

Heartland Water Technology

Company Introduction
2018



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





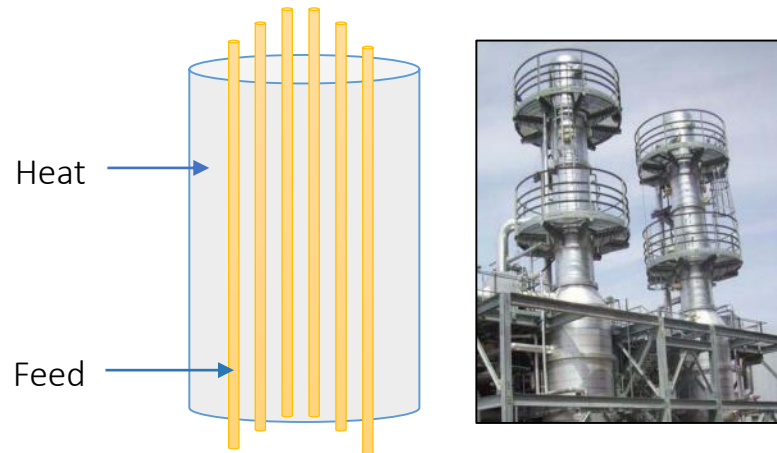
Solution



Heartland Water Technology

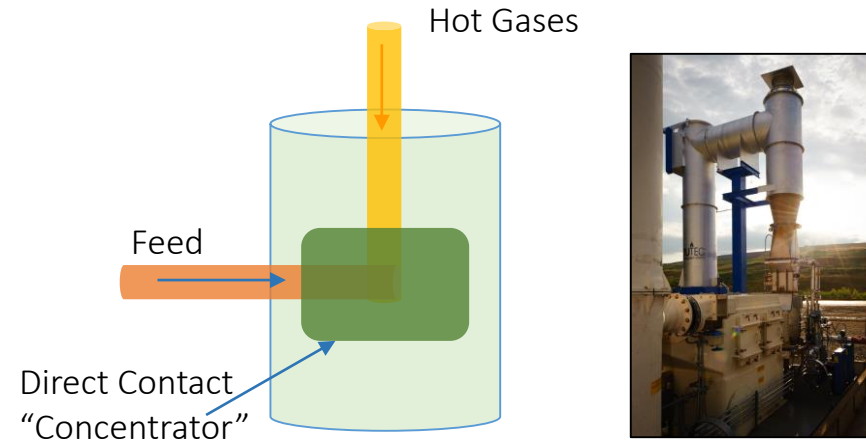
Concept of Operation: Brine Concentration Methods

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**



LM-HT[®] Heartland Concentrator

LM-HT Low Momentum – High Turbulence



- ① Heat Source
- ② Concentrator Section
- ③ Feed and Recirculation
- ④ Droplet Separator
- ⑤ Sump
- ⑥ Exhaust

Sizes	300 to 3,000 BBL/day 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.



Thermal Heat Source Flexibility

While economical running on natural gas, Heartland's Concentrator delivers the industry's lowest cost to treat when utilizing unconventional waste heat.

IC Engine



Flue Gas



Flare Gas



GT Exhaust



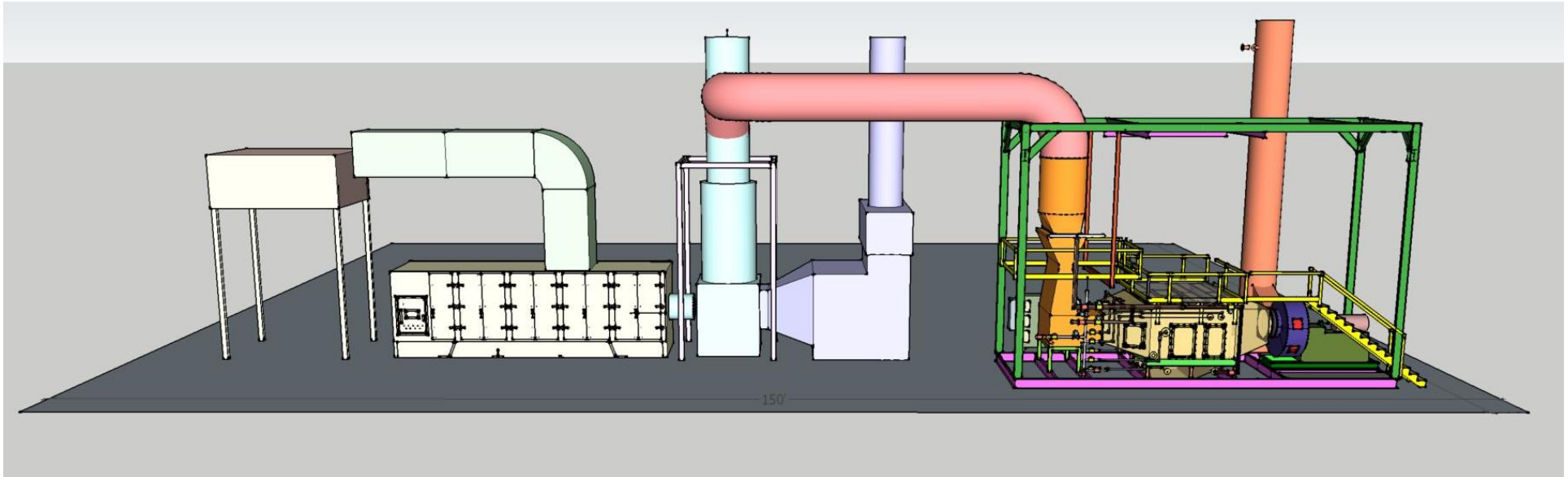
Electric Heater
(pilot)



Biogas



CoVAP™



Cogeneration for Industrial Wastewater Evaporation (CoVAP)

A New Category of Cogeneration Application

Traditional

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

and now...

New

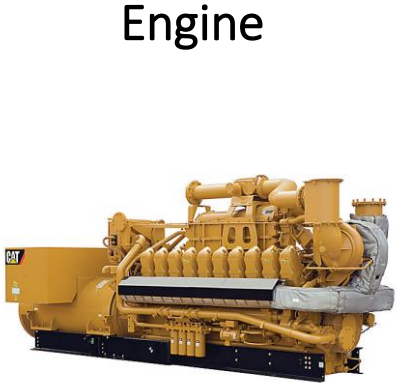
5. **CoVAP**

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

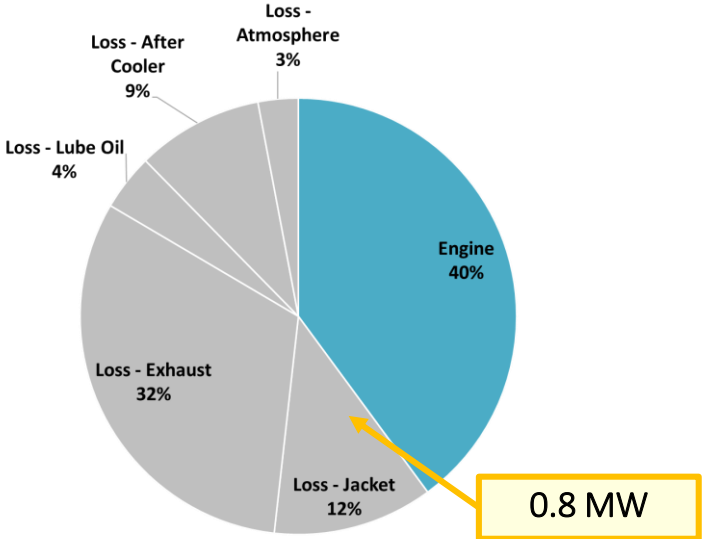


CoVAP™ Significantly Increases Thermal Efficiency

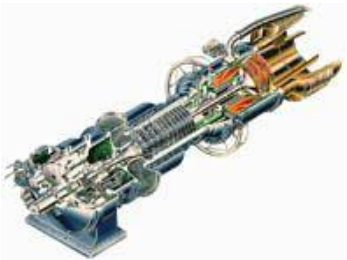
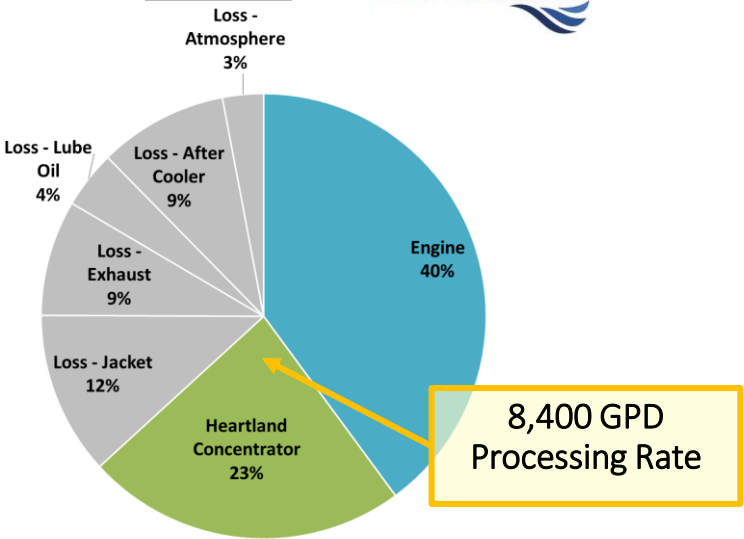


Engine

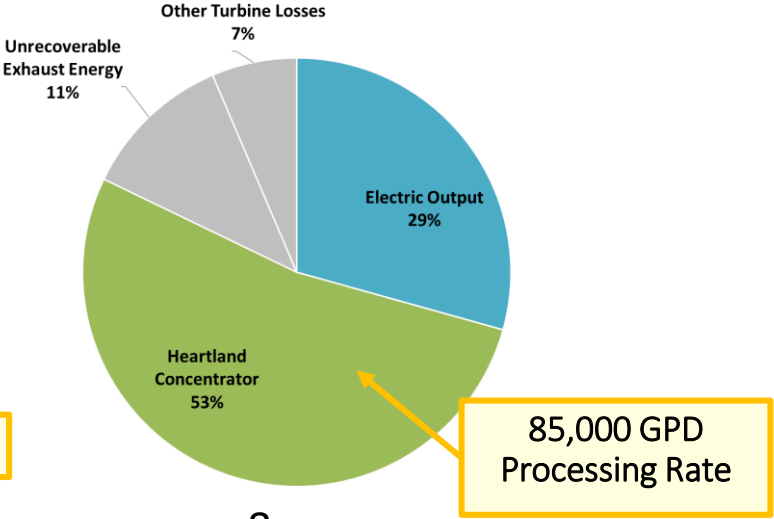
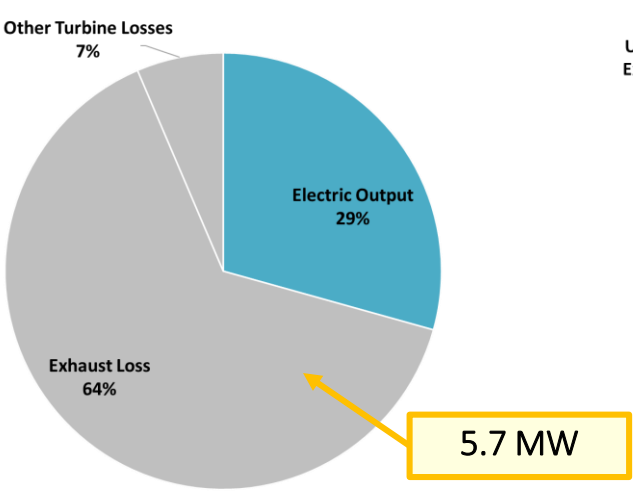
Simple Cycle



CoVAP



Turbine



Proven Application for O&G Frac Water

Owl's Nest Pilot Facility

2008 – 2010



Proven Solution for Produced Water

- Thermal energy from compressor exhaust
- Integration with Caterpillar reciprocating engines
- ZLD solids to conventional landfill (meeting TCLP, Paint Filter and RAD requirements).
- 80% volume reduction

Cherry Flats Compressor Station

2012-Present



Evaporation and Reuse

- Utilize waste heat at compressor stations and drilling locations
- Produced custom tailored heavy brine for drilling.
- Up to 97% volume reduction with condensate recapture
- Minimize deep well injection
- 144K Gal/day per concentrator



Zero Liquid Discharge Option

While not proposed herein for CRC Ventura Basin, Heartland offers zero liquid discharge options for final residual management, with proven success through various dewatering techniques as well as solidification and stabilization. If project economics change, or local brine disposal options evolve, creating a landfillable residual solid may be an attractive option for CRC.



Ox trailer full of dewatered salts from treatment of flue gas desulfurization water at a midwestern power plant. These solids passed paint filtered and disposed of in an onsite landfill.



Solids exiting a centrifuge chute at a midwestern power plant. The centrate return from the centrifuge is re-processed in the Concentrator to yield a ZLD solution.



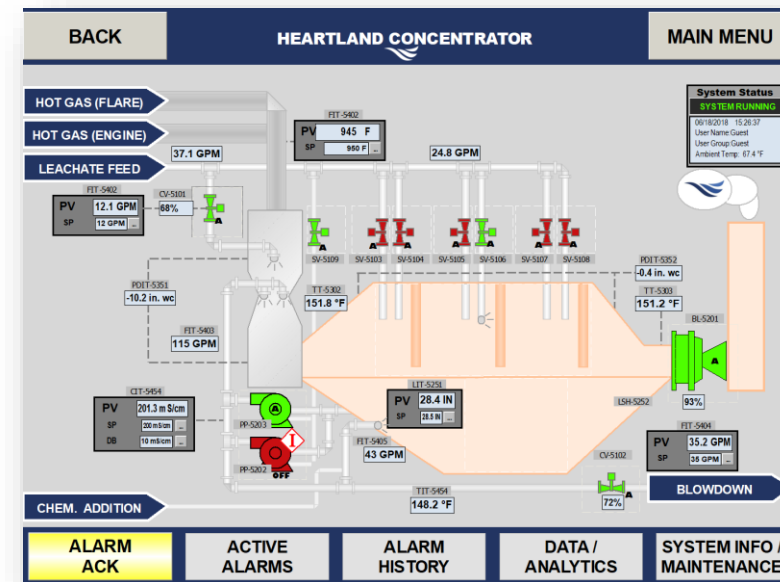
To pass TCLP, salt slurry resulting from concentrating Marcellus shale produced water is solidified with a proprietary mix to yield a superior residual passing all disposal requirements of the local landfill.



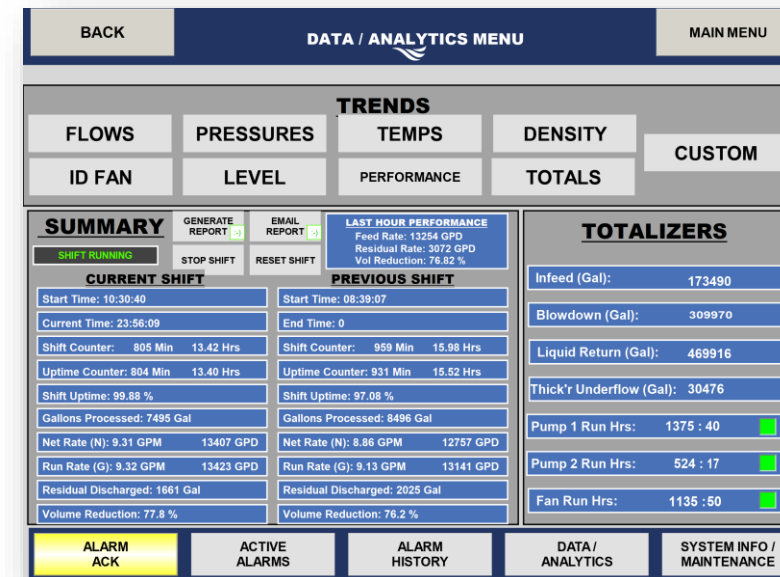
Samples showing a progression of concentration of FGD blowdown at a southern US power plant with the sample on the far right representing a solidified and stabilized residual block with superior mechanical and leaching properties for disposal. Fly ash was used as the stabilizing agent.

Remote Operation & Unattended Campaigns

- Heartland has extensive experience in the O&G industry, and understands the need for reliable and rugged operation with a minimal and rotating staff.
- Thus, for CRC, Heartland has included the following features geared toward serviceability and maximizing remote and unattended operation potential:
 - An automated CIP sequence system that periodically flushes the Concentrator system with water and/or a cleaning agent to reduce frequencies of required servicing and cleaning
 - A 30-day on-site commissioning period coupled with complementary 6 month technical advisory services (TAS)
 - An optional annual Performance Optimization Plan for periodic on-site maintenance and performance review (see Slide 15)
 - Remote control and operation via an integrated 4G LTE data package coupled with VPN service, that can be securely accessed remotely via laptops, Android devices, or iOS devices
 - Data logging and trending of key process parameters with automatically generated and emailed daily reports
 - Operator user access and security levels, including logging of critical process changes by location, personnel, and time
 - Remote alarm call-out and/or email notification for system warnings, notifications, and alarmed shutdowns.



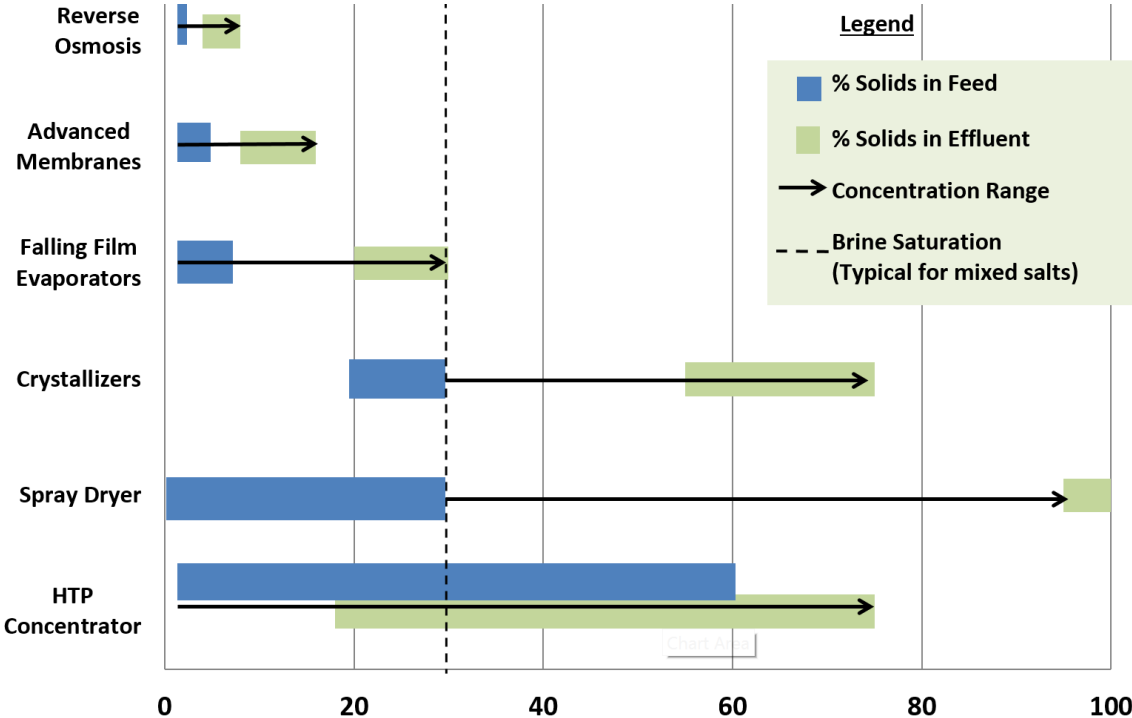
Heartland's HMI, driven by an Allen Bradley Compact Logix PLC, offers an intuitive graphics-based process flow and operator interaction.



Heartland's robust data and analytics package trends all critical process parameters, tracks processing throughputs and system performance to help operators ensure optimal performance and alert them to any potential forthcoming issues.



Concentration Ranges for Different Technologies



Heartland Concentrator

Zero Liquid Discharge	<ul style="list-style-type: none"> - Single unit operation - Future proof (POTW, Regulations)
Flex-Heat Solution	<ul style="list-style-type: none"> - Enable/Leverage LFG-to-Energy - Access CHP Incentives - Hybrid Configuration maximizes electricity sales; gas utilization
LM-HT Process	<ul style="list-style-type: none"> - No Heat Exchangers or Membrane - Low risk of corrosion or fouling - Ability to handle widest range of waste streams, including chlorides, suspended solids
Highly reliable	<ul style="list-style-type: none"> - Only two moving parts - No water chemistry experience req'd
Low Cost Materials of Construction	<ul style="list-style-type: none"> - Low cost - Highly corrosion resistant - Long-lived (20+ years)



**Safe, Simple, Rugged, Reliable and Cost Effective
Built by Operators for Operators**



THANK YOU
www.HeartlandTech.com
(800) 759-1758

