FEATURE Understanding the basics of landfill gas collection system maintenance.

Getting to Know Your GCCS

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A typical landfill gas (LFG) collection and control system (GCCS) is extensive and includes several major mechanical components. Thus, with high energy costs, staying on top of operations and maintenance (O&M) is not only critical for continuity of service, it is crucial to make sure the system doesn't incur costs, or worse, regulatory fines, associated with poor performance and unscheduled downtime.

THE LIMITS OF DUCT TAPE: The hose bend at this GCCS wellhead is too tight, which led it to crack. The use of duct tape would suffice in an emergency, but it will eventually rot, resulting in loss of vacuum.

SMELLS LIKE TROUBLE: A gas collection well equipped with a dewatering pump requires regular attention lest a leachate eruption occur, resulting in a foul-smelling health hazard.

Basic System Components and Checks

A GCCS is a common and major component of most sanitary landfills, designed to help:

- LFG migration control (to reduce potential for an explosion);
- LFG odor control;
- Control non-methanogenic organic compound release to the atmosphere;
- Provide LFG to an energy project; and
- Meet Environmental Protection Agency regulatory requirements.

Care should be taken to understand the basics of O&M, system troubleshooting and management of all the data it takes to keep a system functioning efficiently.

The GCCS includes two basic components:

- **Blower – flare station (BFS).** The BFS is usually a skid-mounted equipment station that includes a condensate removal vessel and pumping system, one or more electric powered gas movers (either a centrifugal or positive displacement blower), LFG piping, a suction side shut-off valve, possibly a discharge throttling valve, a gas flow metering station, thermocouples and a flare.

The flare will include a flame arrester, a pilot gas supply and the main gas burner assembly. A control panel and an automated data recorder are also provided.

- **LFG collection wellfield.** The LFG collection wellfield consists of two major integrated components: vertical wells and horizontal trenches for LFG collection; and main LFG header piping and branch piping connections to wells, trenches and leachate system cleanouts.

Good LFG well performance starts with proper design. This includes the proper number and spacing of collection wells and trenches, adequate size and depth of well boreholes, proper packing and sealing around the well screens and solid casings.

The wellhead should be completed with fittings that allow easy and direct access into the well casing, a flow adjustment valve and multiple points for gas measurements. Provide some extra flexible tube connecting the wellhead to the header to allow for differential settlement. There must be reasonable and safe access for personnel to each wellhead for routine monitoring and maintenance.

The main LFG header piping and branch connecting piping are responsible for distributing the vacuum produced by the BFS out to all collection devices. The piping also must carry some condensed LFG liquid to collection points. Thus, it must be designed conservatively and with an eye toward changes that occur over the life of the landfill that can potentially reduce its capacity.

The main header should form a closed loop, if possible, to more evenly disperse the vacuum and reduce overall vacuum loss. The pipe diameters should be judicious to allow for higher-than-predicted gas flow and/or vacuum, and possible future wellfield expansion. Pipe runs should include adequate slope to account for consolidation and uneven settlement of the waste over time and still allow for continual flow of condensed liquid. A design with undersized pipe and inadequate pipe slope can result in continual problems with lower-than-expected system performance.

Routine monitoring of BFS operations should include measurements of:

- System vacuum strength,
- Gas flow and composition,
- Blower discharge pressure, and
- Flare temperature.

System checks and maintenance should be performed, at minimum, on the following schedule:

MONTHLY

- Check fan blower bearings.
- Check condensate vessel drain outlet and leachate pump (if equipped).
- Verify inlet valve position.
- Check running amps on motors and general condition of all mechanical equipment and mounting hardware.
- Inspect flare guy wire system for corrosion or broken components.
- Ensure electrical panels and switches are closed properly and secured.
- Ensure sufficient area lighting.
- Monitor motor/fan vibration.
- Check that piping, valves and fittings are secure.

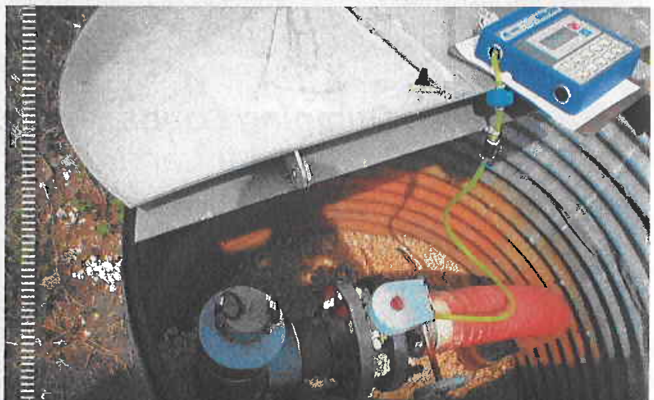
BI-WEEKLY OR MONTHLY

- Measure wellhead vacuum, flow, and gas temperature and composition.

Bi-weekly wellhead monitoring is more common at landfills with energy facilities because fine-tuning of the wellfield is more critical to provide LFG at a consistent rate to maximize power production.

Troubleshooting

A well-designed and constructed GCCS will operate for many years without major problems, but every system requires periodic and continuous maintenance once in service. A GCCS is often installed in areas where waste filling has concluded. However,



CLOSE QUARTERS: Gas collection wellheads inside enclosures like this limit access and make it dificult for the technician to gather data. The confined space also presents breathing hazards.

the landfill in that area will continue to undergo changes that affect the rate of production of gas and the GCCS' ability to efficiently collect gas.

For instance, infiltration of rain into the waste may become problematic. Well screens can become fouled. Cover soil erodes. Waste continues to consolidate over time and areas of waste may trap leachate. The wellhead is continually exposed to the weather. All of these factors can adversely affect the performance of the GCCS.

Maintenance personnel must be diligent in checking and tuning the wells on a regular schedule so that the correct amount of vacuum is maintained.

An experienced technician should be able to identify a problem and determine the cause while onsite during routine monitoring. If a vacuum issue arises at the well, then an immediate adjustment can be made. More cumulative issues can be identified during monitoring, and additional time can be set aside to investigate the issue.

Data Management

The challenge of managing documents and data after a GCCS is in place can be daunting. Once "as built" plans have been created, they are typically filed away until an emergency occurs with the system or construction is taking place in the area. When an emergency occurs, it can be exasperating to not be able to locate a set of plans. One way to manage this information and have it readily available is to use a geographic information system (GIS) as a document management system. Portable document format (PDF) files can be placed into a GIS map corresponding with exact geographic locations of the GCCS.

One example of this is to place a cross section of a LFG header pipe onto the map. A line can be placed on the map representing the geographic location of the header, and a PDF of the cross section can then be attached to that line. When the operator needs to perform work on or around the LFG header, he or she then can easily access the most up-to-date information without having to search through file cabinets or old reports to find the information.

Managing data can be just as challenging. Data from LFG wells and vents can be collected over decades. That's a lot of data to sort through to assess trends or historic results.

To alleviate this problem, set up a database that compiles data over time. Once the database has been created, the user can generate reports that will slice and dice the data in a variety of ways. This capability can save hours of work and yield better outcomes. There are multiple third-party options available to assist in database management.

OIL CAN! OIL CAN!: Rusted bolts make it difficult to access this gas collection wellhead and the outdated butterfly valve makes well tuning difficult.

GCCS Troubleshooting Guide

SYMPTOM	POSSIBLE CAUSES
Low gas flow	Loss of vacuum, wellhead damaged, undersize collection pipe, backpressure too high on blower, liquid in collection well, header valve partially closed.
Surging gas flow	Liquids trapped in header, inadequate pipe slope, undersize pipe, excessive settlement under header, crushed pipe, header valve partially closed, condensate sump pump failure.
Elevated oxygen in well	Air short circuiting, well screen set too high, surface casing annular space not sealed, excessive settlement around well, loss of soil cover, bad wellhead valve, too much vacuum applied to well.
Repeated flare outage	Elevated oxygen in system, loss of vacuum/low methane, excessive liquids, windscreen missing, low flame temperature.
Leachate seeps or gas venting	Landfill "saturated," gas pushing leachate out, perched leachate blocking gas flow and venting out sideslope, elevated liquid level in well.
Vertical well screen fouling	Liquid in well/landfill "saturated," leachate system flooded, silting, dewatering pump rate too high.
Elevated temperature	Air short circuiting at/near well, LFG temperature does not stabilize, combustion byproducts in LFG, cracks in LF surface, "hot" load, subsurface fire.
Combustion byproduct with LFG	Carbon monoxide present, methane drops, cracks in LF surface, elevated LFG temperature, "hot" load, subsurface fire.
Foaming at wellhead	Pump not functioning correctly, excess vacuum on well.

The next level of planning is to create a three-dimensional visual model of the landfill. Off-the-shelf software can create 3D models of landfills from AutoCAD drawings. Liner systems and caps can be placed onto a 3D model relatively inexpensively. Next, the GCCS can be placed into the 3D model along with LFG vents and wells, including the screen intervals.

In the past, the as-built survey of the landfill bottom liner, GCCS plans and LFG well construction logs were stored in multiple drawings and files. It was difficult for the operator to visualize how all of these items interacted. With a single 3D model, the operator or consultant can determine at a glance if a LFG well or vent was installed too deep and penetrated the liner system, or if the wells and vents were not installed deep enough and additional coverage is needed. Using a 3D model can increase an operator's working knowledge of the system, which can result in timely maintenance, more effective response to regulatory agency concerns, more effective troubleshooting of problems, stable performance of the GCCS, and reduced operational and maintenance costs. ■

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