‘Controlling Your Destiny’

Proven, Reliable, On-Site Leachate Evaporation Technology
Content

- Heartland Overview
- Leachate Management
- Solution – The Heartland Concentrator
- Case Studies
- Demonstration Unit
- Q&A
**Direct-Contact Wastewater Evaporator:**
“The LM-HT® Heartland Concentrator™”

The Heartland Concentrator™ is a rugged and cost-effective solution that can concentrate the widest range of challenging wastewaters all the way to zero liquid discharge (ZLD) in one-unit operation.

**Direct-Contact Rotary Drum Dryer:**
“The Heartland Biosolids Dryer”

The Heartland Biosolids Dryer is a direct-contact, rotary-drum that can dry all manner of biosolids including digested or undigested sludges yielding Class A Biosolids.
Overview

Founded in 2008, Heartland Water Technology ("HT") has patented and commercialized novel technology for treating difficult-to-treat industrial waste waters.

The Heartland Concentrator is a direct contact evaporator that sets new benchmarks for reliability, ease of use and cost to treat.

Proven technology with tier 1 customers in key applications:

Proven Applications

- Landfill Leachate
- Flu Gas Desulfurization
- Produced Water
- Enhanced Pond Evaporation
Leachate Management
What Customers Say Regarding Leachate Management: “It just keeps coming!”

Trends Impacting Leachate Management
- **Rising cost** of leachate management
- **More uncertainty** than ever before (regulatory, technical, community)
- **More POTW risk than ever before**
  - Tightening POTW regulation
  - Leachate impact on POTW treatment (visibility, strength, ammonia)
  - Emerging contaminants of concern
  - PFAS(!)
- Continued diligent regulator enforcement
- **Less recirculation** / more dewatering
- Solid waste characteristics changing impacting leachate quality and volume
- Continued demand for renewable energy and CHP
- Managing in conditions of uncertainty
Market Trend: Leachate Treatment Costs Continue To Increase

- The increase in landfill operating costs in 2019 as compared with 2018 was primarily due to higher leachate management costs\(^1\)
- $97,000,000 increase in leachate costs in 2016\(^2\)

- [2019] Landfill operating expenses increased in aggregate dollars due to increased leachate treatment, transportation and disposal costs\(^1\)
- 1,500,000,000 gallons disposed in 2016\(^3\)

- An increase in leachate disposal expenses [in 2019] due to increased precipitation as well as higher costs per gallon for leachate transportation and treatment\(^1\)
- 500% increase in leachate disposal costs in the past 6 years\(^4\)

\(^1\)Source: 2019 Annual Reports
\(^2\)Source: GWI CTO Magazine Dec 2017
\(^3\)Source: Darnell Waste Expo 2017
\(^4\)Source: Shaner Waste Expo 2017
Leachate Management Economics

Broad range of costs dependent on multiple factors
- Proximity to POTW
- Site specific infrastructure
- Leachate chemistry
- Available disposal / treatment options
- Local regulations
- Volume
- Seasonality
- Available on-site storage
- Transportation market competitiveness

Heartland Value Proposition
- Low total cost to treat
- Solution reliability with ability to adapt to changing feed conditions
- Future-Proofing ... ability control your own destiny
- Wide operating range to address leachate variability
- Maximize LFG Value
“You’re Cutoff!”
Now what?

~60% of Leachate is ‘treated’ with ‘solution by dilution’

STP’s are increasingly taking action on leachate disposal
1. Increasing price
2. Requiring more and more pre-treatment
3. 1 and 2 above
4. Cutting off leachate completely

Key Drivers
1. Nutrient loading
2. UV absorption
3. Contaminants of emerging concern
Solution
Concept of Operation: Brine Concentration Methods

**Thermal Brine Concentrators**
- Feed water interior to tube bundles.
- Heat transfers across tube bundles.
- Tube bundles prone to fouling, rapid corrosion.
- Requires considerable high-alloy metals.
- Requires considerable pre-treatment and highly experienced water operators.
- Requires a crystallizer to achieve ZLD.

**Heartland Concentrator**
- **No heat exchange surfaces** or membranes to foul; low-cost materials.
- **Direct use of waste heat** (exhaust gases).
- Patented Gas-Liquid Section creates acres of surface area for rapid evaporation.
- Require little-to-no pre-treatment and anyone can be trained to operate.
- Can deliver ZLD in a single unit operation ... no crystallizer required.
The Heartland Concentrator™ is a rugged and cost-effective solution that can concentrate the widest range of challenging wastewaters all the way to zero liquid discharge (ZLD) in one-unit operation.

The Heartland Concentrator is a ‘direct-contact evaporator’ – where hot gases are mixed directly with feedwaters in Heartland’s proprietary Low-Momentum, High-Turbulence (LM-HT) process.

With only 2 moving parts, no heat exchangers or membranes to foul, low-cost materials of construction, little-to-no pre-treatment required, and ease of operation, Heartland can deliver zero liquid discharge (ZLD) in a single unit operation – with no crystallizer required.
LM-HT® Heartland Concentrator™

Sizes | 12K to 144K gpd per unit
Applications | MSW, Brine Ponds, O&G, FGD Purge Water, Other
Delivery | 6-9 months; Fully skidded, Modular and re-deployable
Flex-Heat | Flare, Recip Engine Exhaust, Recip Engine Jacket, GT, Hybrid
Value Added Solutions | Plume Suppression; Ammonia Management
Lifespan | 20+ years

Left: Process fluids as they exit the concentrator.
Right: Solids accumulating in a settling tank. Liquid recycled back to the concentrator.

1. Heat Source
2. Evaporation Zone
3. Feed and Recirculation
4. Droplet Separator
5. Sump and Blowdown
6. Exhaust
CoVap™ Configuration - Cogeneration for Industrial Wastewater Evaporation

A New Category of Cogeneration Application

Traditional
1. Additional Power Generations
2. Industrial Steam
3. Hot Water
4. Refrigeration

and now...

New
5. CoVAP

Benefits of CoVAP™:

1. Distributed, reliable renewable power
2. Energy efficient use of waste heat
3. Reliable and cost-effective wastewater treatment
4. Easy and reliable integration
5. Simple to retrofit into simple cycle
6. Rapid deployment
All Heartland Concentrators are full Skidded and Ready for Rapid Deployment

1. Minimize field installation complexity – often in remote areas
2. Factory-tested to ensure seamless start-up and commissioning
3. Lower total cost-of-delivery
Case Example: Flare Configuration
Flare Configuration
Beneficial re-use of Landfill Gas for 100% of Thermal Energy

Municipal Landfill – Alaska
- Heartland Unit: 12,000 GPD.
- Challenging climate - equipment located in custom designed building and heat traced.
- Load-out door for transferring residuals
- 100% of Thermal Energy Supplied by Flare Exhaust
- Flexibility: Ability to Operate on Natural Gas or LFG
- Installed & operating since 2014.
Heartland’s Custom Enclosed Flare

- Heartland recommends the use of its custom and proprietary enclosed flare and hot gas transfer system as the Concentrator’s thermal energy system; combustion and gas transfer are automatically controlled by the Concentrator control system in tandem with a flame safety controller integral to the flare operation.
- 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.
- Heartland’s enclosed flare is multi-fueled, and can be configured to burn well pad flare gas, pipeline natural gas, or propane.
- Optionally, Heartland’s enclosed flare can be configured to turn on or off with the Concentrator, or independently if there is a need for flaring even when Concentrator is not operating.
Case Example: CoVAP™ Configuration
Virginia Landfill

8,000 tons per day of solid waste

100K gpd of leachate

Turbine Plant
- 4 Solar Centaur 40 Turbines

Heartland Plant
- 3 40,000 gpd concentrators
Simple and Safe Integration
Case Example: Hybrid Configuration
Hybrid Configuration
Optimal cost-savings with maximum flexibility

Southern United States
- Heartland Concentrator: 25,000 GPD.
- 999 kW LFG Engine on-site
- Custom enclosed flare using Landfill Gas
- Hybrid Configuration utilizes Flare and Engine Exhaust
- Installed & Operating since 2019

Heartland Concentrator (below) operated inside building (above)

Hybrid Configuration ducts Engine Exhaust and flare gas together (above)
Case Example: RO Concentrate
Industry Leader in Landfill Leachate RO Concentrate Evaporation

Location: Cumberland County, NJ Landfill

Thermal Energy: Waste Heat from LFGTE Engines

Capacity: 25,000 GPD
1,000 GPD Demonstration Unit
1,000 GPD Demonstration Unit

- 1,000 GPD trailer-mounted demonstration unit.
- Thermal energy source: 200 kW Electric Heater.
- Advantages: rapid deployment, ease of mobilization/demobilization, ease of integration with site operations, low-cost, key performance indicators (KPI’s) jointly developed pre-deployment, ability to optimize process controls and design for full-scale system, full suite of analytics and metrics developed for performance reporting, operated by HWT personnel, thorough project report available within 3 weeks of completion.
- Duration: suggested duration 150 hours of processing time; duration used successfully on multiple deployments.
- Customer Scope: provide electric connection and leachate to skid, containment if needed.
Intellectual Property

• Heartland maintains a comprehensive IP management program.

• Heartland currently owns 47 active US and foreign patents and patent applications, including:
  • 34 issued US patents, and
  • 13 issued foreign patents

• Heartland’s IP is generally directed to and covers various aspects of Heartland’s technology, which includes
  • Low momentum, high temperature (LM-HT®) evaporative technology, and
  • The basic configuration and construction of the LM-HT® Concentrator system, and
  • The use of the LM-HT® Concentrator with different types of fuel sources and at different temperatures, including low temperatures.
  • The result: unmatched, proprietary ability to assist clients in solving their wastewater treatment needs using a broad range of previously ‘wasted’ thermal energy sources.
## Heartland Concentrator™

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zero Liquid Discharge</strong></td>
<td>- Single unit operation</td>
</tr>
<tr>
<td></td>
<td>- Future proof (POTW, Regulations)</td>
</tr>
<tr>
<td><strong>Flex-Heat Solution</strong></td>
<td>- Enable/Leverage LFG-to-Energy</td>
</tr>
<tr>
<td></td>
<td>- Access CHP Incentives</td>
</tr>
<tr>
<td></td>
<td>- Hybrid Configuration maximizes electricity sales; gas utilization</td>
</tr>
<tr>
<td><strong>LM-HT® Process</strong></td>
<td>- No Heat Exchangers or Membrane</td>
</tr>
<tr>
<td></td>
<td>- Low risk of corrosion or fouling</td>
</tr>
<tr>
<td></td>
<td>- Ability to handle widest range of waste streams, including chlorides, suspended solids</td>
</tr>
<tr>
<td><strong>Highly reliable</strong></td>
<td>- Only two moving parts</td>
</tr>
<tr>
<td></td>
<td>- No water chemistry experience req’d</td>
</tr>
<tr>
<td><strong>Low Cost Materials of Construction</strong></td>
<td>- Low cost</td>
</tr>
<tr>
<td></td>
<td>- Highly corrosion resistant</td>
</tr>
<tr>
<td></td>
<td>- Long-lived (20+ years)</td>
</tr>
</tbody>
</table>

**Safe, Simple, Rugged, Reliable and Cost Effective**

**Built by Operators for Operators**
Next Steps

John Weigold
SVP Business Development
617.823.8097
jweigold@heartlandtech.com
www.heartlandtech.com