Who You Gonna Call?

An increasing number of wastewater treatment plants are refusing to accept and treat landfill leachate.

BY JOHN WEIGOLD AND TRAVIS SMITH

Depending upon environmental conditions and the type of waste stored, a landfill can generate tens of thousands of gallons of leachate per day—creating a major disposal and treatment challenge for operators. In fact, landfill operators spend billions of dollars annually managing landfill leachate while disposal and treatment costs rise each year.

Many operators choose to "outsource" the treatment of their leachate. According to the Environmental Research and Education Foundation, ~62% of all leachate is transported to a sewage treatment plant (WWTP). Here, the smaller volume of leachate is mixed with a larger volume of sewage and then processed for discharge back to the environment.

Even though WWTPs treat millions of gallons of wastewater per day, the nature of the contaminants and the high contaminant loading in the leachate is extremely challenging for WWTPs. So, with higher treatment costs and regulatory hurdles, an increasing number of WWTPs are refusing to accept landfill leachate.

What's behind the trend? Why are WWTPs rejecting landfill leachate?

Landfill leachate is wastewater that accumulates in landfills when rain falls into a landfill. While percolating through the garbage, wastewater dissolves and entrains whatever is in the garbage—resulting in a nasty cocktail of contaminants that is unlike any other wastewater. Moreover, the mix of contaminants in the leachate changes constantly.

Even though WWTPs often play a vital role in leachate treatment, many landfill operators are finding an increasing number of WWTPs reluctant to accept and treat leachate. WWTPs are wrestling with three major issues with respect to landfill leachate: Contaminants of Emerging Concern, Nutrient Loading, and the negative impact on UV Disinfection.

Contaminants of Emerging Concern: Contaminants of Emerging Concern (CEC), very simply, are contaminants found in drinking water and wastewater which are under consideration for regulation and which WWTPs are not specifically designed to remove. For years now, discussions about CECs have revolved mostly around endocrine disrupters—those pharmaceuticals and health and beauty products that impact the human hormone system when consumed. To be clear, endocrine disrupters are still CECs, but the focus rapidly shifted to include PFAS—and people are concerned.

PFAS, or Per-and-Polyfluoroalkyl Substances, are chemicals found in a variety of products. One example is Aqueous Film Forming Foam (AFFF), which is used in firefighting, water and stain repellants for textiles and leather, paper coatings, non-stick coating products, and many more applications. Health studies suggest PFAS may impact cognitive and behavioral growth in children, female fertility, and the hormone and immune systems, and increase the risk of cancer. While there are no official Maximum Contaminant Levels (MCLs) established for PFAS, the EPA issued a Health Advisory for PFAS, setting an advisory threshold on PFAS of 70 ppt (yes, parts per trillion.) PFAS can be found in landfill leachate, often in concentrations that are orders of magnitude above the EPA's health advisory limit.

Nutrient Loading: Nutrient pollution (i.e. eutrophication) in bodies of water is a growing environmental concern. While landfill leachate contains a variety of nutrients, the biggest concern is nitrogen. Leachate nitrogen loading not only causes problems with the treatment process itself but makes it increasingly challenging for WWTPs to consistently meet their NPDES permit limits for Total Nitrogen. The decision for the WWTP operators often becomes quite simple—stop taking landfill leachate.

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UV Disinfection: Prior to discharge into the environment, WWTPs disinfect the treated wastewater to inactivate bacteria and viruses. Increasingly, WWTPs are switching from using chlorine to Ultraviolet (UV) Light systems to disinfect wastewater. According to the Water Environment Research Foundation (WERF), approximately 21% of WWTPs today use UV for disinfection. UV light should be able to penetrate the water to dose all of the viruses and bacteria sufficiently. Landfill leachate can be a big problem for WWTPs using UV because it contains high concentrations of humic and fluvic acids. These absorb the UV light, decreasing the transmittance of UV light in the treated waters. According to Stephanie Bolyard at EREF, landfill leachate volumetric contributions of as low as 0.1% can cause interference with UV disinfection performance.

Individually, any one of these issues is a concern for WWTP managers. Collectively, Contaminants of Emerging Concern, Nutrient Loading, and the Impact on UV Disinfection are causing more and more WWTPs to simply stop accepting landfill leachate. Furthermore, landfill operators are often left with little warning when treatment services are stopped, forcing them to determine new treatment strategies.

You're Cut Off—Who You Gonna Call?

Finding a new disposal outlet for leachate is often quite a challenge—no WWTP wants it. What was once a simple trucking evolution to a local WWTP can become a multi-state, multi-modal logistics operations to haul leachate to a receptive WWTP. You're already thinking this—and you're right—leachate disposal just got very expensive!

More and more, landfill operators are choosing to treat leachate onsite and exercising firm control over their landfill leachate management.

While there can be multiple options for treating leachate onsite, the following two approaches are most common.

Biological Membrane Systems: Biological systems alone, such as a sequencing batch reactor, were a common approach for onsite leachate treatment. Consistently achieving discharge limits with biological systems alone can be problematic given the dynamic nature of leachate chemistry, particularly with the increasing focus on nutrient loading and emerging contaminants. More often today, biological systems are combined with membrane systems, usually consisting of reverse osmosis (RO), nanofiltration (NF) or ultrafiltration (UF), or a combination of membrane technologies. The biological system reduces BOD/COD and nitrogen, and the membrane systems remove dissolved solids and salts so that the water can consistently meet increasingly stringent discharge limits. While effective, the combination of biological and membrane systems must be carefully designed to ensure proper performance and requires a team of skilled operators to run and maintain. These systems can take a long time to design, permit, and construct. Moreover, when using RO, there is always a reject stream (concentrate) to deal with, which can be 20% to 35% of the starting leachate feed rate. Because RO reject is a concentrated stream, it is often more expensive to dispose of than the raw leachate (on a per gallon basis.)

Figure 2 Heartland LM-HT Concentrator

Evaporation Systems: Evaporation is a proven solution for onsite management of leachate. Whether used to treat RO reject or used as a direct treatment for raw leachate, evaporation is gaining broader acceptance by landfill managers for a number of important reasons. First, evaporation eliminates the leachate stream entirely, resulting in a small concentrate volume that can be safely returned to the landfill.

Multiple onsite treatment options exist that can help landfill operators limit risk.

Finally, to be cost-effective, evaporators require low-cost thermal energy. For Submerged Combustion Evaporators, this typically means landfill gas, and for Heartland's LM-HT Evaporator (shown in figure 2), it can mean either landfill gas or exhaust from an engine or turbine that is using landfill gas to make electricity. Use of waste heat in this manner is generally considered the most cost-effective and environmentally friendly leachate evaporation option.

Landfill leachate

Case Study—Municipal Solid Waste Facility, Eastern United States

A large municipal solid waste (MSW) landfill in the eastern US demonstrates the multi-faceted success of an evaporative solution using waste heat. The landfill generates over 100,000 gallons per day (GPD) of landfill leachate requiring appropriate treatment and/or disposal. The landfill also operates a significant Landfill Gas-to-Energy facility, which collects and treats the biogas formed from the decomposition of organic material within the landfill, using Solar Centaur gas turbines to generate electricity from the biogas gas turbines.

Prior to using the evaporative system to address their leachate volume, the landfill hauled leachate to a local WWTP. Due to the challenging nature of the leachate, the WWTP decided to stop accepting leachate and the landfill had to transport the leachate several hundred miles. dramatically increasing the cost.

The landfill now treats its leachate onsite using Heartland Concentrators in a cogeneration configuration with its existing turbines (see figure 3). The simple, pre-tested and skid-mounted system was easily installed and permitted. The ease of operation highlights another important benefit of evaporation over larger biological treatment solutions.

By beneficially reusing thermal energy, the Heartland Concentrators provide a cost-effective way to gain maximal control over leachate management. Onsite leachate treatment removes the

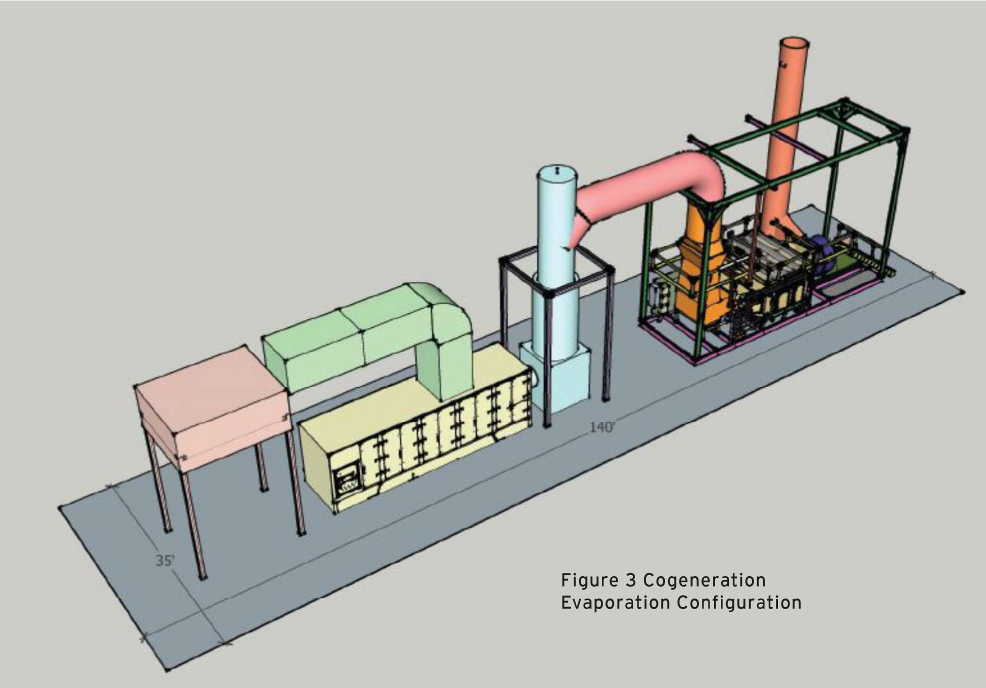

Figure 3 Cogeneration Evaporation Configuration

risk that a WWTP will refuse to accept leachate and allows the landfill to control its own destiny. More importantly, use of the Heartland Concentrator in this cogeneration configuration has dramatically lowered the landfill's cost and other economic risks related to leachate management. It virtually eliminates high trucking disposal costs and significantly reduces the operator's dependency on municipal wastewater treatment plants. In short, use of the Heartland Concentrator at this landfill shows the many benefits attainable through using evaporation in a cogeneration configuration.

Landfills across the country face increasing leachate treatment costs and refusal to accept landfill leachate by the WWTPs is a primary concern. Multiple onsite treatment options exist that can help landfill operators limit risk, regain control, and save real or potential costs. While biological treatment is an important and accepted treatment solution, the complexity of design and operation of these systems should be carefully considered. Evaporation is a proven solution that is gaining broader acceptance for onsite leachate treatment given its low total cost-to-treat and ease of design and operation. MSW

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