

40 years experience with geotextiles HUESKER Synthetic GmbH

Today, this German company based in Münsterland, can look back on over 40 years of successful experience with geotextiles, covering the broadest range of applications. The company's product portfolio is as wide and versatile as the scope of use of its materials, anything from dyke construction, waterways and roads to landfill, earthworks and foundations. The Gescher operation manufactures custom-made geosynthetics for the construction industry, as well as technical textiles for agriculture and industry.

Over many years HUESKER has developed individual solutions for various engineering applications through close cooperation with its customers, consulting engineers, research institutions and testing laboratories - each one innovative, economical, environmentally friendly and well conceived.



HUESKER's first geotextile project in 1963 was actually in the hydraulic engineering field. At that time a dyke was being built to the north of Wilhelmshaven to contain the Rüstersieler Watt mudflats and reclaim almost 600 hectares of land. The use of geotextile materials in the construction of the dyke represented a pioneering achievement: for the first time a sea embankment toe was constructed using 25.000 pcs. large sand-filled nylon containers of each 1m³, with the use of a geofabric to ensure slope stability being another first.

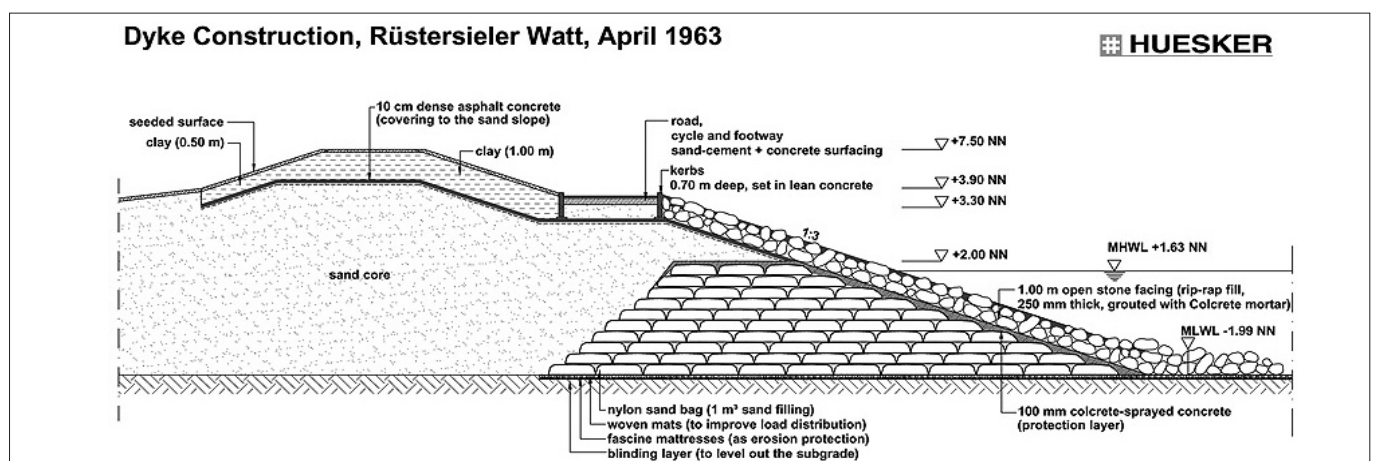
How have things changed in the 40 years since this dyke was constructed?

- HUESKER has gained more experience with geotextiles.
- The HUESKER engineering team has developed further geotextile innovations that are worldwide.
- The HUESKER company philosophy has remained the same:
 - to offer clients and partners custom-made solutions, in which the geosynthetics are optimised to meet local circumstances and engineering requirements.
 - The engineers in Gescher design and develop customised materials, often overcoming particularly difficult problems by coming up with geotextile innovations.
 - Laboratory tests, trial sections and long-term research projects are used, throughout the product range, to achieve a single objective, namely reliability.

In the end, the structures, in which HUESKER geotextiles are used, have to be as successful as the dyke at the Rüstersieler Watt which is still standing and continues to resist the force of the North Sea.

For about half a century textiles have been used in hydraulic and civil engineering construction. A lot of knowledge and practical experience have been gained, design and performance criteria have been developed and improved. New products were designed to respond to more sophisticated applications and construction methods. The idea of packing soil into textiles for confinement was further developed.

- The size of small sand bags has been increased to large units of several cubic meters.
- The use of geotextile tubes allows a reduction in the number of individual textile elements and the use of hydraulic filling methods.



- The use of large volume containers which are dropped from split bottom barges.
- Complete dunes are encased in textile layers to protect them from the extreme loads imposed during storm events.

Each of those applications requires different performance criteria. Durability is different for the core of a dyke covered with stone and rocks, than for a tube acting as a groyne on a beach.

Today we aspire to build large permanent structures, in which we use the textile as structural element, which has to perform throughout the lifetime of the structure. A number of technical requirements therefore have to be met, which are addressed below:

1. Mechanical performance

Tensile strength	Impact resistance
Elongation/Strain	Creep resistance
Abrasion resistance	Pore size

Tensile strength

A large bag to be transported in a filled condition requires a much higher textile strength than a small one.

If textiles are used to stabilize while also confining soils, an even higher load is to be expected during the lifetime of the project.

Proper designs, taking into account all load conditions, have to be performed, incorporating design factors such as installation damage, reduction values for creep, elevated temperature and seam effects.

Elongation/Strain

The more a container deforms the less confinement is provided, and the more soil particles can move and relocate. Deformation also increases the filter opening size and therefore more soil particles may be lost. Hence the use of high modulus textiles does minimise deformation under constant load or under impact load. Containers made from low strength highly deforming non-wovens, may typically produce a failing system.

Abrasion resistance

In a hydraulic environment soil particles are constantly floating in the water. Depending on the energy of the waterflow not only fines, but sand and gravel particles, even stones and rocks can be moved, leading to abrasion of the exposed geotextile. If a geotextile container is not well filled the soil particles inside may lead to damaging abrasion, hence the need for a highly resistant textile.

Impact resistance

Uncovered geotextile structures may suffer from floating debris, boating or any other kind of impact caused by sports activities, especially if they are more or less covered by water and not properly marked. The textile therefore should provide a certain impact resistance which may prevent premature failure.

Creep resistance

Tubes experience their highest loadings during the filling process, with creep not really being an issue, as the time this high load is applied is relatively short compared with the lifetime of the structural element itself. However, if these tubes are exposed to a high ambient temperature at that time, creep rupture may even occur during the few hours taken, if the textile polymer chosen is sensitive to temperature. For PP-fabrics an increase in temperature from 20° to 40° can reduce the tensile strength by up to 50%.

Pore size

All SoilTain® structural elements are designed to achieve the confinement of the soil particles with as little movement as possible within the element, even under repeated hydraulic load. It is therefore important that the textile has the correct pore size to prevent soil particles from passing through, hence allowing proper soil retention.

2. Hydraulic Performance

Permeability	Filter stability
Dynamic load resistance	Stable position

Permeability

Tests undertaken in the large wave flume in Hannover, done by the Leichtweißinstitut of TU Braunschweig in Germany, have proven that a dense system, which does not allow a certain amount of water to pass through the textile element and the containing soil, may lead to hydraulic pressure and uplifting forces which will deform and, over time, damage the system.

If water can penetrate to a similar degree as that in the surrounding soil, the load is dramatically reduced and the long term stability is increased.

Dynamic Load resistance

In coastal applications exposed textile containers will undergo constant hydraulic impact load, generating positive and negative pressure (suction). It is important that the containers do not deform or change their position under this type of loading. This may affect containers with smooth surfaces which can slide more easily than rough ones and those constructed from low strength/high strain textiles may deform and move out of their position.

Filter stability

The pores of the container should be large enough to allow a good waterflow, but fine enough to retain the soil particles inside. If a certain percentage of soil particles is lost, free space inside the container is increased and particle floating and relocation will occur. This, in turn, will lead to further loss of fines and increase of movement up to failure. During filling of the tubes, a loss of fines may not be tolerated i.e. in a beach environment during high season. If textiles with larger openings have to be used, coarser fill, or prewashed fill, should be used. Soil relocation due to loss of fines can also be prevented by covering the tube with a proper filter and armor system.

Stable position

The size of containers/bags is important along with their position and their interlock in the structure. Deformation may allow the fill to become loose and float under hydraulic load causing the structure to be weakened.

Geosynthetic containers which are dropped from split bottom barges are not suitable for long term exposure, because they are only partially filled. However they can be used as core fill for structures which are subsequently covered with armour stone causing their fill to be stabilized.

SoilTain® Systems

The different forms of textile elements include:

- SoilTain® - Bags
- SoilTain® - Tubes
- SoilTain® - Mattresses

SoilTain® – Bags



Bags are geotextile containments with an approximate filling volume between 0.3 m³ and 10 m³. Typically they are used as construction element for dikes, temporary flood protection or as scour protection. Because of their relatively small size they are easy to apply.

SoilTain® – Tubes



Tubes are geotextile containments, hydraulically filled, with an approximately circular cross-section. The diameter and the length can be customized. In general tubes are used as structural elements for groynes, breakwaters, artificial dunes or underwater reefs.

SoilTain® – Mattresses



Mattresses are plane large-area geotextile containments divided into cellular (see brochure "Incomat®") or tubular compartments. Thickness, length and width are produced custom-made. Typical applications are bank protection of rivers or as foundation mattresses for structures on soft soils.

Environment

Geotextile containers can be used for many applications, not only in marine hydraulic engineering, but also for dewatering of sludge or in waste disposal applications (see brochure "Dewatering tubes"). HUESKER's considerable experience with geosynthetics provides extensive advice in the choice of the correct use of resistant textile fibres to deal with chemical contaminants in sludge or waste, or, in hydraulic applications, solutions to UV stability when a container is subject to prolonged exposure to sunlight.

Economy

Geosynthetic elements allow the construction of hydraulic structure with soils available locally on site. This itself will reduce costs compared to conventional rock or concrete structures, where transportation of rock is avoided, hence also providing an environmental benefit.

The technical requirement of the textile will effect the costs, as materials designed to be exposed to the elements for many years will obviously cost considerably more than those required for a temporary, or short term, application.

Summary

The preceding pages demonstrate that HUESKER have a long track record of experience within the Hydraulics sector. The previous pages illustrate just a selection of where, when and for what applications our products have been used.

Our range of geosynthetics has grown substantially over the last 40 years, in part to meet the developing knowledge and demands from within the marine hydraulics sector of civil engineering. This growth in product range has been supported by our technical knowledge gained through experience, or by involvement with, detailed research programmes, over many years.

Our ability to manufacture composite products from multiple polymers puts us at the forefront of geosynthetic manufactures who have the capabilities to understand, design and manufacture solutions for hydraulic applications and at the same time provide advice and guidance on construction methodology and techniques.

We look forward to working with you in the future.

