







## Geosynthetics in Hydraulic Engineering

The application of geosynthetics as economical and ecological construction materials is widespread in the field of hydraulic engineering. Whether in navigable waterway construction, for dam projects or in the coastal protection field; nonwoven fabrics, geogrids and composites are being used.

These products all provide different functions, such as: separation, filtration, protection, containment, reinforcement and sealing.

This brochure provides information on the principal uses and solutions concerning geosynthetics in hydraulic engineering.

# Separation, filtration and protection with HaTe® - woven geotextiles

The use of synthetic woven geotextiles and reinforcement in hydraulic engineering, more than 40 years ago drove the development of geosynthetics to establish them as primary construction materials. Nowadays, wovens are used as filter materials. In ornamental lakes or leisure waterways, in river beds and banks of river areas, pools, ponds and lakes, anywhere in fact where slightly varying hydraulic gradients with partial reversal of the direction of flow occur, and a secondary filter can form in the soil. HaTe® - wovens are a replacement for elaborate mineral multi-layered filters, when used as a sleeve

for trench filters, infiltration ditches or basal filters in road embankments. They are also designed as filter sleeves for vertical mineral drainage elements.

Sink mattresses are made from woven geotextiles with attached fascines for bed protection of channels or rivers and the construction of breakwaters or barriers for coastal protection. For this, the mattresses are produced on a ramp, floated through the water up to the installation site and, there, weighed down with rip-rap.

HaTe® - woven meshes are placed on seeded or planted earthworks slopes for early erosion protection. The openings in the specially developed woven mesh allow the roots of the young plants and grasses to pass through easily.

For the various applications, woven geotextiles and woven meshes that are manufactured from mono- or multifilament yarns, flat tape or split yarns are all used. The selection of the fibre raw material as well as strength and mesh width can be adjusted to the respective application area.



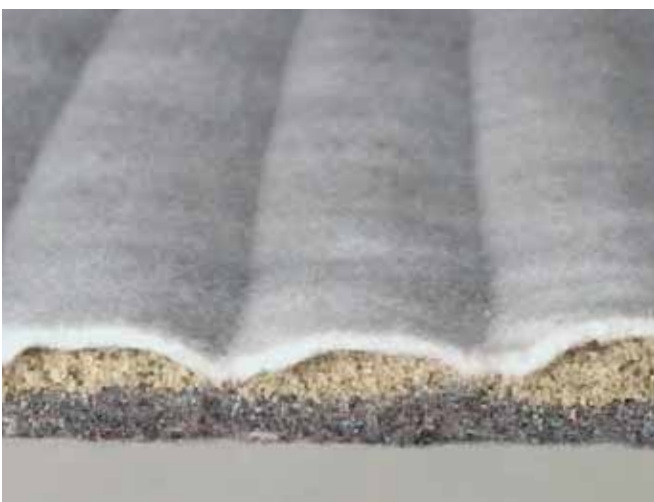
# Separation and filtration with HaTe® - nonwoven geotextiles and the HaTe® - sandmat



**HaTe®** - nonwoven geotextiles are often used to separate two soil layers of different grain sizes. The properties of a non-woven geotextile can also be varied to provide suitable filtration characteristics. Mechanically bonded nonwoven geotextiles are used for navigable waterway construction, coastal protection or dam construction and typically serve as filter layers underneath rock armour. Here, stress is placed on the filter layer by a turbulent current in the boundary layer of filter and soil with rapidly changing pressures and flow directions. The design of the nonwoven fabric, in such a hydrodynamic application, can be according to the requirements shown in the information sheet "Use of geotextile filters for waterways (MAG)" issued by the Federal Waterway Engineering and Research Institute (BAW).

In difficult installation conditions, such as high current speeds, an alternative to a nonwoven fabric is the **HaTe®** - sandmat, which can be used beneath the armour. The **HaTe®** - sandmat is a three-component mat with two stitched nonwoven geotextile layers and a quartz sand layer in between. By the greater weight per unit area, due to the sand, underwater installation is much easier and positional stability increased.

As a further separation and filtration solution, HUESKER offers composite materials comprising **HaTe®** - wovens and **HaTe®** - nonwovens, which combine the advantages of the two geosynthetics. HUESKER Synthetic GmbH can supply customised **HaTe®** - geosynthetics for any filter and separation application in hydraulic engineering.



# Reinforcement and protection with **Stabilenka®** and **Comtrac®**



Geotextile reinforcing elements in the foundation base of groynes, breakwaters, dams or dykes are generally required when the sub-soils consist of low-strength cohesive soils.

For this purpose, the polyester woven fabric **Stabilenka®** or the composite material **Comtrac®** are ideally suited. In addition to the reinforcement function the **Stabilenka®** - woven has a separation and filtration effect. This effect can also be achieved by a combination of **Comtrac®** with a nonwoven geotextile.

**Stabilenka®** - woven, in addition to the reinforcement function, it can also provide a protection function. This is the case if a **Stabilenka®** - woven is used for beach protection using the 'envelope' method.

**Stabilenka®** or **Comtrac®** - materials can be prefabricated/stitched into large panels, and then be economically installed underwater from ship or pontoon.



# Protection and containment with SoilTain® - sandbags and SoilTain® - tubes

Geotextile sandbags and tubes permit the use of local sand for the construction of components or structures for erosion control, both in coastal as well as inland applications. Sandbags are no longer only used for temporary repair of dyke damage in the emergency case but are increasingly being used for permanent erosion or scour protection, e.g. at rivers, lakes, docks and also for offshore wind turbines.

Sandbags are available in different sizes, from 0.3 m<sup>3</sup> volume up to sand-containers with several m<sup>3</sup> of fill

volume. Woven or geotextile composites that provide high tensile strength at simultaneously low deformation are used. For small-size sandbags, however, nonwovens are used also.

**SoilTain®** tubes are exclusively made from wovens and the specially developed **SoilTain®** composite materials. Nonwovens cannot be used on account of their low tensile strength and large elongations and/or the related dimensional instability. Typically, **SoilTain®** tubes are hydraulically filled with a slurry of sand and water.

**SoilTain®** tubes allow the economic replacement of underwater concrete building blocks e.g. for breakwater or groyne cores and rockfill within the core.

Customized to specific requirements, the **SoilTain®** sandbags and tubes by HUESKER are manufactured in accordance with the latest technical requirements of the specific project and based on the latest technical guidelines and standards.



# Protection and sealing with Incomat®



**Incomat®** consists of two high-strength woven geotextile layers connected together with flexible spacers, thereby producing a former which can be filled with concrete. The presence of spacers means that thickness of the **Incomat®** is adjustable to between 6 cm and 60 cm.

HUESKER Synthetic offers various types of mats with different properties, from impermeable and rigid to permeable and flexible.

For a more efficient installation process, several widths of **Incomat®** can be prefabricated into panels and can be joined by sewing or industrial zippers on site.

A big advantage of **Incomat®** compared to conventional concrete work is the possibility of underwater installation, without the drainage or diversion of water courses.



# Protection and sealing with Incomat®



As a revetment, **Incomat®** can be used for dykes, dams, groynes, jetties and breakwaters. As a protective layer or sealing element, **Incomat®** can be used for slurry tanks, rainwater retention basins or fire reservoir ponds. Likewise, **Incomat®** acts as erosion control for overflow routes, dyke openings, inlets and outlets of dyke sluices or flood barriers and stilling basins.

In the offshore and coastal protection area, **Incomat®** can also be used in the channel, river, and port construction applications or in streambed and embankment protection.



# Reinforcement and protection with Fortrac 3D®

**Fortrac 3D®** is a reinforcement grid with in-built soil erosion properties. Its special 3-dimensional structure means that **Fortrac 3D®** improves soil retention while at the same time acting as an anti-slide reinforcement parallel to the slope.

The special **Fortrac 3D®** - structure means that the roots of vegetation can easily pass through it. This not only improves soil retention but efficiently increases turf resistance to overflow water. Even non-planted flood relief gullies can be effectively protected against erosion by using the **Fortrac 3D®** - grid, if installed and secured correctly.

In view of these advantages, **Fortrac 3D®** is the ideal solution for land side dyke rehabilitation for the purposes of protecting against overflow erosion. **Fortrac 3D®** can also be used for stabilisation of dyke openings and overflow sections, for embankment protection, in rainwater retention ponds and for canal banks. Wherever turf without reinforcement no longer suffices as erosion protection, **Fortrac 3D®** can be used.



# Sealing with NaBento®

**NaBento®** is a Geosynthetic Clay Liner (GCL). This laminated composite is approx. 1 cm thick and has high quality bentonite sandwiched between two textile supporting layers. The main component of the bentonite used, montmorillonite, is a three-layer clay mineral.

**NaBento®** is used for various sealing tasks in hydraulic engineering, e.g. with rainwater retention basins, irrigation or ship-traffic channels as well as for collection basins for the protection of groundwater from contamination.

Compared to common mineral seals, **NaBento®** offers several advantages, for instance a largely weather-independent, easy installation and uniform quality due to an industrial production process.

For both **NaBento®** RL-C (calcium bentonite) and RL-N (sodium bentonite) the LAGA – suitability assessments for use in creating mineral seals in landfill surface sealing systems for class I & II landfills are available. These guarantee the **NaBento®** products to have service lives with respect to sealing performance and resistance to mechanical damage of >100 years.



