Biosolids Planning from an End Use Perspective

Natalie Sierra and Perry Schafer

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Brown AND Caldwell

Overview

- How are Biosolids Used?
- What are End Use Considerations?
- Intro to thermal hydrolysis
- Case Studies:
  - DC Water
  - San Francisco PUC
- Conclusions

Biosolids Products and Markets

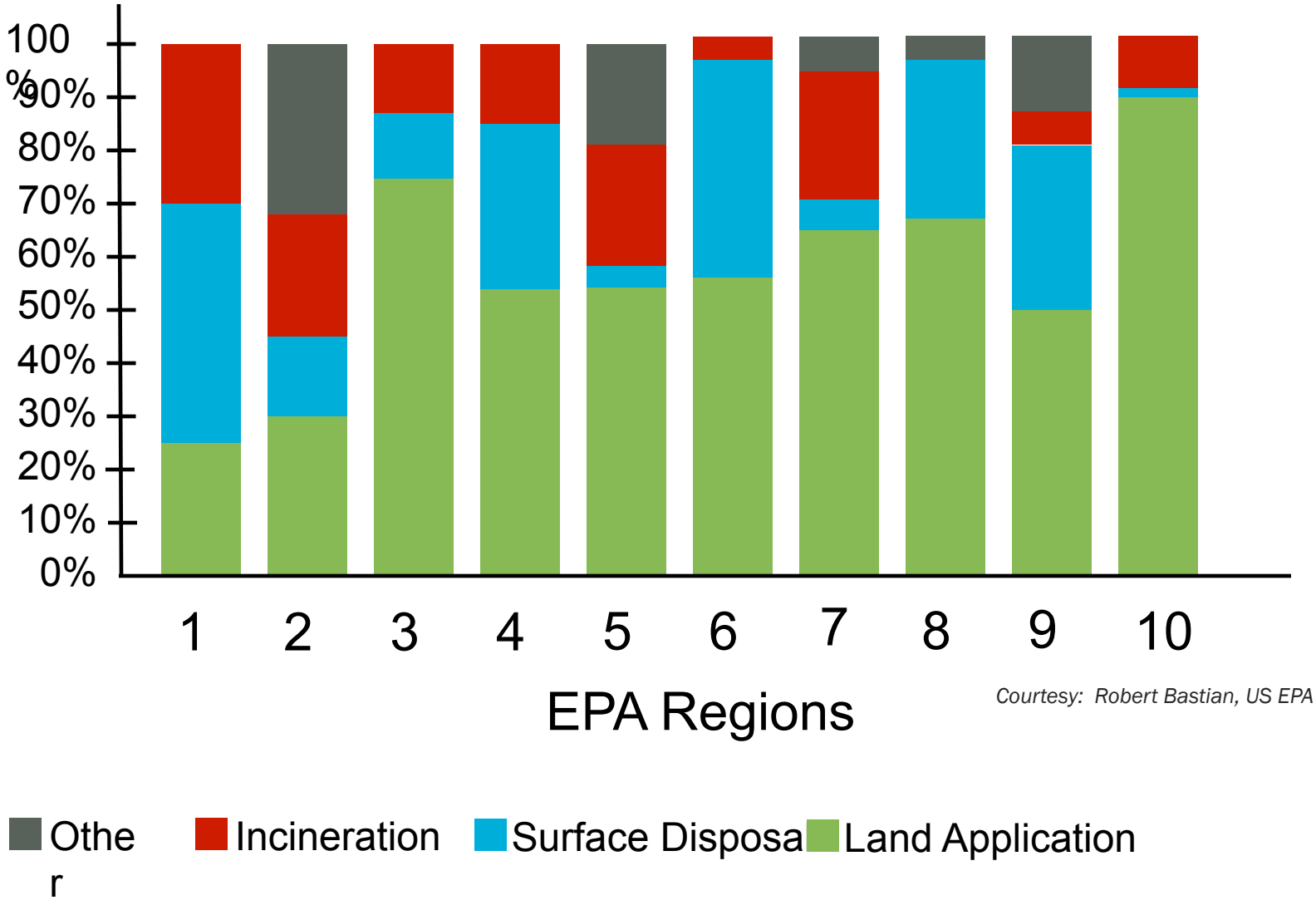
Biosolids Products:

- Cake (Class A or Class B)
- Dried Product
  - Pellets
  - Granules
- Compost
- Soil Blends
- Char
- Ash

Biosolids Markets:

- Bulk Agriculture
- Landscaping/horticulture
- Municipal projects
- Golf courses
- Fertilizer blending
- Redevelopment
- Energy

How are Biosolids Used?



Courtesy: Robert Bastian, US EPA

End Use Considerations

- Product vs. technology
- Accessible markets
- Degree of flexibility and diversity desired
- Risk perception
- Product consistency

"Cake production decreased to less than half, from a total of 19,600 tons in 2004 to 9500 tons in 2006"

Stefan Kawecki and Piotr Pastwa
Kapusciska wastewater treatment, Bydgoszcz, Poland

Cake Product – Before Cambi

Cake Product – After Cambi

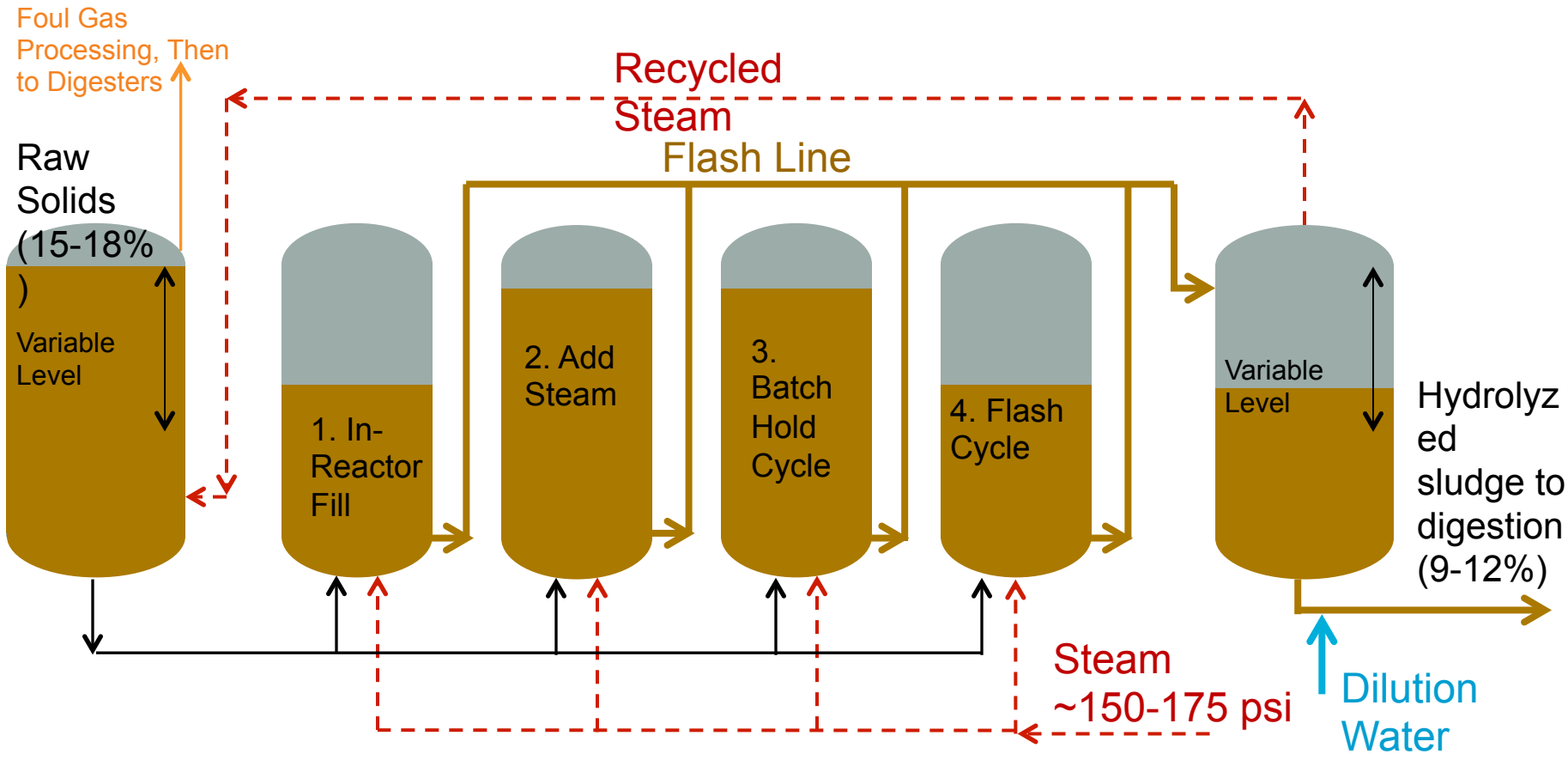
Different Processes Generate Different Product Quality

Example: Cambi Thermal Hydrolysis

- Granular, Class A biosolids
- Easily stored and land-applied
- Low odor
- Higher value products are possible

Bottom line: Working with an end product that can access more markets can stabilize product costs long-term

Cambi™ Thermal Hydrolysis Process (Mark II)



1. In-Reactor Fill Cycle
2. Add Steam to Reach 90 psi, 320 F
3. Batch Hold Time (Class A)
4. Flash (steam explosion) to Flash Tank

Why the Attention on the Thermal Hydrolysis?

- Extensive research showing TH Benefits (Haug et al, 1978 and others)
  - Greater digestion performance - more biogas/energy and less solids for disposition
  - Improved dewatered cakes
  - Allows thick digester feed, with low viscosity slurry
  - <half typical digestion tankage is required
- Easily meets EPA Class A time/temp if batch/plug-flow
  - 140° to 180° C for 20 to 30 minutes
  - This is “sterilization”, not pasteurization

THP Vendors and Offerings are Expanding

Cambi™

- 1995 initial plant (Hias Norway)
- Most systems are batch (Class A)
- Currently, 29 plants operating world-wide and additional plants are in design and construction
- World's Largest THP/digestion at DC Water (370 mgd) was started in Fall 2014, operating well
- Reactor sizes: 2, 6, and 12 cubic meters
- Sole-sourced at DC Water and HRSD, and won Franklin, TN competitive selection process

Veolia - BioThelys™

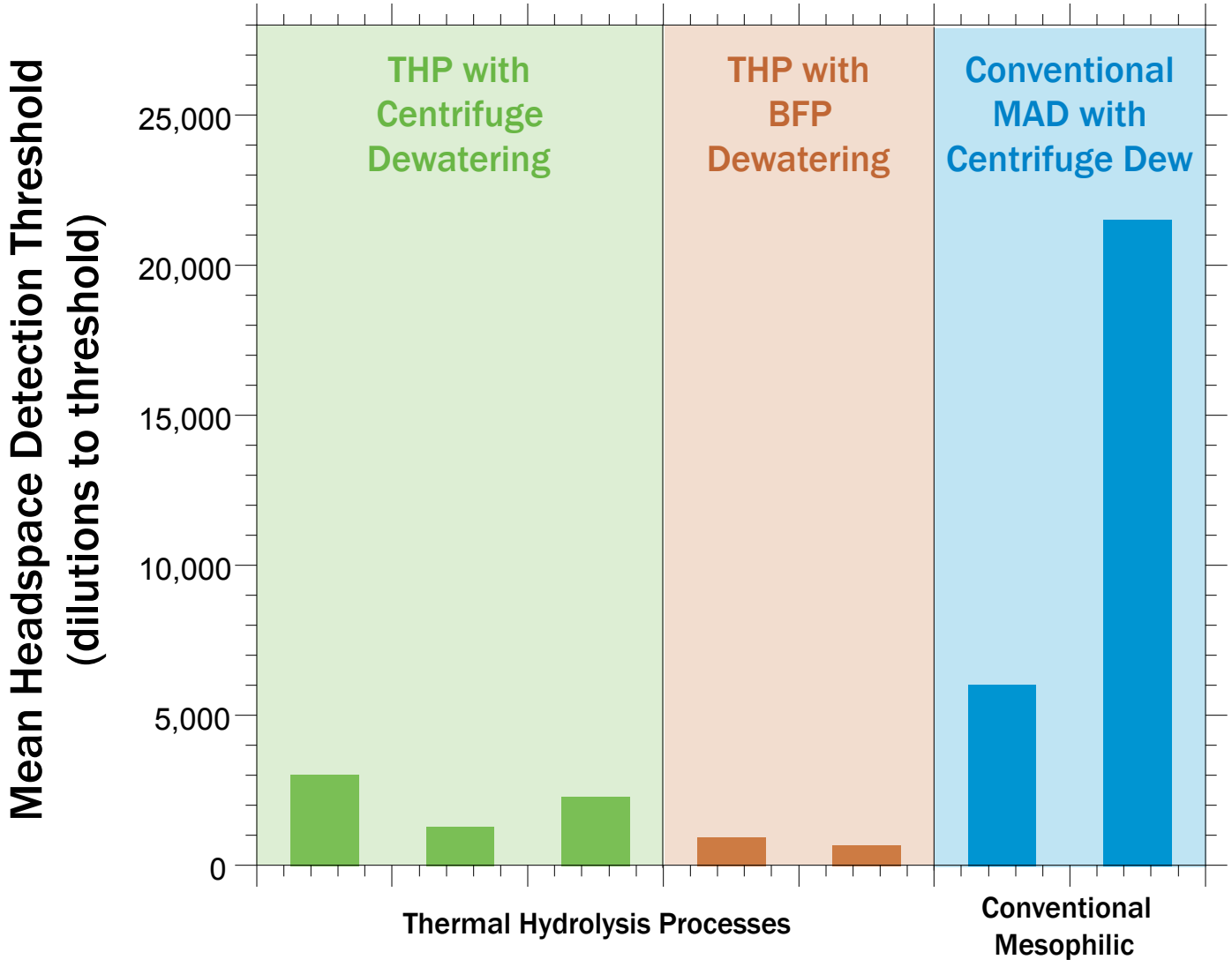
- Batch THP system – installed at a few plants in Europe (LD configuration)
- Two larger systems are now in startup in the UK
- Not being marketed in the US

Veolia/Krüger - Exelys™

- Uses plug flow arrangement – i.e., "continuous" flow reactor
- Installed at a few small or demonstration plants in Europe (DLD configuration)

Thermal Hydrolysis Digested Dewatered Products from the UK

TH/Digestion Cake Odor from Field Sites



Case Study:
DC Water

- Class B lime stabilized biosolids, spread and stored across Virginia
- Public opposition to biosolids land application
- Potential for regulatory changes to biosolids land application
- High energy and disposal/reuse costs
- Earlier digestion project cancelled due to high capital costs

Re-Evaluation of Biosolids Alternatives in 2007 used Updated Research/Information

- DC Water recognized the need for biosolids product improvement and diversification over time
- 12 Alternatives developed/evaluated
  - Various anaerobic digestion processes
  - Digestion pretreatment including TH
  - Thermal drying options
  - Many options used existing lime stabilization capacity to handle peak/abnormal events
- Employed expert panel as part of the evaluations

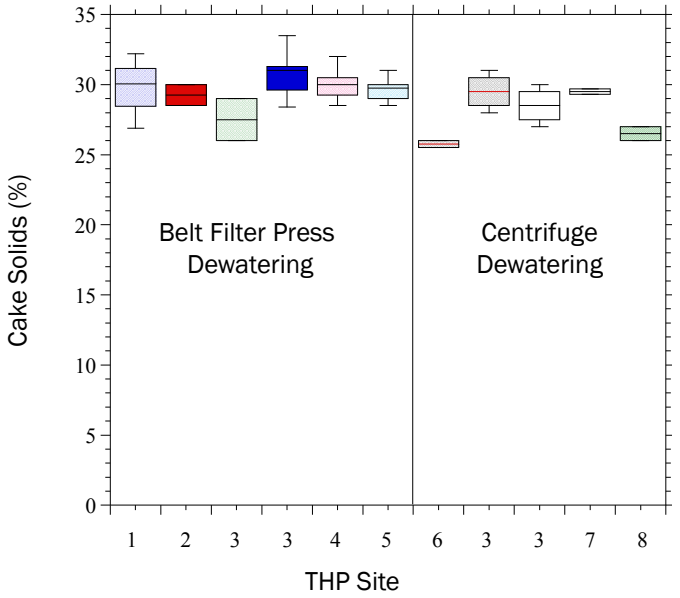
Evaluation included site visits at TH/digestion plants in the UK

Biosolids Program Drivers
DC Water

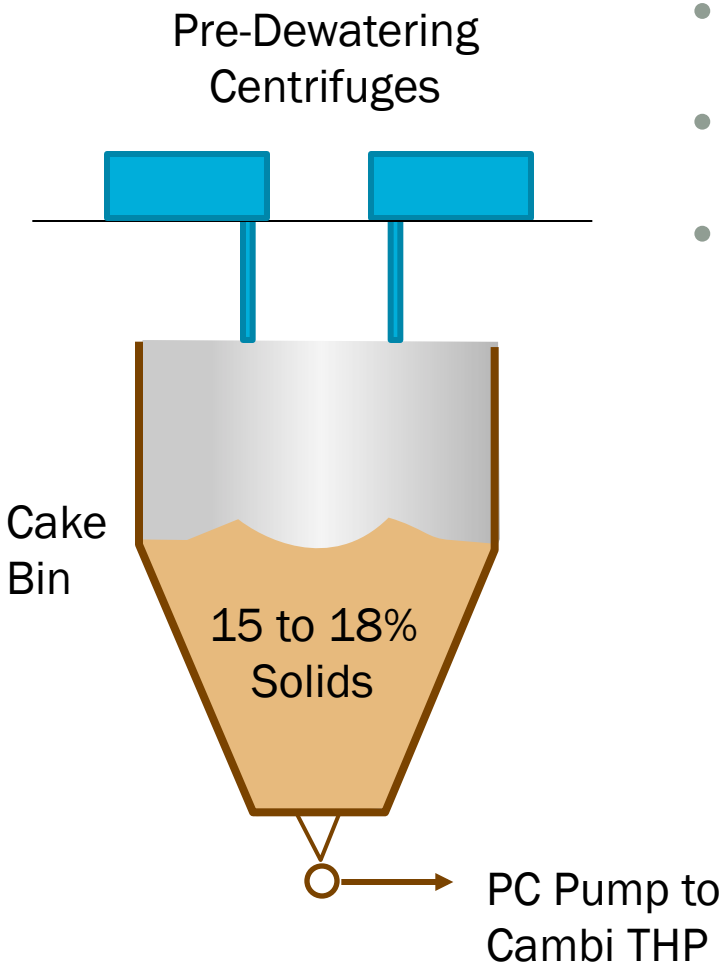
- Reestablish a digestion/energy program at Blue Plains that has long term sustainability
- Greatly reduce biosolids volumes
- Produce a low odor, well dewatered biosolids product with potential for “beyond-ag” uses
- Produce renewable power to offset plant energy needs
- Achieve Class A biosolids

Preserving Cake Quality - Belt Filter Presses Selected over Centrifuges

- Detailed business case evaluation of BFPs vs. centrifuges
- Both technologies achieve ~30% solids
- BFPs use less energy
- Net present value of options was similar - space requirements also similar
- No regrowth with either, but odor regrowth potential with centrifuge
- BFP pilot testing in U.K. on Cambi/digested feed – to determine parameters for design



Preserving Cake Quality - Minimizing Cake Conveyance



- A mantra at DC Water!
- Cake drops directly into cake bins
- Pre-dewatered cake pumped minimum distance to THP trains Final Dewatering (BFP) cake-single belt conveyor to loadout

Win-Win Project:
DC Water

- Thermal hydrolysis (Cambi) facilities on-line
- Produce 13 MW electricity through combined heat and power
- Anticipate further program savings through generation of a marketable soil blend
- Estimated 50,000 metric ton reduction in CO2e emissions

Savings on end use:
No net impact on ratepayers

Case Study:
San Francisco

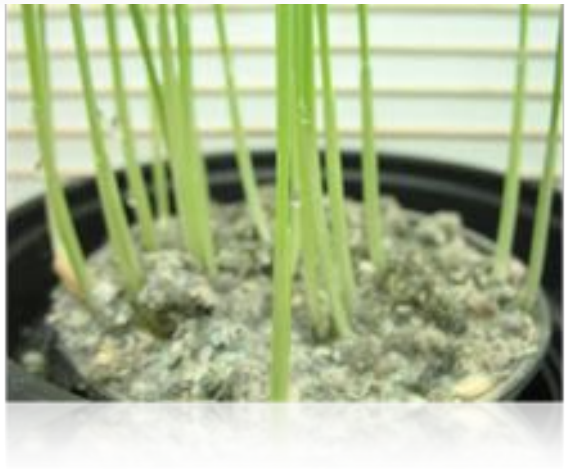
- Class B biosolids through anaerobic digestion, used in land application and landfill cover
- Regulatory and public pressure on both available outlets
- Rising end use management costs
- Vulnerable, aging solids handling infrastructure

Case Study:
San Francisco

- Upgrades at two treatment plants to Class A processes
- Diversification of end uses through planned product marketing within the Bay Area
- Near-term exploration of regional collaborations for Class A and biosolids-to-energy interim options

Summary: Higher Value Products Can Reduce Program Costs

- Cambi or other Class A processes can be the basis for a higher value product (e.g. DC Water soil blend)
- Marketable products can introduce diversity to your biosolids portfolio, decreasing end use risk



Summary: How Does Upgrading Biosolids Treatment Help?

Improve process reliability

- Produce a higher quality, potentially less odorous product
- Perception of decreased public health risk
- Potential to decrease overall program management costs (e.g. improved dewatering, decreased product quantity, reliable access to end use sites)

Class A products allow access to a broader range of markets

Creating opportunities for diversificatio n can help control longterm risks and costs

Introduction of new/ different product in the biosolids marketplace can create a “niche” and create a unique market advantage

Questions?

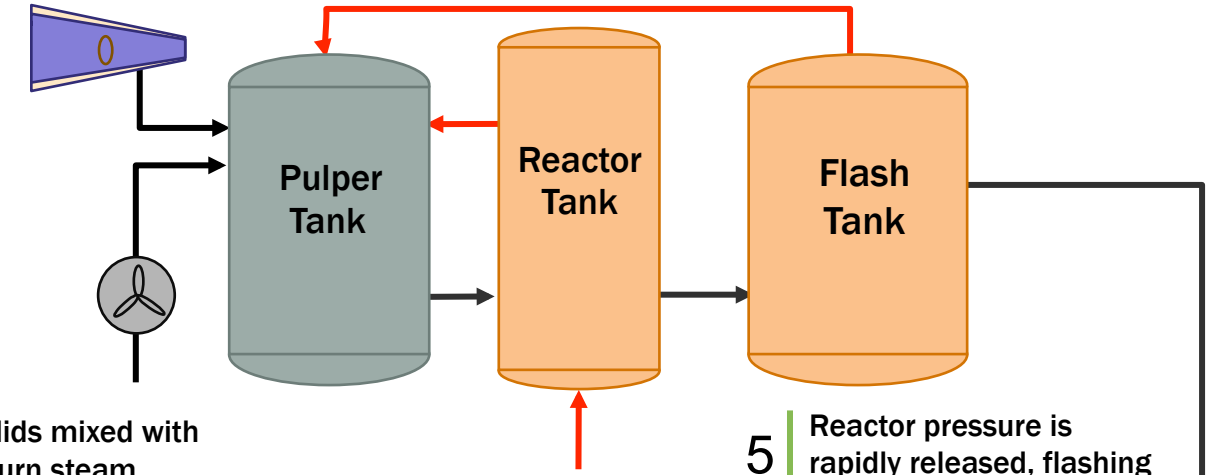
Natalie Sierra, P.E.

nsierra@brwncald.com

Cambi™ Thermal Hydrolysis Process

1 **Solids are dewatered to ~17%, then to Pulper**

4 **Pressure in reactor reduced to 60 psi.**
- Steam is returned to Pulper



2 **Solids mixed with return steam**

3 **Solids are heated by direct steam addition to 320° F and 90 psi for 30 minutes**
- Class A time vs temp.
- Organic compounds are solubilized

5 **Reactor pressure is rapidly released, flashing solids to the flash tank.**
- Flashing causes cells to rupture
- Steam is returned to Pulper Tank
- Hydrolyzed solids have reduced viscosity

Class A biosolids
Reduced volume
- 30 % solids cake
- 60 % V.S. destruction