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TECHNICAL NOTE - TRANSNET® GEONET LAMINATION STRENGTH CONSIDERATIONS OF GEOTEXTILE

DESIGN CONSIDERATIONS AND THE INFLUENCE OF LAMINATION STRENGTH FOR TRANSNET® GEONETS WITH PARTICULAR REFERENCE TO LANDFILL USE

1.0 Geonet Geocomposites

Transnet® geonets are an extruded bi-planar core made from virgin HDPE. The geonet when laminated with geotextile to one or both sides of the core are called Transnet® geocomposites.

Transnet® geocomposites may be used as either liquid or gas collectors. Transnet® geocomposites come in a variety of thicknesses and strengths with varying flow capacities. Dependent upon the grade selected the compressive strength of a Transnet® geocomposite may range from 450kPa to over 2800 kPa when tested using standard ASTM test procedures.

A range of geotextiles is available that may be laminated to the core. The primary application of the geotextile is to prevent uncontrolled movement of fine materials into the geonet core and reducing the ability of the geonet to provide an unimpeded flow path. Geotextiles are typically nonwoven needle punched polypropylene fibre and may be supplied in different grades, dependent upon site specific requirements.

In landfills, the geocomposite may be placed at significant depth as collectors of leachate or used as indicators of leakage of leachate at the underside of a containment system, such as combinations of geomembranes and geosynthetic clay liners. The geocomposite may be placed closer to the surface layers of a landfill to prevent uncontrolled flows of water through the cap system of the landfill to minimise additional leachate formation. The geocomposite may also be placed throughout the landfill system to collect generated gases and divert to gas venting or gas collection systems. In many applications the geocomposite is placed down a slope within the internal boundary of the landfill.

It can be seen that in landfill applications a geonet with geotextiles attached are likely to be subject to significant loads both from the contained materials or indeed from the construction activities associated with the placement of the geocomposite.

There are many factors that the designer must consider in the calculation of the long term drainage capacity of a geonet and these factors may include:

- fabric intrusion of the geotextile into and limiting the drainage capacity of the geonet.
- chemical clogging and precipitation affecting the drainage capacity of the geonet core and indeed the ability of the geotextile to continue filtration functions (when a geotextile is used).
- biological clogging affecting the drainage capacity of the geonet core and indeed the ability of the geotextile to continue filtration functions (when a geotextile is used).
- the ability of the geonet to withstand sustained loads over long periods of time. This is the creep of the geonet (or deformation) under load for long periods of time. In landfills, this may be decades of years of required service.
- the ability of the geocomposite to maintain the integrity of the bonded geotextile to the geonet core under both short term construction and longer term loading conditions. The ability of the lamination process (bonding of the geotextile to the geonet core) to achieve sufficient bond strength is crucial to the long term performance to the drainage and filtration function of the product. Additionally, good lamination strength will contribute to excellent shear strength of the product.

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2.0 Background to the Lamination Process

The lamination process used to manufacture geocomposites involves heating the geonet surface immediately prior to bringing it in contact with the geotextile(s) via two counter revolving cylinders as shown below in Fig. 1. The source of heat is either electrically heated wedges touching the surface or a gas flame hitting the geonet. The lamination process is such that the geotextile fibres are then pushed by the rollers into the partially molten polyethylene of the geonet core. When the polyethylene cools the fibres are locked into the outer surface of the geonet. The amount and distribution of heat, the temperature of the surroundings, air-circulation and cylinder pressure can affect the quality and uniformity of bonding between the geotextile and the geonet core. The drainage and shear performance of the geocomposites can also be affected by the lamination process. Low temperatures and pressure will maintain maximum transmissivity but could result in weak lamination strength. Higher temperatures and pressures will increase lamination strength but will reduce transmissivity and could even lead to damage of the geotextile and/or geonet core.

Landfill liner and cover systems almost always consist of large spatial areas with slopes ranging from almost flat to as high as 20 degrees. Even steeper slopes are encountered but to a lesser extent. The interface shear strength as well as internal adhesion strength (lamination strength) of drainage composites is an important consideration for many designs.

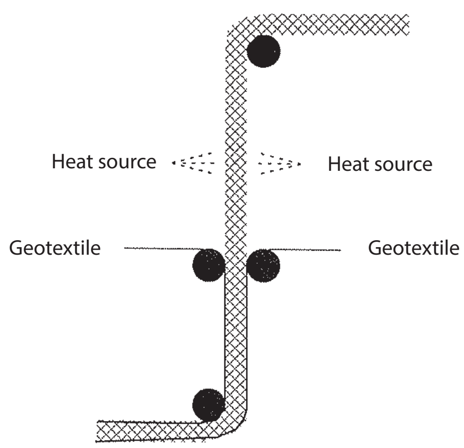

Figure 1. Schematic of geonet-geotextile lamination process.

Some manufacturers of geocomposites use alternative methods of lamination. This is generally a process whereby glue is sprayed to both the geotextile and the geonet core and the two surfaces are brought in contact with each other. This may involve applying pressure or not. Generally this process raises some specific concerns regarding the long term performance of the glue process, the influence of the glue on the filtration drainage characteristics of the applied geotextile and will generally result in low lamination strength for the product. There may also be questions that need to be addressed regarding the consistency of application of the glue and the un-bonded product areas that may be a negative feature of the product. When a glued lamination system is used to bond the geotextile to the geonet the designer must be assured of the compatibility of the glue and the ability to maintain sufficient bond when the geocomposite is exposed to leachates, thermal effects and chemical disintegration.

Research was undertaken by Thiel and Narejo (2005) to determine lamination strength requirements for drainage geocomposites following a failure of such a product in a landfill application in North America. The full paper title is:
Lamination Strength Requirements for Geonet Drainage Geocomposites –R Thiel and D Narejo
Proceedings of the Geo-Frontiers Conference –Austin, Texas January 24-26 2005

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3.0 Summary of Lamination Requirements

It is likely that the primary requirement for good lamination strength is for the initial placement/deployment of the product (construction activities) and for product use where there are slopes involved. The designer should be careful in accepting poorly bonded geocomposites in all situations however as ground settlements may occur causing localised stresses on the geocomposite and hence a potential for progressive delamination of the geotextile from the geonet core.

If lamination is just for the convenience of installation and long term integrity and shear strength of the lamination is not important then it is beneficial to have the lowest peel strength that will just keep the materials together during deployment. The following recommendations apply only to those cases where it is considered important to preserve the bonding and shear strength of the geocomposite and minimise to the extent possible the amount of progressive delamination that may occur during construction.

- maximum allowable un-bonded width along the edges of the geocomposite should be controlled and specified. The current industry standard is 0.3m width.
- the maximum allowable size of the un-bonded area should be specified and made part of the CQA plan. See referenced paper of Thiel and Narejo for specific details on un-bonded area calculations.
- slopes steeper than 20% are recommended to have a minimum peel strength of at least 175 g/cm (ASTM D7005)
- If slopes are between 10%-20% and the peel strength is less than 175 g/cm then the maximum un-bonded area of the geocomposite must be less than 2m^2. Note that with 0.3m un-bonded seam edges on the rolls having the seam edges overlapped approximately 0.06m would barely meet these criteria.
- if the minimum peel strength of 175 g/cm is applied as a specification value then the maximum un-bonded areas for slopes between 20% to 33% is recommended to be 3m^2.
- slopes constructed steeper than 33% should be done with great care and caution as the slope angle may begin to exceed the residual shear strength of any number of internal interfaces including the residual un-bonded shear strength of the internal geocomposite interface.
- The maximum allowable size of the construction equipment allowed on any slope should be specified. The work of Thiel and Narejo was based on the use of a Caterpillar® D6 with LGP tracks. Smaller equipment will produce less potential for delamination and should be considered for slopes steeper than 33%.
- Any materials that are to be placed over the geocomposite and on a slope should be pushed from the bottom of the slope. Pushing down the slope should be discouraged unless approved by the engineer.
- In general where materials are placed above the geocomposite, thinner layers are likely to cause more likely delamination of the geotextile and additional care is required. Industry standard is that the thickness of any soil cover should be a minimum of 0.3m.

Transnet® geocomposite has high lamination strength consistent with best industry practice. Lamination is achieved by heat bonding the geonet core to the polypropylene nonwoven needle punched geotextile that provides the filtration and drainage functions of the product.

This Technical Note is part of a series that includes some discussion on the use of Transnet® geonets in Landfill applications and includes additional topic areas such as Ply Adhesion of geonet geocomposites, Lamination Processes of geonet geocomposites and Geotextile Selection in geonet geocomposites.

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