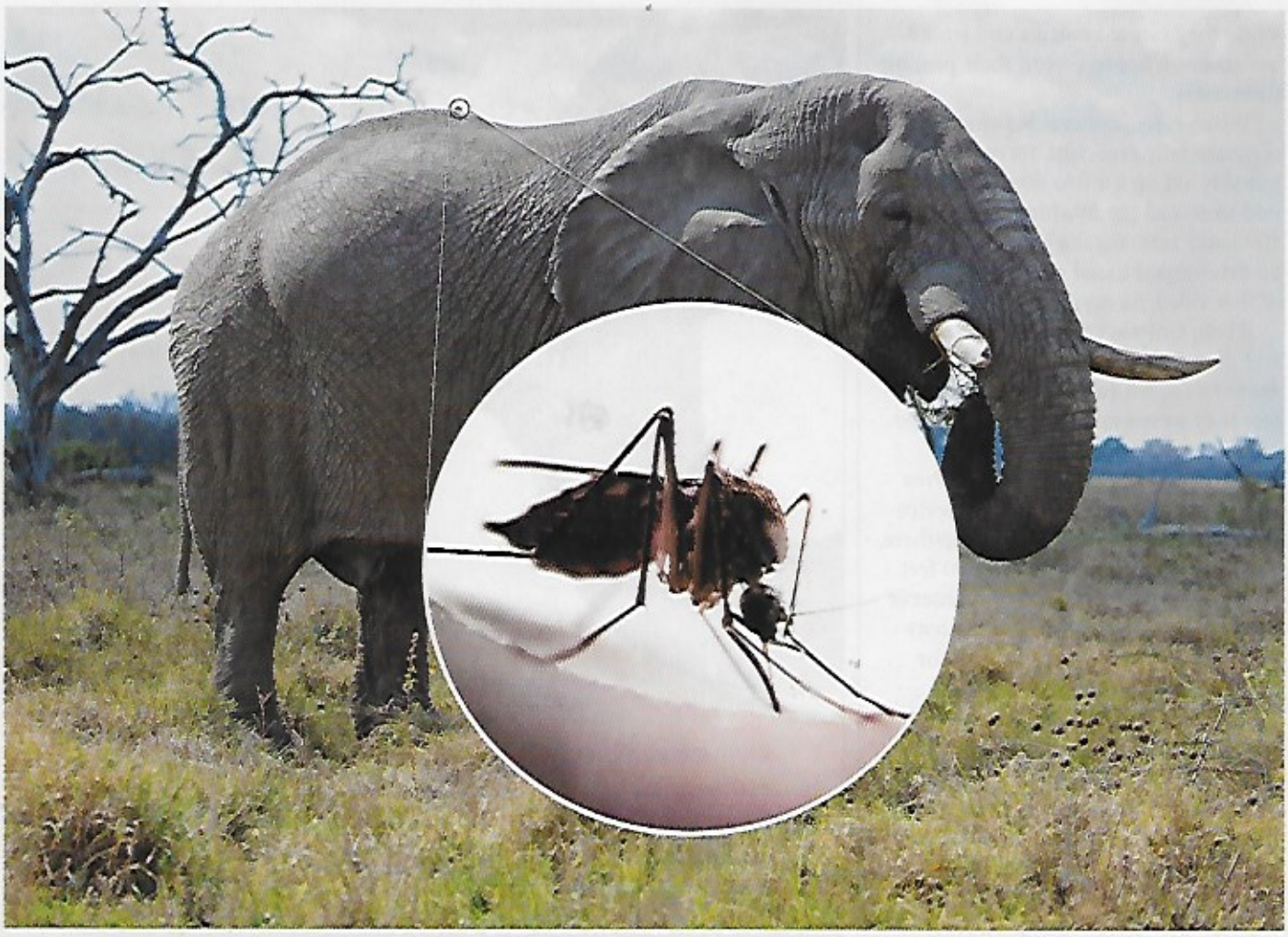

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Don't Get Stung By PFAS

Preventing per-and polyfluoroalkyl substances from contaminating leachate

BY PATRICK STANFORD

This article is based on a presentation Patrick Stanford gave to the Engineering Society of Detroit Solid Waste Conference in March 2019.

For decades, leachate was the elephant in the room for many landfill operators. Everyone knew it was there, but nobody wanted to talk about it. But as a big expensive problem driven by regulatory and public concern about surface and groundwater, operators soon developed the ability to deal with leachate. They installed liners, pipes, pumps, and treatment systems.

Then, another elephant lumbered into the room: growing concern about climate change and the role of methane emissions from landfill gas. Landfill operators learned to deal with this elephant as well—more piping, more pumps to capture the methane—and they even learned to generate revenue from the gas rather than just flaring it.

Now, the doors to the room have opened again, but what comes in isn't so much another elephant, but something more like a…mosquito.

Not as overwhelming as an elephant, but if you've ever been in a room on a hot summer's night when that high-pitched whine intrudes, you know how unsettling it can be. And for many Americans, what's new about mosquito bites is that they carry increased risk from zika, malaria, yellow fever, dengue, and the West Nile virus. What used to cause just an itchy red spot has morphed into fear of something much more life-threatening.

For landfill operators, that "w" is also something small, fast-moving, and increasingly problematic. It comes in the form of emerging contaminants of concern, some of which are measured at nanograms per liter (parts per trillion) detection levels.

PFAS in Leachate: The Shape of Things to Come?

Just as it takes only one small mosquito to transfer a potentially deadly disease, it only takes a tiny amount of the class of chemicals called Per-and Polyfluoroalkyl Substances, collectively known as PFAS, to contaminate leachate.

PFAS is a relatively new area of concern. It joins a steady parade of materials including asbestos, lead, and PCBs that were once used in many products, but are now considered problematic. Our industry needs to get used to dealing with new constituents of concern because that parade will likely just keep on coming.

By way of background—PFAS compounds were first developed over 50 years ago and incorporated into a wide range of products: firefighting foam, paints, cosmetics, breathable outerwear, non-stick cookware, and many industrial processes. This means that for landfill management purposes, they're pretty much everywhere.

What is less certain is how much of a problem they are or will become. Some studies link PFAS to a variety of health concerns. It is most likely that public concern will continue to rise, leading to concern among politicians, leading in turn to tighter regulations.

Attempts to deal with mosquitos

100,000-gpd two-pass RO leachate treatment system

have sometimes had unexpected consequences, as we saw with the 1960s-era insecticide DDT, which had indirect but serious consequences for bird populations. In the same way, efforts to deal with PFAS are likely to have unexpected and unwanted side effects. One of them, of course, is finding a good outcome for the other material left after the water is removed.

Getting Informed About the Tools in Your Toolbox

Your solution to the problem of PFAS in landfill leachate comes from knowledge. There are a wide range of leachate management tools in your toolbox. As full disclosure, note that my company provides solutions around one particular type of technology, but based on my 35 years in the waste management industry, here's a summary of the tools at your disposal to address problems posed by emerging contaminants of concern.

Biological treatment usually works well in the situations for which it is designed, specifically involving degradable organic compounds. This Biological treatment can be useful for a Publicly Owned Treatment Works (POTW), or pre-treatment of your leachate to reduce treatment costs before it enters the sewer. The problem is that biological treatment is not particularly effective in treating PFAS.

There is increasing concern among municipalities that their systems are not sufficient to protect the public from hazards present in industrial wastewater—and this includes PFAS-containing landfill leachate and may limit discharges to POTWs.

Oxidation processes use chemistry, electricity, light, and other methods to break down organics into simpler compounds. Most landfill leachate contains ultraviolet (UV) inhibitors or quench agents so that they just absorb the UV energy. If the POTW you're using has switched from chlorine disinfection to UV disinfection, the POTW may reject your effluent because it can reduce the effectiveness of UV treatment for the municipality's treated sewage.

Activated carbon works well for treating many kinds of effluent. It works by adsorbing contaminants—so the compounds stick to the surface of the carbon. The problem is that other organics tend to have more success than PFAS in adhering to the carbon molecules. Because those other organics also adsorb onto the carbon, it takes a lot of activated carbon to remove those organics before the PFAS gets to the front of the line for removal.

Ion exchange is similar with regards to its PFAS implications—interference of other organics before the process can get working on the removal of PFAS. There are some PFAS-specific ion-exchange systems available, but they still face the problem of fouling by organic compounds before the PFAS.

Evaporation: This is an effective technology, particularly as some landfills have been able to fire their evaporators with landfill gas pumped from their facility. One potential risk is the transfer of PFAS into the air. PFAS tend to have

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relatively low vapor pressures, so they tend to stay with the liquid rather than disappear into the air, but further research needs to be done on this issue.

Incineration will get rid of your problem if it is done at a high enough temperature. One problem with this treatment technology is the cost—about a dollar a gallon, plus hauling costs. Another problem is the limited availability of suitable incinerators. There are about 180 permitted incinerators in the US of which 151 are permitted for site-specific industrial processes. This leaves about 30 incinerators commercially available, which limits the possibility of using this solution for landfill leachate.

Membrane technologies offer the ability to separate out a wide range of constituents of concern, including PFAS (again, as full disclosure, this is the technology my company designs and manufactures). Reverse osmosis (RO) is one type of membrane technology that uses a semi-permeable membrane to remove ions, molecules, and larger particles from wastewater. The result is that the residual leachate (concentrate) is retained on the pressurized side of the membrane and the permeate (RO-treated effluent) can pass to the other side (for an example of RO technology in a successful landfill application, see "Reverse Osmosis to the Rescue," in *MSW Management* magazine, November/December 2018).

Applying the Lessons of PFAS to the Future of Landfill Operation

So, what can we learn from all this?

One lesson is that landfills are absolutely the best place for the safe disposal of problematic materials like PFAS. Today's landfills are carefully engineered, including underlay systems that use engineered clay, HDPE membranes, manufactured clay bentonite, and other materials to contain the leachate within the landfill. Subtitle D landfill standards are working.

We also need to understand that the push for tighter standards for landfill effluent is largely a technology-driven phenomenon. Just a few years ago, it was barely possible to measure concentration in the parts-per-million range. Now we can measure down to parts per trillion. So, it can be said that our industry is being asked to reach extreme levels of contaminant management for leachate largely because it's now possible to measure it.

Will requirements for leachate continue to tighten? Probably. The laboratory standard for testing right now is that used by one national laboratory, which analyzes for about 37 compounds. There are thousands more compounds that are not yet on the regulatory radar. We can expect that as the ability to test for more materials grows, there will come more requirements to test for those materials.

Left: Three parallel 70,000 gpd RO leachate treatment skids; right: 25,000-gcd containerized RO leachate treatment system

From this, we can note that the issue of PFAS and other constituents of concern is more of a politically driven process rather than scientific. We can argue about the toxicology of materials like PCBs and asbestos, as well as PFAS, but public sensitivity about these substances is moving faster than our understanding about the science-based toxicology and risk.

This leads to the need for all of us in this industry to stay informed. Attend conferences, read publications such as this one, talk with people in the industry including vendors and consultants. When the regulations change, you'll need expert advice and knowledge about the solutions available. So, start finding people to talk with and build those relationships, so you'll have them in place when you need them. This way, you'll get their full attention, rather than being at the bottom of the waiting list.

Be aware of the regulatory environment in your state—and note that increasingly, municipalities are passing their own regulations on environmental matters. Pay attention to the political climate, because as we've noted, this is as much a political process as it is scientific. You also need to pay attention to changes

Leachate treatment effluent flowmeters

in technology, and if you don't want to do this yourself, you'll need to pay someone else to do it for you, to have the right solutions available when you need them.

Be careful about solutions that depend on outside entities. If you're using third-party incineration, for example, note that the company providing that service may go out of business, decide they no longer want to service your landfill, or increase prices to a level beyond what you can pay. Landfills that depend on POTW services through a sewer connection are particularly vulnerable to a decision that will stop your leachate processing solution cold.

Stay informed about the risks—not only for the health hazards found in solid waste but also about the risk that comes from regulatory uncertainty. We don't know what the regulations will cover or what the expected levels will be.

In regards to PFAS, it is pretty much impossible to ban. Essentially, PFAS is in all of our lives. It is in many or even most products. So, we learn to live with it.

There are some comments about PFAS being classified as a hazardous waste. We do not want that to happen, and as an industry, we need to make our voices heard. Putting PFAS under the Toxic Substances Control Act (TSCA) would not be as bad, because that would just mean that anyone using it in industrial quantities would have to monitor its use and report on that each year.

Finally, DON'T PANIC. PFAS in landfill leachate is what might be called a "slow-moving catastrophe." Regulators, politicians, the scientific community, and the solid waste industry have time to figure it out. Consultants and manufacturers are coming up with solutions.

Just take steps to stay informed and take action when appropriate. That way you'll be ready for whatever comes next—be it an elephant or the mosquito. MSW

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