Talking... TRASH

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Managing Precipitation Infiltrating Into Final Cover

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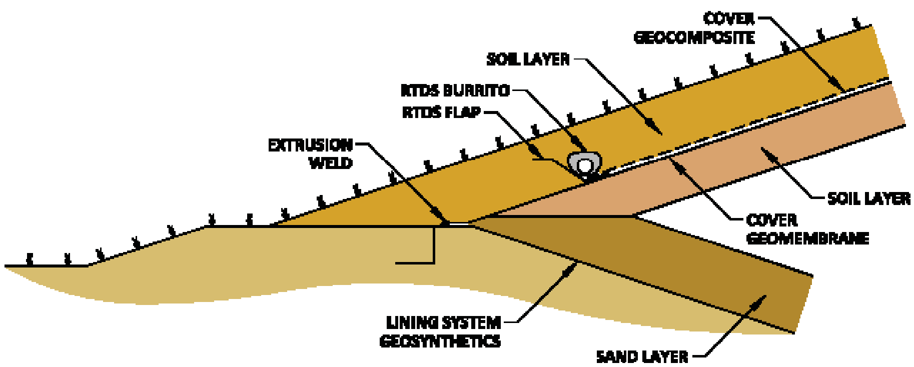
Rainwater falling on landfill slopes is managed by various systems developed at the stage of the design / permitting of the landfill. The surface water runoff is managed through swales and downchute systems on the slope. The collected water in the swales is conveyed to downchute pipes and then to the landfill perimeter storm water management system. Rainwater that percolates into the final cover generally exits the final cover in two different ways: i) a portion of the water stored in the final cover soil layer evaporates out of the final cover; and ii) water that percolates through the final cover soil layer reaches the drainage layer overlying the cover geomembrane. By design, the final cover geomembrane is generally textured to improve the interface friction within the final cover structure. The drainage layer may be a granular drainage layer or a synthetic drainage layer. The widely accepted synthetic material used for the final cover drainage layer is geocomposite. Geocomposite consists of a single layer of geonet heat bonded on both sides to geotextiles. The lower geotextile acts as the friction layer against the underlying textured geomembrane, and the upper geotextile acts as the filter to prevent soil particles from entering and clogging the geonet, which acts as the drainage medium. The subject of this article is related to those final covers including a synthetic drainage layer overlying a geomembrane barrier layer.

Rainwater reaching the geocomposite in the final cover percolates through the upper geotextile and flows down the slope through the geonet layer of the geocomposite. The water in the geonet at the bottom of the landfill slope must be managed in such a manner that water is not backed up in the geonet. The backing up of water in the geonet causes saturation of soil in contact with geocomposite, and saturation could potentially cause instability issues within the final cover. The best management technique would be to provide a collection system at the lowest point of the slope to efficiently remove water from the geocomposite and drain it out of the final cover. In the event that depressions exist in the landfill slope by design (such as benches, terraces, or access roads) with a low point toward the landfill slope, it is anticipated that the geocomposite conforming to the depression will have a low point as well. Water can get trapped in the geocomposite low point and back up in the geonet if a collection system and removal system for the water in the geocomposite is not provided. Removal of water from the geocomposite at such depressions is intentionally kept out of the remainder of this article and will be discussed in a future article. Thus, this article only discusses the collection system at the toe of the landfill slope, near the landfill perimeter berm.

LOCATION OF RTDS



The author developed the collection system discussed below approximately 17 years ago and later coined it as the “Rainwater Toe Drain System” or RTDS. Up to that point in time, the water in the geocomposite was directly discharged out of the lower edge of the geocomposite exposed to the open environment or buried in a gravel bedding on top of the landfill perimeter berm. Over time, it was proved that such designs could potentially fail to effectively remove water from the geocomposite due to the clogging of the geocomposite end point. Dirt accumulation, soil from erosion of cover soils from higher up on the slope, or vegetative growth around the geocomposite end point clogged the pathway for water out of the geocomposite and caused saturation at the toe of the landfill slope at the perimeter berm. The RTDS discussed below proved to be an efficient system requiring no maintenance, while performing effectively for an extended period of time. Like almost every new idea, the author had to upgrade his design over time to improve performance of the RTDS and reduce maintenance of the system. The diagram shown below illustrates the most efficient version of the RTDS with respect to location and geometry, which was adopted by the author's clients as a standard feature in all of their final cover systems.

The RTDS includes a geomembrane flap (RTDS flap) welded to the cover geomembrane along a sloping line a short distance above the lowest point of the landfill slope. The flap is welded such that a depression can be created above the flap for positioning a perforated pipe (RTDS pipe) encased in gravel and wrapped in geotextile (RTDS burrito) inside the depression. A small soil berm above the cover geomembrane at the lowest point of the slope is constructed to support the RTDS flap and to form the desired depression. The sloping extrusion weld of the RTDS flap to the cover geomembrane will provide a sloping depression for the RTDS burrito. Each sloping section of the RTDS flap is approximately 150 ft long extending from a high point to a low point with approximately 2-ft vertical difference between the high and low points. The geocomposite drainage layer on the slope is terminated such that the RTDS burrito is positioned directly above the end point of the geocomposite. With this design, water in the geocomposite drains directly into the RTDS burrito and into the RTDS pipe. No soil should exist between the geocomposite and the bottom of the burrito, otherwise a hydraulic bottleneck will be created that will significantly reduce efficiency of the system.

Water flowing through the RTDS pipe drains out of the RTDS and out of the final cover through lateral pipes (at low points of the RTDS flap) positioned at 300 ft spacing (at the converging low ends of the two adjacent 150 ft long RTDS) along the landfill perimeter berm. Water is drained to the landfill perimeter storm water system. Each lateral pipe is connected to the RTDS burrito at the high end by penetrating the RTDS flap, and discharges to the landfill perimeter ditch at the low end of the pipe. The penetration through the RTDS flap must be booted, and an erosion control mat should be installed at the low point of the RTDS lateral drain pipe to eliminate soil erosion at the point of discharge.

Typically, the construction cost for a RTDS is approximately $30 to $40 per linear foot.