Hsu, Benjamin

Subject: FW: Evaporator
Attachments: Hillsborough SE County LF Evaporator Assessment 20190201.pdf

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From: Cassady, George <CassadyG@hillsboroughcounty.org>
Sent: Monday, March 25, 2019 9:34 AM
To: Yeargan, Mary <Mary.Yeargan@dep.state.fl.us>; Vazquez, Pamala <Pamala.Vazquez@dep.state.fl.us>
Subject: FW: Evaporator

Good morning. Here is the final report from SCS and Pelz Environmental Services. Let me know if you have any questions or want to discuss.

George

---------- Forwarded message ----------
From: "**Ruiz, Larry**" <RuizLE@HillsboroughCounty.ORG>
Date: Fri, Feb 1, 2019 at 1:55 PM -0500
Subject: FW: Evaporator
To: "Schinella, Beth" <SchinellaB@HillsboroughCounty.ORG>

Please let me know if you have questions or comments

From: Guilbeault, Ken [mailto:KGuilbeault@SCSEngineers.com]
Sent: Thursday, January 31, 2019 11:19 PM
To: Ruiz, Larry <RuizLE@HillsboroughCounty.ORG>
Cc: Curtis, Bob <BCurtis@scsengineers.com>
Subject: RE: Evaporator

[External]

Larry,
Attached is the draft report on the Evaporator. Please let me know if you have any questions or comments. Thank you.

Ken Guilbeault, P.G.
Project Director
SCS Engineers
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www.scsengineers.com

From: Ruiz, Larry <RuizLE@HillsboroughCounty.ORG>
Sent: Thursday, January 31, 2019 4:44 PM
To: Guilbeault, Ken <KGuilbeault@SCSEngineers.com>
Subject: Evaporator

What is the Status?

Larry E. Ruiz
Manager Landfill Operations
Solid Waste Management Division

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February 1, 2019

File No. 09215600.07

MEMORANDUM

TO: Mr. Larry Ruiz, S.C.

FROM: Mr. Sam Cooke and Mr. Ken Guilbeault, P.G.

SUBJECT: DRAFT Hillsborough SE County Landfill Leachate Evaporator Review

This memo was prepared based on the Hillsborough County Transportation & Utilities, Solid Waste Management (SWMD) staff request for a landfill leachate evaporator review report. The request for this report was made during a January 25, 2019, meeting between Ken Guilbeault and SWMD staff.

The report was requested to include the following information:

1. Evaporator pilot study site visit
2. Leachate sample collection
3. Permitting considerations
4. Secondary containment requirements
5. Air quality issues
6. Personnel needs
7. Maintenance costs
8. Any issues that may show up based on your experience with other evaporators
9. Alternative treatment options
10. Opinion
11. Pelz Environmental Sevices, Inc. review

1 EVAPORATOR PILOT STUDY SITE VISIT

Sam Cooke, Viraj deSilva, and Caroline Devitt of SCS Engineers (SCS) participated in a tour of the Heartland Water Systems (Heartland) landfill leachate evaporator pilot test setup at Hillsborough's Southeast County Landfill (SCLF) on Tuesday, January 8, 2019. The purpose of the evaporator pilot testing was for SWMD staff to evaluate if a full-scale Heartland evaporation unit could be used to effectively dispose of landfill leachate. The following Heartland staff were present during our tour: John Weigold (Business Development Manager), Ben Laurent (Process Engineering Lead), and Rick Boughner (Operations Manager). Ben Laurent was the primary source of information and led us on the tour.

The Heartland evaporator pilot test unit began operation on Sunday, January 6, 2019, and consists of trailer mounted equipment that approximates the operation of a full-scale Heartland Concentrator. Heartland located their pilot leachate evaporator unit near Ponds A and B and extracted landfill leachate to feed the leachate evaporator using a submersible pump in the SCLF's main leachate pump station (MLPS) (see **Figure 1** for the site location map provided by Heartland).

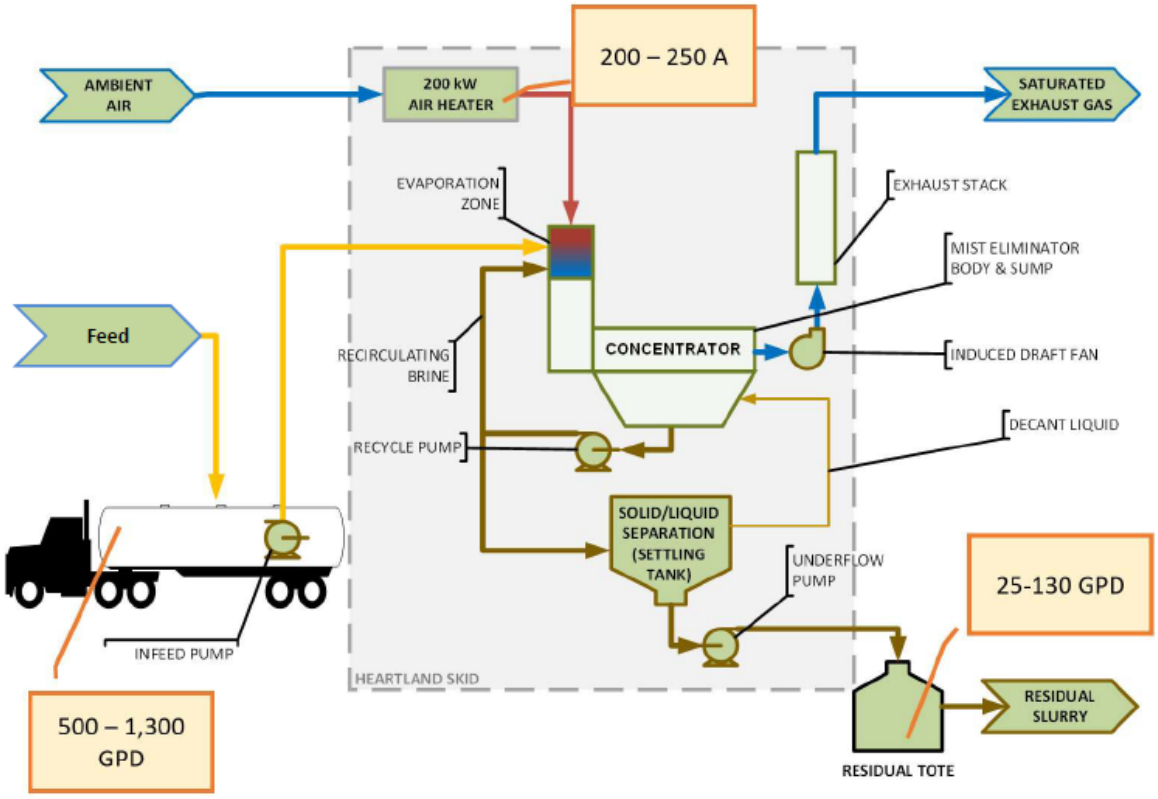
Figure 1. Site Location Map

Relevant information about the pilot-scale leachate evaporator includes the following:

- The Heartland pilot-scale leachate evaporator unit has a ~1,000 gallons per day (GPD) capacity, and the unit typically evaporates 90% to 95% of the leachate that it treats.
- It was predicted by Heartland that the SCLF leachate would allow evaporator operation closer to the higher 95% evaporation rate, based on the fairly low concentration of leachate constituents.
- Instead of an electric heat source used to operate the pilot-scale unit, a full-scale Heartland Concentrator would be expected to utilize hot gases discharging from a new enclosed flare, to heat the leachate being evaporated through the Concentrator.

A process flow diagram provided by Heartland is shown as **Figure 2**.

Figure 2. Process Flow Diagram



The purpose of Heartland's pilot-scale leachate evaporator unit operating at the landfill was to demonstrate that the SCLF leachate could be reliably evaporated and to provide site-specific data regarding the pilot-scale unit operation. A description of the pilot-scale unit's process flow is as follows:

1. **Hot Air is Generated** – Outside air is heated to a temperature of ~800°F, using a 200kW electric heater, and is drawn through fan ducting into the venturi section (aka Evaporation Zone in **Figure 2**) of the evaporator pilot unit. The negative air pressure to draw the hot air through the unit is generated using an induced draft fan. (Note: The full-scale evaporator will use hot gases that discharge from the combustion of landfill gas or natural gas within an enclosed flare – an electric heater is used for the pilot unit so that landfill or natural gas connection is not necessary.)

2. **Leachate is Heated by the Hot Air –** Raw leachate is pumped, using a submersible pump, from the MLPS and is injected either above the evaporation zone section of the evaporator pilot unit where the leachate drops through the venturi and is heated to ~150°F by being directly exposed to the hot air. Raw leachate is also injected into the Concentrator by spraying the leachate over the evaporator mist eliminator chevrons to assist with cleaning solids from the surface of the chevrons.

3. **Hot Leachate Generates Water Vapor –** The heated leachate becomes a saturated liquid and vapor mixture that flows through the evaporator mist eliminator section (aka Concentrator in **Figure 2**). The entrained hot liquid portion of the high velocity liquid/vapor mixture impinges on the mist eliminator chevron surfaces and flows down into the bottom sump of the Concentrator, beneath the demister chevrons. The hot vapor flows through the mist eliminator section chevrons and out the exhaust stack as a visible white water vapor plume.

4. **Unvaporized Leachate is Recirculated –** The hot leachate that collects in the bottom sump of the Concentrator, beneath the mist eliminator chevrons, is recirculated by a pump back into the evaporation zone to be reheated and further evaporated. As stated above, raw leachate is introduced above the evaporation zone where it mixes with the hot recirculated liquid. A defoamer chemical is added to the sump.

5. **Concentrated Unvaporized Leachate and Solids are Transferred to a Settling Tank –** Recirculation of the mixture of newly introduced leachate and concentrated leachate continues from the Concentrator sump back to the evaporation zone, and the leachate is steadily becoming more concentrated. The concentration of the recirculated liquid is controlled based on the conductivity and/or density of the liquid, through use of in-line analysis. When the evaporated and more concentrated liquid meets the pre-determined conductivity or density set point, then a control valve opens and some of the concentrated liquid is "blown down" or pumped to a cone bottom settling tank for accumulated solids reduction (i.e., total suspended solids (TSS) and precipitated dissolved solids are removed in the settling tank).

6. **Sludge from the Settling Tank is Transferred to a Tote –** The concentrated liquid that is "blown down" to a settling tank is partially clarified, with the decanted clarified liquid exiting the top of the settling tank, and flows back into the bottom sump of the Concentrator. The higher concentrated "sludge" that accumulates in the bottom of the settling tank is periodically pumped to a plastic tote for storing the residual. At the time of our site visit, Heartland had not had to pump any sludge to the tote.

Figure 3. Pilot-Scale Evaporator

Leachate is heated in the evaporation zone, shown in the upper right.

Heated liquid and vapor are separated in the Concentrator, the white cone bottom unit shown in the lower center.

Vapor exits through the grey fan and white exhaust stack, shown to the left.

2 LEACHATE SAMPLE COLLECTION

SCS collected samples from the leachate sump and from the final residual aggregate to compare the pre- and post-treatment concentrations. Table 1 summarizes the detections of the pre-treatment leachate sample (SP-1) and the post-treatment residual aggregate (SP-6).

The detected concentrations in the SP-1 and SP-6 samples were below the Title 40 Code of Federal Regulations Section 264.24 toxicity characteristics. Therefore, the residual aggregate can be disposed of as non-hazardous waste.

As the evaporator reduces the volume of liquid, the constituents that are present in the leachate become more concentrated in the remaining liquid. If this liquid is recirculated back into the landfill the quality of leachate may become more concentrated and may cause issues with disposal if some of the leachate is diverted to the publicly owned treatment works facility (due to excess volume over what the evaporator can treat or if the evaporator is temporarily down for maintenance).

3 PERMITTING CONSIDERATIONS

To fully evaluate the requirements for permits, the final conceptual design of what exactly will be installed is necessary; however, for this initial evaluation, SCS has assumed that what will be installed is a new enclosed flare with its exhaust connected to one or more Heartland Concentrator unit(s). With those assumptions, the permit work that would be needed to add this type of landfill leachate evaporator system at the SCLF is expected to be the following:

- Submit a minor modification to the Leachate Management Plan that is part of the facility's Solid Waste Permit (35435-022-SO/01).
- Complete permit(s) required for construction of the evaporator system, as required by the local building department (concrete, electrical, fencing at a minimum) and state regulatory agencies (Environmental Resource Permit, Notice of Intent to Construct).

Additional information was provided by Heartland regarding the evaporator permitting considerations, as follows:

Typical new and modified permits for installation and operation of a Heartland Concentrator include the following permits:

- **Solid Waste Permit.** Heartland's understanding is that the leachate concentrate for this project will be returned to the landfill. This may require a change to the solid waste permit. It is not expected that return of leachate to the landfill will be a problem based on Florida Statute:

  62-701.300 Prohibitions.

  (10) Liquids restrictions.

  (a) Noncontainerized liquid waste shall not be placed in solid waste disposal units which accept household waste or construction and demolition debris for disposal unless:

2. *The liquid waste is leachate or gas condensate derived from the solid waste disposal unit, or byproducts of the treatment of such leachate or gas condensate, and the solid waste disposal unit is lined and has a leachate collection system.*

- **Construction and Building Permits.** As required by state and local authorities for installation and operation of this equipment.

4 SECONDARY CONTAINMENT REQUIREMENTS

The secondary containment requirements for a Heartland Concentrator installation would be expected to be at least 110% of the volume of the largest leachate storage container that is installed with the evaporation unit. This is a typical standard for all above-ground storage tanks.

Additional information was provided by Heartland regarding the secondary containment consideration, as follows:

Containment type and design for this project will be determined during the design phase of the project. The majority of Heartland Concentrators installed in permanent installations are installed in a concrete containment, although there are installations with other containment systems. Concrete containment systems typically have the following features:

- Robust concrete design that functions as both foundation for the equipment as well as secondary containment. Concrete walls border the containment area. This type of construction has a very long operating life.
- Design capacity is 110% of the largest tank volume, as well as consideration for additional capacity for a rain event.
- The design of the containment is slightly sloped to drain liquid to a sump within the containment. The sump has a pump that can be configured for manual or automatic starting when there is liquid in the sump.
- A high-level switch in the containment interlocks a number of devices that will shut down the Heartland Concentrator™, close block valves that are sending liquid into the containment, and control other devices as appropriate based on final design configuration.

The base instrument package of the Heartland Concentrator™ and ancillary tanks (residual, feed tank, etc.) also includes high-high level switches interlocked with the control system. As a result, if a high level is detected in any process vessel, the system will automatically and safely shutdown and provide an e-mail or phone call out to the operator, even if the system is running unattended. Additionally, a remote operator will be able to view the status of all instrumentation via a virtual private network (VPN) remote log-in function.

Please note, Florida statutes [62-762] include requirements for above ground storage tanks. A further assessment would be required to determine if any of these requirements are applicable for tanks storing leachate.

5 AIR QUALITY ISSUES

Prior to the installation and after operating a new evaporator unit, complete the following air permits and/or air quality related activities:

- FDEP Air Construction Permit – this is required to be submitted and approved prior to the installation of the evaporator system.
- Before 180 days of the initial operation of the evaporator system is completed, conduct Initial Performance Testing (IPT) using stack testing techniques including collecting a representative discharge gas sample and analyzing the gas sample for various hazardous air pollutants (HAPs). This will be written into the permit based on claim of performance provided in the construction permit application.
- Before 180 days of the initial operation of the evaporator system is completed, prepare and submit an Air Operation Permit Modification to bring the new unit into the operations permit. The construction permit ends at this time.

Additional information was provided by Heartland regarding the evaporator air permit and air quality consideration, as follows:

Air Permit. The project at the SCLF will involve installation of new enclosed flares as well as the Concentrators. Addition of the flares and evaporation equipment will require a permit modification. The flare has a number of important features:

- Heartland's enclosed flare is designed for adequate combustion residence time and temperature to ensure adequate destruction efficiency of fuel gas and non-methane organic carbon (NMOC) compounds.
- Flare temperature is controlled for optimization of combustion efficiency and is independent of concentrator operation.
- Combustion and gas transfer are automatically controlled by the Concentrator's control system in tandem with a flame safety controller integral to the flare operation.

Heartland has successfully permitted its Concentrators in six states. Heartland has not requested an air permit for a permanent facility in Florida in the past, although we do not anticipate any specific air permitting issues for Concentrator installation at SCLF for the following reasons:

- Since Hillsborough currently combusts landfill gas at the SCLF, we do not expect any actual increase in emissions from combustion products (NO_x, CO, SO_2) as a result of Heartland's process. Consideration will be given to overall flare capacity requirements for the site and its effect on potential to emit.
- The enclosed flare should directionally improve emissions relative to an open flare. The enclosed flare will also provide a means to measure emissions, should stack tests be required.
- Volatile Organic Compounds (VOC's) are very low levels in SCLF leachate. VOCs can be a source of odor in other leachates. Based on an EPA 8260B VOC analysis performed by the County on the raw leachate, only one VOC compound, naphthalene, was detected at 13 ug/L. At a leachate processing rate of 100,000 GPD, assuming 100% of the VOCs

are emitted, the resulting emissions would be less than 0.01 tons per year (TPY). Even assuming every VOC scanned as part of the 8260B test method were present at each respective detectable limit, the total VOC would only be approximately 350 ug/L, which would similarly correspond to an emission rate of less than 0.1 TPY.

- The water analysis performed by the County indicated low levels of potential odor causing constituents. These analyses were qualitatively validated during Heartland's recent Pilot, i.e., there was no perceived odor attributable to the Pilot Concentrator operations. Thus, odor is not anticipated to be an issue for a commercial scale Heartland Concentrator™ at SCLF.

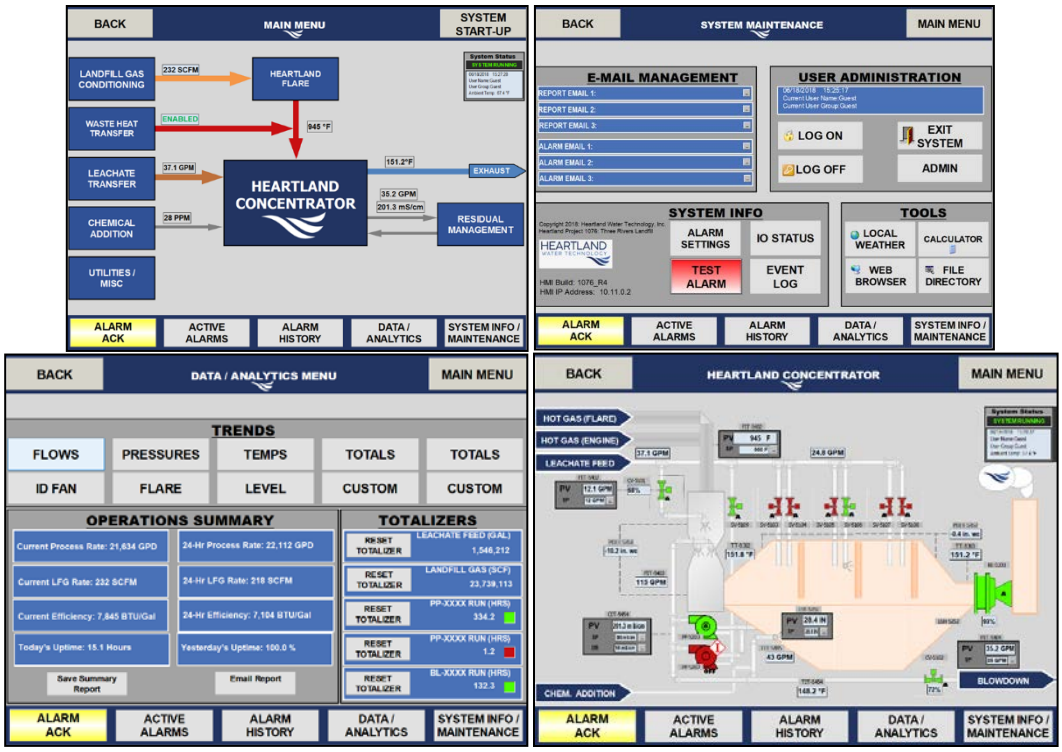
6 PERSONNEL NEEDS

This section was written based on the experience of our SCS Field Services Operation, Maintenance and Monitoring (FS OM&M) staff who have installed and operated a leachate evaporator at a landfill in the Southeastern United States. Typically, one full-time operator, per evaporator unit, should be planned. Although the evaporator unit is designed to operate automatically and can run without supervision, periodic inspection, cleaning, maintenance, monitoring, sludge handling, and other tasks are enough to keep a full-time operator engaged. However, to the extent that the evaporator unit can be operated unsupervised during nights, weekends, and holidays, telemetry can be used to keep track of the evaporator's operation, until an operator is needed.

Additional information was provided by Heartland regarding the evaporator personnel needs, as follows:

Heartland Concentrators are designed for unattended operation, and therefore require less operator attention than may be required for other systems. An important element is Heartland's advanced control system. The controls include instrumentation, PLC hardware, system software, and overall functionality that are customized to adhere to each customer's specifications. Functionally, these features facilitate ease of integration with existing and balance of plant systems. Key features include:

- Remote monitoring and control
- Data management and trending
- Flow-based HMI graphics and color schemes and navigation
- Enhanced HMI security
- Other features that improve the overall operability of the Concentrator system



The system is also designed for ease of maintenance and improved operations.

- Quick release openings reduce time to service equipment
- Cleanout ports on piping system improve access
- Lift equipment assist operators in servicing mist eliminators
- Ladders and platforms are near equipment requiring service
- Automated spray nozzles are used to wash internal parts of the system
- Many other improvements reduce service requirements based on over 10 years of design and operation of Heartland Concentrators

At other Heartland Concentrator leachate sites, typically one full time equivalent (FTE) operator is assigned to a single Concentrator. The FTE would be responsible for normal operation and call-outs on nights/weekends. Since this project will have multiple Concentrators, it is likely multiple FTEs would rotate coverage on off hours. At another 100,000 GPD Heartland site processing landfill leachate, there are three Concentrators operated by three FTEs.

7 MAINTENANCE COSTS

With a well-designed evaporator unit, there certainly will be maintenance issues that need to be addressed, which will have a cost, but the evaporator maintenance cost does not stand out as being significantly more than what would be considered routine maintenance on pumps, motors, fans, tanks, and controls for any other leachate treatment system.

Additional information was provided by Heartland regarding the evaporator maintenance costs, as follows:

Operating & Maintenance (O&M) costs include primarily labor, maintenance, antifoam, and electricity. These O&M costs (not including capital costs) collectively typically run between $0.015-$0.03 per gallon processed. They are dependent on a number of factors including final equipment configuration, overall yearly processed leachate, electricity unit cost (US$/kWh), and antifoam costs.

Estimated cost range for this type of system is between $0.045 and $0.06 per gallon. This price includes capital and O&M costs over a 10 year period.

8 ISSUES THAT MAY BE OF CONCERN

Based on our experience at other leachate evaporator facilities, the general issues listed below have come up as being of concern for other landfill leachate evaporator operators or may be a concern at this site. Of course, these may not be issues at the SCLF facility but are being presented for consideration. It should be noted that this list does not anticipate all possible concerns associated with the operation of a leachate evaporator:

- Generation of landfill gas decreases significantly, and natural gas has to be used to evaporate the leachate, which can significantly increase the annual operation cost.
- Odors caused by the volatilization of leachate constituents can become a nuisance to neighbors. At one landfill leachate evaporator, with fairly high concentrations of ammonia and other odor causing constituents, odors were detected by neighbors over a mile from the evaporator. There are methods that can be employed to eliminate odors from being a nuisance, including installation of a regenerative thermal oxidizer (RTO). However, RTO capital and O&M costs can be significantly high.
- A visible plume of water vapor from the exhaust stack can be considered an issue, by those observing the visible plume. The use of an RTO will super-heat the vapor and eliminate the visible water vapor plume, but that adds capital and O&M costs.
- Proximity of the evaporator operation to the Tampa area potable water reservoir is an issue that may come up, especially if there are nuisance odors associated with the evaporator operation. Public opinion may consider the any visible emissions as a source of contamination to the reservoir.

9 ALTERNATIVE LEACHATE TREATMENT OPTIONS

The alternative leachate treatment options, provided below, are presented for discussion purposes. A more detailed review would be needed to develop budgetary cost estimate information and provide other details. Bench-scale and/or pilot-scale testing of the alternative treatment options is also recommended to better predict the operation of the treatment options. Additional treatment options, such as membrane technology (e.g., ultrafiltration and/or reverse osmosis) and physical-chemical methods of leachate treatment are also available for consideration and additional evaluation, if desired, to find the most cost effective and feasible method of leachate treatment.

Alternative Treatment Option 1: Membrane Bioreactor (MBR)

1. Technology description – An MBR is a continuous biological system that involves a combination of two highly efficient biological treatment systems (both denitrification and nitrification) working in concert with ultrafiltration membranes to separate the suspended bio-solids that recirculate through the MBR treatment system. The MBR equipment includes two reactor tanks, two aeration blowers, recirculation and transfer pumps, controls, and a containerized ultrafiltration (UF) system, as well as chemical amendment and cleaning tanks/pumps. The additional biological reactor tanks and UF membrane container would be located adjacent to the existing leachate storage tanks. Operation of the MBR can be part of the evaporator operator's responsibilities. More detailed information is available through discussion with SCS or can be provided in the equipment supplier's proposal.

2. Fuel options and sources – No landfill gas is needed to operate the MBR, but some energy input may be needed to heat the leachate during the winter season. However, an operating MBR can generate heat as a result of the microbial activity, which is exothermic with as much as 2 to 5°F temperature increase expected. The desired leachate temperature is ~85 to 98°F, so heat may need to be added during the winter season.

3. Emission and air permit issues – An MBR equipment supplier was consulted by SCS to assess the emissions and air permit issues associated with the MBR operation. The expected emissions associated with an MBR operation are as follows:

    a. VOCs – Very low emissions due to low VOCs in the leachate
    b. HAPs – Very low emissions due to low HAPs in the leachate
    c. SO_x – No SO_x should be generated
    d. NO_x – No NO_x should be generated
    e. CO – No CO should be generated
    f. PM_{10} – No PM_{10} should be generated

4. Odor control – The odor control for an operating MBR reduces of the following constituents at the listed potential reduction efficiencies:

    a. Ammonia – 95% to 99% reduction
    b. Sulfur-based compounds – 85% to 95% reduction
    c. Organic compounds – 95% VOC reduction, 95% BOD reduction, and 70% to 85% COD and aldehyde reduction
    d. Other odor causing constituents (suspended solids) – >99% reduction

The MBR treated leachate, fed to the evaporator, would have the above expected odor reduction. The bioreactor tanks and leachate equalization tanks can be vented to a bio-filter, if necessary, for odor control of the MBR and leachate collection system.

5. Conceptual design parameters and assumptions – The following design parameters/ assumptions apply to the MBR:

    a. Leachate Flow Rate: 100,000 to 200,000 gallons per day
    b. Influent leachate constituent concentrations (based on limited data review):
        i. Ammonia: 300 - 600 mg/L

ii. BOD: 10 - 400 mg/L
iii. COD (unfiltered): 400 - 900 mg/L
iv. pH: 6.0 to 8.5
v. TSS: No data
vi. Alkalinity: 200 - 2,100 mg/L
vii. Sulfate: 100 mg/L
viii. Temperature: 15 to 25°C

c. Effluent leachate constituent concentrations:
   i. Ammonia-N: < 1 mg/L
   ii. BOD: < 30 mg/L
   iii. TSS: < 30 mg/L
   iv. TN: < 50 mg/L

d. Assumptions associated with the biological treatment system equipment needed:
   i. Feed and recirculation pumps, plus inlet strainer
   ii. Denitrification reactor
   iii. Nitrification reactor (with jet aeration)
   iv. Aeration system capacity (two blowers)
   v. Chemicals Added: NaOH, H_3PO_4, CH_3OH, Anti-foam
   vi. Excess sludge handling equipment

e. Assumptions for membrane: Three external tubular ultrafiltration membrane systems with six modules per loop (five ultrafilter modules, plus an empty module per loop)

6. **Procurement lead time and installation time** – The amount of time that is expected for procurement and installation of an MBR unit is as follows:
   a. Procurement time – The normal equipment procurement time would require 6 to 12 months, depending on what equipment supplier is selected.
   b. Installation time – SCS predicts that the equipment installation time will require 2 to 3 months plus an additional 2 to 3 months to establish the microbial population, using a starter sludge from another local facility.
7. **Facilities that have a MBR system** – The following is a list of facilities with a MBR system:
   a. Republic Services – Modern Landfill, York, PA – 120,000 gpd
   b. Republic Services – Carbon Limestone Landfill, Lowellville, OH – 120,000 gpd
   c. Waste Management – Atlantic Landfill, Waverly, VA – 336,000 gpd (MBR and reverse osmosis)
   d. Pollution Control Financing Authority of Warren County, Oxford Township NJ – 75,000 gpd
8. **Estimated cost range** – Estimated cost range for this type of system is between $0.025 and $0.06 per gallon. This price includes capital and O&M costs over a 10 year period.

Alternative Treatment Option 2: Sequencing Batch Reactor (SBR)

1. **Technology description** – An SBR is a batch biological system that includes the sequential operation of two different biological treatment systems (nitrification followed by denitrification) followed by a clarification step to separate the suspended bio-solids generated by the treatment system. The equipment includes reactor tanks, aeration blowers, recirculation, decanting, and transfer pumps, as well as chemical amendments and pumps. An additional biological reactor tank could be located adjacent to the existing leachate storage tanks in a separate secondary containment. Operation can be part of the evaporator operator's responsibilities. More detailed information is available through discussion with SCS or can be provided in the equipment supplier's proposal.
2. **Fuel options and sources –** No landfill gas is needed to operate the SBR but some energy input may be needed to heat the leachate during the winter season. However, an operating SBR can generate heat as a result of the microbial activity, which is exothermic with as much as 2 to 5°F temperature increase expected. The desired leachate temperature is ~85 to 98°F, so heat may need to be added during the winter season.
3. **Emissions and air permit issues –**The emissions typically associated with an SBR operation are as follows:
    a. VOCs – Very low emissions due to low VOCs in the leachate
    b. HAPs – Very low emissions due to low HAPs in the leachate
    c. SO_x – No SO_x should be generated
    d. NO_x – No NO_x should be generated
    e. CO – No CO should be generated
    f. PM_{10} – No PM_{10} should be generated
4. **Odor reduction potential –** The odor reduction potential for an operating SBR reduces the following constituents at the listed potential reduction efficiencies. Further odor control is typically not required for SBRs.
    a. Ammonia – 85% to 95% reduction
    b. Sulfur-based compounds – 80% to 95% reduction
    c. Organic compounds – 95% VOC reduction, 95% BOD reduction, and 50% to 75% COD and aldehyde reduction
    d. Other odor causing constituents (suspended solids) – >80% reduction
5. **Conceptual design parameters and assumptions –** The following design parameters/ assumptions apply to the MBR:
    a. Leachate Flow Rate: 100,000 to 200,000 gallons per day
    b. Influent leachate constituent concentrations (based on limited data review):
        i. Ammonia: 300 - 600 mg/L
        ii. BOD: 10 - 400 mg/L
        iii. COD (unfiltered): 400 - 900 mg/L
        iv. pH: 6.0 to 8.5
        v. TSS: No data
        vi. Alkalinity: 200 - 2,100 mg/L
        vii. Sulfate: 100 mg/L
        viii. Temperature: 15 to 25°C

c. Effluent leachate constituent concentrations:
   i. Ammonia-N: < 1 mg/L
   ii. BOD < 30: mg/L
   iii. TSS: < 30 mg/L
   iv. TN: < 50 mg/L

d. SBR Cycle Times proposed:

Parameter	Value	Unit
No. of batches/day/SBR	3.00	per SBR
Maximum Fill Time	4.00	hrs. per basin
Fill Time at ADF	4.00	hrs.
Anoxic Fill Time	1.40	hrs.
Aerated Fill	2.60	hrs.
React Time	2.60	hrs.
Settle Time	0.75	hrs.
Decant Time	0.50	hrs.
Idle Time	0.15	hrs.
Complete Cycle Time	8.00	hrs. per basin

e. Assumptions associated with the biological treatment system equipment:
   i. Feed and recirculation pumps, plus inlet and strainer/screen (1/4-inch static screen is suggested)
   ii. Additional leachate storage tank
   iii. Aeration system capacity (two duty, one standby blowers)
   iv. Decanter
   v. Waste Sludge Pump
   vi. Excess sludge handling equipment

f. Assumptions for solids wasting/dewatering:
   i. The wasting of sludge will happen at the end of decant period, while the sludge is still settled. Wasted sludge will have an estimated 0.85% solids content.

6. Procurement lead time and installation time – The amount of time that is expected for procurement and installation of an SBR unit is as follows:

   a. Procurement time – It is predicted that the equipment procurement time will be the following, with tanks procured and aeration system, decanters, pumps, controls, and chemical feed systems:
      i. Submittals: Proposed 10-12 weeks
      ii. Approvals: Proposed 4 weeks
      iii. Shipment: Proposed 22-26 weeks

b. Installation time – SCS predicts that the equipment installation time could be the following:

   i. 2 to 4 months for site and slab work
   ii. Tank installation: proposed 16 – 20 weeks for tank erection and equipment installation
   iii. 1 to 3 months to establish the microbial population, using a starter sludge from another local facility.

7. Facilities that have a MBR system – The following is a list of facilities with a MBR system:
   a. South Dade landfill, Miami, FL – 320,000 gpd
   b. Tomoka Farms Road Landfill, Port Orange, FL – 60,000 gpd
8. Estimated cost range – Estimated cost range for this type of system is between $0.025 and $0.06 per gallon. This price includes capital and O&M costs over a 10 year period.

10 OPINION

Based on what was observed during the evaporator pilot test and experience with other leachate treatment systems, including full-scale Heartland, John Zink, and Aptum evaporators, SCS have the following opinions regarding the Heartland evaporator technology:

- Evaporation Technology – Heartland has developed their evaporation "Concentrator" technology based on a lower temperature heat requirement that differs from the other evaporators I have seen. The fact that the Heartland evaporator heat source can be from waste heat from a landfill gas to energy (LFG-E) system is a compelling point (although, it isn't necessarily an advantage to the Southeast County Landfill, because there is no LFG-E system). Also, the fiberglass reinforced plastic construction of the Concentrator chevrons and shell are also compelling.
- Quality – SCS' observations of the materials of construction, evaporation technology basis, sophistication of controls systems, design of the Concentrator unit, etc. are favorable. It is SCS' experience that Heartland looks for ways to improve upon what is a sound technical system for disposing of wastewater by evaporation.
- Professionalism – It is SCS' opinion that Heartland has a good technical team that has developed an effective leachate evaporation system. It is SCS' experience that their approach is methodical, technically sound, and professional and they have consistently followed through on what they committed to.
- References – The references that SCS have spoken with regarding the Heartland evaporation technology application for landfill leachate have given very good reviews, based on their multi-year experience with Heartland.

- **Possible Concerns** – The concerns that SCS have apply to the use of any evaporator technology for landfill leachate disposal, as follows: 1) If LFG generation decreases and the quantity of landfill leachate does not decrease, natural gas may be needed, which can increase the operation cost. 2) Odors can be a nuisance and be detected over a mile away from the operating evaporator, 3) A visible plume of water vapor can be a negative to certain people who observe it, 4) Proximity to the Tampa area potable water reservoir may be an issue of concern, if the evaporator causes nuisance odors that are carried to the reservoir.

11 PELZ ENVIRONMENTAL SERVICES, INC. REVIEW

A review conducted by Pelz Environmental Services, Inc. has been included as an attachment.

Attachment 1

Table

Table 1. Summary of Leachate Quality Analytical Results (Detected Parameters Only)
Southeast Landfill, January 2019

Parameter	Toxicity Characteristics	Units	SP-1	SP-6
Volatile Organic Compounds				
Acetone	NS	ug/L	50 U	86
Trans-1,2-Dichloroethene	NS	ug/L	3.6 U	1.8
Naphthalene	NS	ug/L	13	0.82 U
Metals				
Cadmium - Total	1000	ug/L	3.58	62.9
Cadmium - TCLP	1	mg/L	0.0113	0.0212
Chromium	5000	ug/L	18	613
Copper - Total	NS	ug/L	1.24	533
Copper - TCLP	NS	mg/L	0.0250 U	0.0369
Lead	5000	ug/L	11	641
Mercury	200	ug/L	0.0263	0.862
Molybdenum	NS	ug/L	19.4	285
Nickel - Total	NS	ug/L	31.6	576
Nickel - TCLP	NS	mg/L	0.0700 U	0.515
Zinc - Total	NS	ug/L	92.8	3390
Zinc - TCLP	NS	mg/L	0.158 U	0.526
General Chemistry				
Ammonia as N	NS	mg/L	300	57
Chloride	NS	mg/L	3800	91000
Cyanide	NS	mg/L	0.0067 U	0.13
Specific Conductance (EC) at 25 Deg C	NS	umhos/cm	14490	>20000
Specific Gravity	NS	S.U.	1.0	1.1
Sulfate	NS	mg/L	130	2700
Sulfide	NS	mg/L	5.1	28
Total Alkalinity as $CaCO_3$	NS	mg/L	2450	18000
Total Dissolved Solids	NS	mg/L	8300	170000
Field Parameters				
Conductivity	NS	ms	18.50	>500
Total Dissolved Solids	NS	g	10.14	>100
Field pH	NS	S.U.	6.94	8.20
Field Temperature	NS	°C	34.9	38

Notes:

1. ms = millisiemens
2. umhos/cm = micromhos per centimeter
3. mg/L = milligrams per liter
4. ug/L = micrograms per liter
5. NTU = nephelometric turbidity units
6. S.U. = Standard Units
7. g = grams
8. °C = degrees Celsius
9. **U** = Analyte concentration was below the laboratory detection limit (value shown).
10. **I** = Analyte concentration was between the laboratory detection limit and laboratory practical quantitation limit.
11. NS = No Standard.

Attachment 2

Pelz Environmental Services, Inc. Review

Pelz Environmental Services, Inc.

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Memorandum

To: Ken Guilbeault, P.G., SCS Engineers, KGuilbeault@SCSEngineers.com
Bob Curtis, P.E., SCS Engineers, BCurtis@scsengineers.com

From: Susan J. Pelz, P.E., Susan@PelzEnvServices.com
Pelz Environmental Services, Inc.

Date: January 9, 2019

Subject: Hillsborough Southeast County Landfill (SCLF)
Heartland Leachate Evaporator Pilot Project
PES File #20181228

Pelz Environmental Services Inc. (PES) is pleased to provide this memorandum regarding the Heartland leachate evaporator pilot project at the Hillsborough Southeast County Landfill (SCLF). Our observations and comments are based on our regulatory experience and perspective, and are intended to assist in the future permitting process should the County decide to proceed with a full-scale system.

Background

To prepare for the field observation, the following documentation received from Heartland Water Services (Heartland), Hillsborough County and/or the Florida Department of Environmental Protection (FDEP) Southwest District office regarding the Heartland system was reviewed.

Ref. 1. "Conceptual Heartland Concentrator Residual TCLP Analysis," dated November 29, 2018;
Ref. 2. "Proposal for a 1,000 GPD Pilot Demonstration of the Heartland Concentrator™ at Hillsborough County's Southeast Landfill, HWT Budgetary Proposal Number: 180331 November 2018," dated December 4, 2018;
Ref 3. "Objectives and Description, for On-Site 1KGPD Pilot Demonstration of Heartland Concentrator™ at the Hillsborough County Southeast Landfill," dated December 17, 2018;
Ref 4. Email correspondence dated December 10 and 20, 2018 (Ref 4a), and January 8, 2019 (Ref 4b).

Site Visit

I conducted the site visit on the morning of Tuesday, January 8, 2019. Several personnel were at the pilot project area when I arrived. Hillsborough County personnel, Larry Ruiz (solid waste) and George Cassady (utilities); Heartland staff, John Weigold (business development), Ben Laurent (process engineer), and Rick Boughner (operations manager); and Pero Engineering's, Dave Pero (Heartland's consultant) were present.

The pilot project was set up adjacent to Ponds A and B and the Main Leachate Pump Station (MLPS) (see Figure 1). The trailer mounted equipment was positioned such that any spillage or leakage would be contained within the trench drain that discharges back into the MLPS. Operation began on January 6, 2019[1].

Figure 1 – Project Location

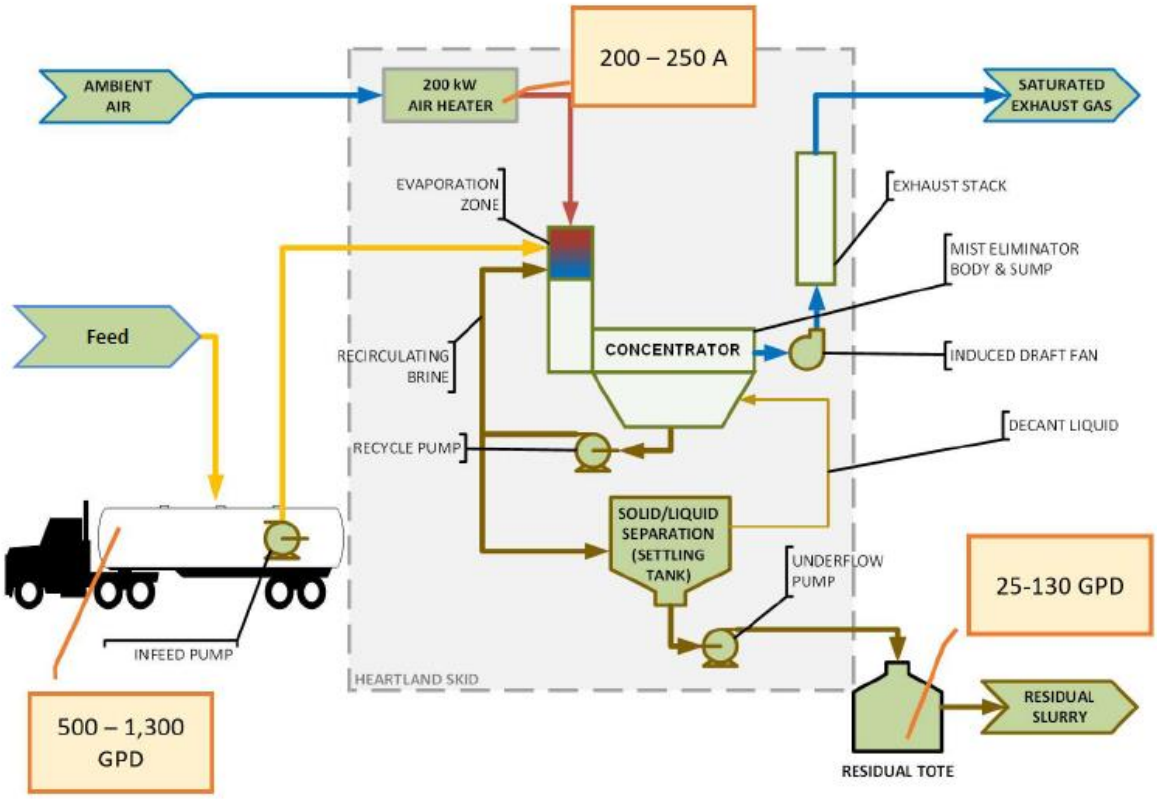
Source: Ref 3., Page 7 of 12

[1] Ref 4b.

Process Flow

Ben Laurent, Heartland's process engineer explained the process and described the function of the equipment components to me. The Process Diagram provided to the County is illustrated in Figure 2 and is described in Ref. 3, page 5 of 12.

Figure 2 – Process Diagram



Source: Ref. 3, Page 6 of 12

Ambient air is drawn through a heat source (in the pilot this was an electric heater) to provide heat needed to evaporate the leachate water. Hot air (~800 degrees F[2]) is drawn into the Evaporation Zone where leachate is injected and heated. For this pilot project, leachate was pumped from the MLPS into the system. According to Heartland personnel, the stack shown in Photo 1 ("Heat release stack") is only used to dissipate heat from the Air Heater when the unit is initially shut down. The hot leachate liquid/vapor/air mixture is then drawn into the Concentrator, where demisters cause the hot liquid to flow down into the bottom of the Concentrator and the saturated vapor/air exhaust gas is discharged through an Exhaust Stack. Raw leachate is also introduced directly

[2] Ref 2, page 12 of 12

into the Concentrator where it mixes with the hot liquid and the mixture is then recirculated back into the Evaporation Zone.

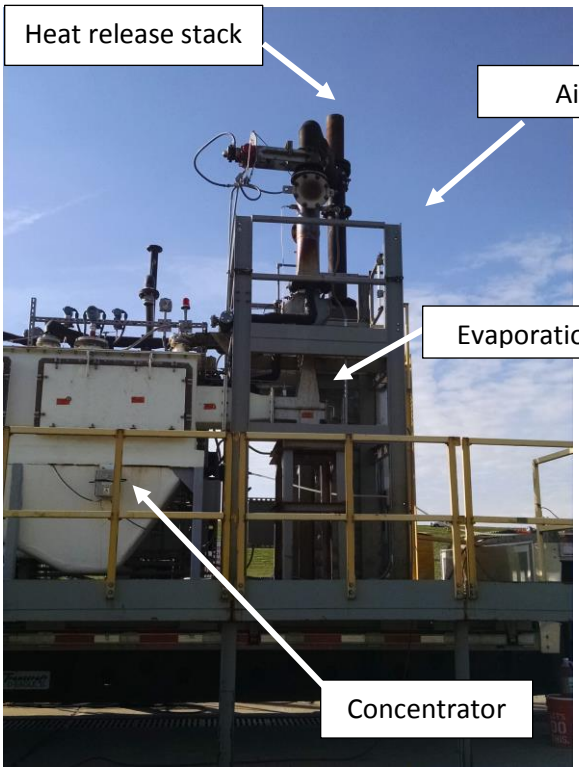


Photo 1

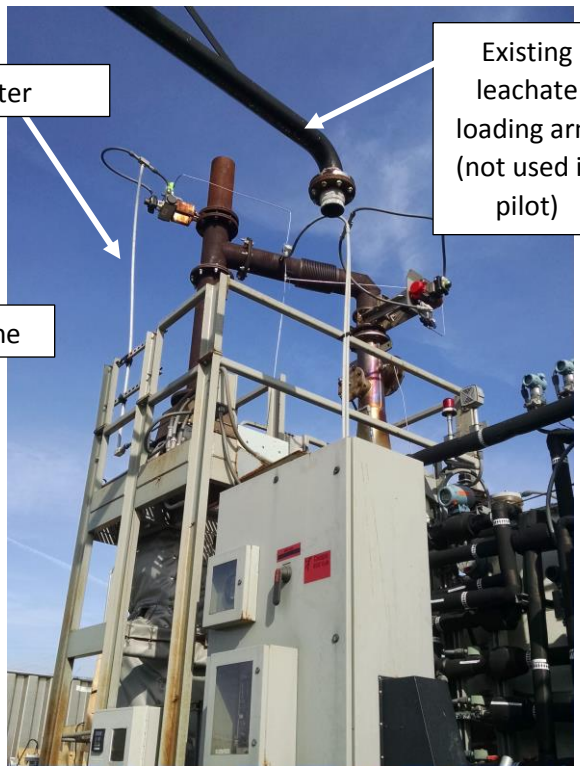


Photo 2

The mixture of liquids from the Concentrator are recirculated back to the Evaporation Zone until a specified conductivity and/or density is achieved. At that point, the concentrated liquid is discharged into the cone-bottom Settling Tank for liquid/solid separation. Liquid that flows to the top of the Settling Tank is recirculated back to the Concentrator and the residual slurry that collects in the bottom of the Settling Tank is pumped to a Residual Tote for storage until testing is complete. At the time of the inspection, no liquid had been pumped from the Settling Tank into the Residual Tote. Disposal of the residual slurry will be determined based on the test results.

Photo 3

Photo 3 shows an insulated Settling Tank used in the pilot project. However, this was due to equipment availability for the project, and the insulation is not required or anticipated for full-scale operation at the SCLF.

Pilot Project Testing

Parameters tested[3] during the pilot project included total solids, specific gravity, pH, conductivity, TCLP metals, chloride, sulfate, sulfide, ammonia, arsenic, volatile organic compounds (VOCs), solids, and alkalinity. Other samples were also collected during the pilot project with the frequency and parameters tested depending on sampling location. Testing of raw leachate (MLPS), concentrator recirculating loop water, Settling Tank (cone bottom) decant (liquid), Settling Tank (cone bottom) discharge (slurry), and final residual (Residual Tote) was included in the pilot project. Additionally, the County (utilities) proposed to analyze the residual concentrate for primary and secondary drinking water parameters[4].

Sampling of the Exhaust Stack emissions was not proposed by Heartland. However, according to Heartland personnel, since there was no combustion occurring in the system, exhaust gas was expected to be water vapor only. The County (utilities) anticipated conducting exhaust stack testing for particulate matter, VOCs, chemical oxidation demand, ammonia, and metals[5]. However, it is my understanding that the testing was not conducted due to the availability of the monitoring contractor and the short timeframe (5 days) for the pilot test.

Discussion

A proposed full-scale operation is assumed to include disposal of concentrated residual slurry in the landfill and the use of landfill gas flare exhaust as a heat source.

1. Long-Term Leachate Quality

a. If concentrated residual slurry is continuously disposed in the landfill over the remaining life of the landfill, what are the long-term effects on leachate quality?

i. Although the residual is not anticipated to be hazardous, it is expected to be concentrated and as such, may make the overall leachate more concentrated. Higher strength (i.e. concentrated) leachate may not be effectively managed by the proposed system, or in the event that it is necessary to haul it offsite for disposal, it may be unable to be treated at County utilities.

[3] Ref 3, page 10 of 12
[4] Ref 4a, email dated December 20, 2018
[5] Ref 4a, email dated December 20, 2018

ii. Also, the leachate character (e.g., dissolved solids or saltiness) may reduce biological activity within the landfill in the long-term. This may result in a regulatory requirement for an extended long-term care period of the landfill.

b. Heartland personnel indicated that its system has been in use at some landfills for as much as 9-10 years with no impact on leachate quality.

2. Air Emissions

a. What is the quality of the Saturated Exhaust Gas?

i. In the proposed full-scale system, the existing open flare would be replaced with an enclosed flare, and the exhaust gas from the enclosed flare would be used as the heat source for the Evaporator. Under this condition, any constituents not fully combusted by the flare would be introduced into the Heartland system and could be concentrated into the residual slurry (water soluble constituents) or discharged through the Exhaust Stack. It is not known if these constituents could concentrate in the air exhaust stream prior to discharging.

ii. Heartland indicated that since there is no combustion in the system, the Saturated Exhaust Gas is only water vapor. However, since the Saturated Exhaust Gas contains water vapor, water-soluble leachate constituents will likely be present in the Exhaust Gas. Although combustion by-products (e.g., NOx, SOx, CO) are not anticipated, water-insoluble, volatile constituents (e.g., VOCs, ammonia, etc.) that are present in the leachate will also likely be present in the Exhaust Gas.

b. Heartland personnel indicated that it has successfully obtained Title V air permits for its system at other landfills, and that the details of the Exhaust Stack emissions would be developed as part of that permitting effort.

3. Landfill Operations

a. Will disposal of a residual slurry be an operational problem for the landfill (especially in the wet season)?

i. Rule 62-701.400(5), Florida Administrative Code (F.A.C.) allows leachate recirculation under certain conditions One such condition (Rule 62-701.400(5)(d), F.A.C.) is, “leachate shall not be recirculated during weather conditions or in quantities that may cause runoff outside the solid waste disposal unit, surface seeps, wind-blown spray, or exceedance of the limits of the leachate head on the liner. Ponding is prohibited unless it is an integral part of the design plan.”

ii. Weather conditions that prevented leachate recirculation occurred throughout 2018. An alternate disposal location for the residual slurry has not been identified. Additional processing of the residual

may be required (especially during the rainy season) to produce a solid material (i.e., that passes the paint filter test) suitable for disposal in the onsite landfill.

iii. Processing of the residual slurry is outside the scope of the Heartland pilot project. However, additional residual processing options could include a filter press, belt press, centrifuge or other typical wastewater sludge unit processes. Liquids from these processes may be suitable for discharge to the County utilities system or be recirculated to the landfill during times when the weather dictates that recirculation is possible. Solids would likely be accceptable for disposal in the SCLF. It should be noted that the reuse of the effluent (liquid) from these processes in the domestic waste composting project may reclassify the composting project as solid waste composting since the liquid is considered to be leachate (solid waste) (See Rule 62-640.100(6)(e), F.A.C.).

b. Will the system be able to treat the volume of leachate expected on a daily basis?

i. As reported in the County's Monthly Leachate Water Balance Report, approximately 6.3 million gallons of leachate was removed for offsite disposal in August 2018 (approx. 200,000 gallons per day). The largest Heartland system can treat "up to 150,000 GPD."[6] If the Heartland system is the only leachate management option at the site, it is not clear how the full-scale batch system will have the capacity required to maintain compliance with regulatory leachate management requirements.

Recommendations

The following information should be considered in the County's evaluation of proceeding with a full-scale Heartland evaporator system.

1. For landfills that have similar Heartland systems in operation, the following information would be helpful:
    a. leachate quality data prior to and after the implementation of the Heartland system,
    b. a description of the system used,
    c. the length of time in full-scale operation,
    d. type of waste disposed at each of the sites, and
    e. air emissions data for the Exhaust Gas.
2. Due to rainy season conditions and Heartland system capacity, supplemental leachate disposal methods should be considered.

[6] Ref 2, Page 4 of 12

3. Additional processing of the residual slurry to generate a "solid" should be considered since the slurry may not be able to be disposed during inclement weather. If effluent from this process will be reused in the composting operation, a solid waste permit (or modification of the landfill permit) may be required.
4. Additional costs for employees, training, and maintenance should be considered.
5. Financial assurance cost estimates will need to be revised to include treatment system operation and maintenance, and equipment replacement at appropriate intervals.

If there are any questions, please contact me at Susan@PelzEnvServices.com .