Technical Note

Specifying DRAINTUBE® as a Drainage Geocomposite

Prepared by: Sanborn Head & Associates, Inc.

Drainage geocomposites are used to meet the regulatory requirements for liquid or gas removal in a variety of applications including: foundations; mechanically stabilized walls; landfills (gas extraction, leachate collection/leak detection, and capping systems); pond leak detection; roadway and pavement drainage; and other subsurface drainage system applications. Cost-effective, efficient, and effective drainage solutions are critical to the operation, maintenance, and regulatory compliance of these systems. The long-term performance of drainage geocomposites can be limited by several factors including intrusion of the geotextile and biological clogging. Multi-linear drainage geocomposites like DRAINTUBE® offer the advantage of better long-term hydraulic performance, and its ease of installation make it an ideal material to increase the performance of a system and reduce the overall construction cost.

This technical note is intended to aid designers, owners, and agencies to establish guidelines for multi-linear drainage geocomposites, like DRAINTUBE®, as a drainage geocomposite for a variety of applications.

DRAINTUBE®, manufactured by AFITEX Texel Geosynthetics inc., combines geosynthetic and pipe technology into a product that has a variety of fluid management applications.

DRAINTUBE® consists of two geotextile layers comprised of short synthetic staple fibers of 100% polypropylene needle-punched together with perforated corrugated polypropylene pipes regularly spaced inside. The pipes have two perforations per corrugation at 180° and alternate at 90°.


Interface Shear Strength

Interface shear strength testing was performed by GAI-LAP certified laboratories on a variety of DRAINTUBE® products and other typical materials. The overall results are summarized here (see right). Engineers are encouraged to base their design on parameters derived from tests performed on site-specific materials under anticipated conditions.

<table>
<thead>
<tr>
<th>Material Tested</th>
<th>Typical Friction Angle (°) with DRAINTUBE®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Sand/Granular Soil</td>
<td>Directly related to the internal friction angle of the soil.</td>
</tr>
<tr>
<td>Textured Geomembrane</td>
<td>28-30</td>
</tr>
<tr>
<td>Bituminous Geomembrane</td>
<td>36</td>
</tr>
<tr>
<td>Gripnet Geomembrane</td>
<td>35</td>
</tr>
<tr>
<td>Geosynthetic Clay Liner</td>
<td>23</td>
</tr>
<tr>
<td>Low-permeability soil</td>
<td>Directly related to the internal friction angle of the soil.</td>
</tr>
</tbody>
</table>
How Does DRAINTUBE® Compare?

Design Considerations

**Mechanical Behavior**

Unlike geonet drainage geocomposites, normal load has little effect on the transmissivity of multi-linear drainage geocomposites. Because the normal loads to the mini-pipes are reduced due to soil arching, the pipe/backfill interaction, and corresponding load transfer (when confined), transmissivity is not impacted and there is no geotextile intrusion or creep over time (as per ASTM D7931-17).

DRAINTUBE® has been tested under high compressive loads, and the results indicate that the transmissivity of the product is not load or time sensitive. When the product is properly confined, increasing the normal load does not significantly effect the transmissivity at loadings up to 50,000 pounds per square foot (psf). Additionally, test data indicates no change in transmissivity over the first 1000 hours.

**Transmissivity and Flow**

Multiple studies have been performed on the long-term transmissivity of DRAINTUBE® to assess the chemical and biological clogging of DRAINTUBE®. Over an 18-month long test program, neither the geotextile filter nor pipe of DRAINTUBE® ACB (with non-leachable, silver based biocide treatment) appeared to clog, and it exhibited same or better long term hydraulic behavior than gravel layer.

Over a 3-year long test program that simulated in-landfill conditions, the residual long term flow capacity of DRAINTUBE® (designated as NWNP w TUBE in figure) was about 75% whereas a typical single sided geonet geocomposite (designated as NWNP w GN in figure) was about 30%.

As expected, the transmissivity of DRAINTUBE® is proportional to the number of pipes per unit width. In other words, the properties that are measured on one pipe and calculated for a unit width of one meter, can be multiplied by the number of pipes per unit width to find the transmissivity of a product with increased number of pipes.

Transmissivity test methods for multi-linear drainage geocomposites, like DRAINTUBE®, are provided in the Geosynthetic Institute GRI Test Method GC 15 (revised in May 2017).

**Peal Strength**

Drainage geocomposite materials usually consists of at least one geotextile attached to a geonet or other type of drainage core through heat bonding or the use of an adhesive. Designers and engineers must consider the peel strength of these materials for their application; however, because DRAINTUBE® is a needle-punched geocomposite, peel strength is not a factor or consideration in the design process.
How Does DRAINTUBE® Compare?

Specifying Drainage Geocomposites

The performance of drainage geocomposites is limited by several factors that should be taken into consideration when specifying/designing: (1) geotextile intrusion into the geonet, RF_{GI}; (2) geonet crushing, \( RF_{CR} \) (i.e., creep); and (3) biological and chemical impacts, \( RF_{CC} \) and \( RF_{BC} \).

Basic Design Formula:

\[
q_{allow} = q_{100} \left( \frac{1}{RF_{CR} + RF_{CC} + RF_{BC} + RF_{GI}} \right)
\]

- \( q_{allow} \): allowable flow rate for a drainage geocomposite
- \( q_{100} \): initial flow rate determined under simulated conditions for 100-h duration
- \( RF_{CR} \): reduction factor to account for long-term behavior
- \( RF_{CC} \): reduction factor for chemical clogging
- \( RF_{BC} \): reduction factor for biological clogging
- \( RF_{GI} \): reduction factor for geotextile intrusion past the initial 100-h seating time

The basic design formula (see left) can be used to specify/design the appropriate drainage geocomposite for a specific application. A summary of typical ranges for each of the reduction factors for some common applications of drainage geocomposites is provided in the table below along with the reduction factors that can be used for DRAINTUBE®, based on many of the studies and testing already discussed above.

One of the benefits of using multi-linear drainage geocomposites is that there is no creep or geotextile intrusion overtime and under load.

<table>
<thead>
<tr>
<th>Applications</th>
<th>Type of Geocomposite</th>
<th>( RF_{CR} )</th>
<th>( RF_{CC} )</th>
<th>( RF_{BC} )</th>
<th>( RF_{GI} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill Leachate Collection</td>
<td>Geonet</td>
<td>1.4 to 2.0</td>
<td>1.5 to 2.0</td>
<td>1.1 to 1.3</td>
<td>1.5 to 2.0</td>
</tr>
<tr>
<td></td>
<td>DRAINTUBE®</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Retaining Walls</td>
<td>Geonet</td>
<td>1.2 to 1.4</td>
<td>1.1 to 1.5</td>
<td>1.0</td>
<td>1.3 to 1.5</td>
</tr>
<tr>
<td></td>
<td>DRAINTUBE®</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Sport Fields</td>
<td>Geonet</td>
<td>1.0 to 1.5</td>
<td>1.0 to 1.2</td>
<td>1.1</td>
<td>1.0 to 1.2</td>
</tr>
<tr>
<td></td>
<td>DRAINTUBE®</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Landfill Covers</td>
<td>Geonet</td>
<td>1.1 to 1.4</td>
<td>1.0 to 1.2</td>
<td>1.2</td>
<td>1.3 to 1.5</td>
</tr>
<tr>
<td></td>
<td>DRAINTUBE®</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* In cases when using DRAINTUBE® ACB, which contains a non-leachable, silver based biocide treatment

Sanborn Head would like to acknowledge the assistance of AFTEX-Texel Geosynthetics Inc. in preparing this Technical Note. Sanborn Head reviewed technical and peer-reviewed literature to provide this evaluation. The findings and conclusions herein should be used in conjunction with good engineering practices, site and application specific considerations, and design calculations.

For Additional Information, including technical data sheets, product specifications, detail drawings, and additional publications, visit the manufacturer’s website: www.draintube.net

References:

5. GRI Standard – GC15, 2017 Determining the Flow rate per Unit width of Drainage Geocomposites with Discrete High Flow Components. Geosynthetic Institute, Folsom, PA
6. GRI Standard – GC8, 2013 Determination of the Allowable Flow Rate of a Drainage Geocomposite, Rev. 1. Geosynthetic Institute, Folsom, PA