



Smart Solutions®

Technical Note

SM-110

Gas and Water Transmissivity Testing of Nonwoven Geotextiles

Independent Lab Test Results



GPD-SM-110
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INTRODUCTION

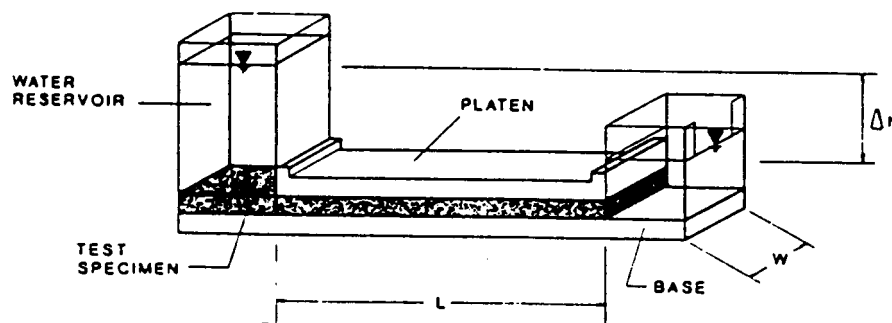
Nonwoven needlepunched geotextiles can offer an economical alternative to sand and gravel or geocomposite drainage systems in solid waste landfills that require moderate to low in-plane flow rates.

This in-plane flow rate per unit width, also called transmissivity, is determined by measuring the quantity of water or gases that pass within the plane of the material in a specified time under specific normal loads and hydraulic gradients.

Synthetic Industries has conducted a series of transmissivity tests at independent laboratories to evaluate the gas and water transmissivity of our nonwoven, needlepunched staple fiber polypropylene geotextiles. This technical note summarizes the tests conducted and provides guidance for selecting values for use in design.

WATER TRANSMISSIVITY

Tests were conducted on several styles of nonwoven geotextiles to give a sampling of values for the design of low in-plane flow drainage systems. An independent laboratory evaluated three products in accordance with ASTM D4716-87, as shown in Figure 1. The parameters selected were intended to model a specific set of conditions.



**Figure 1. Constant Head Hydraulic Transmissivity Test Device
(ASTM, 1993)**



RESULTS

The results obtained from the test program are shown in Table 1. As you can see from the styles tested, values range from 1 to 20 x 10⁻⁶ m²/sec, which is reasonably consistent with other published data (Christopher, 1990; Koerner et al, 1984).

Table 1. Water Transmissivity Test Results (ASTM D4716-87)

Product Style	Test Conditions		Results	
	Normal Load	Gradient	ft ² /min	m ² /sec
401	500 psf (23.9 kPa)	1.0	2.2 x 10 ⁻³	3.4 x 10 ⁻⁶
1201	500 psf (23.9 kPa)	1.0	7.4 x 10 ⁻³	1.1 x 10 ⁻⁵
1601	500 psf (23.9 kPa)	1.0	10.3 x 10 ⁻³	1.6 x 10 ⁻⁵

GAS TRANSMISSIVITY

Nonwoven needlepunched geotextiles have a three-dimensional fiber structure and a high percentage of air voids that also allows a flow of gases within the plane of the fabric (Christopher, 1990). The unique composition, coupled with the low cost and rapid deployment of geotextiles in general, has led to an increased use of nonwovens as gas collection layers in solid waste landfills. This “venting” layer, which is placed between the impermeable “cap” and the waste itself, is relied upon to manage between 0.5 to 7 liters/kg of the gas generated in solid waste landfills per year (Richardson and Koerner, 1989).

Although one research project has shown that gas transmissivity is approximately ten times greater than water transmissivity in nonwoven geotextiles, very little work has been done in this area since (Koerner et al, 1984).

A separate independent laboratory evaluated several SI nonwoven geotextiles for gas transmissivity. A special test apparatus was constructed to carry out the tests, which was modeled after a water transmissivity device. This device is shown in Figure 2 on the next page.



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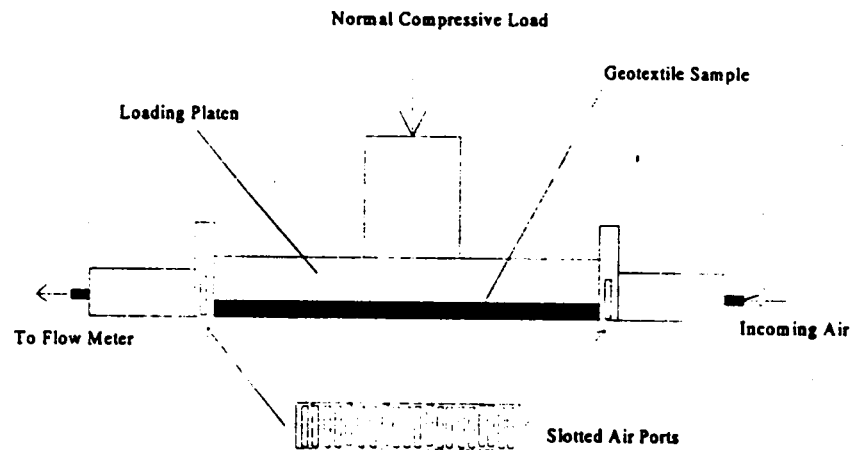


Figure 2. Air Transmissivity Test Device

TEST PROCEDURE

A specimen measuring 6" x 12" (0.046 m²) was placed in the center of the box and a normal load was applied with an Instron machine. A pressure gauge was affixed to the inlet side of the box and air was introduced to the desired pressure. A flow meter was placed at the outlet to measure the flow through the specimen. The box was tested for leaks by using a piece of 30 mil PVC sheet and looking for leaks. The leaks that were found could be sealed with carpenter's putty.

It was discovered that this device could only accommodate inlet pressure from 2-3 psi. At pressures below 2 psi, the flow meter became unstable and oscillated. And, at pressures above 3 psi, the putty was no longer able to maintain a seal and would "blow out". Therefore, the results were generated at two inlet pressures (2 and 3 psi).

The box could be loaded at a wide range of normal loads, but two were chosen based on the overburdens of 500 and 850 lb/ft² (3.5 and 5.2 psi).



TEST RESULTS

The results of the test program are presented in Table 2.

Table 2. Air Transmissivity Test Results (m²/sec)

Product Style	Normal Stress = 3.5 psi Inlet Pressure		Normal Stress = 5.2 psi Inlet Pressure	
	2 psi	3 psi	2 psi	3 psi
801	1.06	0.96	1.02	0.91
891	1.61	1.44	1.54	1.42
1101	1.80	1.74	1.80	1.66
1601	1.42	1.36	1.37	1.36

As can be seen above, flow rate is more dependent on inlet pressure than normal load. This would indicate these test results may be indicative of transmissivity values at higher loads. This observation is consistent with previously reported results (Hoechst Celanese 1990, Koerner et al, 1984). It is also interesting to note the only very slight differences between the various mass per unit area geotextiles.

DISCUSSION OF RESULTS

Previous research has shown gas transmissivity values are approximately ten times that of water transmissivity, when tested under similar hydraulic and normal pressures. The laboratory testing contracted by Synthetic Industries supports this generalization and is shown in Table 3.

Table 3. Gas vs Water Transmissivity Relationships

Nominal Mass/Unit Area (oz/yd ²)	Typical Water Transmissivity (m ² /sec)	Typical Gas Transmissivity (m ² /sec)	Approximate Relationship (Gas/Water)
8-11	0.00001	1.0	1 x 10 ⁵
12-16	0.00002	1.5	1 x 10 ⁵



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REFERENCES

_____, “Standard Test Method for Constant Head Hydraulic Transmissivity of Geotextiles and Related Products”, American Society of Test Materials, Philadelphia, PA, 1993.

Christopher, B.R. “Geotextiles in Landfill Closures”, Proceedings of 4th GRI Seminar, Geosynthetics Research Institute, Philadelphia, PA, 1990, pp. 74-86.

Koerner, R.M., Bove, J.A. and Martin, J.P., “Water and Air Transmissivity of Geotextiles” Geotextiles and Geomembranes, Volume 1, Number 1, 1984.

Richardson, G.N. and Koerner, R.M. “Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments” United States Environmental Protection Agency, Cincinnati, OH, 1989.

Hoechst Celanese Corporation Tech Note 013-90, “Planar Gas Flow of Trevira Spunbound Geotextiles”, Spartanburg, South Carolina, February 19, 1990.

Letter Report by Rick Thomas, TRI/Environmental to Kent Snyder of SI dated December 26, 1994.