Gas and Liquid Carrying Pipes in Landfills and Complexity of Conflicts

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A virtual view of modern landfills' interior reveals a maze of pipes running in various directions at the bottom, near the top, and in between throughout the waste vertical column. Some of these pipes are constructed at locations that will not change over the landfill life, and other pipes get shifted around as the landfill settles over time. Settlement in waste piles is not a new phenomenon and has been observed as long as piles of trash existed around human dwellings from eons ago to the modern days at specific landfill locations. Settlements can occur due to the deterioration of organic matter in the landfill and the addition of more waste over and around the waste mound.

Pipe Design

Some of the pipes are specifically designed to be located at the bottom of the landfill, such as leachate collection pipes, leachate toe drain pipes, pressure release pipes, etc. These pipes will experience none or very little settlement in the landfill foundation soils over the landfill's life. If excavation is necessary, it is highly likely to find these pipes at the same location as were initially constructed many years earlier. Other pipes may be near the landfill final cover system, either below or above, closely interacting with the final cover geosynthetics. Many such pipes are for the control of landfill gas or leachate seeps at the landfill surface. These pipes include vertical gas wells, horizontal gas wells, condensate sumps, condensate force main, compressed air lines to gas well pumps, condensate sumps, seep control sumps, electric conduits to sump pumps, leachate recirculation force main and storm water downchutes. Some of these experience settlements that occur in the waste column and get shifted over time.

Many pipes involved in construction of final cover.

Positioning existing large and small pipes above a new final cover geomembrane.

Pipes near the final cover system, above or below final cover geosynthetics, are designed to consider multiple factors, including location and orientation. The force of gravity applies to liquids flowing through the pipe, such as condensate lines, which is an important factor for positioning pipes at right locations. The connection to other pipes in significantly different orientations, such as lateral gas pipes connecting to vertical gas wells, is another important factor. Shifting of waste in vertical or horizontal directions can adversely impact vertical and horizontal pipes if the connection design is inadequate.

Another aspect of piping and their interaction with the final cover is the conflict among different pipes—more specifically, conflicts among gas pipes and liquid-carrying pipes, in or near the final cover system. Liquid-carrying pipes may include stormwater downchutes, rainwater toe drain pipes, and leachate toe drain pipes. Storm water downchutes usually are large diameter pipes extending from the top of the landfill to the perimeter storm water system. Rainwater toe drain pipes are pipes that receive water from the final cover geocomposite drainage layer and are located at terraces on slopes and the toe of the slope near the perimeter berm. Leachate toe drain pipes collect leachate seeps below the final cover geomembrane and are located at terraces on slopes and the toe of the slope near the perimeter berm.

Things to Consider

While preparing design sets, evaluating the relative positions of pipes and the final cover geosynthetics avoids conflict among pipes.

Engineers specifically pay special attention to the following:

- For gas wells near the landfill's final surface, the final cover soils and geosynthetics layers are included in the gas design details to show relative depths and locations.
- Design the flow control valves located below the final cover near the landfill's perimeter with a vertical casing around the valve. It is tall enough to extend through the future final cover and booted at the final cover geomembrane penetration.
- Condensate sumps and associated stub outs (such as condensate force main, compressed air lines, or electric conduits) installed within the landfill footprint before construction of the final cover are designed tall enough to accommodate the final construction cover system around the condensate sump. There will be sufficient space to boot the final cover geomembrane to the condensate sump's exterior walls.
- Pipes exiting the liner boundary at the perimeter of the landfill are designed to be at least 1 foot above the anchor trench shoulder, so that a geomembrane boot can be installed on the pipe at the point of penetration through the final cover geomembrane.
- Locate the flow control valves near the landfill perimeter and within the lined area outside the alignment of future rainwater toe drain system at the slope's toe.
- Design gas pipes located above the final cover geomembrane and crossing terraces or access roads to eliminate conflict with the rainwater toe drain at the terrace or adjacent to the road.
- Large gas headers located across the slope above the final cover geomembrane design will eliminate conflict with stormwater downchutes.
- Design large gas pipes on top of the final cover geomembrane crossing a tack-on swale to eliminate adverse impacts to the swale flow line.

Lateral gas header, condensate force main, and compressed air line involved in final cover construction.

Coordinate Efforts

The complexity of landfills varies from site to site. Issues related to conflicts among gas and liquids pipes, pipes and final cover geosynthetics vary depending on the geometry and other landfill features involved at each location. The best way to resolve conflicts before the project goes to construction is to coordinate efforts among parties involved in the design to discuss and find solutions to every conflict at the design stage.

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