Watered In: Liquid Issues in Landfill Gas Extraction Wells

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Over the years, the solid waste industry has observed an increase in liquids in landfills. These liquids are generated from the existing moisture content in the raw waste, degradation of the waste over time and rainfall infiltration. Landfills are designed for these liquids to drain vertically downward to the landfill's bottom leachate collection system where the liquids are piped to leachate storage tanks or ponds. *However, some liquids become trapped in the varying waste layers.* A possible cause of trapped liquids may be improved waste compaction, which limits pore spaces, resulting in minimal liquid flow downward to the leachate collection system. Landfills that receive incinerator ash may also have perched liquids that result when landfilled materials harden in place and cause impermeable layers within the waste mass.

Figure 1 - Excess pressure/liquids inside wells can result in geyser conditions.

As landfill gas (LFG) extraction wells are installed into a landfill waste mass to remove LFG, due to the path of least resistance, trapped liquids are flooding the wells causing the wells to be "*watered in*". In some cases, the gas pressure inside of a watered in well is so high that the liquids in the well will geyser upward as shown in Figure 1. When liquids in the wells inhibit gas collection, waste instability and compliance issues relating to surface emissions and odors can occur. Newer regulations require the monitoring of penetrations during quarterly surface emissions monitoring events, depending on if the landfill is subject to the newer regulations, trapped liquids in the wells may increase the effort of managing the number of exceedances observed, corrective actions needed to be performed to remediate those exceedances and coordination with regulatory agencies. *Liquids are becoming more difficult to remove from landfills and new extraction methods are having to be implemented to accommodate the increase in liquids.*

Gas Extraction Well Design

One of the common ways the industry is removing liquids is through gas extraction wells that have now become dual liquid and gas extraction devices. Traditional well designs have included 6-inch High Density Polyethylene (HDPE) or Polyvinyl Chloride (PVC) well casings inside a 36-inch diameter boring that is backfilled with large (1 to 3-inch) non-calcareous stone and sealed near the surface with a bentonite or foam plug. New well designs include larger diameter casings to allow for the easier installation and removal of the pneumatic pumps (typically 4 inches in diameter). Using thin slots (40-mil) instead of holes (5/8-inch) in the well casing to minimize the amount of silt that enters the wells has also been implemented. Another option is to use smaller diameter aggregate in the borehole, which will limit the amount of silt brought into the well while the pneumatic pump is operating. The smaller diameter aggregate will also provide a denser backfill in the borehole that will minimize shifting and well settlement.

Occasionally, trapped liquids may lead to higher temperatures within the wells, which then requires the use of Chlorinated Polyvinyl Chloride (CPVC) or steel casings to avoid deformation of the well casings due to heat. These designs along with modifications to the liquid conveyance infrastructure for the wells can assist the LFG and landfill operators in capturing liquids that enter the gas wells.

Managing the Collected Liquids

The liquids collected from the gas extraction wells are often referred to as "top liquids" since they are extracted from the top layers of the landfill and not through the landfill's bottom leachate collection system. Top liquids, similar to the leachate collection system, must be conveyed across the landfill to leachate storage tanks or ponds through a piping network. The piping network, referred to as the dewatering forcemain system, must be designed to handle the required flow and corrosive and silty nature of the top liquids (see Figure 2). The dewatering forcemain system must also be designed with minimal low spots, air release valves, cleanouts every 500 feet, and an appropriate diameter to allow for scouring velocity flow. The installation of pressure gauges on the dewatering forcemain piping is also beneficial for operations troubleshooting as blockages may develop in the system over time causing elevated pressures. The chemical composition of the top liquids must also be considered when determining whether to mix these liquids with other landfill liquids or to manage them separately. The top liquids often tend to be more potent than liquids that are collected in the bottom leachate collection system since the top liquids are not filtered through the waste mass.

Figure 2 - Pressure gauges and cleanouts are beneficial for troubleshooting dewatering forcemain systems.

A Healthy and Compliant System

Overall, landfill owners and operators should understand the removal of landfill liquids is pertinent to a healthy and compliant gas collection and control system and for the longevity of the landfill. All gas wells should be designed to remove liquids or at least have the contingency to do so. Troubleshooting appurtenances described should also be integrated in the dewatering forcemain system for operation and maintenance purposes.

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