Solutions for designing ponds
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Where tradition...

... meets progress!
Product Groups (Geo)

Geogrids

Container and Tubes

Wovens

Non Wovens

GCL

Composites
Our engineers continuously develop creative, new and market-driven answers for technically high demanding challenges.

Our highly competent Engineering Department is a basis for our economical success.

Every seventh employee at HUESKER is an engineer
We shape the World

Project Examples
GRS (Geosynthetic Reinforced Soil)

Fortrac® GRS-System

Fortrac® Nature S
Coastal Protection

Coastal protection

Land reclamation by enclosure
Hydraulic Engineering

Bank protection

Canal rehabilitation
Environmental Engineering

Sludge lagoon capping

Landfill sealing
Sludge Dewatering

Mining residuals

Port sediments
Primary Barrier Protection

Common standard: Cover / Ballast layer installation
The purpose of the ballast layer is to:

- Protect the primary geomembrane from:
  - Mechanical damage
  - UV degradation
  - Temperature effects
- Ensure intimate contact:
  - Limit leakage by preventing pathways
- Risk:
  - By placing and spreading ballast material in a thin layer above geomembrane, mechanical damage is likely to occur which will lead to an increased leakage rate.
Reasons for geomembrane damage

GEOMEMBRANE LINER DURABILITY: CONTRIBUTING FACTORS AND THE STATUS QUO

<table>
<thead>
<tr>
<th>WHEN/WHERE</th>
<th>AMOUNT</th>
<th>DETAILS</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liner installation</td>
<td>24%</td>
<td>Extrusion</td>
<td>61%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Melting</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stone Puncture</td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cuts</td>
<td>4%</td>
</tr>
<tr>
<td>Covering</td>
<td>73%</td>
<td>Stone Punctures</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy Equipment</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grade Stakes</td>
<td>16%</td>
</tr>
</tbody>
</table>

Primary Barrier Protection

ELL (Electric Leak Location) survey data from 300 sites - over 3M m² of Geom.

<table>
<thead>
<tr>
<th>Table 1. Location of Holes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. of Holes</strong></td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>4194</td>
</tr>
<tr>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Cause of Holes vs. Size of Holes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size of Holes (cm³)</strong></td>
</tr>
<tr>
<td>&lt;0.5</td>
</tr>
<tr>
<td>0.5-2.0</td>
</tr>
<tr>
<td>2.0-10</td>
</tr>
<tr>
<td>&gt;10</td>
</tr>
<tr>
<td>Amount</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
Solution: Flexible Ballast layer SoilTain Protect

SoilTain Protect is a geotextile containment system which provides a tubular system interconnected into a singular mattress configuration.

Weaving technology enables customization of tube dimensions to suit project requirements. Various raw materials can be considered depending on the project requirements.
Primary Barrier Protection

1st Trial
Primary Barrier Protection

1st Trial
Primary Barrier Protection

1st Trial
Primary Barrier Protection

1st Trial
Advantages: SoilTain Protect

- Elimination of heavy construction equipment on top of primary geomembranes
- Improvement of liner integrity
- Enhancement of site safety through reduction of construction traffic
- Increase of storage space due to utilization of waste (e.g. tailings, coal, ash, sludge etc.) inside the protection tubes
- Reduction of capital expenditure (costs)
- Safe and efficient protection of environmental investment
Primary Barrier Protection

Trial, 1 year later
Primary Barrier Protection

Trial, 1 year later (Pic from the base)
Primary Barrier Protection

Installation 2016
Primary Barrier Protection

Installation 2016
Primary Barrier Protection

Installation 2016
Tailings Volume Increase with SoilTain Protect

Replacing a 300 mm thick sand or soil protection/ballast layer with SoilTain Protect, the total facility storage volume is increased by 3% to 4%.

**ADVANTAGES**
- Less environmental impact (carbon footprint)
- Increased safety due to less traffic
- Increased liner integrity

**Storage area:** 500,000 m² at 9 m effective depth

- **Conventional ballast layer**
- **Ballast layer with SoilTain Protect**

**Storage improvement**
- 3% - 4% or 150,000 m³
- 6,000 trucks less

Source: HUESKER Engineering department
Load Decoupling
A geomembrane is a barrier and should never become part of the structure / structural support system.

[…] The role of the barrier layer is sealing. This layer should not be stressed by tensile loads. (French regulation: XP G38-067, 2010)

Thus it should not be designed to adopt forces.

All loads on top of a geomembrane should be decoupled from the barrier system to protect it from failure.
Geocomposite liners on steep slopes

Solution: Decouple the loads from the geomembrane by using geogrid
Veneer Reinforcement

Main aims:

- Guarantee the stability of the system on a slope
- Avoid excessive tensile loads within the geomembrane
Advantages:

- Decoupling the barrier system from loads
- Enabling steeper slope construction
  → Increasing volumes
- Contributing to interface stability of barrier systems
Tensile loads in the geosynthetics

Design methods

- Limit equilibrium analysis
- Numerical analysis
- Analytical model
1. Textured GMB no reinforcement

% carried by GTX = \( \frac{K_{ttx}}{K_{tto}} = \frac{50}{358.3} = 14\% \)

% carried by GMB = \( \frac{K_{tamb}}{K_{tto}} = \frac{308.3}{358.3} = 86\% \)

2. Textured GMB with geogrid reinforcement with high tensile stiffness

% carried by GTX = \( \frac{K_{ttx}}{K_{tto}} = \frac{50}{941.6} = 5\% \)

% carried by GMB = \( \frac{K_{tamb}}{K_{tto}} = \frac{308.3}{941.6} = 33\% \)

% carried by GR = \( \frac{K_{tar}}{K_{tto}} = \frac{583}{941.6} = 62\% \)
Decoupling of Load from Geosynthetic Barriers

Assumptions:
- 30 m slope length
- 1:4 slope
- 60.7 kN/m load

Within the barrier layerworks a textured geomembrane carries 86% of the total tensile forces imposed on the slopes of the barrier system. When geogrid is incorporated on top of the barrier, the tensile force imposed on the barrier reduces to 33%.

- Increased (long term) safety
- Increased lifetime of barrier system

Textured geomembrane with geogrid
Textured geomembrane without geogrid
Sludge lagoon covering

- Example from Finland -
Several sludge lagoons were filled with:
- dredged pulp mill sludge
- waste water sludge
- other kinds of liquid waste.

Sizes between 30 - 60 m in length and 40 - 200 m in width.

Very low undrained shear strength around 5-10 kPa with alkaline conditions.

3 lagoons had to be covered with a surface lining system.
Sludge Lagoon covering
Sludge Lagoon covering

Topic of the work

- Cover the lagoons by using geosynthetics, each with a single large panel of reinforcement using a woven material.

- Provide a soil stabilized working area.

- Working area had to be sealed to avoid further rainwater passing into the sludge.
Sludge Lagoon covering

1. Step

Installation of a horizontal reinforcement layer to enable light construction equipment to move onto the sludge and to install the cover soil.
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1. Step

Installation of a horizontal reinforcement layer to enable light construction equipment to move onto the sludge and to install the cover soil.
2. Step - “anchoring”

Anchor and tight the reinforcement layer
Sludge Lagoon covering

3. Step - “Covering”

- Cover the area in three stages

![Diagram showing three stages of covering]

![Photo of the covering process]

1. Stage
2. Stage
3. Stage
SoilTain® Dewatering Tubes
Sludge dewatering applications

Sediments

Infrastructural sludge

Sewage sludge

Mining residuals

Industrial sludge
System configuration

1. Extraction
2. Conditioning
3. Dewatering
4. Disposal

Dewatering with SoilTain
System configuration

Sludge flow

Extraction  Conditioning using flocculating agents  Dewatering

Addition of flocculation aids
Features

- Optimization of application through resource-efficient tube sizes
- Recirculation of water, e.g. as process water
- Sludge encapsulation prevents rewetting
- Very high filling capacity
- Low energy requirement
- Straightforward installation
Tubes stacked two layers high in staggered pattern (higher storage capacity, lower space requirement, etc.)
SoilTain dewatering

Benefits at a glance

- **Fast**
  - SoilTain dewatering is the dewatering system with the highest filling capacity

- **Large volumes**
  - The flexible system allows the treatment of large volumes

- **Cost-effective**
  - The passive dewatering process begins as soon as the sludge is in the tube
  - Relatively low labour, capital and energy requirements
Case study: Talvivaara

Talvivaara Mine, Finland, since 2014
Case study: Talvivaara

Dredging operations in the pit
Case study: Talvivaara

Flocculated mining residual
Case study: Talvivaara

Dewatering Field 4: First tube layer installed
Case study: Talvivaara

Dewatering Field 4: Second tube layer installation
Case study: Talvivaara

Dewatering Field 4: Third tube layer installation
Case study: Talvivaara

Dewatering Field 4: Fourth tube layer installation
Case study: Talvivaara

Dewatering Field 4: Fifth tube layer installation
Case study: Talvivaara

Dewatering Field 4: Five tube layers installed
Questions
Thank you for your kind attention