Feeling the Flow

Evaluating drainage layer products to ensure long-term performance.

GEOSYNTHETIC PRODUCTS RECENTLY became available to the industry for use as lateral drainage layers in leachate collection and removal systems (LCRS). The lateral drainage layer is important because it reduces the potential for liquids to leak through the liner system. But no single drainage product is well-suited for every landfill. Consequently, engineers should consider the following when evaluating geocomposite product design characteristics to pick the best product for their application.

A key step in the design process is to evaluate the slope and slope lengths because they will determine the requirements for the drainage layer. A slope of 2 percent is the practical minimum because foundation settlement, as well as construction tolerances and methods, might render a lesser slope ineffective. However, slopes greater than 2 percent may be required in localized areas to make use of sections where excavation may occur while maintaining a minimum separation distance between groundwater and bedrock.

The optimal slope distance and the spacing between the leachate collection pipes is affected by several issues, including site geometry and leachate head calculations. By maximizing the spacing between collection pipes, landfill operators can minimize construction costs. Collection pipe spacing usually is limited by the requirements for the maximum allowable head on the liner. An efficient lateral drainage layer is important to maximizing collection pipe spacing.

After establishing the design geometry for the LCRS, options for the lateral drainage layer can be examined. Geocomposite drainage products are available for this application. The products are designed to efficiently move liquid to the collection pipes. However, under heavy landfill stresses, the synthetic materials can deform. Geocomposite drainage products are specifically shaped to perform their function, so shape deformations will alter their performance, thus reducing their flow capacity. This is called long-term creep reduction. Engineers should compare various products' performance under anticipated conditions to evaluate their long-term performance.

The core of geocomposites is the geonet, which is where lateral flow occurs. The geonet can have a bi-planar or tri-planar design in various thicknesses. A bi-planar geonet is constructed of two layers of extruded high-density polyethylene (HDPE) ribs that overlap at an acute angle to form a three-dimensional lattice. A tri-planar geonet has upper and lower layers that are similar to a bi-planar product, but with a third thicker layer placed in between.

When bi-planar geonets were introduced, they were typically about 200 mils thick. The tri-planar geonet is about 300 mils thick and previously provided greater leachate flow. Recently, however, bi-planar geocomposites have been manufactured in greater thicknesses to provide comparable flow characteristic to tri-planar products. Bi-planar geocomposites offer multi-directional flow capability and are potentially cheaper to buy and install. But bi-planar products tend to suffer flow reduction from long-term creep.

Tri-planar products have higher long-term flow capabilities under heavy normal loads, but they have the disadvantages of unidirectional flow and potentially higher total costs.

For any LCRS configuration, the lateral drainage layer must provide a flow rate, called

transmissivity, at a certain minimum level to reduce hydrostatic pressure on the liner. Hydrostatic pressure is the force that causes liners to leak if there is a defect. Transmissivity values are a function of the hydraulic gradient (or slope) and loading stress applied to the laboratory test setup. When design conditions are mimicked in the laboratory, the long-term effect of the loading stress, known as compressive creep reduction, is not accounted for. In this case, a separate test is required.

The Geosynthetic Research Institute (GRI) has developed a document (GRI Standard GC8) that can determine the allowable flow rate of a drainage geocomposite. The document also provides a method to measure the compressive creep reduction of the material. In general, a product with a higher creep reduction factor will require a higher initial flow value. Thus, GRI's publication is a good tool to compare the long-term performance of different geonsynthetic drainage products under demanding conditions. For a copy of the publication, visit www.geosynthetic-institute.org.

— John A. Banks, Project Director
SCS Engineers
Tampa, Fla.