Cogeneration for On-Site Evaporation of Landfill Leachate RO Concentrate

The Cumberland County Improvement Authority ("The Authority") Solid Waste Complex maximizes value of its on-site Landfill Gas-to-Energy Facility by using engine exhaust to evaporate landfill leachate reverse osmosis concentrate with Heartland's CoVAP™ Solution.

Figure 1. Profile view of the Heartland CoVAP™ Leachate Evaporation Facility

Location

Deerfield, NJ

Cumberland County Improvement Authority Solid Waste Complex

- 275 acres permitted
- Over 6 million tons of waste in place
- Receiving approximately 750 tons per day of solid waste

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Figure 2. Concentrated Leachate from the RO Plant requires treatment

Key Takeaways

- **RO Concentrate Treatment** – direct contact evaporation is one of the best ways to treat challenging Reverse Osmosis (RO) concentrate
- **Cogeneration for Evaporation –** beneficial use of engine exhaust for evaporation improves engine efficiency and cost effectively evaporates leachate
- **Environmental Sustainability –** through on-site evaporation, The Authority is taking significant steps toward achieving their sustainability goals
- **Energy Efficiency** – beneficial use of engine jacket heat preheats water and improves treatment effectiveness
- **Economic Benefits –** RO Concentrate treatment reduces overall leachate treatment costs

Case Study Overview

In 2018, Operators of the Cumberland County Improvement Authority ("The Authority"), in partnership with their landfill gas-to-energy plant operator Energy Power Partners, saw an opportunity to reduce operating expense for the county Solid Waste Complex while meeting key sustainability goals for the Authority. By installing the Heartland Water Technology CoVAP™ leachate evaporation system (see Figure 1), The Authority has saved concentrated leachate transport and disposal costs while increasing energy efficiency and reducing the environmental impact of the Solid Waste Complex.

The Authority

The Authority's mission is the development, financing and integration of projects, strategies, and initiatives integral to the sustainability of the economic and environmental future of Cumberland County NJ. In line with this mission, the Authority has led several projects at the county's Solid Waste Complex in Deerfield, NJ. One such project has improved both economic and environmental sustainability for the county by installing an on-site landfill leachate treatment plant.

Reverse Osmosis (RO) Concentrate

The Solid Waste Complex, like all landfills, generates landfill leachate. Leachate is wastewater that accumulates when rain falls onto a landfill. The Authority is the only solid waste complex in the State of New Jersey with a direct discharge permit for treated leachate. A treatment facility utilizing a combination of ultra-filtration and reverse osmosis (RO) systems, shown in figure 2, removes contaminates and generates clean water. The contaminates, however, are separated into a smaller waste stream, called RO Concentrate, which is generally 3 to 4 times the strength of raw leachate, and which requires further treatment for disposal.

Changes in regulation and a requirement to have multiple disposal options forced the Authority to haul significant amounts of the concentrated liquid over 40 miles to the Delaware County Regional Water Quality Authority (DELCORA) in Chester PA. With 25 truck trips per week, transport and disposal

costs rose to over $1M per year. Additionally, the Authority recognized important environment impacts and risks associated with so many trucks on the road hauling concentrated leachate.

Energy Power Partners

The Authority first partnered with Energy Power Partners (EPP) to install a renewable landfill gas to energy plant which began operations in November of 2008. EPP is a private market fund manager that specializes in developing renewable energy projects. EPP owns and operates the landfill gas-to-energy plant, located at the Solid Waste Complex. The plant uses three caterpillar 3520 engines to generate 4.8 MW of renewable electricity.

In early 2018, EPP saw an opportunity to help the Authority address its leachate disposal challenges and increase the overall efficiency of the landfill gas-to-energy plant at the same time by beneficially using engine waste heat to evaporate concentrated leachate using the CoVAP™ configuration of Heartland's LM-HT Concentrator®. Figure 3 shows the energy distribution of a typical reciprocating engine which are generally only 36% efficient. Sources of heat loss include exhaust, friction, and jacket water.

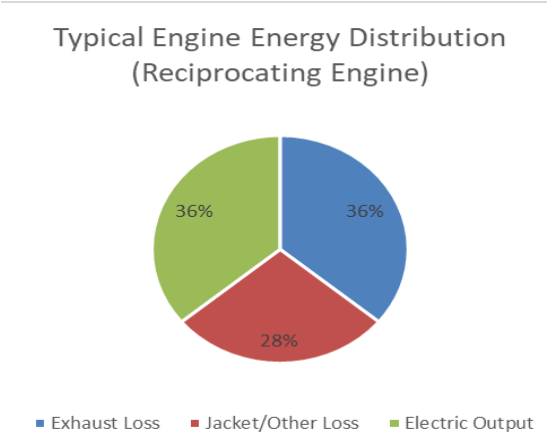

Figure 3 Typical Reciprocating Engine Energy Distribution

CoVAP™ Configuration

CoVAP™ stands for Cogeneration for Industrial Evaporation. The Heartland Concentrator was designed and patented for using waste heat from engines or turbines beneficially to evaporate wastewater. This is a classic Cogeneration solution.

The Authority's CoVAP configuration utilizes, ~900˚F engine exhaust from three Caterpillar 3520 engines. Shown in Figure 4, the exhaust is ducted together and transferred to the Heartland Concentrator™ which evaporates the concentrated leachate. The concentrator operates under slight negative pressure and pulls the heat across wastewater using a direct contact approach. Additionally, heat from jacket loss is reused to pre-heat feed water and increase the efficiency of the process.

For the Solid Waste Complex, The CoVAP™ solution has several important benefits. By beneficially using the engine exhaust, EPP was able to increase overall efficiency of the plant. Additionally, by beneficially reusing the exhaust and jacket water, thermal energy costs, which is often the most significant cost associated with evaporation, was removed. In the same project the Authority both saved cost and reduced the carbon footprint of the landfill.

Figure 4. (1) Hot generator exhaust gas is ducted together to provide thermal energy for evaporation in the Heartland Concentrator™ (2)

Results

EPP began operation of the Heartland Concentrator™ in January of 2021. The project has been considered successful both economically and environmentally.

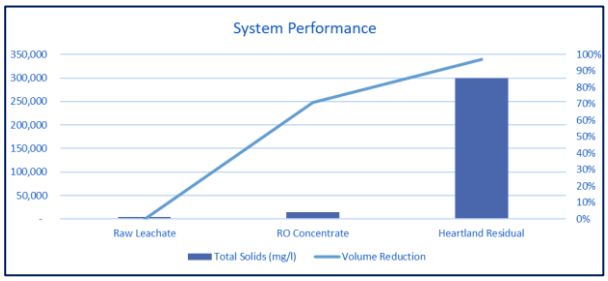

Chart 1. Wastewater Treatment, July – August 2021

Chart 1 shows the water treatment performance of the leachate treatment system between June 1st and August 31st 2021 . Total solids concentration increased from 5,000 mg/l in the raw leachate to over 300,000 mg/l in the Heartland residual. This residual concentration corresponded with an over 97% total system volume reduction. The remaining highly concentrated residual waste slurry is suitable for landfill disposal which further reduces the requirements for off-site disposal.

Table 1 shows the improvement in energy efficiency associated with the capture and beneficial reuse of the engine exhaust. By increasing energy efficiency to over 75%, the Authority has reduced its carbon footprint and taken steps toward achieving its sustainability goals.

Conclusion

On-site leachate treatment reduces cost and removes trucks from the road. Every eliminated trip reduces environmental risk of hauling leachate around the state of NJ and further shrinks the carbon footprint of the solid waste complex by eliminating truck emissions.

Prior to installing the concentrator, the solid waste complex was hauling 25 trucks per week of RO Concentrate to wastewater treatment plants for disposal. Due to its partnership with EPP and Heartland, the Authority has reduced their annual disposal costs by 20-25% while increasing the efficiency of their energy plant.

Said President/CEO of The Authority Gerard Velazquez, III. "The ability to implement these programs while creating environmentally friendly and sustainable systems is integral to the ongoing operations of The Authority and its partners."

	Waste Heat		Recovered Heat			
	Exhaust Loss	Jacket/Other Loss	Electric Output	Recovered Jacket	Heartland Concentrator	Thermal Efficiency
Prior to Project	36%	28%	36%			**36%**
After Project	0	24%	36%	4%	36%	**76%**

Table 1 Energy Efficiency Improvement