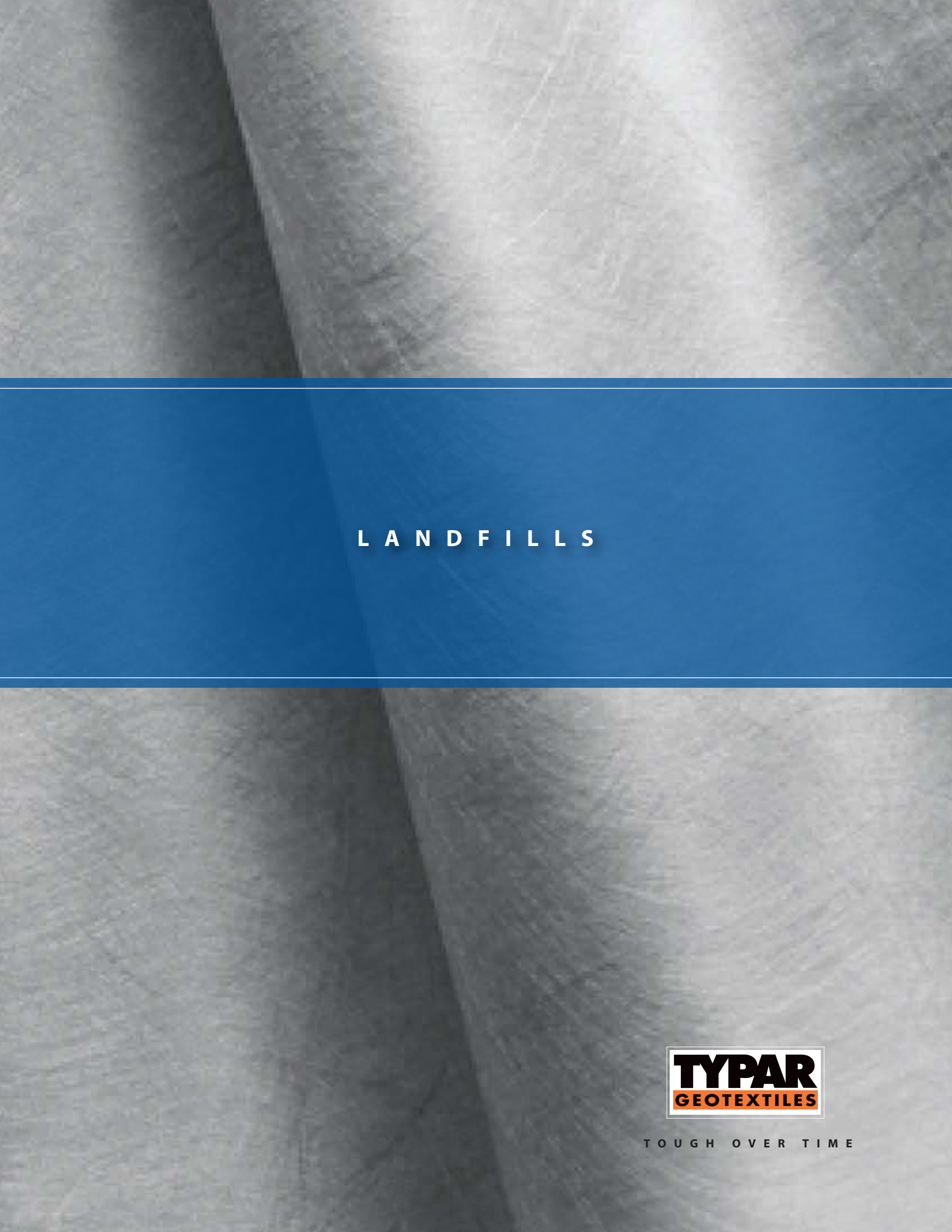

LANDFILLS

TYPAR GEOTEXTILES

TOUGH OVER TIME

LANDFILLS

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1.0 FEATURES OF LANDFILLS

Landfills are used to dispose of much of the industrialized world's municipal and hazardous waste. A landfill is a carefully designed excavation with a lining system on its side slopes and bottom that prevents the migration of leachate (liquids generated largely by the percolation of rain water through the waste) out of the landfill and into the ground. Materials used in the design of containment systems include:

- Geomembranes for liquid and solid containment
- Geosynthetic clay liners for liquid and solid containment
- Geocomposites for drainage, leachate control and gas venting
- Geotextiles for membrane protection, separation, stabilization, drainage composites, drainage and lining (coated)

Geomembranes are sheets of flexible, usually thermoplastic polymeric materials, fabricated into liners and seamed in the field. A geomembrane is a virtually impermeable liner or barrier that must withstand puncture and tear stresses. It must also endure ultraviolet degradation and attack from biological hazards such as fungi, bacteria and chemicals that can cause the material to become brittle and crack.

Geosynthetic clay liners (GCL) are factory-made hydraulic barriers made of bentonite or other very low permeability clay and supported on both sides by a geosynthetic fabric. GCLs are widely used as a component of a composite liner for landfills and surface impoundments and have been successful in reducing leakage rates. They are also used as a cover over solid waste. As with geomembranes, GCLs must withstand rupture, puncture, delamination and tear stresses.

Drainage geocomposites used in landfills are normally a combination of a geotextile and a geonet. The benefit of a geocomposite is its ease of handling and installation versus individual components. It can offer dramatic savings compared to traditional solutions (fabric and stone). Typar is the recommended geotextile for use with all geocomposites.

Typar geotextiles fulfill a number of important roles in containment systems. They are used as a separation layer to ensure the design layers of the system are maintained over the long term and as protection for geomembranes and clay liners. Geotextiles are required in drainage construction and drainage composites. Typar geotextiles are also used as a substrate for sprayed-in-place liner applications. Typar geotextiles are recommended for protection, separation, stabilization, filtration and drainage applications.

1.1 SOLID MATERIAL LANDFILL LINERS

The amount of solid waste generated in the United States is estimated to exceed half a billion tons each year, and the landfill method of disposal requires lining systems to contain the waste and control the emissions. As a groundwater pollution control mechanism, the use of impermeable liners on the bottom, sides and top of the landfill has been required by the Environmental Protection Agency (EPA) for many years. Moisture interacting with solid waste results in a liquid called leachate. Leachate flows downward and is channeled by the liner to a collection point, where it is collected and removed from or recycled back to the landfill. A geocomposite layer between the primary and secondary liners serves as a leak detection system.

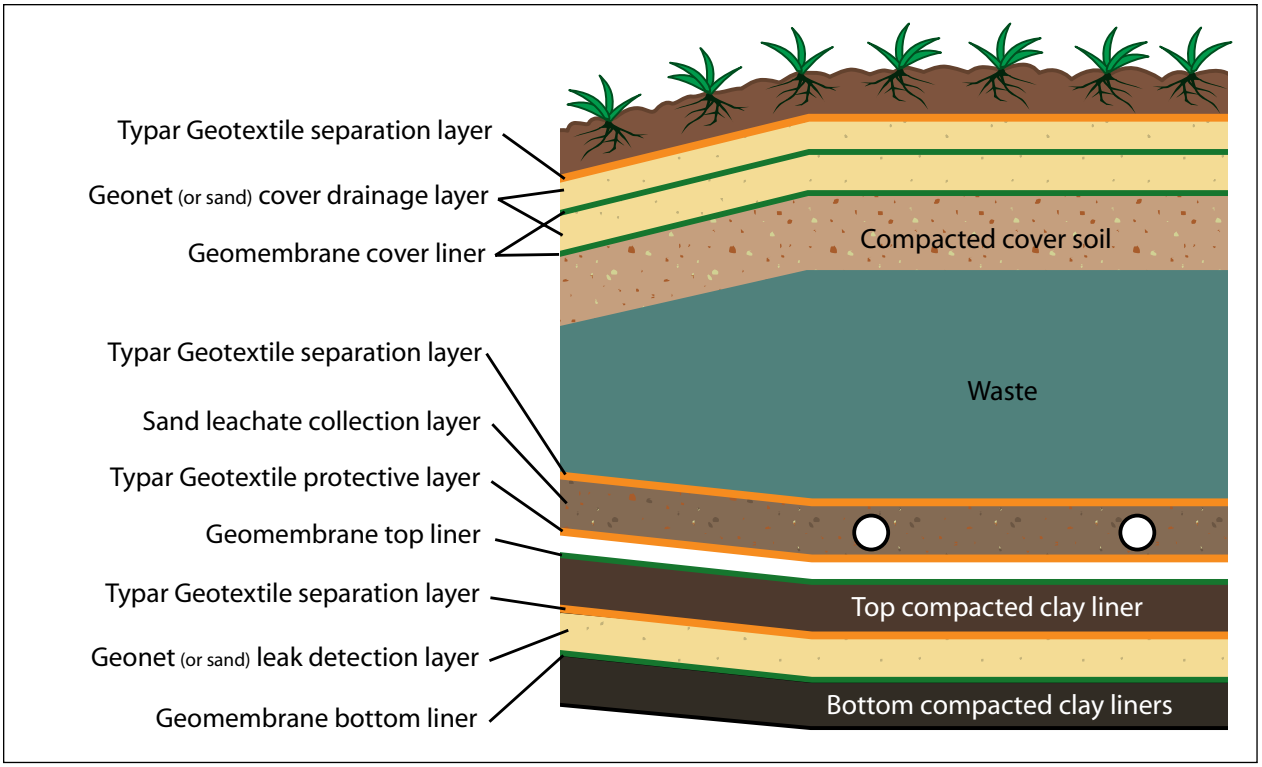

Figure 1: Typical solid waste containment system.

2.0 HOW TYPAR GEOTEXTILES WORK

Typar geotextiles serve a number of important functions in all types of landfill applications:

- Protective layer to prevent geomembrane liner damage
- Permeable separation layer to preserve the layers in landfill design
- Drainage filter to facilitate flow through drainage systems and geonets
- Filtration layer to prevent clay or soil intrusion
- Landfill daily covers to provide overnight surface confinement

Because Typar is manufactured from polypropylene, it resists a wide range of chemicals and is used frequently in hazardous waste containment systems that are exposed to a variety of waste materials.

2.1 PROTECTIVE LAYER

Geomembranes prevent contamination of soil and groundwater by leachate seepage. However, they are only able to perform this function if they are reliably protected against damage during installation and landfill operation. As a protective layer, Typar can be used independently in layers or in combination with other materials.

2.2 SEPARATION LAYER

Landfill designs consist of many layers that create a very durable system. Using Typar geotextiles to separate these layers of engineering materials ensures long-term durability of the design. The process of intermixing drainage materials with soil is greatly accelerated by the presence of water, causing most failures. Typar geotextiles strengthen and stabilize by

providing a permeable separation layer between the drainage materials, aggregate base and subgrade.

2.3 DRAINAGE FILTER

Drainage systems in landfills are critically important in the protection of the ground and surface water. The main functions of drainage systems in a landfill are:

- Removal of leachate from the waste body
- Collection of leachate at defined points for extraction or recycle
- Prevention of leachate build-up in the landfill, which can cause added stress on the liner and accelerate leakage, polluting the surrounding soil and reducing the long-term stability of the landfill

The primary design requirements of the leachate drain system are to convey leachate to the collection point while preventing solid particles from entering the drain system, maximizing the flow rate through the system. Typar promotes the development of a natural filter layer that resembles a well-graded aggregate filter. Typar provides an effective drainage structure since it has both excellent permeability and the ability to restrain soil adjacent to the Typar. This prevents piping of soil and blocks fine particles from entering and clogging the drainage layer or geonet.

Typar has significant benefits over needlepunched fabrics when used with geonets as drainage geocomposites. Needlepunched geotextiles are mechanically bonded, which allows individual fibers to move. This results in excessive stretch of the geotextile, allowing the needlepunched geotextile to be pushed into the core space of the geonet, severely reducing its drainage capacity (transmissivity). Typar geotextiles are thermally bonded, resulting in a significantly higher modulus fabric that preserves the geonet cross section, therefore greatly increasing transmissivity under load for a given net.

The adjacent soil cannot push the Typar geotextile into the geonet core in the same way, thus allowing free flow of liquids through the open core space. Drainage flow rates through geonets with Typar are significantly higher than those offered by needlepunched geotextiles (Figure 2).

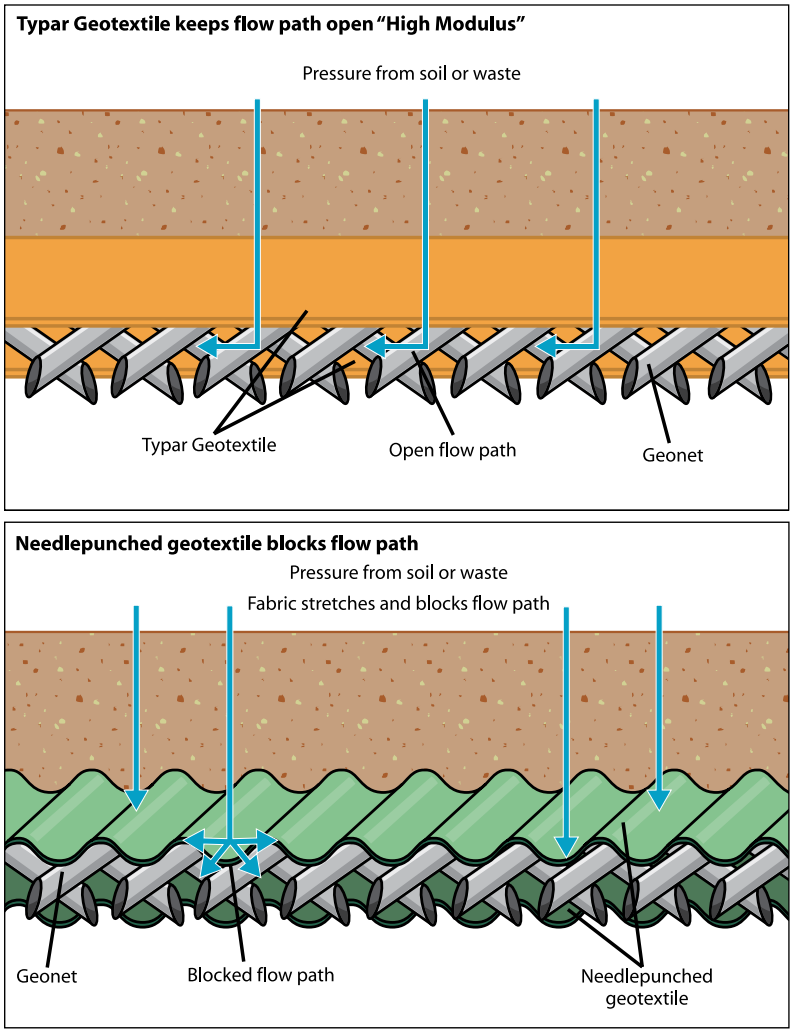

Figure 2: Compared to typical needlepunched geotextiles, Typar prevents the adjacent soil layer from pushing into the geonet, while allowing more flow through the geonet.

SOIL NAME	DIAMETER		US STANDARD SIEVE SIZE	FAMILIAR EXAMPLE
	mm	inches		
Boulders	Over 300	Over 12	> 12"	Larger than basketball
Cobbles (rounded)	76-300	3-12	3-12"	Grapefruit
Coarse gravel	19-76	0.75-3.0	0.75-3"	Orange or lemon
Fine gravel	4.75-19	0.19-0.75	No. 4-0.75	Grape or pea
Coarse sand	2.0-4.75	0.08-0.19	No. 10-No. 4	Rock salt
Medium sand	0.42-2.0	0.016-0.08	No. 40-No. 10	Sugar or table salt
Fine sand	0.074-0.42	0.003-0.016	No. 200-No. 40	Powdered sugar
Silt sizes	0.002-0.074	0.0008-0.003	Rock flour and finer; particles cannot be distinguished with naked eye at distances of 20cm (8").	
Clay sizes	< 0.002	< 0.00008		

Figure 3: Soil description based on typical grain size.

2.4 FILTRATION LAYER

Unlike most other geotextiles, Typar geotextiles are available in different styles having various opening sizes. This allows the designer to select the appropriate filter opening size for specific soil conditions.

2.5 LANDFILL DAILY COVER

A landfill daily cover helps control and prevent disease, fire, odor, blowing litter and scavenging in landfills. It is also expected to control dust, improve general site aesthetics and act as a moisture barrier to limit excess precipitation from entering waste. Soil is most commonly used as a daily cover, but it may be in short supply and expensive to transport. It consumes landfill space (up to a 6-inch layer over the working face every day) that could be used for waste disposal. Additionally, wet weather conditions can complicate the use of soil. Typar is an ideal reusable daily cover material. Ease of handling allows Typar to be quickly installed and removed on a daily basis (even in cold, wet weather), thus consuming no landfill space. Its smooth surface makes it slide easily over compacted refuse, and its tight fiber structure sheds excess precipitation. Typar can be used over and over again.

3.0 DESIGN CONSIDERATIONS AND SELECTION OF GEOTEXTILES

Geotextile design for landfill systems is essentially the same as geotextile design for filters in subsurface drainage systems. The primary function of the geotextile is filtration. The design requires evaluation of two criteria:

- Retention criteria ensures geotextile openings are small enough to prevent migration of soil particles (piping).
- Permeability criteria ensures geotextile is permeable enough to allow liquids to pass freely through. "Permeability" of a geotextile is measured by permittivity (or cross-plane flow rate).

3.1 RETENTION CRITERIA

Soil identification based on grain size is a useful indicator of the soil behavior when filtered by a geotextile. The selection of a geotextile is normally based on the percent of the subgrade soil passing through a 0.075 mm sieve (No. 200 sieve). Figure 3 describes the different types of soil based on typical grain size.

3.2 PERMEABILITY CRITERIA

The default geotextile selection is based on the simple premise that permeability of the geotextile is greater than permeability of the soil. All grades of Typar geotextiles are more permeable than clean well-graded sand and gravel, making it suitable in most environments (Figure 4 and Figure 5).

3.3 SELECT THE GEOTEXTILE

The EPA has Guidelines and Standards that differ from state to state. Most landfills are designed by a registered engineer or geologist referencing EPA Guidelines and Standards. Selection of the appropriate geotextile and Typar style is dependent on the appropriate EPA Guidelines and Standards.

Use Figure 6 as a guide to select the appropriate Typar geotextile. The engineer should always refer to the full EPA Guidelines and Standards for final selection of the geotextile.

SOIL TYPE	PERMEABILITY COEFFICIENT K (CM/SEC)
Uniform coarse sand	0.4
Uniform medium sand	0.1
Clean, well-graded sand and gravel	0.01
Uniform fine sand	0.004
Well-graded silty sand and gravel	0.0004
Silty sand	0.0001
Uniform silt	0.00005
Sandy clay	0.000005
Silty clay	0.000001
Clay	0.0000001
Colloidal clay	0.000000001

Figure 4: Typical permeability of soil types.

4.0 INSTALLATION GUIDE

Successful use of geotextiles in landfill design requires proper installation.

	PERMITTIVITY (D4491) sec^{-1}	PERMEABILITY (D4491) cm/sec	WATER FLOW (D4491) $gal/min\ ft^2$	APPARENT OPENING SIZE (MAX) (D4751)	
				mm	US Sieve
TYPAR 3801	0.1	0.01	8	0.09	170
TYPAR 3631	0.2	0.01	20	0.10	140
TYPAR 3601	0.1	0.01	15	0.10	140
TYPAR 3501	0.5	0.03	50	0.20	70
TYPAR 3401	0.7	0.03	60	0.21	70
TYPAR 3341	0.7	0.03	85	0.25	60
TYPAR 3301	0.8	0.03	95	0.30	50
TYPAR 3201	1.0	0.03	190	0.59	30
TYPAR 3151	1.5	0.04	235	0.84	20

Note: The ability of a geotextile to pass water is indicated by the permittivity–therefore it should be used to compare the ability of various types (needlepunched, SRW, and heatbonded), NOT PERMEABILITY. For comparisons, permittivity of fabrics should be measured UNDER_LOAD. See ASTMD-4491. To get permeability, you multiply permittivity by the fabric thickness. Therefore, if the fabrics pass the same amount of water and one is twice as thick, it will appear to pass water twice as fast which could be misleading.

Figure 5: Hydraulic properties of Typar Geotextiles (Minimum average roll values except AOS).

	3301	3341	3401	3501	3601	3631	3801
Daily covers			✓	✓	✓		
Filtration	✓	✓	✓	✓	✓	✓	
Drainage	✓	✓	✓	✓	✓	✓	
Separation stabilization		✓	✓	✓	✓	✓	✓
Protection					✓	✓	

Figure 6: Selection of Typar style in pond and landfill applications.

If the geotextiles will be placed on the natural ground, grade the site smooth and proof-roll. If the geotextiles will be placed on a layer of compacted clay or sand, make sure the layer has been compacted smooth. If the geotextiles will be placed on a synthetic drainage layer, make sure the layer is clean and flat.

Do not use stakes or pins to secure the geotextile; these may damage the geomembrane liner or cause a breach in the clay liners. If needed, secure the geotextile in place using sandbags or other stones and toe-in at the top.

Spread overlying soil layers in minimum 8 or 12 inch lifts. If a geonet or geomembrane liner is placed under the geotextile, take extreme care not to damage the geotextile or the underlying materials. Use light ground-pressure-tracked construction equipment, and limit compaction of the first fill lift over the geotextile.

5.0 OVERLAP AND JOINING

Overlaps provide continuity between adjacent sections of geotextiles and are required to prevent separation of the fabric during installation. Overlaps at roll ends and adjacent rolls should be overlapped by 2 feet and, where placed under water, by 4 feet.

Successive sheets should be overlapped upstream over downstream and upslope over down slope. Where wave action or multidirectional flow is anticipated, all seams perpendicular to the direction of the flow should be sewn. All overlaps can be replaced by sewn seams.

6.0 SETTING SPECIFICATIONS

Specifications should generally follow the design considerations in Sections 3.0 to 3.3. Primary considerations include the minimum geotextile requirements for the design retention, filtration and survivability.

When specifying Typar geotextiles for landfills, specify the appropriate Typar grade with the confidence that all Typar geotextiles are manufactured to the high quality standards required by the landfill industry.