

Low Temperature Thermal Hydrolysis Process for Biosolids and Organics Management

Lystek THP®
Enhancement of Anaerobic
Digestion and BNR With Your Existing
Cake



PA Water & Wastewater Technology
Summit

November 1st 2018

Lystek Overview

- Multi award-winning provider of proven solutions for biosolids & organics management
- Founded in 2000 at the University of Waterloo, Ontario with offices & numerous successful operations in the USA & Canada
- Patent protected Clean/Green technology that has been repeatedly recognized as environmentally responsible & sustainable
- Low temperature Thermal Hydrolysis Process (Lystek THP®)



Current Installations

Location	Status	Capacity (WT/Y)	Site	LysteGro Class A/ EQ/CFIA	LysteMize Digester Enhancement	LysteCarb BNR Carbon Source
Guelph	2008	18,000	On-Site	Yes	Full-Scale Pilot	N/A
St. Marys	2010	3,500	On-Site	Yes	N/A	Full Scale
*Southgate	2012	150,000	Off-Site	Yes	N/A	N/A
*Iroquois	2012	40,000	Off-Site	Yes	N/A	N/A
Elora	2014	3,500	On-Site	Yes	N/A	N/A
North Battleford	2014	3,500	On-Site	Yes	N/A	N/A
*Fairfield	2016	150,000	On-Site	Yes	Full Scale	Future
St. Thomas	2018	5,600	On-Site	Yes	N/A	N/A
Innisfil	2018	5,500	On-Site	Yes	Future	N/A
St. Cloud, MN	2018	15,000	On-Site	Yes	Future	Future
Goleta	2018	Demo	On-Site	Yes	Full-Scale Pilot	N/A
*Regional facilities serving cities - Ontario: Toronto, Ottawa, Waterloo, Niagara, Peterborough; Owen Sound - California: Fairfield, San Francisco, EBMUD, Santa Rosa, Central Marin, Petaluma						

Lystek THP - One System, Multiple Benefits

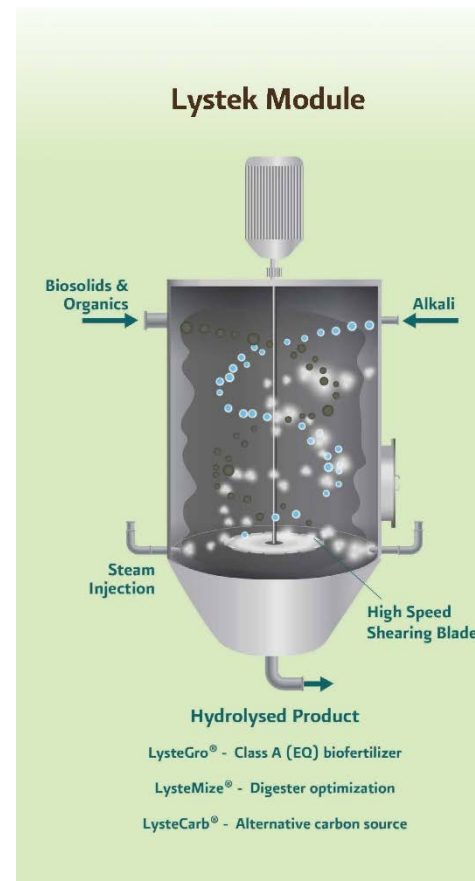
Produces a completely hydrolyzed, multi-use, end product:

- **LysteGro®**: Biofertilizer - Class A EQ (U.S. EPA), CDFA (California) & CFIA (Canada)
 - Nutrient rich, high solids (13-16%) liquid
- **LysteMize®**: Anaerobic digestion enhancement
 - Improves biogas yields, reduces solids
- **LysteCarb®**: BNR carbon source
 - Safer, cost effective, replaces commercial compounds such as methanol or glycerol

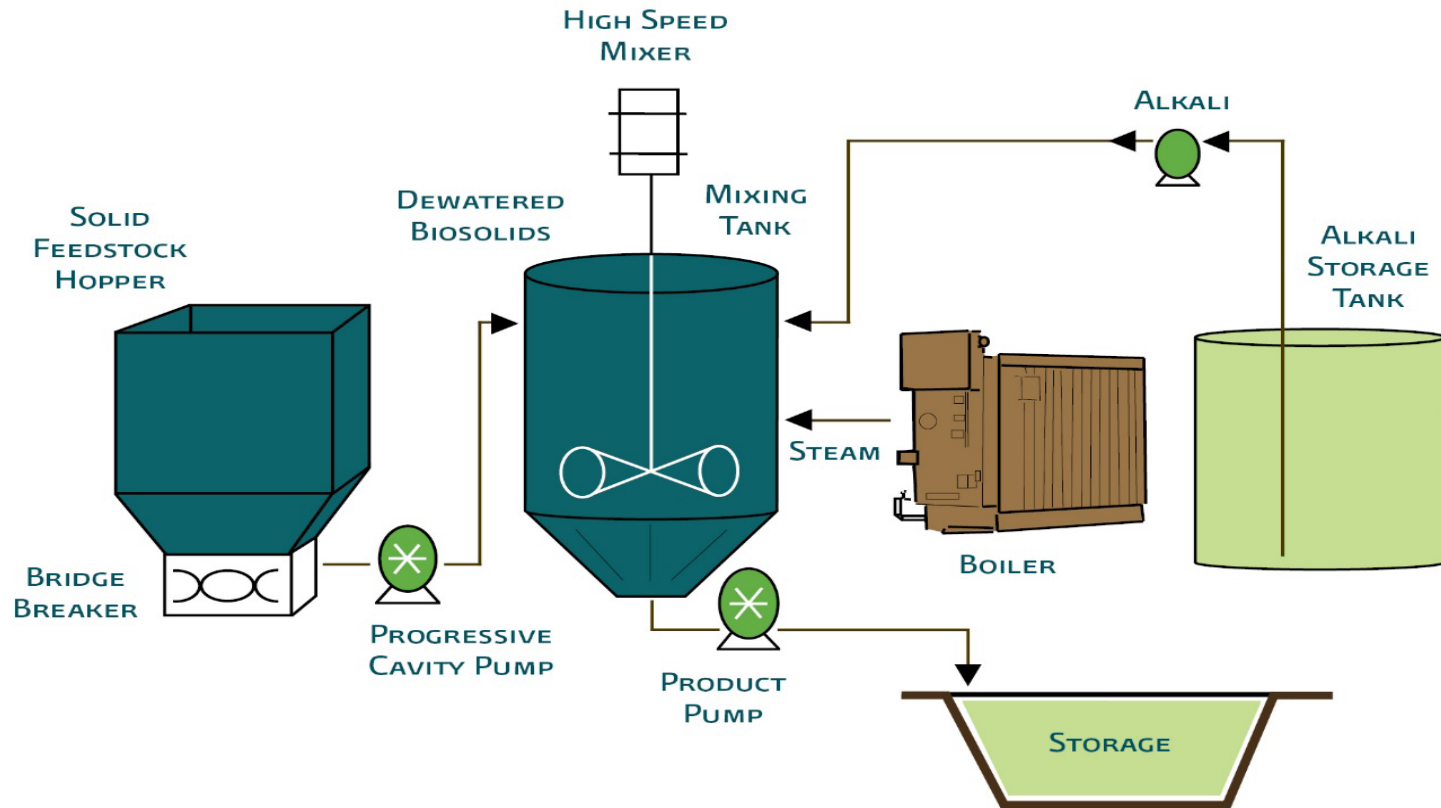


How Does it Work?

- Processing time = minimum 30-45 minutes – total 1 hr
- Processes 1%-35% biosolids and/or non-hazardous organics w/combination of:
 - Heat - low pressure steam injection (15 psi max), low temperature – 167°F (75°C) (Reactor Vessel Non-Pressurized)
 - High speed shearing/mixing (Max 1000 RPM)
 - Alkali for pH adjustment (9.5 - 10) to facilitate hydrolysis (~268 lb/dry ton)
- No additional waste (i.e. side streams/centrate) to further treat/manage



Lystek Process Flow Diagram

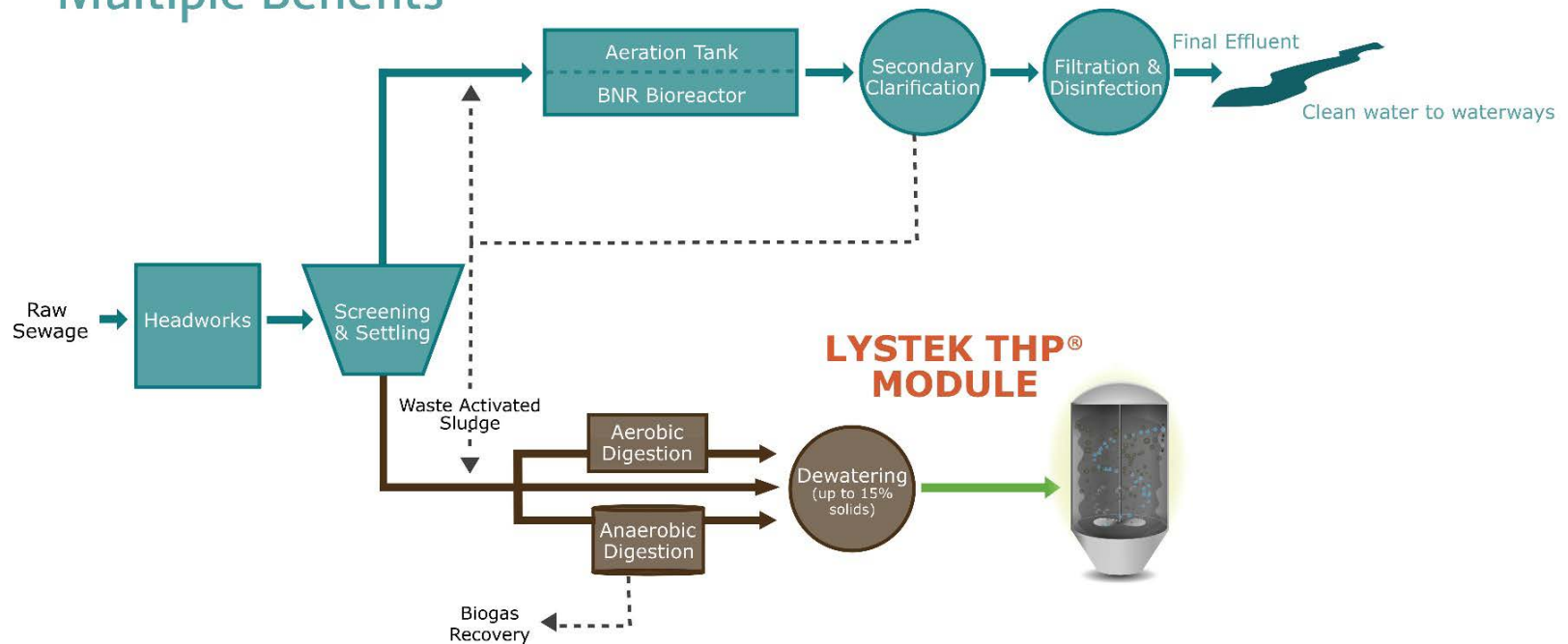


No proprietary or specialized equipment required



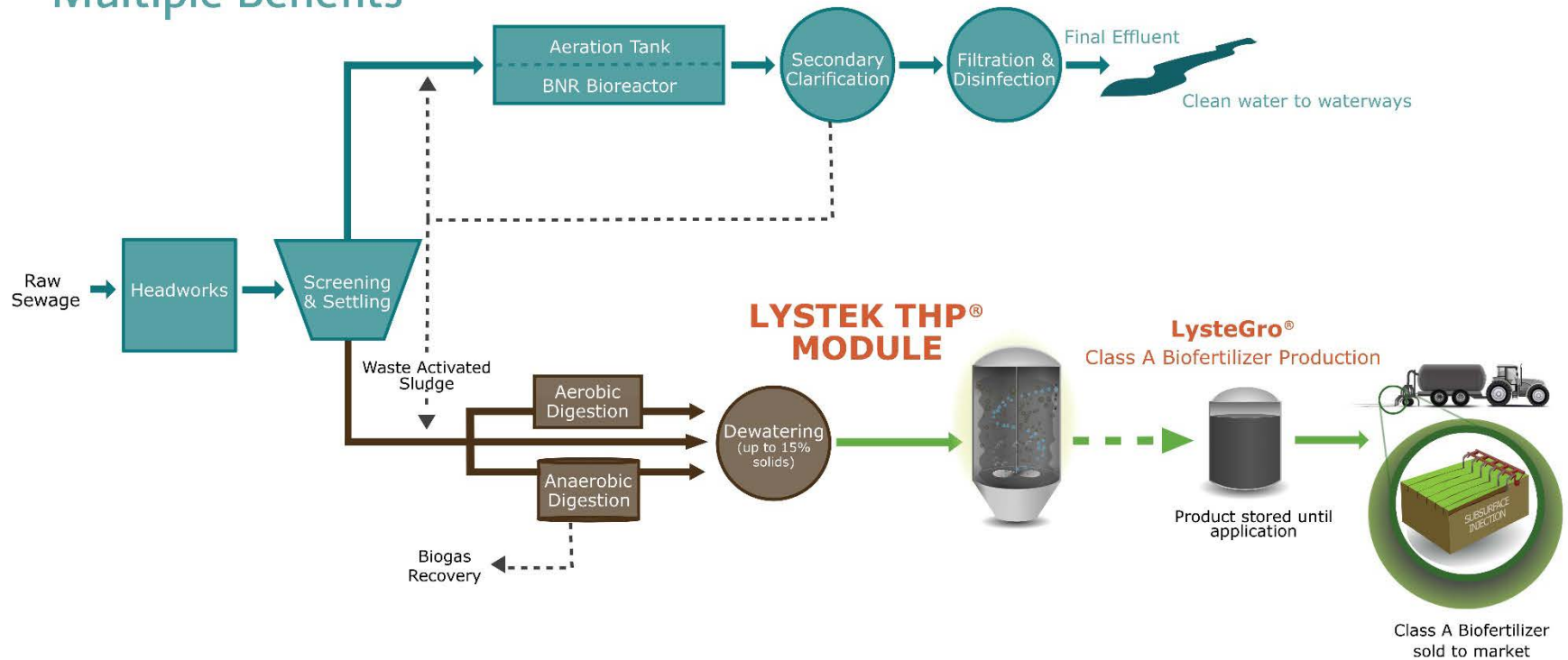
Overview – Lystek THP WWTP Integration

One System
Multiple Benefits



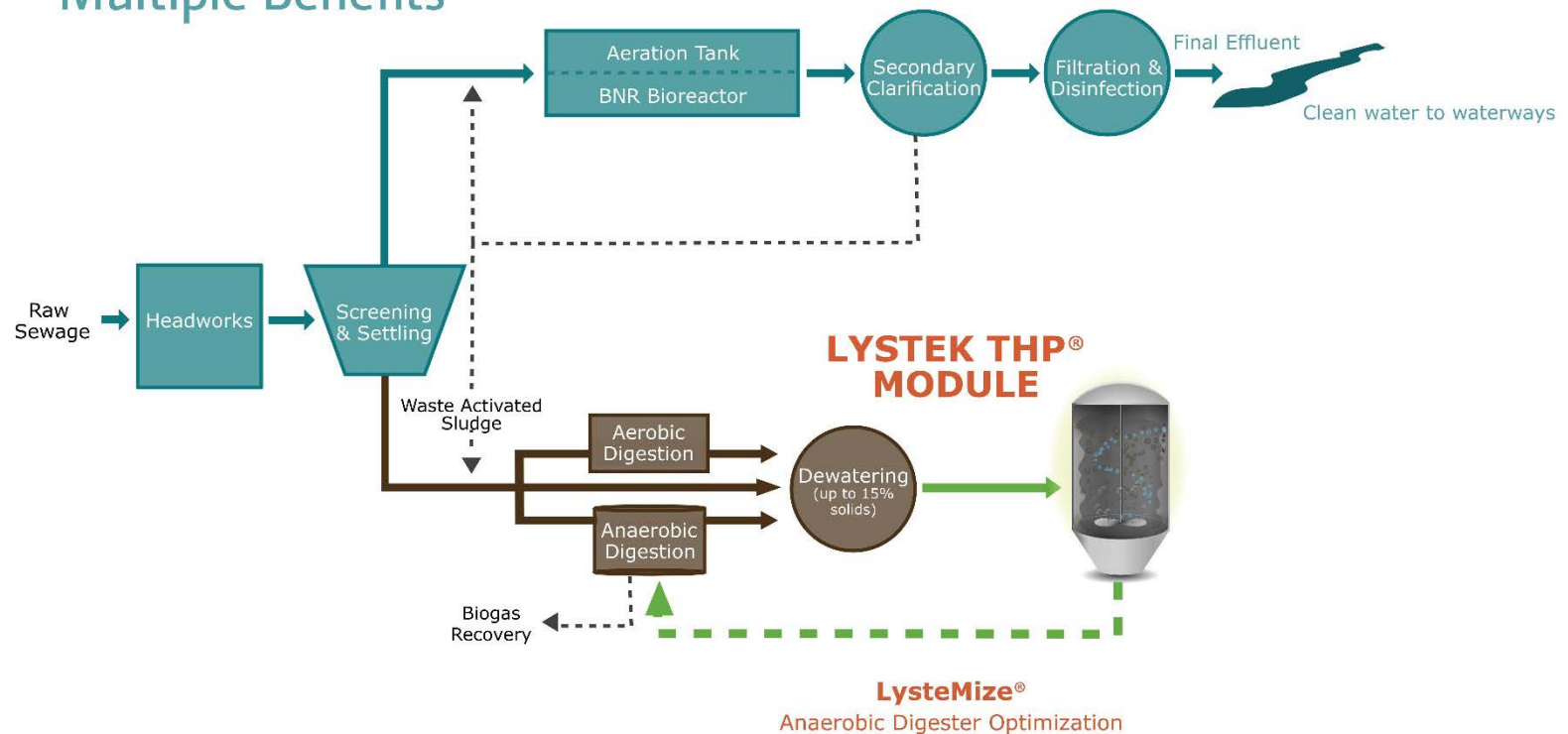
Overview – LysteGro Biofertilizer

One System Multiple Benefits



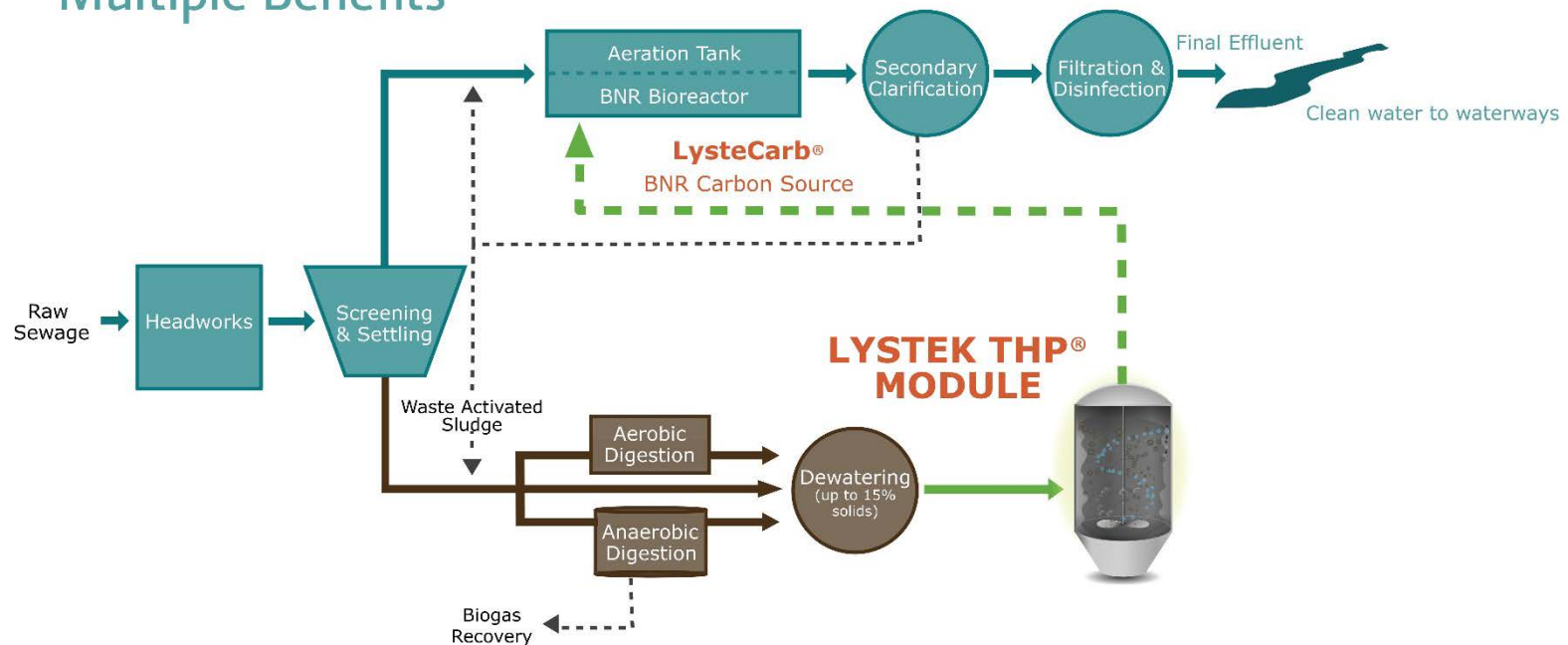
Overview – LysteMize AD Optimization

One System
Multiple Benefits



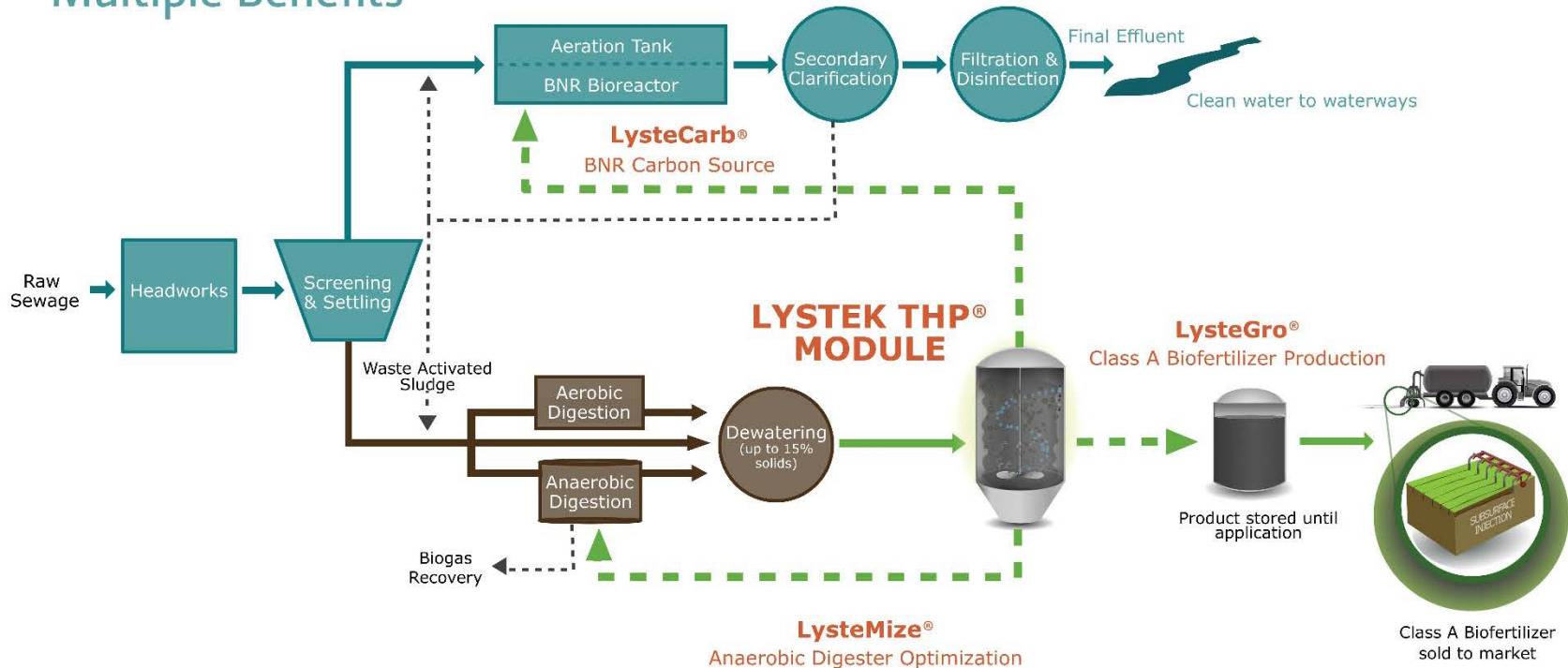
Overview – LysteCarb BNR Carbon Source

One System
Multiple Benefits



Lystek THP – Operational Flexibility

One System
Multiple Benefits



The Lystek System

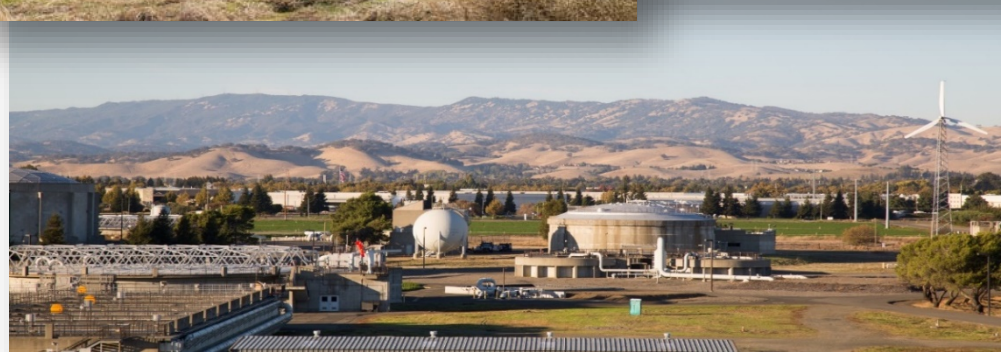
Process Reactor & High Speed Shearing Blade



Regional Processing Center (OMRC)

Fairfield-Suisun, California, USA

- First US deployment
- Capacity = 150,000 tons/year
- LysteGro biofertilizer production
- LysteMize anaerobic digester enhancement
- Lystek Reactor – 16 WT/h Capacity



2018 New Lystek Installation

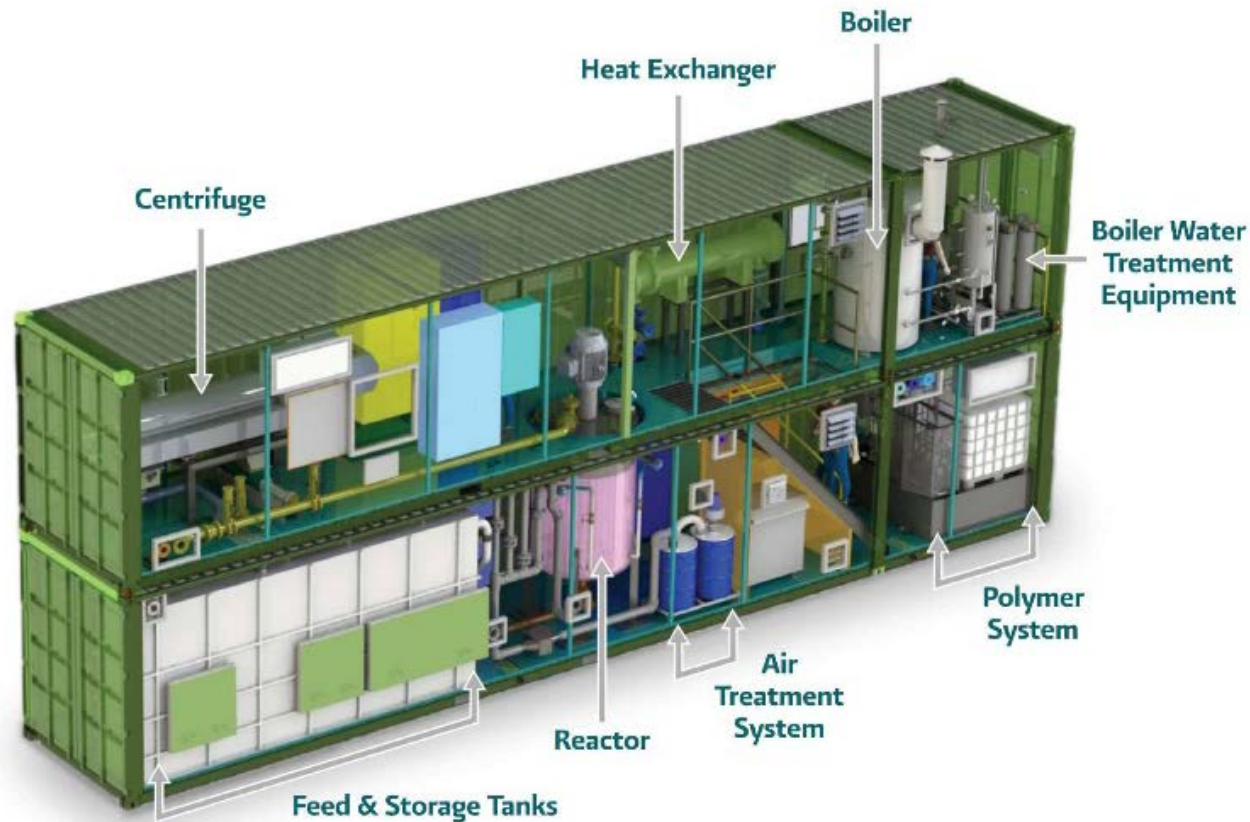
St. Cloud, Minnesota, USA



- Upgrade of biofertilizer product to Class A EQ
- Reduced solids production
- Enhancement alongside Ostara process
- 15,000 W/T per year processing capacity



Lystek Mobile THP[®] - 3 WT/h Capacity



LysteGro – Biofertilizer Product

- Homogeneous liquid/ high solid (13-16%) product
- Viscosity <5,000 cP
- Fully pumpable using conventional equipment
- Enhanced treatment = pathogen-free/Class A EQ
- Nutrient rich (NPK 4:3:2)
- Long-term storage stability
- No pathogen regrowth issues



BNR Enhancement - LysteCarb

- BNR enhancement can be realized utilizing the soluble COD in the carbon provided by the LysteGro product
- Practical application onsite – St. Mary's Ontario
- Ability to complement nutrient management technologies existing currently (St. Cloud, MN)
- Multiple studies available – Manhattan College, Chicago MWRD, Western University, etc.



BNR Enhancement – LysteCarb Testing

- **Manhattan College, New York: 2014**
 - Independent study on potential of Lystek biosolids as a carbon source in BNR systems - using a variety of sludges
 - Lystek shows significantly higher specific denitrification rates (SDNR)
 - Additional, detailed studies underway

	Early Rates - First 30 minutes			
Carbon Source	Stamford	26th Ward	Battery E	Hunts Pt
Endogenous	-0.0208			-0.0597
Primary Effluent	-0.0284	-0.0309	-0.0495	-0.1384
Methanol	-0.0443		-0.0462	
Glycerol		-0.0493	-0.0277	-0.0586
Lystek	-0.0491	-0.1832	-0.0656	-0.0920



Average SDNR Values (mg NO_x-N/mg VSS)



Is Class A Sludge in my Future?

- I think producing Class A sludge sounds great
- I like the idea of reusing my biosolids as a fertilizer, **BUT**
- I currently get rid of my biosolids at a very low cost **OR**
- I have a sweetheart deal, I get rid of my sludge at low or no cost because I accept landfill leachate at a penny per gallon
- So do I really need Lystek Technology?

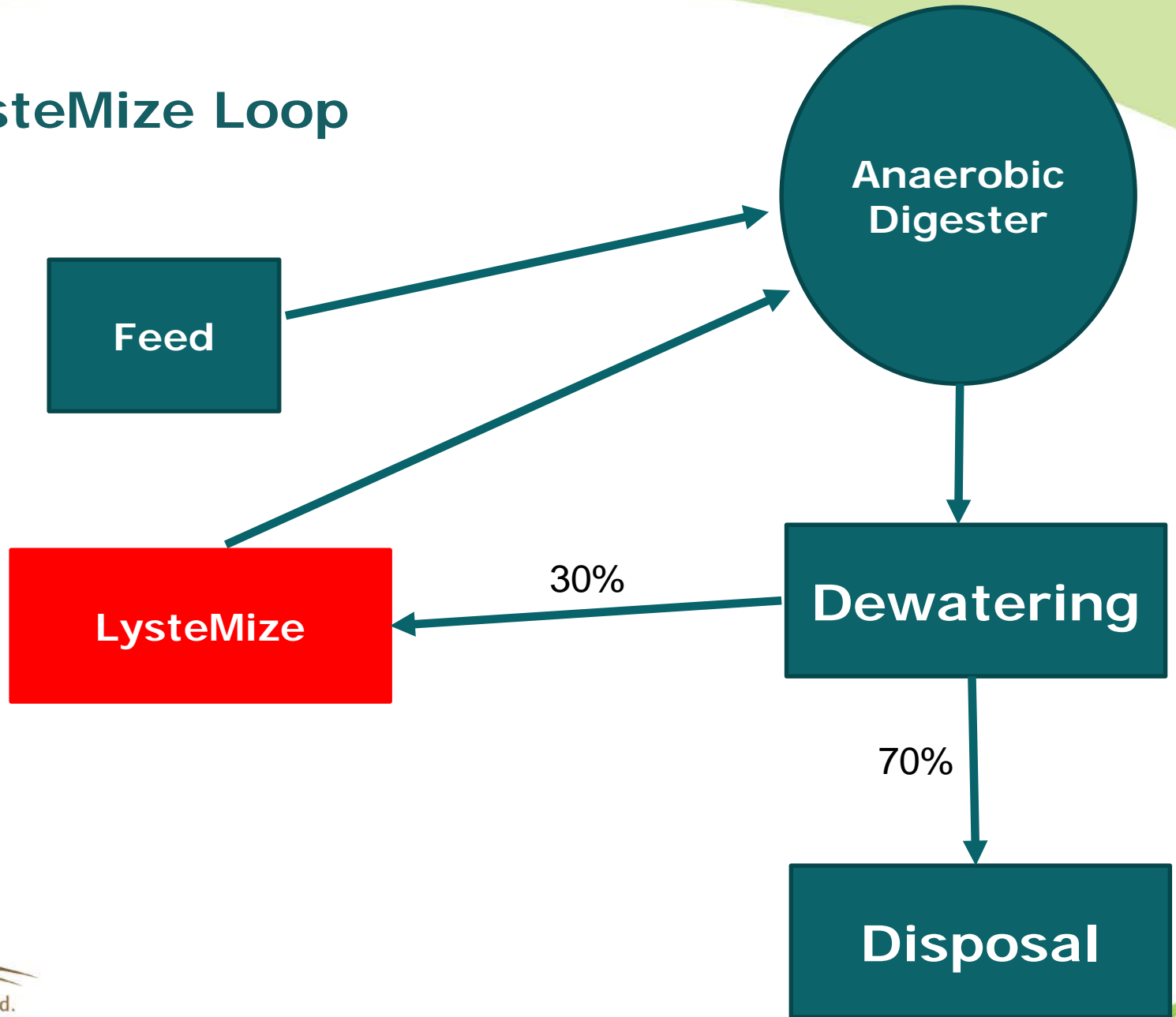


Why Not LysteMize Only?

- My anaerobic digester does a great job converting organic waste to biogas
- My anaerobic digester reduces my sludge volume reducing disposal by 30%+
- But when the anaerobic digestion process is complete, I am sending many tons of carbon and volatile solids to the landfill
- Can I get more energy out of my existing sludge?



The LysteMize Loop



Digester Performance Enhancement

- City of Guelph, Ontario – Full-scale pilot study:
 - >40% extra biogas and >25% solids reduction by re-feeding the Lystek product into the test digester
 - Biodegradability of VS in Lystek product was 65-70%

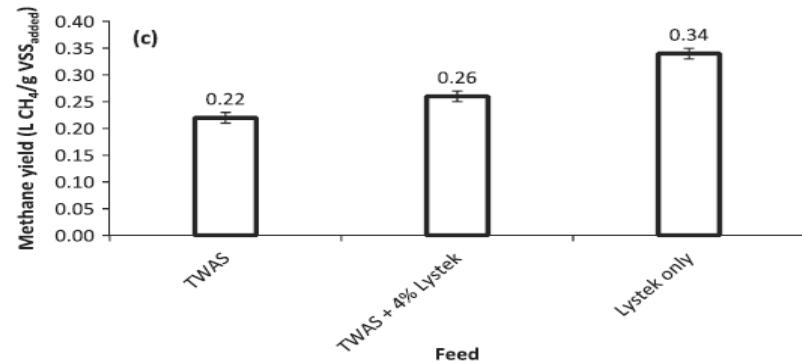
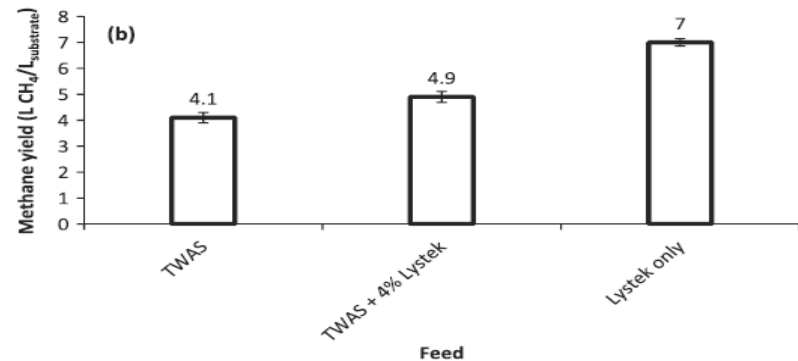
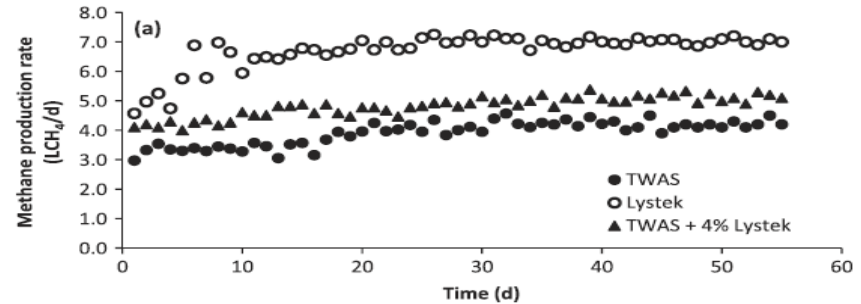
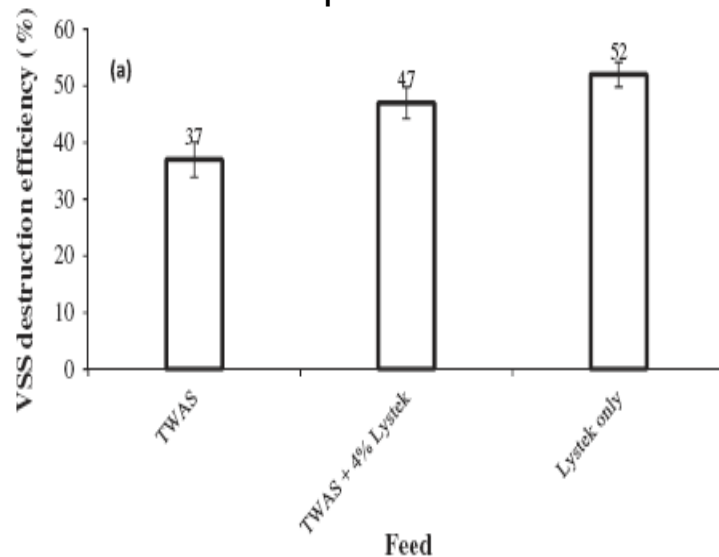
Parameters (average of different feed rates over 6 months study)	Control Digester without Lystek biosolids	Test Digester with Lystek biosolids
Influent VSS primary sludge (kg/d)	2307	2278
Lystek VSS (kg/d)	0	921
Combined Influent VSS (kg/d)	2307	3199
Effluent VSS (kg/d)	1118	1222
VSS Destroyed (%)	51	62
Biogas production (m ³ /d)	1189	1977



TWAS Digestion Enhancement

- St. Marys, Ontario 2013

- Independent lab study at Western University
- >40% increase in VSS destruction efficiency and methane production

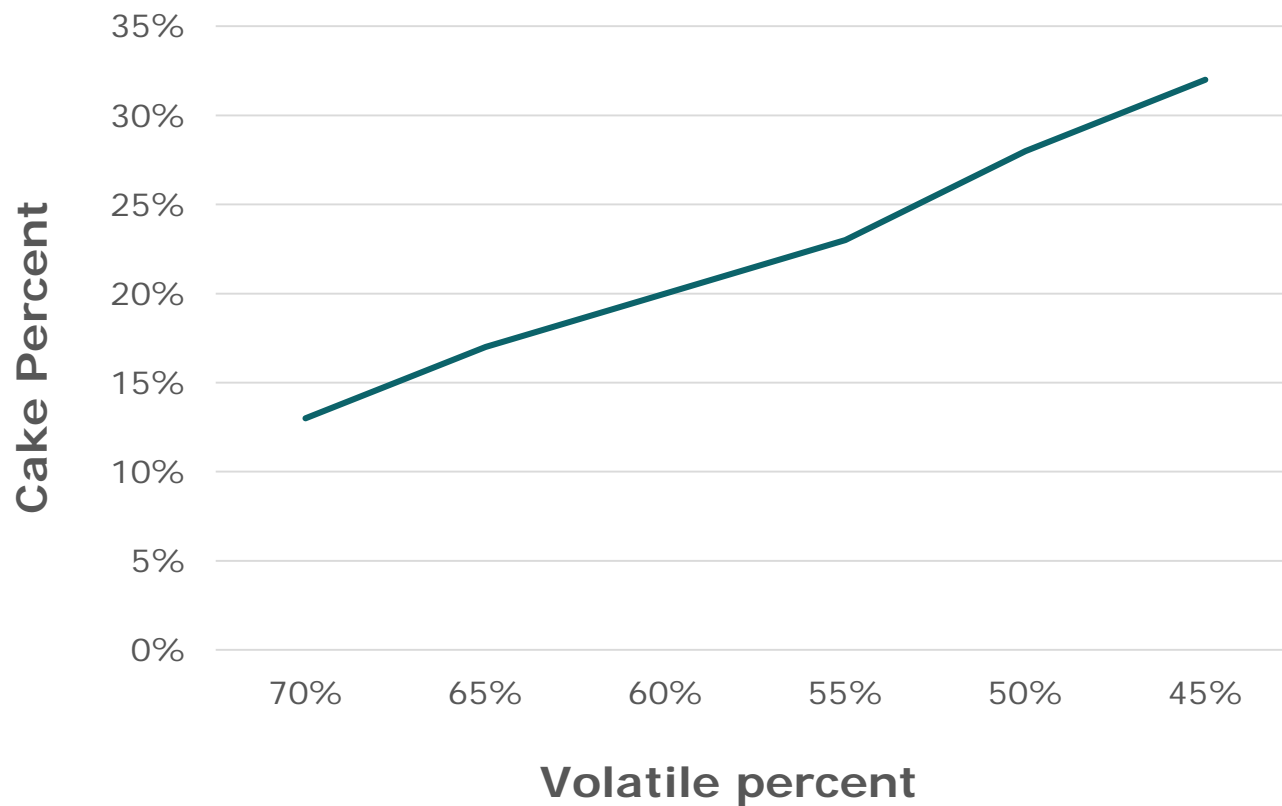


LysteMize Benefits

- Lystek and LysteMize names derived from the word lysis
- Cell lysis is used to break open cells
- LysteMize breaks open the cells, makes the sludge more soluble
- An anaerobic digester needs soluble COD
- LysteMize loop results in more organic destruction
- Lower VS = better dewatering



Dewaterability



Additional LysteMize Benefits

- LysteMize back to the digester includes free heat
- LysteMize also automatically thickens your digester, replaces recuperative thickening
- LysteMize reuses your existing dewatering equipment
- LysteMize can be used at a higher recycle percent if you need more feed to an under loaded digester



Summary

- Lystek system is simple to operate & inexpensive to maintain
- Small footprint – easy to retrofit to existing facility infrastructure
- Can be deployed as post- or pre-digestion solution
- Can also be deployed as an alternative to AD systems
- One system – multiple beneficial applications for resource recovery
- Class A EQ fertilizer product registered with CFIA, Canada and CDFA, California
- Performance of Anaerobic Digesters and BNR systems can be improved by increasing biogas yield, reducing biosolids generation and by replacing commercial carbon requirement in BNR



Thank You – Q & A!



**Nothing wasted.
Everything to gain.**

Jim Belcastro, Ajay Singh, George Bevington

t: 508-463-5444
e: jbelcastro@lystek.com
w: www.lystek.com



APPENDICES



Pathogens Below Detection Limits

Pathogens	MDL	Class A Criteria	Untreated dewatered biosolids	Lystek treated biosolids
Fecal coliforms (MPN/g dry wt)	1.8	<1,000	>1,600	<1.8
<i>Escherichia coli</i> (MPN/g dry wt)	1.8	-	<1,600	<1.8
<i>Salmonella</i> (P-A/25 g)	1	<3 MPN/4g	POS	NEG
<i>Polio virus</i> (pfu /4 g)*	1	<1	776	<1
<i>Ascaris</i> eggs (per 4g)*	1	<1	131	<1



LysteGro Fertilizer Composition

Product Characteristics	
Total Solids (%)	14 - 16
Volatile Solids (% of TS)	55 - 60
Total Organic Carbon (%)	26 - 28
Organic matter (%)	45 – 50
TCOD (mg/L)	105,000 – 150,000
SCOD (mg/L)	40,000 – 60,000
RbCOD (mg/L)	25,000 – 30,000
VFAs (mg/L)	10,000 – 15,000
Viscosity (cP) of product	4,000 – 6,000



LysteGro Fertilizer Composition

Metals Analysis				
Heavy Metals	LysteGro Average ^a	EPA 40 CFR Part 503 Limits ^b	% of maximum allowable concentration	Units
Arsenic (As)	5.00	41	12.20%	mg/kg
Cadmium (Cd)	4.50	39	11.54%	mg/kg
Copper (Cu)	373	1500	24.84%	mg/kg
Mercury (Hg)	0.81	17	4.76%	mg/kg
Molybdenum (Mo)	13.21	75	17.62%	mg/kg
Nickel (Ni)	27.80	420	6.62%	mg/kg
Lead (Pb)	22.65	300	7.55%	mg/kg
Selenium (Se)	5.79	36	16.09%	mg/kg
Zinc (Zn)	915.33	2800	32.69%	mg/kg



- ^a Values represent the mean of weekly samples throughout 2017
- ^b As per EPA 40 CFR Part 503 Regulations Table 3

