/m/hr peak
- Diluting feed from 5% to 3.5%
- Cake TS = 30 - 32%
- Polymer dose = 18 lb/dt +/-
- Filtrate and wash water are collected separately
- High ammonia filtrate will be treated using DEMON (2017)
Project Summary

Cambi THP O&M

Training:
• O&M Training complete May 2015
• Shadow Training complete July 2015

DC Water Operations:
• Two operators for whole MPT due to fully automated operation
• Operators monitor, sample and carry out daily PM’s

DC Water Maintenance:
• Carry out more major PM’s – averages around two hours per week for THP
Modular Cambi THP

B-2 System: 8 x 40’ Footprint
24 dry tons per day

B-6 System: 30 x 40’ Footprint
90 dry tons per day
Thank you

Benn Astbury
benn.astbury@cambi.com