LYSTEK BIOSOLIDS PROCESSING TECHNOLOGY AND BENEFICIAL APPLICATIONS OF THE PROCESSED BIOSOLIDS – FULL SCALE RESULTS

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ABSTRACT

An innovative biosolids treatment and processing technology (Lystek Process) has been successfully developed over 3 years at bench- and pilot-scale and further tested at a full-scale at the Guelph wastewater treatment plant. The processing requires an optimum application of heat, alkali and mixing in a batch or semi-continuous system to achieve a high solids concentration (15-18%), pathogen-free and nutrient-rich liquid biosolids product that meets US EPA criteria for a Class A material for agricultural land application. Unlike dewatered biosolid cake which requires specialized pumps or equipment to handle the biosolids, Lystek processed biosolids are fully compatible with conventional equipment in use for land application of biosolids and liquid manure, storage, and transport. The processed biosolid product retains pumpability suitable for beneficial re-use and application as a fertilizer product even after prolonged seasonal storage at ambient temperature in Canadian weather conditions. There was no evidence of re-growth of harmful pathogens such as *Escherichia coli*, *Salmonella* and fecal coliforms even after storing the processed materials over long periods (~3 years) at room temperature (17-22^{o}C). Successful trials of Lystek process to treat raw wastewater and other intermediate wastewater biosolids indicated the versatility of the process with a potential to minimize the burden on the existing intermediate biosolids handling processes within the wastewater treatment facility, increase energy recovery, reduce total volumes of biosolids generated and reduced storage requirements in the plant.

INTRODUCTION

Over 10 million dry tonnes of biosolids are produced in municipal wastewater treatment facilities in North America that are disposed mainly by land application either in liquid states (2-3% solids) or as dewatered cake, incinerated or buried in the approved landfills. Due to a growing public interest and involvement in environmental programs, biosolids waste generators continue to face new technical and financial challenges in treating, safe disposal or utilization of biosolids. A high level of stabilization of organic matter in the biosolids is required for safe recycling and utilization of biosolids. Conventional stabilization methods such as aerobic or anaerobic digestion, composting, chemical treatment and drying are either less effective or expensive to maintain (Lynch 1993; Epstein 1997; Dumontet et al. 1999). More effective biosolids management technologies are being continually sought because recycling and utilization of improperly stabilized biosolids source of nutrients for land application could be a serious threat to human and animal health (Straub et al., 1993; US EPA, 1999ab; Brown et al., 2002).

The Guelph wastewater treatment plant (WWTP) generates over 4000 dry tonnes of biosolids per year. The biosolids discharged from the anaerobic digester system are dewatered through a belt press system to produce 17-24% biosolids that are either composted in an enclosed vessel composting system or mixed with wood chips and transported to a municipal landfill. The Guelph WWTP is currently conducting a biosolids master planning exercise to establish its biosolids handling and disposal opportunities to a 2016 planning horizon with an objective to maximize the potential for beneficial reuse of biosolids and is looking for alternative cost effective methods to manage the biosolids.

Lystek technology is an innovative biosolids treatment and processing technology that produces a high solid and low-pathogen liquid product that can be utilized for land application without the health and environmental risks associated with the high-pathogen biosolids currently being spread on the agricultural land. The process was successfully developed over 3 years at bench- and pilot-scales and recently tested at full scale with the collaborative efforts of Lystek and the City of Guelph, Ontario at the Guelph wastewater treatment plant. The objectives of the pilot and the full-scale studies were:

- Scale up and optimization of the semi-continuous full-scale operation for processing of dewatered biosolids;
- Design of a full scale biosolids treatment system which can be easily integrated into any existing wastewater treatment system; and
- Evaluation of potential application of the processed biosolids product in the wastewater treatment plant and agriculture.

This paper presents some of the results of pilot- and full-scale feasibility studies conducted on the Lystek technology at the Guelph Wastewater Treatment Plant. Environmental benefits of the process and the beneficial recycling potential of high solids pathogen-free liquid biosolid product are also discussed.

METHODOLOGY

Lystek process flow diagram is presented in Figure 1. The full-scale Lystek's biosolids management facility was connected to the dewatered biosolids storage tank through a conveyer system. To operate the system in a batch mode, a progressive cavity pump was used to pump the dewatered biosolids (17-24%) from storage tank to the processing reactor. An appropriate amount of warm effluent water is added to dilute the dewatered biosolids to the processing range of 12-18% solids in the reactor. The temperature and pH of the feed biosolids were adjusted to the optimum operating range and mixed for 40-60 min in a batch.

For a semi-continuous system in the 5-m^3 reactor with 10-25% volume removal and replacement, a batch of Lystek process at the optimum process conditions was prepared by adding approximately 3500 L dewatered biosolids, 1000 L warm water and appropriate amount of alkali. The processed material was removed using a centrifugal pump and replaced with desired volumes of dewatered biosolids, water and alkali solutions. This process was repeated every 4-8 minutes and the operation achieved in a semi-continuous mode.

Samples were collected and analyzed frequently for viscosity (Brookfield digital viscometer, model DV-E), pH and temperature (Accumet 1001, Fisher Scientific), and solids concentration (Quincy Lab drying oven). Treated and untreated control samples were collected for analysis of *Escherichia coli*, fecal coliforms (Ont. SOP 0196), *Salmonella* (Ont. SOP 0189) and cyst forming pathogens. For the analysis of *Cryptosporidium* oocysts and *Giardia* cysts, samples were prepared by ImmunoMagnetic Separation (IMS) technique and stained using FITC fluorescent antibody and DAPI fluorescent DNA staining for immuno-fluorescence assay (FA) microscopy.

Chemical (metals and general chemistry) analyses were carried out using standard methods by Maxxam analytical laboratory, Mississauga, Ontario. The effect of long-term storage of the Lystek processed material was evaluated by storing samples for 3 years at room temperature (17-22^{o}C). Maxxam follows laboratory methods Ont. SOP 0072, 0101 and 0100 for the analysis of metals, ammonia and nitrite, respectively.

An experiment was planned at the DeGroot farm in Guelph to compare the effect of Lystek processed material with dewatered biosolids and a control with only farmer's chemical fertilizer program. The Lystek demonstration plot consisted of three replicated strips with each having Lystek material, Guelph cake and control. Application rate of Lystek material was 22 m^3 per acre based on the average solid content (13.5%). The soil samples were sampled for analysis of metals and nutrients. Proper sampling method was applied and samples were collected using a standard soil sampler.

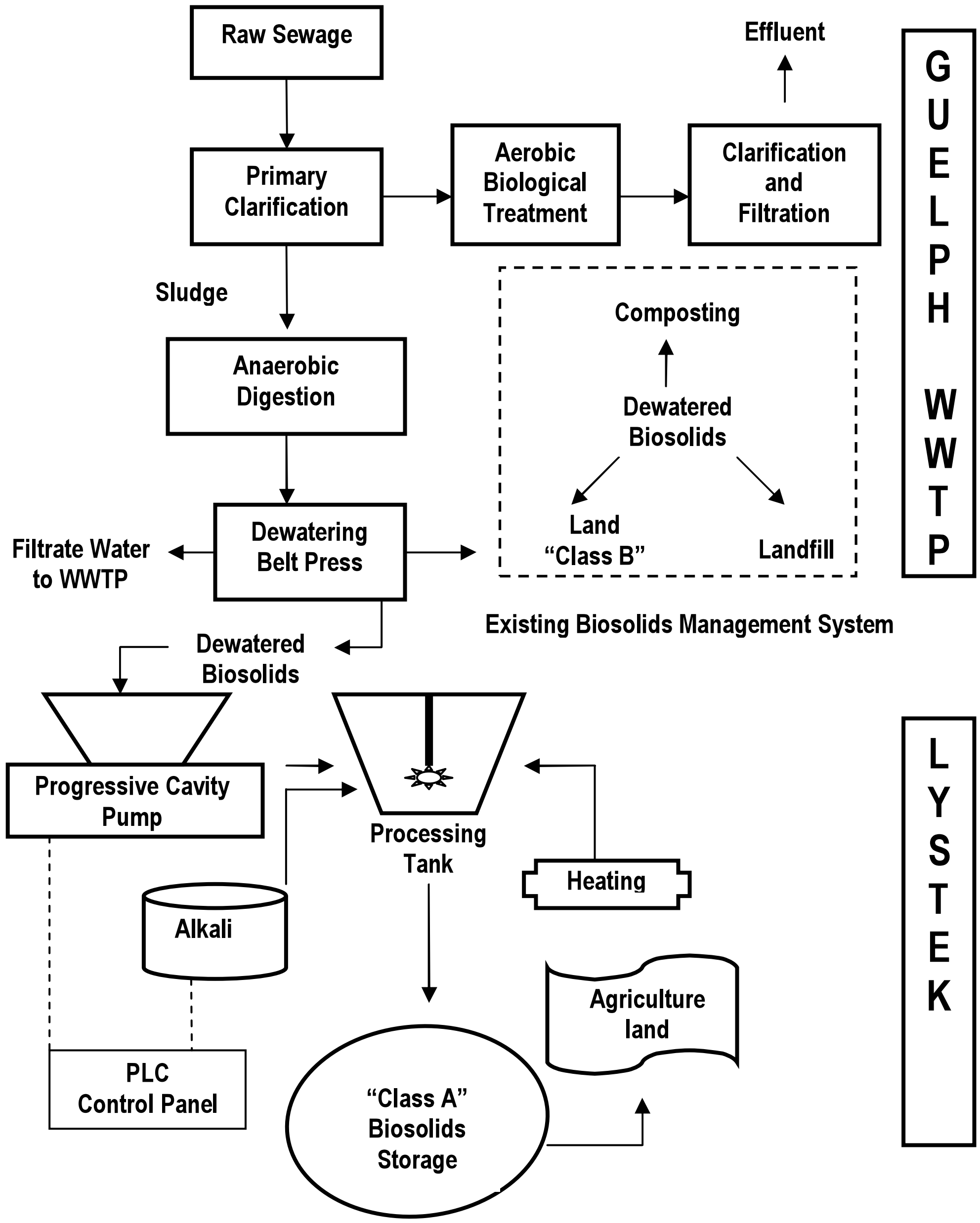


FIGURE 1. PROCESS FLOW DIAGRAM OF GUELPH WWTP AND LYSTEK SYSTEM

RESULTS

Dewatering belt filter presses at the Guelph WWTP dewater anaerobically digested sludges to generate biosolid cake with 18-24% solid content. Chemical characterization of various sludge streams generated in the Guelph WWTP is shown in Table 1.

TABLE 1. CHEMICAL CHARACTERIZATION OF DIFFERENT BIOSOLIDS STREAMS AT GUELPH WASTEWATER TREATMENT PLANT

Parameters	Raw biosolids (mg/L)	Secondary digester biosolids (mg/kg)	Dewatered biosolids (mg/kg)
Metals			
Arsenic	0.1	0.1	2
Cadmium	0.5	0.5	5
Chromium	2.2	1.9	124
Cobalt	0.5	0.5	2
Copper	14.7	12.2	639
Lead	5	5	27
Mercury	0.014	0.017	2
Molybdenum	2	2	13
Nickel	2	2	20
Phosphorus	572	519	28,570
Potassium	100	100	1004
Selenium	0.2	0.1	2.5
Sodium	312	305	2,021
Zinc	29	21	988
General chemistry/microbiology			
pH	5.4	7.4	7.1
Conductivity (µmhos/cm)	NA	7040	9100
Total solids (%)	2.9	1.7	17.0
VSS (%)	75.0	62.4	63.0
Total NH_3-N	NA	666	6,128
Total NO_3-N	NA	2	4.8
Total NO_2-N	NA	2	NA
TKN (mg/kg)	NA	963	31,953
E. coli (CFU/g)	NA	1,000 – 6,000	10,000 – 40,000
Fecal coliforms (MPN/g)	>1600	>1600	>1600
Salmonella (P-A/25g)	POS	POS	POS

Note: Data from City of Guelph; NA, no analyzed; POS, positive

Batch processing of biosolids in a 2 m^3 pilot and a 5 m^3 full scale reactor showed dramatic reductions in the viscosity of the processed materials (Table 2). The feed material (18-24% solid) exhibit a viscosity of greater than 2,000,000. The liquefied Lystek processed material (12-18% solids) with viscosity <6,000 cP shows properties that fully compatible with conventional equipment in use for land application as apposed to dewatered biosolids which requires expensive specialized pumps or equipment for handling.

TABLE 2. BATCH PROCESSING OF BIOSOLIDS AND THE PROCESSED PRODUCT STORAGE

Processing Reactor / Parameters	Fresh processed samples	8 Months after storage at room temperature	24 Months after storage at room temperature
Untreated dewatered biosolids			
Total solids (%)	17.0 – 24.0	17.0 - 24.0	Not detected
Viscosity (cP)	>2,000,000	>2,000,000	Not detected
Salmonella (P-A/25 g)	Positive	Positive	Not detected
Fecal coliforms (MPN/g)	>1600	>1600	Not detected
Escherichia coli (MPN/g)	>1600	>1600	Not detected
Processed biosolids in 2 m^3 Reactor			
Total solids (%)	12 - 14.0	12.0 - 14.0	12.0 -14.0
Viscosity (cP)	1220 - 1590	1890 - 2570	1740 – 2200
Salmonella (P-A/25 g)	Negative	Negative	Negative
Fecal coliforms (MPN/g)	<1.8	<1.8	<1.8
Escherichia coli (MPN/g)	<1.8	<1.8	<1.8
Processed biosolids in 5 m^3 Reactor			
Total solids (%)	12 – 19.0	12 - 19.0	Not detected
Viscosity (cP)	1025 - 5500	1580 - 6500	Not detected
Salmonella (P-A/25 g)	Negative	Negative	Not detected
Fecal coliforms (MPN/g)	<1.8	<1.8	Not detected
Escherichia coli (MPN/g)	<1.8	<1.8	Not detected

While all the unprocessed biosolids samples showed the presence of *Salmonella*, *E. coli* and fecal coliforms, these pathogens were not detected (<1.8 MPN/g sample) in the Lystek-processed material. Storage stability in terms of pH, viscosity and pathogen regrowth were determined after prolonged storage at room temperature. An increase in viscosity by 50-100% was observed in the processed samples stored at room temperature (17-22^{o}C). However, mixing for few minutes brings the viscosity levels very close to the original values.

A semi-continuous process approach was tested successfully at the pilot- and full-scale reactors by removing 10-25% of the total volume and replacing that volume with a mixture of dewatered biosolids, water and alkali solution (Table 3).

The results showed consistent viscosities and solids concentration through various cycles indicating that a semicontinuous process is feasible in processing of dewatered solids with high solids concentration with Lystek process. Using semi-continuous process strategy in the full-scale 5-m^3 reactor, about 1 dry tonne per h can be processed. The full-scale testing results indicate that a semi-continuous process can effectively be applied without compromising the desired process parameter and product quality in the Lystek system in terms of viscosity or pumpability and pathogens.

TABLE 3. TEST RESULTS FOR SEMI-CONTINUOUS SYSTEM USING A 2-M^3 PILOT AND A 5-M^3 FULL-SCALE REACTORS*

Description	Total solids (%)	Viscosity (cP)	*Salmonella (P-A/25g)*	Fecal coliforms (MPN/g)	*Escherichia coli* (MPN/g)
Untreated biosolids	19.8	More than 2,000,000	POS	>1600	>1600
Average 10-25% Removal Cycle with 4-8 min hold time in 5-m^3 reactor					
Cycle – 1	16.8	5230	NEG	<1.8	<1.8
Cycle – 2	17.5	5370	NEG	<1.8	<1.8
Cycle – 3	16.9	5320	NEG	<1.8	<1.8
Cycle – 4	17.2	5150	NEG	<1.8	<1.8
Cycle – 5	17.5	5450	NEG	<1.8	<1.8
Average 10-25% Removal Cycle with 4-8 min hold time in 2-m^3 reactor					
Cycle – 1	12.8	1180	NEG	<1.8	<1.8
Cycle – 2	13.0	1190	NEG	<1.8	<1.8
Cycle – 3	13.1	1170	NEG	<1.8	<1.8
Cycle – 2	13.0	1150	NEG	<1.8	<1.8
Cycle – 3	13.1	1180	NEG	<1.8	<1.8

*The pH of untreated biosolids ranged from 7.3 to 8.0

Nutrient and metal analysis of Lystek processed biosolids from the full-scale tests are presented in Table 4. Chemical characteristics of the processed material are not expected to be different from the unprocessed dewatered biosolids, except for the level of potassium that was added through potassium hydroxide for optimum pH. Following Canadian guidelines for the general chemistry parameters of interest both the processed and unprocessed material were found suitable for land application. However, the Lystek processed material is very homogeneous and does not separate significantly even after prolonged storage and the low viscosity product can be handled using conventional pumps.

TABLE 4. NUTRIENT ANALYSIS OF LYSTEK POROCESSED MATERIAL AS PER NUTRIENT MANAGEMENT ACT

Nutrient	Concentration (mg/kg dry wt)	Maximum allowable metal concentration[1] (mg/kg dry wt)	Addition to soil (kg/ha)	Maximum permissible metal application per 5 years[2] (kg/ha)	Addition to soil as % of maximum allowable per 5 years
Arsenic	1.83	170	0.01	1.4	1.05
Cadmium	1.15	34	0.01	0.27	3.41
Cobalt	6.48	340	0.05	2.7	1.92
Chromium	124.96	2800	1.00	23.3	4.29
Copper	833.65	1700	6.67	13.6	49.04
Mercury	1.08	11	0.01	0.09	9.60
Molybdenum	15.46	94	0.12	0.8	15.46
Nickel	28.53	420	0.23	3.56	6.41
Lead	36.18	1100	0.29	9.0	3.22
Selenium	4.50	34	0.04	0.27	13.33
Zinc	1,289	4200	10.31	33.0	31.25
Ammonia N	9,741.50		77.93		
Available N	9,744.50		77.96		
TKN	26,919.50		215.36		
Organic N	17,175		137.40		
Nitrate N	3.05		0.02		
Total P	30,283		242.26		
Potassium	78,750		630.00		
% Total solids	17.0				
% Volatile solids	11.10				
E. coli (CFU/g)	<10				

Data is average of 6 Lystek samples
[1]Table 1, Column 4 and [2]Table 2, Column 5 in "Guidelines for the Utilization of Biosolids and Other Wastes on Agricultural Land, March 1996
Reportable *E. coli* detection limit - 10

Microbiological analysis of Lystek processed material is shown in Table 5. *Clostridium* spores and *Cryptosporidium* oocysts were not found in any of the samples tested. Approximately 200-1000 Giardia cysts like objects were located under FA microscopy in each sample. However, most of the viewable objects under 1000x appeared to be empty cysts. While F+ Coliphage was below the detection limit in all the samples, Somatic Coliphage was only detected in raw sludge samples. These pathogens may have already been destroyed during anaerobic digestion and dewatering processes. Earlier results on testing for Class A requirement on pre-seeding biosolids with enteric viruses (*Poliomyelitis* virus) and helminthes ova (eggs from *Ascaris* sp.) and then treating with Lystek process have indicated that all processed samples meet the 2-log reduction enteric virus and helminths ova as required by the US EPA for Class A criteria.

TABLE 5. MICROBIOLOGICAL ANALYSIS OF LYSTEK PROCESSED BIOSOLIDS

Pathogens	Raw sludge	Dewatered biosolids	Lystek biosolids
Escherichia coli (MPN/g)	>1,600	>1,600	<1.8
Fecal coliforms (MPN/g)	>1,600	> 1,600	< 1.8
Salmonella (P-A/25 g)	Positive	Positive	Negative
Giardia	Cyst like objects, appears empty	Cyst like objects, appears empty	Cyst like objects, appears empty
Cryptosporidium	No oocyst-like objects found	No oocyst-like objects found	No oocyst-like objects found
Clostridium perfringens (CFU per g)	<10	<10	<10
F+ Coliphage (PFU per g)	<1	<1	<1
Somatic Coliphage (PFU/g)	18	<10	<10
Ascaris	Not detected	Not detected	Not detected
Polio virus (pfu/4g)	-	776	< 1
Ascaris eggs (numbers/4g)	-	130.8	< 1

Note: < Indicate below detection limit. For Class A criteria, fecal coliforms and *E. coli* must be less than 1000 MPN/g dry wt and *Salmonella* must be less than 3 MPN/4 g dry wt. Results on Polio virus and *Ascaris* eggs are from our previous studies (Singh et al. 2004; 2005)

Raw wastewater (3.9-4.4% solids) was successfully processed on its own or mixed with dewatered biosolids as 10-20% diluent in some of the studies carried out in 2-m^3 reactor in standard batch processing mode. The results were quite similar to the ones achieved with the dewatered biosolids.

The results on field experiment conducted on the dewatered untreated and processed biosolids are shown in Tables 6. Soil analysis of various plots was carried out first after few days of application and then after 7 months. Most of the analysis was similar for both sampling periods. Thus there was no significant change in soil analysis after only one application of the either dewatered cake or Lystek processed biosolids when applied at the 22 m^3 per acre application rate. The quantities of metals are generally the limiting factors for biosolids application to land. However, with the controlled application of the processed biosolids, there are not expected to be any impediments to land application. Further no significant differences in the nutrient analysis among corn samples grown in the fields with dewatered biosolids cake, Lystek processed biosolids and the control plot with regular fertilizer were observed. Additional analysis on average weight of a cob or grains and the size of grains did not reveal any significant differences indicating any detrimental impact of Lystek processing on the quality of biosolids.

TABLE 6. SOIL NUTRIENT AND METAL ANALYSIS AFTER APPLICATION OF LYSTEK PROCESSED AND GUELPH DEWATERED BIOSOLIDS

Parameters	MOE Limits (Soil) (mg/kg)	Lystek processed biosolids plot soil (mg/kg)		Dewatered biosolids plot soil (mg/kg)		Regular fertilizer plot soil (mg/kg)	
		Dec 2005	July 2006	Dec 2005	July 2006	Dec 2005	July 2006
Arsenic	14	3.3	2.7	3.2	3.2	3.3	2.8
Cadmium	1.6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium	120	19.3	26.3	19.0	31	19.6	23.3
Cobalt	20	5.6	6.1	5.3	6.4	5.7	5.1
Copper	100	13.3	17.7	12.3	19.3	13.0	14
Lead	60	21.3	24	20.7	25	22.6	24
Magnesium	-	303	298	338	345	325	331
Mercury	0.5	<0.05	0.06	<0.05	0.05	<0.05	0.06
Molybdenum	4	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Nickel	32	12.0	16	11.7	18.6	11.7	17
Phosphorus	-	17.3	34	16.3	29	20.6	19
Potassium	-	111	257	123	115	111	119
Selenium	1.6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium	-	10	66.3	<1	32	<1	28.3
Zinc	220	81	89	79	99	84	89

Note: The data is average of three replicate analyses

DISCUSSION

Large quantities of sludges are generated during the treatment of municipal wastewater that requires environmentally safe disposal or reuse (Chernicharo, 2006; O'Flaherty et al., 2006). Co-disposal of biosolids at solid waste landfills is not a viable long-term alternative and efforts are being made to promote the options of recycling, composting, energy production. Agricultural utilization of biosolids as soil conditioner and fertilizer is an attractive means of recycling (Warman and Termeer, 2005). Wastewater treatment plants hardly produce effluents that comply with usual discharge standards established by government environmental agencies (Andreadakis et al., 2002). Therefore, a post-treatment step is often required as a means to adapt the treated effluent to the requirements of the environmental legislation. Conventional methods are usually not very effective and new methods are continually being sought.

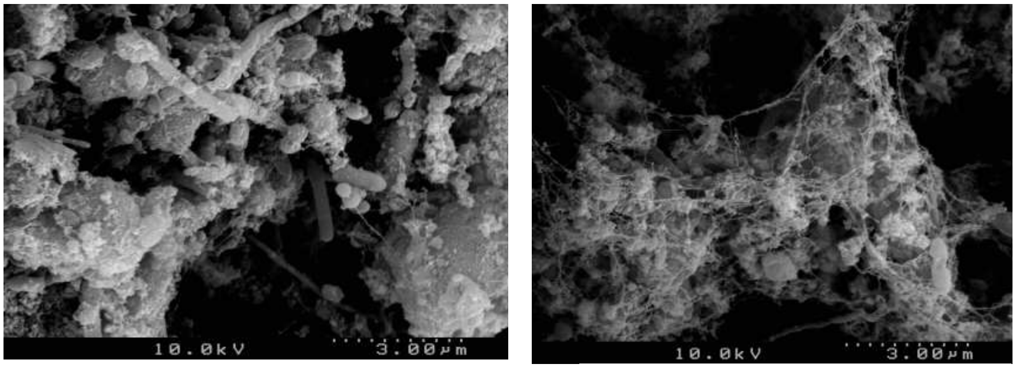
Lystek process is a unique process of treating dewatered biosolids to produce a pathogen-free high solid liquid fertilizer product for safe land application. Under optimum processing conditions, >99% reduction in the viscosity (<6000 cP) can be achieved of the unprocessed biosolids (17-24% solids) which is otherwise not truly quantifiable due to the limited equipment range, i.e. 2,000,000 cP. The main function of the mixing unit is to reduce particle size, thereby at higher temperature and pH, general mass transfer is increased. One of the issues associated with sludge dewatering and handling is the trade-off between processing costs and disposal/transportation costs. Typically any liquid or partially dried material >6% solids by volume require more expensive pumping and handling systems. This represents one of Lystek Process's greatest benefits since subsequent to process treatment, the high solid (15-18%) liquefied material's handling, storage and transportation requires conventional and much less expensive equipment. Homogeneous biosolids product is freeze-thaw stable that requires about 5-6 times less space for winter storage due to high solids. Thus significantly impacts on the cost for biosolids treatment.

Semi-continuous process is expected to considerably enhance the overall process productivity. The unique feature of this semi-continuous process is that operating conditions can be optimized and maintained constant at the optimized levels. Since the viscosity of the product remains more or less constant, it should also significantly affect the load on the motor and is expected to save energy usage of the mixer unit. Once in continuous mode labour input should also be minimal.

Since application of untreated sewage biosolids can pose serious threat to the environment as well as human beings (Dumontet et al. 1999), Canadian and US regulators have created certain standards where material applied to agricultural land must meet the prescribed requirements that classify Class “B” biosolids in Ontario and Class “A” and “B” biosolids in USA (USEPA, 1992). All the testing to date has indicated that the Lystek processed biosolids meets the applicable requirements to be classified as Class “A” biosolids.

The potential of the Lystek process to directly use on raw wastewater sludge was also investigated in order to evaluate broader applications of the Lystek technology in the wastewater treatment plants. It was expected that the raw wastewater can replace the filtrate water for dilution of dewatered biosolids produced at the Guelph WWTP. This would potentially help further minimize the burden on the existing digesters and reduce volumes of biosolids produced.

SEM analysis of Lystek processed and unprocessed samples were also carried out to study the impact of high shear processing of biosolids at moderately high pH and temperature. The results are shown on Figure 2. The results indicated the microbiology is almost completely destroyed by the Lystek processing of biosolids and the samples appeared more macerated.



Dewatered biosolid Lystek processed biosolid

FIGURE 2. SCANNING ELECTRON MICROSCOPY OF DEWATERED AND LYSTEK PROCESSED BIOSOLID PRODUCT

No significant changes in the general chemistry of the processed material are expected since only KOH is added to adjust pH. When compared the general chemistry parameters with the Canadian guidelines presented in the "Guidelines for the Utilization of Biosolids and Other Wastes on Agricultural Land" (MOE 1996) as well as the United States guidelines presented in "A Plain English Guide to the EPA Part 503 Biosolids Rule" (US EPA 1994), both the processed and unprocessed biosolids material met both the Canada and United States guidelines. Verification of land application of processed material using different methods at different agricultural sites was conducted by Terratec Environmental Ltd, Ontario using a Terragator or Draghose system commonly used for liquid biosolids or animal manure. The homogenous nature of the processed materials provided for uniform control of application with conventional equipment.

There are numerous benefits associated with the Lystek processed biosolids (Figure 3). The processed material is a pathogen-free Class A fertilizer product that can provide essential nutrients to the soil beneficial to the crops (deFreitas et al., 2003; Shober et al. 2003). According to National Biosolids Partnership “EMS Program Measurement of Benefits Leading to Final Report and Recommendations in 2004”, biosolids can provide farmers with about $180-200 per acre worth of organic fertilizer value that includes many essential nutrients not typically found in chemical fertilizers. Presence of the K in Lystek product provides additional nutrient value which otherwise is not present in significant amount in the biosolids. With current fertilizer prices Lystek processed biosolids can provide farmers with about $250-280 per acre worth of organic fertilizer.

Chemical, thermal and mechanical pretreatment of wastewater biosolids to improve solubility of organic matter has been studied by different groups using strategies of high temperature range of 60-175^{o}C (Tanaka and Kamiyama, 2002; Vlyssides and Karlis, 2004), chemical solubilization (Lin et al., 1997; Penaud et al., 1999), and ultrasonic (Chiu et al., 1997) and mechanical disintegration (Camacho et al., 2002). Similarly appropriately processed biosolids material from the Lystek process may be more conveniently digested during the anaerobic process. This application would particularly be useful during the winter season for smaller plants and all year around for larger plants having gas to energy recovery system. However, detailed investigations are needed to test this application.

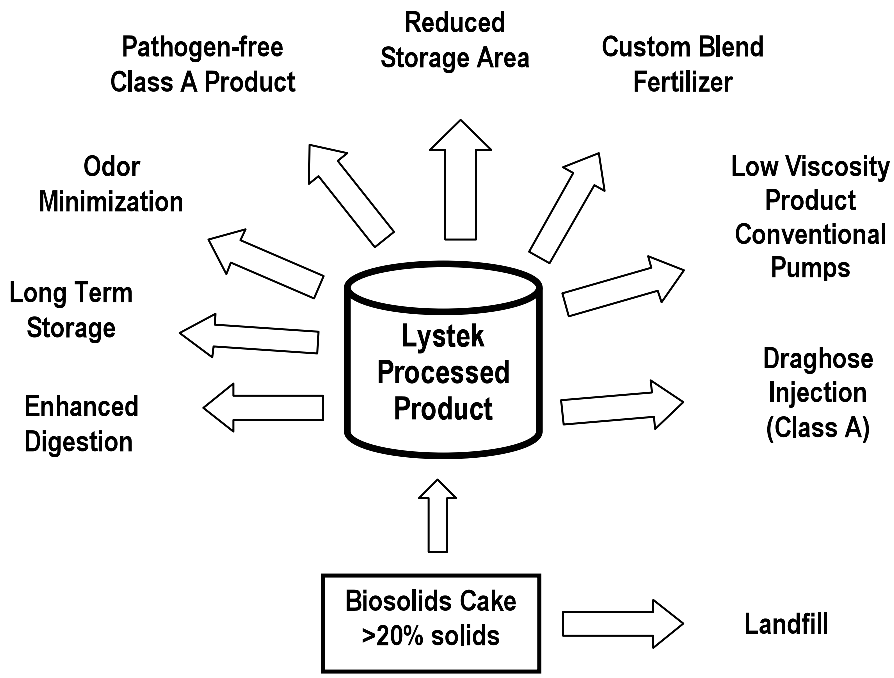


FIGURE 3. BENEFICIAL APPLICATIONS OF THE LYSTEK PROCESSED MATERIAL IN DIFFERENT AREAS

CONCLUSIONS

Full-scale testing at Guelph WWTP confirmed the commercial potential of the Lystek process to consistently achieve a high solids pathogen-free liquid biosolid product that is fully compatible with standard equipment in use for handling and land application of biosolids and animal manure even at high solids (15-18%). Some of the direct benefits of the technology and the processed product include:

- Small foot print of the system at the end of the WWTP and flexible approach to biosolids management at any WWTP;
- Reduced handling, storage, transportation and disposal costs;
- Meets US EPA Class A criteria - pathogen free, which is not required by Canadian regulation but which is a future objective for the regulators;
- Safe, nutrient-rich fertilizer for local farmers;

- Reduced truck traffic on the roads compared to other biosolids processing systems because of more local deposition sites and efficient transfer;
- Reduced greenhouse emissions from reduced trucking;
- Stable for winter storage (freeze-thaw stable);
- Nutrients much more evenly applied and hence loadings to agricultural lands are predictable, consistent and can be tracked accurately;
- Uniform spreading of homogenous material for field application is simple, quick and fully compatible with current farming operations;
- Reduced compaction in the fields with less run over of the land;
- Less risk of nutrient-runoff in the field;
- Improved use of nutrient through better placement/timing of nutrients;
- Much more predictable NPK values; and
- Recyclable product conserves landfill space.

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