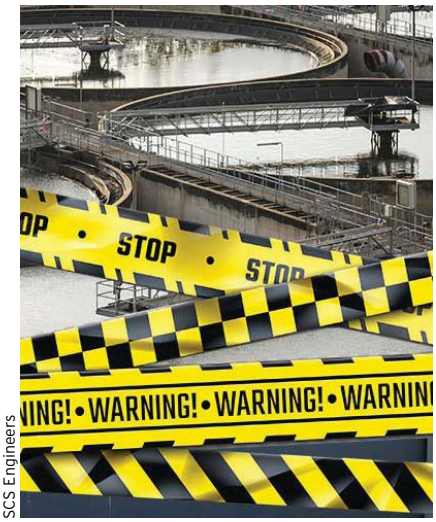
Methods for Managing Landfill Leachate



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Professionals compare leachate management strategies and share common obstacles to dealing with leachate at a landfill.

BY JESSICA REED

When water comes into contact with trash at a landfill, it quickly becomes contaminated with various constituents. The resulting contaminated water is what we call landfill leachate. More than 6 billion gallons of leachate are generated on landfills in the U.S. every year. Over time, we have developed several methods of dealing with leachate, with the goal of eliminating as many contaminants from the liquid as possible.

Samuel Cooke, Vice President/National Expert on Liquids Management at SCS Engineers, works with clients to solve their issues with landfill leachate and industrial wastewater pretreatment. He uses his experience along with his knowledge of engineering principles, landfill operations, and equipment to bring unique solutions for leachate treatment to his customers. The biggest trend in leachate from a regulatory standpoint, Cooke remarked, is PFAS—per- and polyfluoroalkyl substances—also known as "forever chemicals." Though PFAS have been around for decades, he has observed that they can become an increasingly significant problem for landfill operators.

"Some of the more common leachate and wastewater constituents that we deal with are ammonia and carbon-based material, BOD or COD (biochemical oxygen demand and chemical oxygen demand), suspended solids, or particulates. There are also metals such as arsenic, lead, mercury, and chromium that we have to treat the wastewater to reduce, as well as volatile organics and semivolatile organics."

Cooke commented that the SCS Engineers team frequently works with membrane bioreactors, which he described as "a form of biological treatment that results in fairly high-quality discharge considering particulates, nutrient reduction, and carbon reduction, but it can't reduce the PFAS. On the downstream side of that membrane bioreactor, you have another treatment process like a reverse osmosis system, foam fractionation, ion exchange, or granular activated carbon." He mentioned four companies he works with frequently that offer membrane bioreactor solutions: Dynatec, Rochem, Evoqua, and Veolia. Cooke recalled that Dynatec and Rochem have also provided reverse osmosis solutions for landfill leachate. Evoqua and Veolia also offer granular activated carbon products, as does a company called Calgon Carbon.

Another method of dealing with leachate is evaporation. Evaporators,


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Cooke said, are often ideal at sites where there is no liquid discharge point or treatment plant nearby. Landfill operators frequently discharge to publicly-owned treatment works or a local treatment plant. Those facilities handle many millions of gallons of liquid each day, and many are capable of handling most of the contaminants found in leachate—except for PFAS. The SCS Engineers team has worked with evaporator companies including ENCON, John Zink, and Heartland Water Technology.

A major concern for landfills now and in the near future is finding an efficient way of completely eliminating PFAS from the wastestream. "That can be done with very high temperatures—1800, 1900 degrees Fahrenheit," said Cooke. "What I anticipate occurring in the future is an even more efficient way of reducing or destroying PFAS. Even though landfills take in the PFAS and retain most of the PFAS, the landfill still releases a little bit of it. That PFAS in the landfill's leachate then goes to the wastewater treatment plant, and the treatment plant's sludges can end up disposed back at the landfill. So it's a vicious cycle. A cost-effective and energy-efficient method of destruction of the PFAS constituents, so that the full range of PFAS constituents are actually eliminated, is a high-priority goal with a lot of research being conducted now."

Emerging contaminants such as endocrine system disruptors and siloxanes, include substances that can be found in many everyday consumer products. From a regulatory and potable water standpoint, another especially problematic contaminant is chloride, which is very soluble, difficult to cost-effectively reduce, and can have a corrosive effect on infrastructure if concentrations are high. Cooke said that if one or more effective and lower-cost ways of reducing these contaminants, along with hardness and metals such as iron, chromium, lead, and mercury, is successful, then it could really shake up the wastewater treatment industry.

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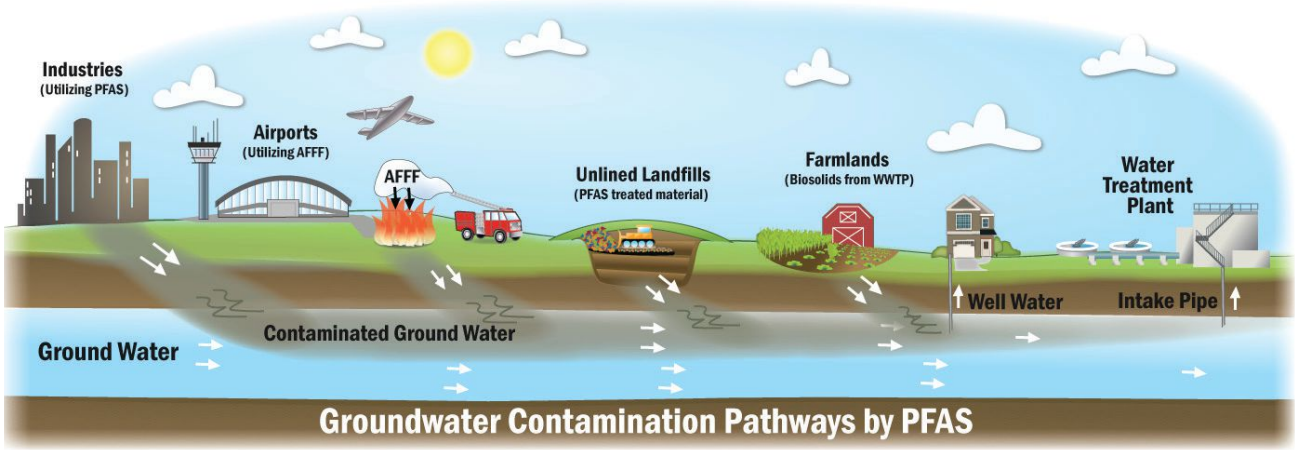
Brad Granley of Leachate Management Specialists offered some insights into popular methods for handling leachate. Leachate Management Specialists was founded on the principle of leveraging natural processes to solve problems, such as landfill leachate disposal. Granley mentioned that Phyto-Utilization is a main technology that they use. The process involves the installation of specialized plants such as vetiver grass and hybrid poplar and willow trees on top of landfills. "This is important because if this is done off the landfill, there is a risk of adversely impacting soil and groundwater," he noted. The leachate is pumped through an automated distribution system after it is filtered, and the liquid is taken up by the plants and then transpired into the air.



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The plants they select have a high water demand due to a fast growth rate, said Granley, "and because many contaminants in leachate are considered macro and micronutrients for the plant; in a way, we're making a resource out of the leachate. Phyto-Utilization systems eliminate or greatly reduce offsite disposal for the sites where installed." This reduction (or elimination) of offsite disposal and transportation delivers significant savings in operating costs for a landfill.

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"It doesn't get much greener than plants" for managing leachate, Granley stated. "We're taking diesel-burning tanker trucks off the road, and we're reducing the existing carbon footprint because these plants also sequester CO2."

A challenge that many clients face is the increasing implementation of restrictions at wastewater treatment plants that make it more difficult to dispose of leachate, especially for leachate contaminated with constituents such as ammonia, PFAS, or metals such as arsenic.

Many treatment plants now use UV disinfection in treating wastewater before discharging it. Unfortunately, Granley explained, leachate has the potential to interfere with the disinfection process and render it less effective. The treatment plants that perform this UV disinfection might therefore refuse to accept leachate.

"We have no idea when, but we know that many landfills will be cut off from discharging to treatment plants because of PFAS compounds," Granley said. "Because limits are so low, there are not a lot of good options for treatment, but we do offer an effective foam fractionation system for direct removal of PFAS down to low ppt levels from untreated leachate."

The Phyto-Utilization system gives landfill operators more control over leachate management at their site. It eliminates or reduces dependency on offsite treatment plants, so operators no longer have to worry about rising fuel costs or being refused access to a wastewater treatment plant.

Granley described some of the benefits of their Phyto-Utilization system: "There aren't a whole lot of moving parts, it's easy to maintain, and it can function for weeks at a time without anyone visiting the system."

However, one limitation is that it's a semi-permanent system and can't be moved to meet changing conditions at the site. "We're looking at how to make it more mobile and flexible so we can use the open, interim areas of landfills—a system that we can roll out and install using different types of plants and simplified irrigation methods. We can put the interim areas to productive use and save money from offsite disposal," shared Granley.

The resulting biomass can also serve a purpose. Vetiver grass can be made into bales for erosion control; and trees or grass can potentially be used to produce biochar, which is desirable for various applications including as a concrete or asphalt additive, with a potential value of up to $500 per ton, Granley explained.

Another process for managing leachate that he described was Wind-Aided Intensified eVaporation (WAIV). The system is modular, and it incorporates suspending large sheets of a specialized fabric (called sails) in a horizontal array on a rigid frame to create a large amount of wetted surface area to facilitate leachate evaporation by leveraging wind and differences in relative humidity. The "attached evaporative process" doesn't spray anything into the air and does not use any supplemental fuel. Because of its modularity, the system is easier to place at a landfill.

Engineered wetlands are yet another natural system used to deal with leachate. Granley noted that an engineered wetland is effective for reducing ammonia concentrations, phosphorous, and some metals, but isn't capable of removing salt or boron.

"My specialty is the landfill gas and leachate side of the business," said Dave Simpson, Product Marketing Manager for QED Environmental Systems. "We manufacture several different types of pumps: double diaphragm pumps, displacement pumps, electric pumps, and piston pumps." His work focuses mainly on leachate and condensate wells at landfills.

The main products that QED Environmental offers for landfills are gas wellheads to control gas flows. The air-actuated line of pumps operate at pressures from 0 to 80 psi to

remove condensate and leachate from landfills. Their products have evolved to address the needs of landfill operators; they deliberately use plastic materials that are compatible with both low and high pH levels to give the pumps a longer life in the wells.

Simpson explained, "The biggest problem at landfills is clogging of the pumps. Iron, silts, calcium—these solids build up inside the pumps, which is not ideal for an electric pump because it'll burn out. It's a problem with any pump on the market right now."

To address this problem, they added a special polishing process to some of the inner workings of the pump system that makes it harder for chemicals to build up. "Last September, we also launched the Xtreme line of pumps that has a device in the pump that keeps the fluid spinning and keeps solids suspended in the fluid," shared Simpson.

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He views it as a never-ending task to keep up with the changing needs of a landfill. "If you have failure in some of these pumps over time, whether it's leachate or condensate, you can run into all kinds of problems from slope failures at the well, odor control problems which can lead to compliance violations, complaints from neighbors around the landfills, higher elevations in the wells, and even some fugitive emissions."

A wide range of pumps can be used at landfills, with some versions performing better at certain sites. Electric pumps, for example, are best for a landfill with high-flow needs. QED Environmental manufactures an aboveground double diaphragm pump that is only able to pump from a depth of 22 feet, so it is used more often as a transfer pump than at a landfill.

The AutoPump line is the most commonly selected product, noted QED's Dave Simpson. The new AutoPump AP4 Ultra can last up to 10 times longer between service events, and has been tested in severe applications. These pumps increase landfill gas extraction rates, reduce the risk of liquid leaking through liners, and result in lower rates of odors and non-methane organic compounds.

QED Environmental offers air-powered Pneumatic Displacement Pumps that require an external timer-based controller to manage air cycling off and on to the pump. One advantage to this type of pump is that there are only two moving parts down well. It is also designed without any electrical connections at the wellhead, so it is fast and easy to install.

Landfill leachate is a constant problem for operators. And there is a wide range of chemicals that contaminate leachate, so no solution will be able to manage all types of leachate. To select the right method and technology for one landfill, it's essential to know the most common contaminants in the leachate, the budget set aside for leachate management, and any limitations based on the region or the type of landfill in question. MSW

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