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Geotextiles

Geosynthetic Solutions for Improve Ground Structure

Technical Brochure

ALKEGEN

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1. The Problem

Construction projects are subject not only to site-specific ground conditions but also to strict scheduling constraints and cost- and impact-management requirements. These factors create significant challenges during both the design phase and project execution.

2. The Solution

2.1 Texel by Alkegen Geotextiles Solutions

Used in civil engineering, environmental applications, and landscape architecture, geotextiles provide effective separation, filtration, drainage enhancement, reinforcement, and load distribution.
Whether from the 76 Series, the 900 Series, or the F Series, these geotextiles are permanent materials and are unaffected by the naturally occurring acids found in soils, giving them a service life that exceeds that of the structures they protect. They therefore represent:

- proven solutions that substitute for natural materials and support sustainable development;
- innovative solutions that help reduce construction time and backfilling;
- adapted products that contribute to lowering overall construction costs;
- practical products that facilitate the construction of structures even in the most challenging soil conditions;
- products that maximize the service life of the works; and
- products that help reduce social impacts and ensure scheduling compliance.

2.2 Manufacturing Process

The 76 Series, 900 Series, and F Series geotextiles are permeable technical textiles made from needle-punched nonwoven synthetic fibers. This manufacturing process enables geotextiles to withstand significant mechanical stresses, ensuring separation, reinforcement, or protection while also providing hydraulic properties that allow for effective soil filtration and drainage.

2.3 Multiple Functions of Geotextiles

A separation geotextile is required when the filter criterion D_{15}filter < 5 × d_{85}soil is not met. All needle punched nonwoven geotextiles act as separators; however, their mechanical and hydraulic properties allow them to perform multiple functions simultaneously. The functions of geotextiles are defined below.

Separation: a geotextile between two layers of different types of materials prevents interpenetration and prevents contamination and deterioration of the structure.

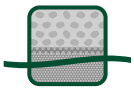
Filtration: a geotextile in the soil can allow liquid to flow through while preventing uncontrolled migration of particles, thanks to controlled filtration opening sizes.

Drainage: geotextiles are the preferred solution for managing liquids because they can contain, channel, and transport liquids, thereby controlling the water content on the site.

Reinforcement: thanks to their mechanical properties, geotextiles are resistant to constraints and prevent deformities that can impact structures, thereby helping to stabilize and/or increase the soil's load-bearing capacity.

Protection: geotextiles serve as a local constraint-reduction layer to prevent or reduce potential damage that could occur to other layers of material.

3. Optimal Functions Performed by the Different Series

	 Separation	 Filtration	 Filtration <70 μ m	 Drainage	 Reinforcement	 Protection
C Series	■	■		■	■	■
E Series	■	■	■	■	■	■
F Series	■	■	■	■	■	■
Texel Geo-9	■	■	■	■	■	

4. Geotextile Selection Guide

The choice of a geotextile and of its physical, mechanical and hydraulic properties depend on the surrounding aggregate materials. In addition to the information presented here, don't hesitate to ask your Texel representative for the geotextile selection tool.

Mechanical properties:
The mechanical properties of a geotextile allow you to select the product best suited to the constraint applied during construction and the lifecycle of the project. The following table shows the constraint level and the corresponding minimum required mechanical properties:

Constructability constraints scale			
	Low	**Low average**	**High**
Tensile	400 to 500 N	500 to 1000 N	1000 to 1500 N
Tear	150 to 250 N	250 to 400 N	400 to 800 N
NCBR Puncture	1000 to 1550 N	1500 to 2550 N	2500 to 5000 N

Note: A subgrade soil with low load-bearing capacity (CBR <2 or Cu <60 kPa) and/or a plasticity index less than 5 (PI<5) generally requires a geotextile with a tensile modulus greater than standard geotextiles such as Texel Geo-9. This value is obtained through wide width tensile testing at 5 to 10% elongation. These soil conditions also require more rigorous hydraulic criteria such as filtration openings that are much finer than those found in standard geotextiles.

Physical properties:
For protective applications, the physical properties of the geotextile also represent an important selection criterion. For covering applications, the table below presents the recommended thicknesses and basis weights according to the size of the aggregate.

	Sloping Covering			Cover Over/Under Geomembrane			
Stone Size	< 30 cm	30 cm – 1 m	> 1 m	≤ 10 mm	≤ 25 mm	≤ 38 mm	≤ 50 mm
Geotextile Thickness	2,2 à 2,8 mm	3,2 à 5,0 mm	5,5 à 7,0 mm	-	-	-	-
Geotextile Basis Weight	-	-	-	250 g/m^2	400 g/m^2	600 g/m^2	900 g/m^2

Note that the dimensions provided for slope covering do not take into account hydraulic criteria, fall height, or the angularity of the rockfill.

Hydraulic properties:
Hydraulic properties enable the geotextile to provide optimal filtration and drainage. For soils where 50% of the particles pass below 60 µm (D50 < 60 µm), a geotextile with a maximum FOS of 60 µm is typically needed.

5. Economic Benefits of Geotextiles

Using a geotextile can allow you to replace a layer of granular material of at least 150 mm thick or reduce the amount of landfill required. A geotextile can allow you to separate soils in order to preserve their distinct intrinsic mechanical and hydraulic properties, as well as protecting the project.

A geotextile is required for separation and filtration when the following criteria have not been respected:

$$D_{15}\ \text{backfill} < 5 * d_{85}\ sol\ subgrade$$

Geotextiles are often used to replace a layer of granular material for its anticontamination properties.

Figure 4 - Road structure without geotextile

Figure 5 - Road structure with geotextile

Using less granular material allows you to save money on material and transportation, as well as reducing the time needed for installation.

Example of the calculation of monetary savings

Let us consider the potential monetary savings for a 1000 m^2 project for which the thickness of granular filter layer was evaluated to be 0.150 m in order to satisfy the separation, filtration and drainage requirements. The cost of the granular material for filtration was evaluated at $18.00 /tonne and the density of the material is 2.2 tonne/m3. The cost of the geotextile that makes it possible to achieve the same separation, filtration and drainage criteria is evaluated at $2.00/$m^2$. The following table shows the values achieved.

As well as saving money, geotextiles can simplify the work process and quality control.

Thickness of filtration material	0.150 mm
Surface to be covered	1 000 m^2
Cost of aggregate filtration material	18.00 $/t
Density of aggregate material	2,2 t/m^3
Unit cost of aggregate filtration layer	5,94 $/$m^2$
Cost of aggregate filtration layer	5 940.00$

Unit price of geotextile	1.50 $/$m^2$
Surface to be covered	1 000 m^2
Cost of geotextile filtration layer	1 500.00 $
Savings with geotextile layer	4 440.00$

6. Environmental Benefits of Geotextiles

The environment benefits from the extraction of less granular material, less material transport and simplified installation. This reduction of CO_2/m^2 equivalent reduces the environmental impact of your project.

Example of the calculation of environmental savings

Let us determine the potential environmental savings for the same project by considering the installation of aggregate material at a rate of 65 tonnes an hour by two men and the installation of geotextile at the rate of571 m2 an hour by three men. The CO2 equivalence factors are from: ADEME (2009), Carbon Balance Method Version 6 and Koerner, B. (2013) Carbon footprint of geosynthetics.

Source	Aggregates	Geotextile
Material		
Mass per unit area	0,33 t/m²	0.200 kg
Factor	10	2.7
Kg equivalent CO_2/m^2	3.30	0.54
Installation worksite equipment		
Diesel consumption	40 l/h	20 l/h
Quantity installed	65 t/h	571 m²/h
Mass per unit area	0.33 t/m³	-
Factor	2.9425	2.9425
Kg equivalent CO_2/m^2	0.60	0.10
Material Transport		
Distance to travel	5 km	200 km
Mass per unit area	0,33 t/m²	0.200 kg/m²
CO_2 Equivalence factor	1.0782	0.2572
Transport equivalence factor	20 tons/truck	0.001 kg/t
Kg equivalent CO_2/m^2	0.089	0.010
Setup labour		
Workers' hourly wages	30 $/h	30 $/h
Number of workers	2	3
Quantity installed	65 t/h	571 m²/h
Factor	0,0367	0,0367
Kg equivalent CO_2/m^2	0,034	0,006
Total emissions in kg CO_2/m^2 equivalent	4,02	0,66
Environmental savings with geotextile	3.36 kg CO_2/m^2 equivalent	

Social Avantages of Geotextiles

As well as saving money and reducing the environmental impact, reducing the amount of granular material needed also has an unquantifiable impact on social costs. Social costs include the inconvenience and discomfort to those living near the worksites, which is caused by increased traffic, risk of accidents, noise and several other factors (CERIU, 2010).

7. Technical Documents Available for Geotextiles

Consult the following documentation for examples of geotextile performance.

- Performance brochure
- Performance brochure F series
- Geotextile selection tool and guide
- Selection of a protection geotextile
- Product data sheets
- Installation guide
- Technical specifications
- Standard technical drawings
- Site inspection guide
- Fiber resistance table
- Comparison of puncture resistance tests
- Comparison of typical, minimum, and minimum average roll value
- Definition of standards and test procedures

In addition to the information presented here, Texel also provides access to:

- An offer that goes far beyond your project thanks to our consulting services, technical support, and in-house training given free of charge;
- A research and development team that custom designs products that comply with the requirements of the many market imperatives.

WANT TO LEARN MORE?

Feel free to contact one of our representatives to discuss your project. 1 800 463-8929 | texel.ca | info.geosynthetiques@alkegen.com

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