Landfill Final Cover Design and Planning for Long Term Performance

Ali Khatami, Ph.D., P.E., SCS Engineers

Chapter 62-701 of the Florida Administrative Code (FAC) requires the final cover for Class I and Class III landfills to include a barrier layer with hydraulic conductivity that is substantially equivalent to, or less than, the hydraulic conductivity of the bottom liner. Rule 62-701.400(3)(d), FAC, requires Class I and Class III landfills to be lined with polyvinyl chloride (PVC), high-density polyethylene (HDPE), or linear low-density polyethylene (LLDPE) liners. The final cover barrier layer must be PVC, HDPE, or LLDPE as well.

There are more than 60 active Class I landfills and over 35 active Class III landfills in Florida. Many of these landfills are anticipated to remain active for decades to come, and Chapter 62-701, FAC, requires slopes reaching permitted final elevations to be closed within 180 days. This means partial closure of slopes is part of the operational requirements of Class I and Class III landfills.

Figure 2 - Final cover geomembrane installation in progress.

Maintaining Landfills Beyond Closure

According to Chapter 62-701, FAC, following the completion and closure of Class I or Class III landfill, the facility's owner must maintain the landfill for a minimum of 30 years beyond the final closure date. Extension of the long-term care period beyond the 30-year long-term care period depends on meeting certain conditions that must be reviewed and approved by the Florida Department of Environmental Protection (FDEP). Even if FDEP approves completion of the long term care period for a specific landfill, the final cover system of the landfill is anticipated to perform for many years to come; otherwise, environmental issues associated the final cover with not properly performing may force FDEP to spend money that is no longer available.

Figure 1 - LTDS under construction at the toe of the landfill slope.

Designing for Long-Term Performance

For the past two decades, the author has designed and permitted final cover systems with special features to prolong the system's performance beyond the long-term care period of the landfill. The final cover systems are designed to:

- Maximize available airspace in the landfill
- Simplify waste placement in the vicinity of the exterior landfill slopes
- Simplify stormwater management components over landfill slopes
- Effectively collect and remove rainwater percolating through the final cover soils, collect lateral leachate seeps below the final cover barrier layer

- Effectively encapsulate landfill gas at the landfill perimeter

Real World Implementation

The first partial final cover with the aforementioned features was constructed in 1998. Since then, more than 20 other partial closures with these features have been built in Florida under the author's direct supervision. All partial closures are performing satisfactorily without failure. Regular maintenance of the final cover vegetation and occasional cleaning of drainage swales have been the only measures taken by the facilities' operators. The special features that were incorporated into the final cover systems were:

- Straight 3H:1V slopes to the top of the landfill with no benches or terraces, providing benefits such as maximizing airspace; eliminating complications during filling of the landfill near exterior slopes; allowing final surface water drainage swales to be constructed during the construction of the final cover, which provides flexibility for the swale locations, swale slopes, drainage points of swales on the slopes; and downchute pipes that do not require complicated geometric features at the point of connection to drainage swales on the slope (Figures 2 and 4).
- A leachate toe drain system (LTDS) (Figure 1) collecting and disposing of leachate seeps below the final cover geomembrane reaching the bottom of landfill slope.
- A rainwater toe drain system (RTDS) (Figure 3) collecting and draining out of the final cover the rainwater that percolates through the final cover reaching the cover system geocomposite drainage layer.

Figure 3 - RTDS completed near the toe of the landfill slope.

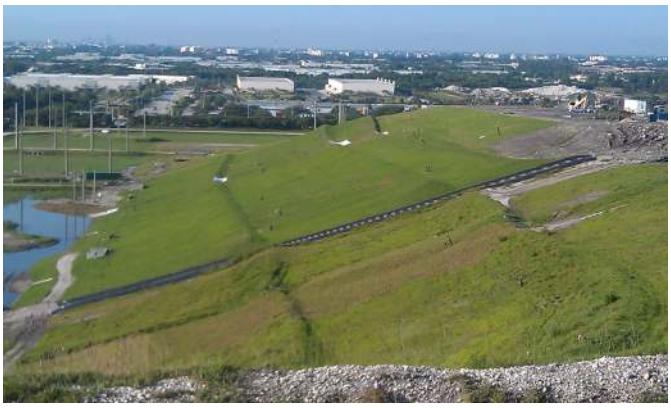

Figure 4 - Final condition with drainage swales and downchutes.

These features provide financial, performance and stability benefits for the facility for many years to come. So far, such final covers have been constructed on 3H:1V slopes as long as 550 ft. in length with no terraces. Several completed final covers were partial closures on a 3H:1V slope, where the next phase was constructed directly above a previous phase with the two phases tied together at the phase boundary.

Proper design and planning for the construction of partial final covers are significantly important for the long-term performance of landfills during the active life and during the long-term care of the landfill.

Ali Khatami, Ph.D., P.E. *is Vice President of SCS Engineers. He has more than 30 years of experience in design, permitting, and construction of landfills. Dr. Khatami can be reached at akhatami@scsengineers.com or www.scsengineers.com.*