DESIGN CONSIDERATIONS AND THE INFLUENCE OF CREEP/COMPRESSIVE STRENGTH ON TRANSNET® GEONETS WITH PARTICULAR REFERENCE TO LANDFILL USE

1.0 General

Transnet® geonets are an extruded bi-planar core made from virgin HDPE. The geonet may have, heat laminated to this core, a nonwoven polypropylene geotextile in situations when the geonet has to provide a filtered drainage path. This product is called a Transnet® Geocomposite. Dependent upon the application the geotextile may be affixed to either one or two sides of the geonet core.

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

In landfills, the geonet 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 geonet 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 geonet may also be placed throughout the landfill system to collect generated gases and divert to gas venting or gas collection systems.

It can be seen that in landfill applications a geonet is subject to an extreme range of load conditions.

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).
- And finally 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.

2.0 Creep Considerations

In the design of geonets in landfills there are many references to suggested default reduction factors to be applied to flow rates due to creep considerations. (ref. Koerner 1997). However these default values may seriously underestimate the effects of creep and hence the allowable geonet flow capacities. Due to the compressive creep nature of polymeric materials in plane flow capacity must be considered in a more rational manner. (Slocum, Demeny and Christopher (1986), Smith and Kraemer (1988), Campbell and Wu (1994), Fannin and Choy (1995).

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To address the long term compressive stress on the geonet core the design pressure is suggested by Holtz, Christopher and Berg (1997) to be limited to either:

a) the maximum pressure sustained on the core in a 10,000 hour (minimum) duration creep test (ASTM D7406).
Note: 10,000 hours is just a little more than one year duration.

b) the crushing pressure of a core as defined with a quick loading test divided by a reduction factor of 5.

Recent developments in creep testing allows the use of Stepped Isothermal Methods (ASTM D7361) to accelerate creep effects and allows the prediction of likely creep effects over long periods of time. This may be 100 years in many geosynthetic applications such as their use in containment facilities, such as landfills. Refer to Thornton et al. (2000), Narejo and Allen (2004) and Narejo (2007) for details on of the equipment and procedures.

Testing and knowledge of the Transnet® geonet with respect to creep is a major consideration in selecting an appropriate grade of Transnet® geonet for a specific application.

3.0 Compressive Strength of Transnet® Geonet

Transnet® geonet is manufactured from virgin HDPE polymers and is available in a very wide range of thickness and consequently a wide range of available compressive strengths. The determination of compressive strength is carried out using ASTM test method D6364.

The range of Transnet® geonet available compressive strengths is shown below.

Transnet® Grade	Compressive Strength – ASTM D6364 (kPa)
TN160	450
TN220	650
TN250	830
TN270	1300
TN300	1530
TN330	1920
TN350	2275

4.0 Creep Testing of Transnet® Geonet

4.1 TN220 Transnet® Geonet

Normal Load (kPa)	Duration of Load Years	Long Term Retained Thickness %	Reduction Factor for Creep
720	1.14 (10,000 hours)	62	1.87
	10	58	2.38
	20	56	2.71
	30	56	2.72
	50	56	2.91

Note: Creep testing performed at 20°C

4.2 TN 300 Transnet® Geonet

Normal Load (kPa)	Duration of Load Years	Long Term Retained Thickness %	Reduction Factor for Creep
78	1.14 (10,000 hours)	94.5	1.039
	10	94	1.057
	20	94	1.061
	30	94	1.065
	50	94	1.067

Note: Creep testing performed at 20°C

4.3 TN 300 Transnet® Geonet

Normal Load (kPa)	Duration of Load Years	Long Term Retained Thickness %	Reduction Factor for Creep
720	1.14 (10,000 hours)	78	1.23
	10	76	1.39
	20	75	1.46
	30	75	1.49
	50	74	1.56

Note: Creep testing performed at 20°C

4.4 TN 330 Transnet® Geonet

Normal Load (kPa)	Duration of Load Years	Long Term Retained Thickness %	Reduction Factor for Creep
720	1.14 (10,000 hours)	80	1.18
	10	78	1.32
	20	77.5	1.38
	30	77	1.42
	50	76	1.47

Note: Creep testing performed at 40°C

4.4.1 TN 330 Transnet® Geonet

Normal Load (kPa)	Duration of Load Years	Long Term Retained Thickness %	Reduction Factor for Creep
240	1.14 (10,000 hours)	90	1.05
	10	90	1.08
	20	90	1.09
	30	90	1.09
	50	89	1.10

Note: Creep testing performed at 40°C

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4.4.2 TN 330 Transnet® Geonet

Normal Load (kPa)	Duration of Load Years	Long Term Retained Thickness %	Reduction Factor for Creep
240	35	94	1.05
475	35	90	1.07
720	35	88	1.11
960	35	82	1.39
1200	35	77	1.60
1440	35	65	1.65

Note: Creep testing performed at 20°C

4.0 Summary

Global Synthetics Transnet® geonet has been extensively tested to allow the designer to make informed decisions regarding the long term likely reduction factors to be applied to a Transnet® geonet for long term loading conditions. All data presented was tested at 20°C although additional testing has been carried out at more elevated temperatures on selected products and further information is available if required.

Global Synthetics Transnet® is made from virgin HDPE polymer. The use of recycled HDPE will generally behave in a dissimilar manner to that of virgin polymers and the designer should always inform themselves that alternative suppliers are using virgin polymers.

The use of thin geonets is not suggested for applications of long term/high loading conditions such as found in many landfill applications associated with base lining/drainage in landfills. Generally, Global Synthetics would suggest the use of a minimum **Transnet® TN350 for such applications where cover loads may be very significant.**

Drainage systems in landfills associated with capping systems can be accomplished with a thinner product such as Global Synthetics **Transnet® TN220 where cover loads are minimal. However, in capping systems there is usually a requirement for high flow capacity of the geonet and hence this flow requirement will dictate the selection of the geonet.**

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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