Lystek THP

Low Temperature Thermal Alkaline Hydrolysis Process

Nothing wasted.
Everything to gain.

Presentation to Franklin, TN
Board of Mayor and Aldermen
October 28, 2016

Who Are We?

- Founded in 2000 – University of Waterloo, Ontario, Canada
- Ownership: Management & RW Tomlinson Ltd, Ottawa, Ontario – 60+ year old, billion dollar corporation - Privately Held
- Patented and proven award-winning low temperature Thermal/Chemical Hydrolysis technology – Typically Installed after Digestion and Dewatering
- Produces a Hydrolyzed Product with Multiple Benefits:

    1. Fertilizer, Class A EQ & CDFA - California Licensed Fertilizer Product (US), CFIA Registered (Canada)
    2. Anaerobic Digester Enhancement - Improved Biogas Yields
    3. BNR - Carbon Source

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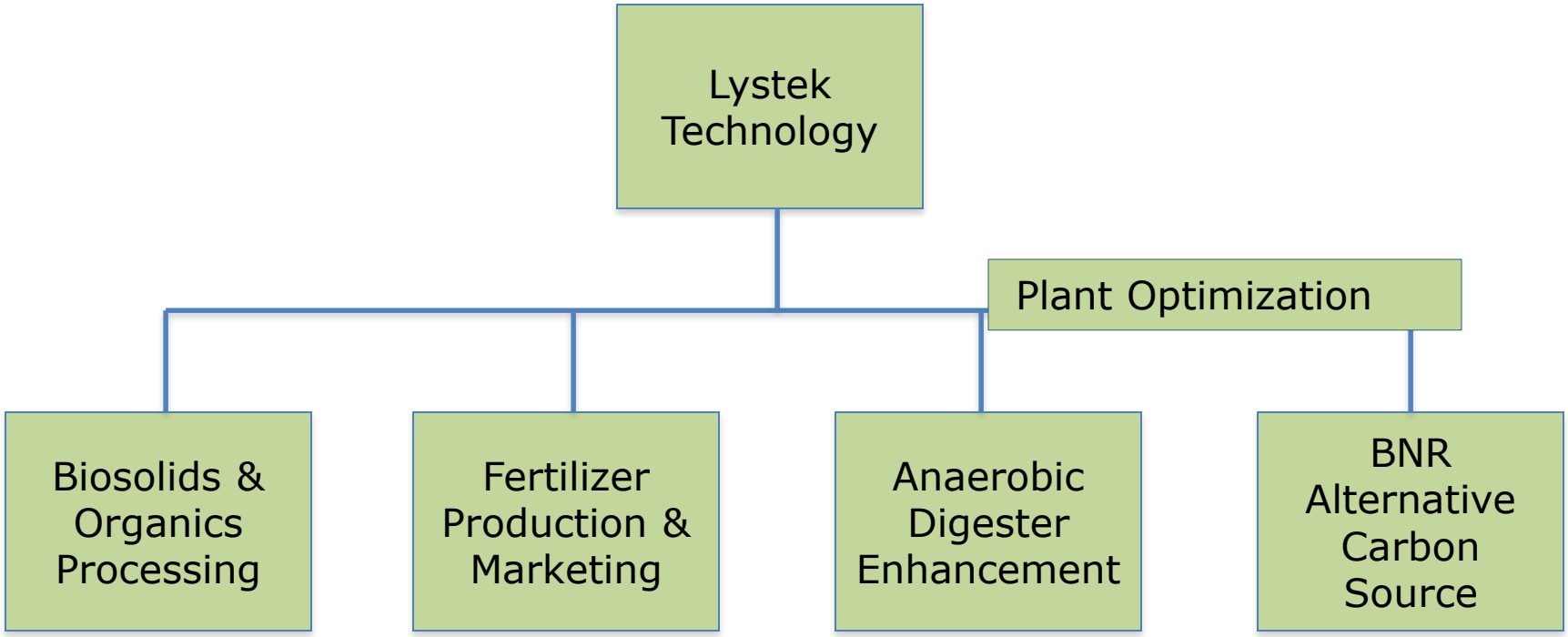
Overview of Solutions



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Current Lystek Installations

Location	Status	Capacity (WT/Y)	Location	LysteMize Digester Enhancement	LysteCarb Carbon Source for BNR
Guelph	2008	18,000	On Site	Full Scale Pilot	No
St. Mary's	2010	3,500	On Site	Full Scale	Yes
*** Southgate**	2012	150,000	Off Site	Merchant Plant (No Digestion)	No
Iroquois	2012	40,000	Off Site	Merchant Plant (No Digestion)	No
Elora	2014	3,500	On Site	Aerobic Digestion	No
North Battleford	2014	3,500	On Site	Aerobic Digestion	No
*** Fairfield, California**	2016	150,000	On Site	Full Scale	No
St. Thomas	2017	5,600	On Site	No	No
Innisfil	2018	5,500	On Site	Aerobic Digestion	No

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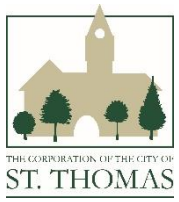
* Serving several surrounding cities in Ontario - Toronto, Ottawa, Peterborough etc., and in California - Santa Rosa, Central Marin & several other communities

Example Customers



Performance Indicators

- (Un) Digested biosolids & organics–1%-35% fed @ 15%-17% solids level in the reactor
- Power input (pumps/mixer): 52-58 KWH per dry ton
- High Speed Shear Mixing (800-1000 RPM)
- Chemicals:
  - KOH/NaOH (45-50% sol) / CaO: 200-240 lbs/dry ton to pH 9-10 depending on the final use of the product
- Natural gas (low pressure boiler) input: 45m^3 per dry ton to 70-75oC / 158-167oF / 30 Min / Class A Regime (Propane 13-15m^3 per dry ton)
- Labor <1 hour per shift; Fully automated SCADA system
- Small Footprint:1,200-2,500 sq ft for –25,000-100,000 WT/Y
- Side Streams: None

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Performance Indicators

- Lystek produces a high solids, 15-17% liquid biofertilizer product (LysteGro™)
- Refeeding into BNR (LysteCarb™)
    - Complete replacement of commercial C source (methanol or glycerol) depending on the carbon requirement for denitrification or biological phosphorous removal
- Refeeding into Anaerobic Digesters (LysteMize™)
    - 30-50% of the product can be refed into digesters
    - 30-50% more biogas yield potential
    - 20-30% additional VS breakdown after refeeding

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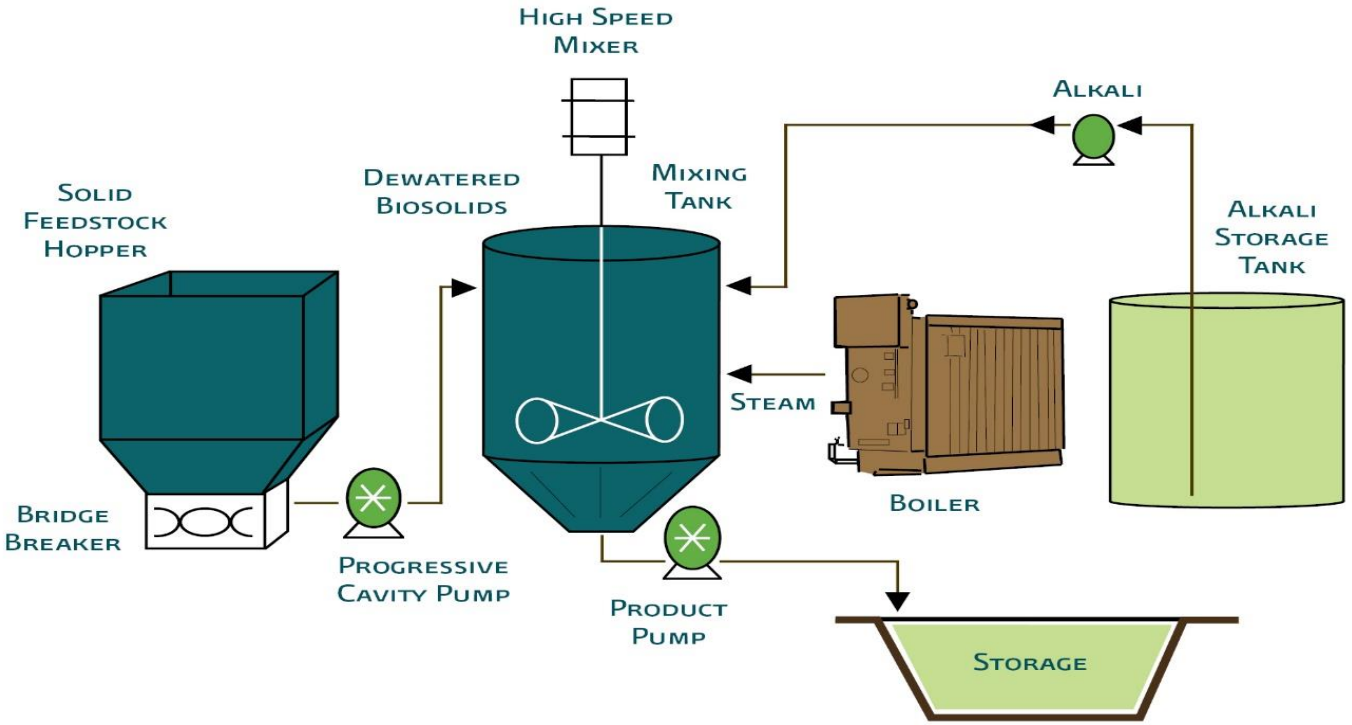
System Overview – Simple PFD



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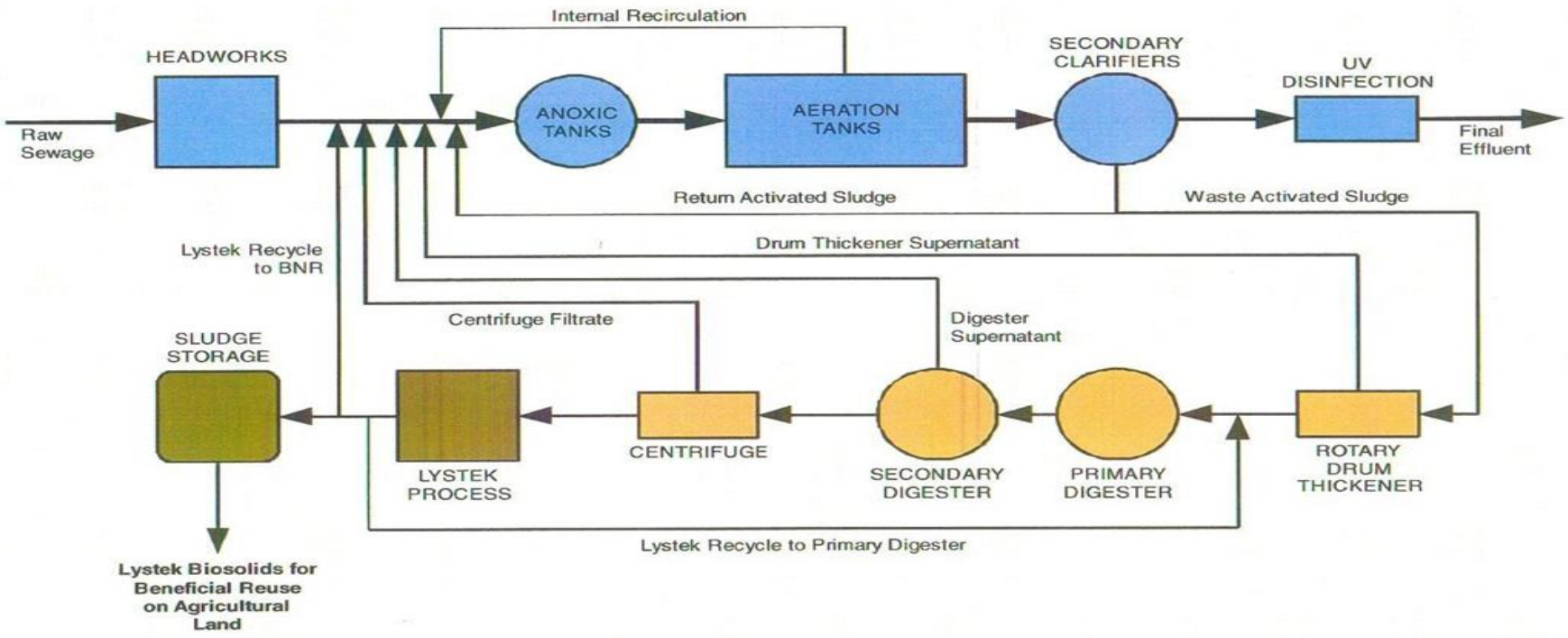
LysteMize™ & LysteCarb™ Digester & BNR Optimization



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LysteGro™ Product

- Homogeneous liquid/ high solid (15-17%) product, viscosity <5,000 cP
- Fully pumpable using conventional liquid equipment
- Enhanced treatment = pathogen-free/Class A / Class A EQ – Licensed Fertilizer in California
- Nutrient rich (NPK 4:3:2)
- Long-term storage stability
- No pathogen regrowth
- High demand from growers!

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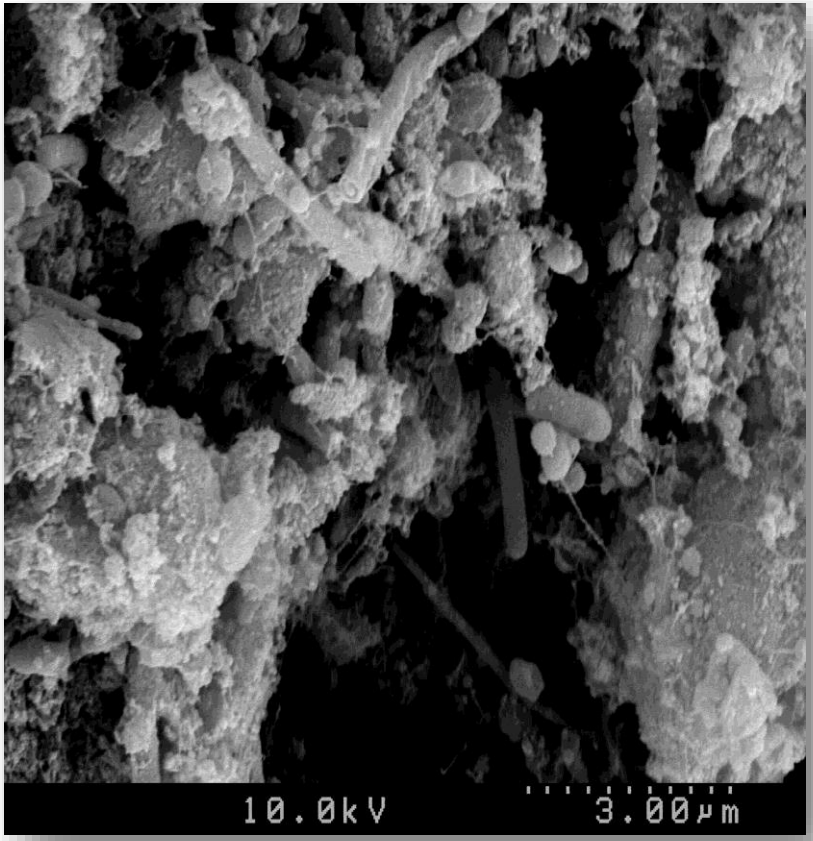
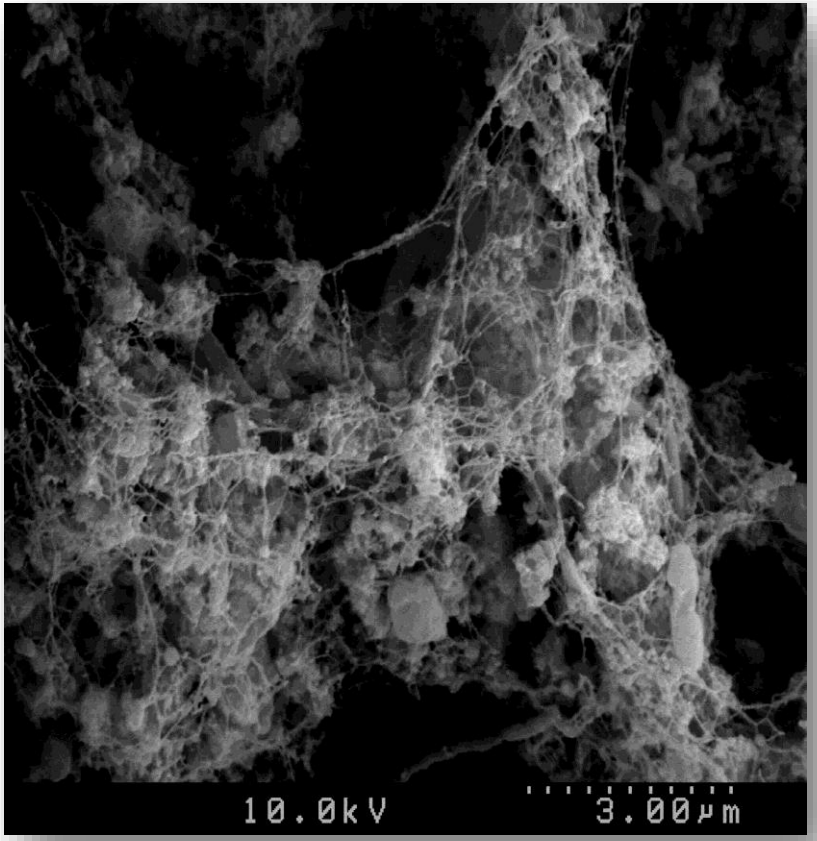
Electron Microscopy





Untreated Biosolids

Lystek Biosolids

Lystek
Nothing wasted.
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LysteGro Fertilizer – Pathogen Kill

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
Escherichia coli (MPN/g dry wt)	1.8	-	> 1,600	< 1.8
Salmonella (P-A / 25 g)	1	< 3 MPN/4g	POS	NEG
Polio virus (pfu / 4g)*	1	< 1	776	< 1
Ascaris eggs (per 4g)*	1	< 1	131	< 1

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Onsite Processing

Centre Wellington – Elora Plant

Lystek Reactor –5 WT/h

Lystek
Nothing wasted.
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Regional OMRC – Southgate, ON

Southgate, Ontario - 150,000 WT/year
Design, Build, Own, Operate

Nothing wasted.
Everything to gain.

Regional OMRC – Southgate, ON

Lystek Reactor –30 WT/h (15% solids)

Lystek
Nothing wasted.
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Product Storage

Lined & Covered Storage Lagoon

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Nothing wasted.
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Product Delivery – In the Field

Standard Trucking & Application Equipment

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Product Application – Standard Equipment

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First United States Installation - Fairfield Suisun Water District - California (FSSD)

- 26 MGD Plant
- 14,000 Wet Tons Per Year Anaerobically Digested Sludge Internally – Post-Dewatering
- 150,000 Wet Tons Per Year Processing Capacity to include 3rd party contracts

- Processing Digested and Undigested Biosolids & Organics
- Generating LysteGro from feedstock, storage in Lagoon for future sale to agriculture and agribusiness
- Refeed of biogas for energy value – sale to grid

Lystek
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First US Installation – Fairfield-Suisun Sewer District - California (FSSD)

- Lystek Equipment installed in FSSD's dewatering building
- Processing FSSD digested biosolids + 3rd party biosolids / organics to produce a Class A EQ high solids liquid Fertilizer + Digester Enhancement – Regional Processing Plant
- Lystek equipment installed by Lystek under a DBFOM (20 year agreement + 10 year renewal)
- FSSD pays a tip fee to Lystek to process their biosolids
- Lystek pays FSSD a host fee, a fee for every ton processed by 3rd party agencies and shares digester enhancement benefits (more biogas, biosolids reduction)
- FSSD staff estimates annual net annual benefit of $675,000 at full capacity

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Federal Recognition / Registration

LYSTEK PRODUCT LABEL

Registration Number 2009017D Fertilizers Act

BRAND	: LYSTEK
FERTILIZER NAME	: LYSTEK PROCESSED BIOSOLIDS
GRADE	: 2-2-2
MANUFACTURER	: CITY OF GUELPH WASTEWATER SERVICES, 59 CARDEN STREET, GUELPH, ON N1H 3A1
PRODUCT WEIGHT	: WEIGHT ON BILL OF LADING
LOT NUMBER	:

GUARANTEED MINIMUM ANALYSIS:

Total Nitrogen (N)	2%
Available Phosphoric Acid (P_2O_5)	2%
Soluble Potash (K_2O)	2%
Organic Matter	6%

DIRECTIONS FOR USE:
Maximum application rates for Lystek product should not exceed 4 dry tonnes per hectare. Reference should be made to local Agricultural Guidelines regarding crop nutrient requirements prior to using Lystek Product.

MATERIAL SAFETY DATA

PHYSICAL PROPERTIES		STORAGE	Liquid storage tanks or lagoon
FORM	Semi-solid Liquid	SPILLAGE	Prevent from entering drain
SOLUBILITY	Insoluble in water	WASTE DISPOSAL	In accordance with local regulations
pH VALUE	7 - 10		
FIRE AND EXPLOSION DATA		PRODUCT CLASSIFICATION	
EXTINQUISHING MEDIA	CO_2, Dry powder, foam, water	CONVEYANCE	Protect from leakages
PRECAUTIONS IN USE		HAZARDS	
EYE PROTECTION	Safety Glasses	SKIN	May cause irritation. Wash with water and soap
HAND PROTECTION	Rubber Gloves	EYES	May cause irritation. Flush with water thoroughly. Seek medical advise if irritation persists
PROTECTIVE CLOTHING	Overalls		
RESPIRATORY PROTECTION	N/A	LUNGS	May cause irritation. Remove patient to fresh air. Seek medical advise if irritation persists
VENTILATION	N/A		
OTHER PRECAUTIONS	Do not eat, drink or smoke while handling material	INGESTION	May cause illness or upset stomach. Seek medical advise

KEEP AWAY FROM CHILDREN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

February 27, 2014

Ward Janssens
Lystek International Inc.
1425 Bishop St. N. Unit 16
Cambridge, Ontario, N1R 6J9

Re: Demonstration of Vector Attraction Reduction using Optim 2 for Lystek Thermo-Alkaline Treatment

Dear Mr. Janssens,

Thank you for your e-mail and attached paper from Dr. George Nahlik of February 3, 2014 with results of volatile solids reduction tests on anaerobically digested biosolids treated with the Lystek Thermo-Alkaline treatment process.

The results showed that for the sampling periods in question, VAR Option 2 was met, as the volatile solids were reduced by less than 17% during additional digestion. This option may be used in the future to demonstrate vector attraction reduction.

The frequency at which the test must be run is specified in 40 CFR 503.16, ranging from once per year for facilities producing less than 290 dry metric tons of biosolids per year, to once per month for facilities producing over 15,000 dry metric tons per year.

Demonstration of VAR using this method, in conjunction with demonstration of Class A pathogen reduction and pollutant concentrations meeting 40 CFR 503.13 Tables 1 and 3 limits, demonstrates "exceptional quality" biosolids that may be distributed without further restrictions.

Please contact me at 415 972-3514 or Fondahl.lauren@epa.gov with any questions regarding this.

Thank you,

Lauren Fondahl
Biosolids Coordinator, WTR-5

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Materials Management, Bureau of Waste Reduction & Recycling
625 Broadway, 9th Floor, Albany, New York 12233-7253
P: (518) 402-8706 I F: (518) 402-9024
www.dec.ny.gov

Jim Belcastro
BD Manager – Northeast Region
Lysek International Inc.

OCT 18 2016

Dear Mr. Belcastro:

Re: Class A Pathogen Reduction Criteria and Vector Attraction Reduction Criteria for Biosolids

As we discussed, facilities located in New York State that process biosolids into a product are required to obtain a permit from the New York State Department of Environmental Conservation (NYSDEC) under 6 NYCRR Part 360-5.

Under 6 NYCRR 360-5, in addition to other criteria, the biosolids must be treated by a Class A pathogen reduction (PR) method and a vector attraction reduction (VAR) method. The options for meeting these requirements are outlined in 360-5.5(b).

Based on information provided by you, the Lysek process is able to achieve Class A PR and VAR by the following methods:

Anaerobically digested biosolids:

Class A PR: Salmonella sp. less than 3 MPN/4 dry grams or fecal coliform less than 1000 MPN/dry gram and Pasteurization (temperature of 70C or higher for at least 30 minutes)

VAR: Bench scale additional digestion with less than 17 percent volatile solids reduction

Other biosolids:

Class A PR: Salmonella sp. less than 3 MPN/4 dry grams or fecal coliform less than 1000 MPN/dry gram and Pasteurization (temperature of 70C or higher for at least 30 minutes)

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

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Financial Considerations

- Plant Sizing / Current Wastewater & Biosolids Management Process Employed
- Generation and Application of Renewable Energy – Utilization of Energy
- Population Size, both Current and Future
- Funding Capabilities (Grant / Loan / Self) & Future Plant/Municipality Plans
- Project Structure – Multiple Approaches
  - Design, Build Transfer (DBT) – Lystek with Engineers & Municipality
  - Design, Build, Own, Operate (DBOO) – Lystek with Municipality
  - Design, Build, Spec (DBS) – Lystek with Municipality's Engineer
  - & Many Others

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Financial Considerations

- A proposed Lystek installation at Franklin may include:
  - Lystek Reactor System
  - Low Pressure Steam Boiler
  - Pumps, Piping
  - Chemical Dosing Pump(s)
  - Holding / Hopper Tank

- Lystek System, Standalone – ESTIMATED COST - $20MM US or Less

- Lystek System, With Anaerobic Digestion – ESTIMATED COST - $25MM US or Less

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Uses & Benefits

- Simple, easy to operate & inexpensive to maintain
- Small footprint – easy to retrofit to existing facility infrastructure
- Product meets/exceeds stringent, regulatory guidelines set out by federal agencies in the USA (Class A EQ – US EPA) & Canada (CFIA registration)
- WWTP Enhancement approach can be leveraged to increase the performance of Anaerobic Digesters, BNR systems :
    - Reduces biosolids generation by 20% (or more)
    - Increases biogas yields by 30% (or more)
    - Potential to replace 100% of Carbon requirement in BNR
- Can also be deployed as an alternative to AD systems

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CCME
Canadian Council of Ministers of the Environment
Le Conseil canadien des ministres de l'environnement

EPA
United States Environmental Protection Agency

How Our Solutions Help

- Meets guidelines & regulations for beneficial use - recognized as Class A / Class A EQ - USA EPA, Licensed in California & CFIA registered in Canada
- Produce high quality, biofertilizer product in high demand – agriculture, sod farming, horticulture, golf courses, marginal soil revitalization, etc.
- Develop revenue generating/sharing models that help to offset infrastructure investments & ongoing, operational costs
- Plant optimization - increase biogas recovery for conversion into "green energy" while reducing GHG's & overall volumes of biosolids
- Provide viable solutions for sustainable, long term, beneficial use programs

Lystek
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Thank You

Nothing wasted.
Everything to gain.

Jim Belcastro
Business Development Manager - Northeast Region

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s:

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