



Geo-X

Landfill Cappings

29 June 2016

Presented by: Wouter van Zyl

Content

1. Geo-X
2. GCL Barriers
 - Capping challenges
 - Coated GCL
3. Veneer Reinforcing
 - General criteria when to use Veneer reinforcing
 - Effects of Temperature, pH , Loads and oxygen on design life
 - How to choose the best “DNA” polymer
 - Effect of strain on design life
4. Tectoseal Active
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6. Geo-Q



Geo-X Pty Ltd

- Lining Installation Company
- Supply Geosynthetic products and solutions
- 3,5 years old
- Employees 50+ years collective experience – Linings & Geosynthetics
- Partners from Germany (design & supply including PI)
 - * Lining supplier – Naue
 - * Geosynthetics & Geogrids (5kN -3000kN) - Huesker



Issues with normal GCLs

- Dessication
- Root penetration
- Dry GCL's are not Gas barriers
- Cation-exchange.....

based on this Naue developed a new coated GCL

Bentofix® Product Description



	A	B	C	D
Bentofix®	X2		BFG	5300
Bentofix®	X2		NSP	4900
Bentofix®	X5	F	BFG	5300
Bentofix®	X5	F	NSP	4900
Bentofix®	X10	F	BFG	5300
Bentofix®	X10	F	NSP	4900

A Mass per unit area of coating [$\times 100\text{g/m}^2$]

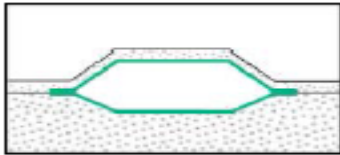
B Embossed friction surface (F)

C BFG – Bentofix® with bentonite impregnated nonwoven (1) and slit film woven (2) as the encapsulating geotextiles

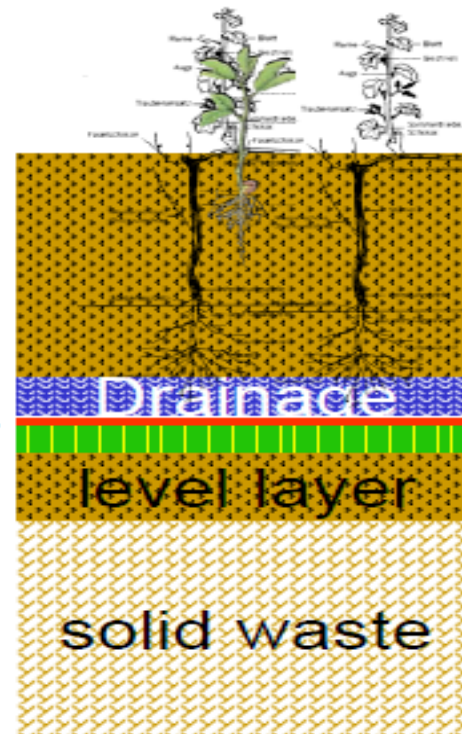
NSP – Bentofix® with a nonwoven (1) and slit film woven (2) as encapsulating geotextiles

D Total mass per unit area (g/m^2) of Bentofix® without coating

Applications – Landfill Cap



GCL Coated -



- Coating up
- Root barrier
- Desiccation barrier
- Gas barrier

Acceptable, if not in contradiction with regulations!

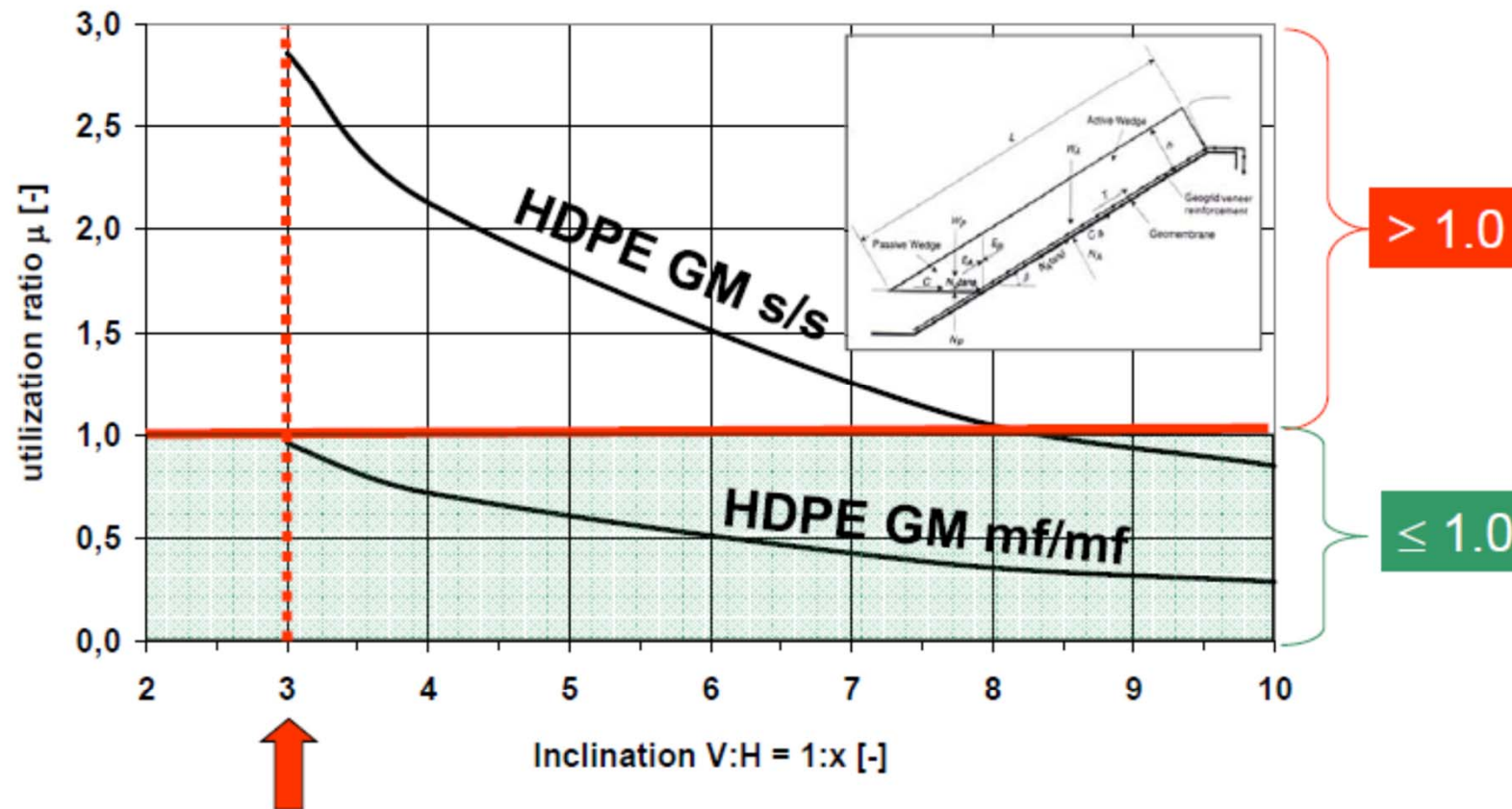
$\frac{\Sigma \text{ Driving Forces}}{\Sigma \text{ Resisting Forces}} > 1.0 \rightarrow$ insufficient stability



Even when Min Requirements are met failures may occur due to:

- Design failure
- Lack of best practice considerations
- Using inferior “ Products “
- Poor Installation

General rule of thumb based on experience

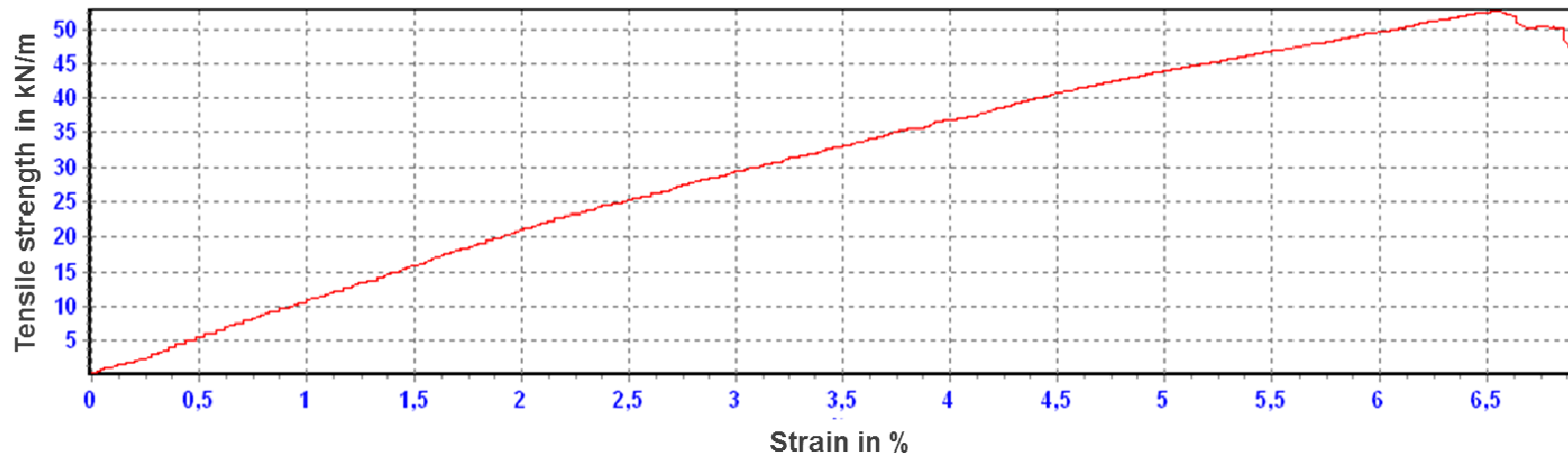


Veneer Reinforcing Design Criteria

- Slopes angle and slope length
 - GM - Smooth or textured
 - Loads
 - Soil characteristics
-
- Short term and long term creep characteristics
 - Resistance to pH levels, temperature , oxygen , UV

Geosynthetic 1

Geogrid Fortrac R 40/40-30 MT (PVA, 40 kN/m)



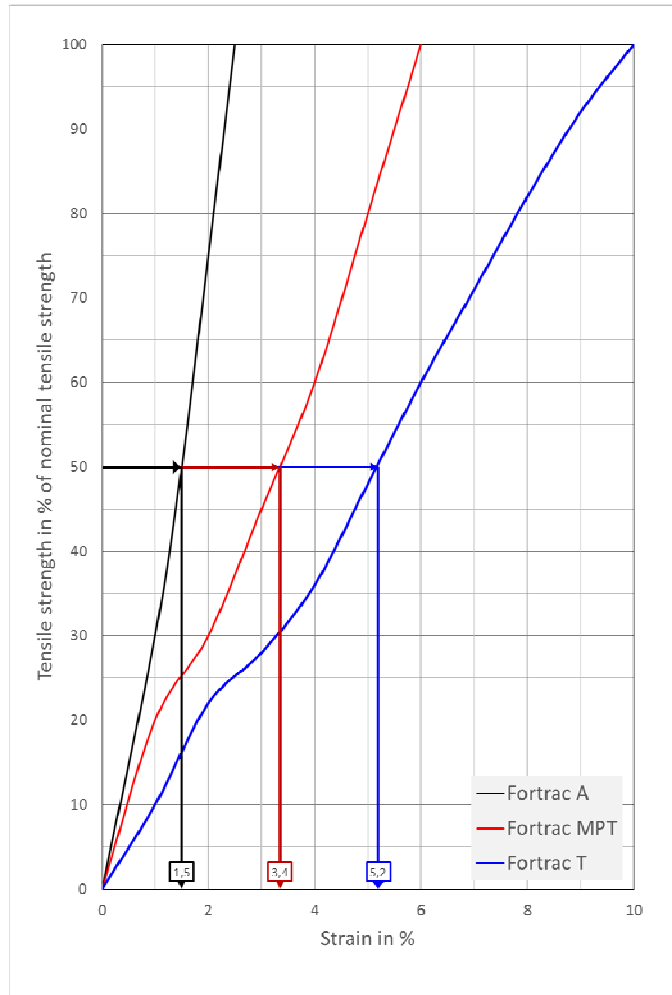
Remember:

- Soil fails between 2-5% strain
- Max allowed deflection in GM <6%

Raw material characteristics

Raw material	PA (6,6)	PE	PET	PP	AR	PVA
Density (g/cm ³)	~ 1,14	~ 0,95	~ 1,36	~ 0,90	~ 1,44	~ 1,31
Softening- / Melting Temperature (°C)	~ 220 / 260	~ 105 / 135	~ 230 / 260	~ 150 / 165	char > 450	~ 220 / 260
Specific tensile strength	High	Medium	High	Medium	Very high	High
Strain of yarn at max. tensile strength (%)	30 - 50	15 - 30	9 - 15	10 - 20	3 – 4	5 – 6
Tendency to creep	Low	High	Low	High	Low	Low
Durability: - Acidic solutions - Alkaline solutions - UV resistance	low good Low	good very low low	good low good	good very good Low	good good low	good very good very good

Tensile stiffness / Short term values!!!!



- # Typical stress-strain diagrams for
 - # Fortrac A (Aramid)
 - # Fortrac M (PVA)
 - # Fortrac T (PET)



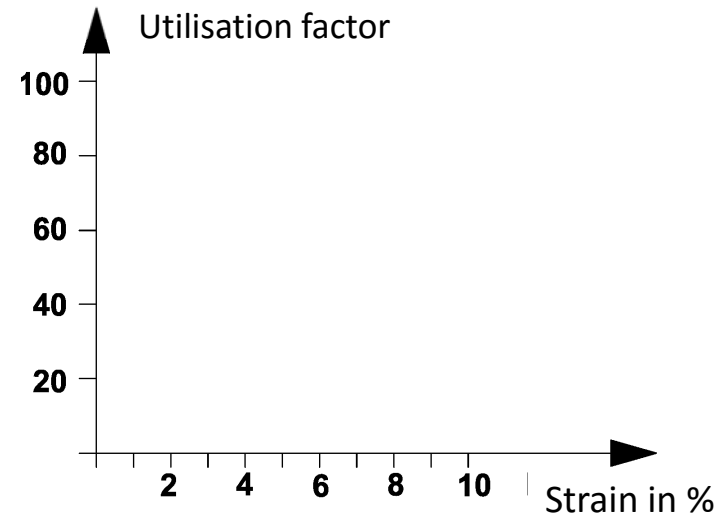
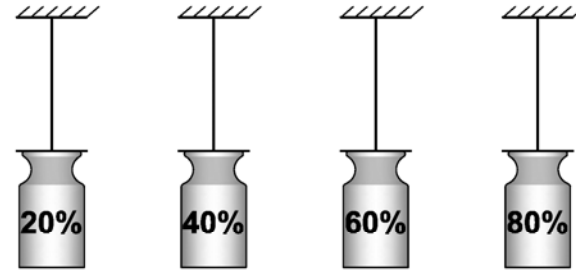
Be carefull not to use it wrong !

Tensile stiffness / Long-term

Isochronous curves

Preparation:

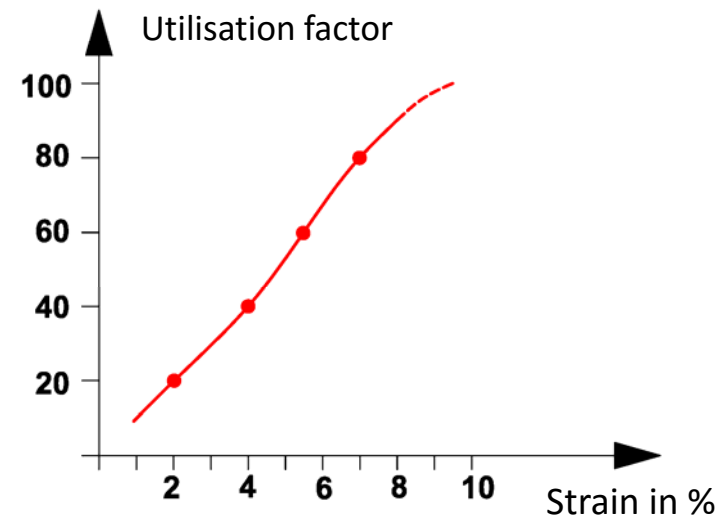
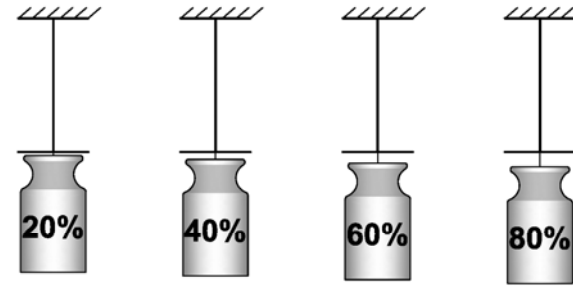
- # Specimens are loaded with different loads (utilisation factor)
- # $T = t_0$



Tensile stiffness / Long-term

Isochronous curves

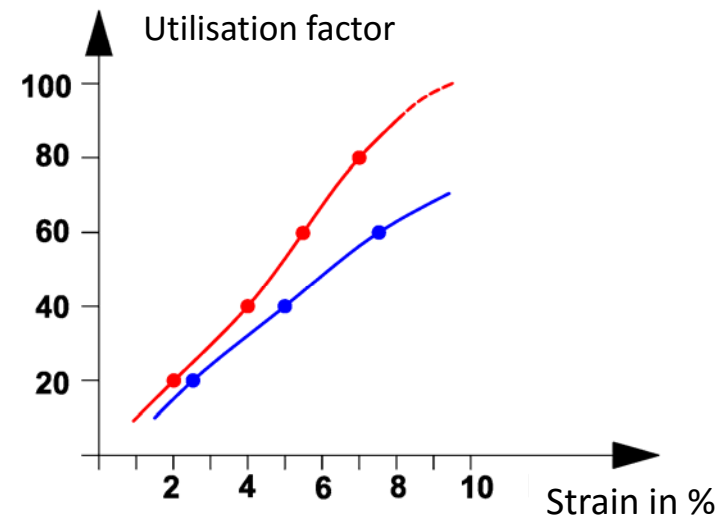
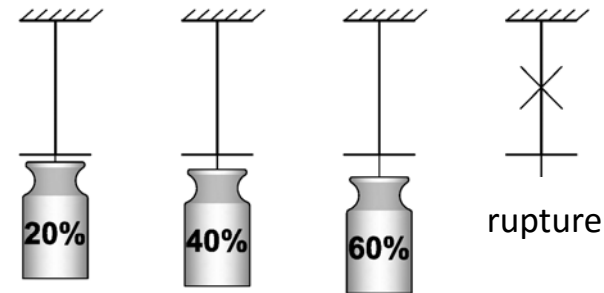
- # Measurement of strain at time $T = t_1$



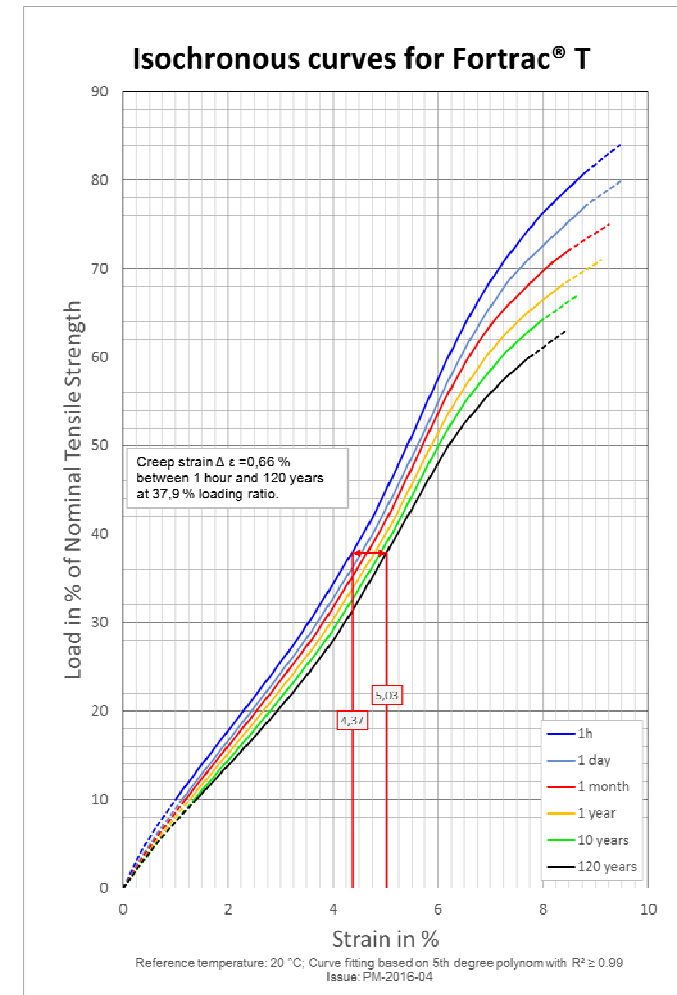
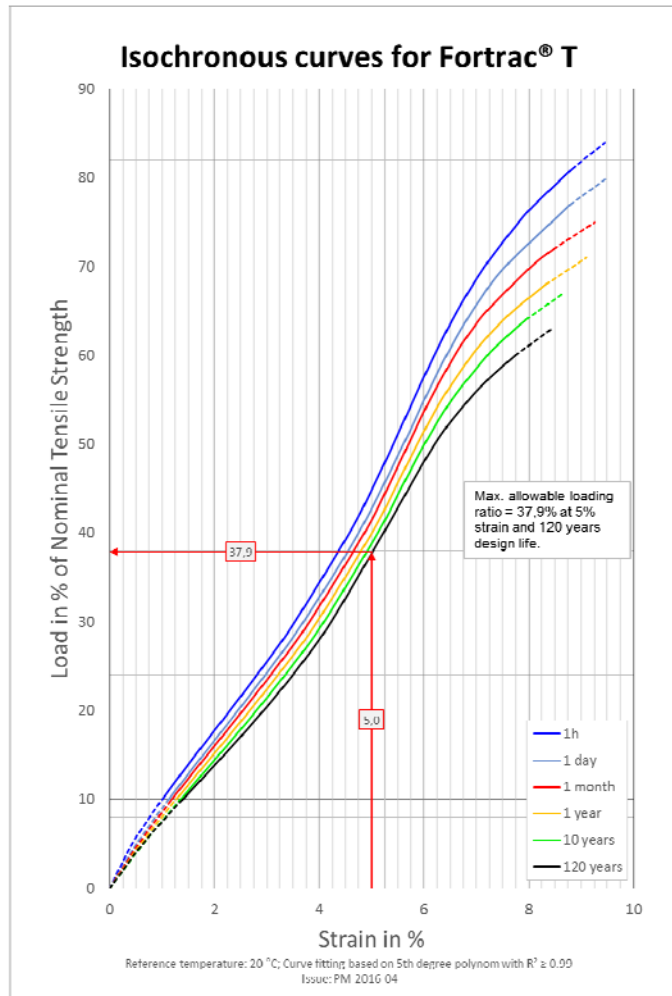
Tensile stiffness / Long-term

Isochronous curves

- # Measurement of strain at time $T = t_2$



Tensile stiffness / Long-term



Product Information

Questions ...

HUESKER

Product Description

1. Product Name: Fortrac® T

2. Product Description: Flexible and highly resistant geogrid with protective polymer coating

3. Raw Materials used: MD / CMD, PEY

4. Environmental Aspect: non-hazardous

Technical data

01. Mass per unit area (EN ISO 10370): g/m² x 100

02. Aperture Size (aperture): mm: 25 x 25

03. Nominal Tensile Strength (EN ISO 10370): MD: kN/m, CMD: kN/m

04. Strain at Nominal Tensile Strength (EN ISO 10370): MD: %, CMD: %

05. Standard Roll Dimensions (width x length): m x m: 3,00 x 200

06. Durability: Predicted to be suitable for Minimum 120 years in natural soils with a pH of 5 and soil temperatures < 20 °C

HUESKER

Calculation of the Design Strength of Fortrac® T geogrids
in accordance with EBGEO 2010 and M Gek 6 2008

According to [2] the design value of the tensile strength R_{Ed} of Fortrac® T geogrid reinforcement is determined as follows:

$$R_{Ed} = \frac{R_{k,Ed}}{\gamma_{G,Ed}} \times \gamma_{G,Ed} \times \gamma_{G,Ed} \times \gamma_{G,Ed} \times \gamma_{G,Ed}$$

Where:

$R_{k,Ed}$: Characteristic value of the tensile strength of geogrid reinforcement

$R_{k,Ed}$: Characteristic value of the short-term tensile strength

$R_{k,Ed}$: Characteristic value of the long-term tensile strength

$\gamma_{G,Ed}$: Reduction factor for creep and long-term behavior, depending on the test duration

$\gamma_{G,Ed}$: Reduction factor for damage caused during installation

$\gamma_{G,Ed}$: Reduction factor for geogrid reinforcement, depending on the test duration

$\gamma_{G,Ed}$: Reduction factor for environmental impacts (resistance to weathering, chemical, microorganisms, etc.)

$\gamma_{G,Ed}$: Reduction factor for the impact of dynamic action, in the case $\gamma_{G,Ed} = 1.50$

$\gamma_{G,Ed}$: Partial safety factor for the structural resistance of flexible reinforcement elements

In the short-term tensile strength is defined as $R_{k,Ed}$.

The characteristic value of the short-term tensile strength $R_{k,Ed}$ for Fortrac® T geogrids in tension direction is given in the Table. For the tension type the characteristic short-term tensile strength is given in machine direction and cross-machine direction.

Notes:

(1) Recommendations for Design and Analysis of Earth Structures using Geogrids

(2) Detailed test and evaluation of geogrids in tension direction

(3) Detailed test and evaluation of geogrids in tension direction

(4) Detailed test and evaluation of geogrids in tension direction

(5) Detailed test and evaluation of geogrids in tension direction

Rev. 01/2010

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Rev. 01/2010

HAPAS HUESKER Synthetic GmbH

BBA

FORTRAC T AND E GEOGRIDS

Technical data and test results of Fortrac® T and E geogrids.

1. Mass per unit area (EN ISO 10370): g/m² x 100

2. Aperture Size (aperture): mm: 25 x 25

3. Nominal Tensile Strength (EN ISO 10370): MD: kN/m, CMD: kN/m

4. Strain at Nominal Tensile Strength (EN ISO 10370): MD: %, CMD: %

5. Standard Roll Dimensions (width x length): m x m: 3,00 x 200

6. Durability: Predicted to be suitable for Minimum 120 years in natural soils with a pH of 5 and soil temperatures < 20 °C

kiwa

Test Report No. 1.2/17910 (1991.0.1-2016)

External Survey: 001.8, first year 2016

General:

Order: 24 September 2015

Order by: HUESKER Synthetic GmbH

Material: Fortrac® T

Order date: 25 August 2016

Complete delivery: 25 August 2016

Order from date: 25 August 2016

Results:

1. Mass per unit area: 100 g/m² x 100

2. Aperture Size: 25 x 25 mm

3. Nominal Tensile Strength: 100 kN/m

4. Strain at Nominal Tensile Strength: 10 %

5. Standard Roll Dimensions: 3,00 x 200 m

6. Durability: Predicted to be suitable for Minimum 120 years in natural soils with a pH of 5 and soil temperatures < 20 °C

DABAS Goldfields Test No. P1821/2016

HUESKER

Fortrac® T

Test Date: 24.04.2016

Article No.: Fortrac® T

Test No.: P1821/2016

Test Results:

1. Mass per unit area (EN ISO 10370): g/m² x 100

2. Aperture Size (aperture): mm: 25 x 25

3. Nominal Tensile Strength (EN ISO 10370): MD: kN/m, CMD: kN/m

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5. Standard Roll Dimensions (width x length): m x m: 3,00 x 200

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HUESKER

ISOLATION OF PERFORMANCE

Fortrac® T

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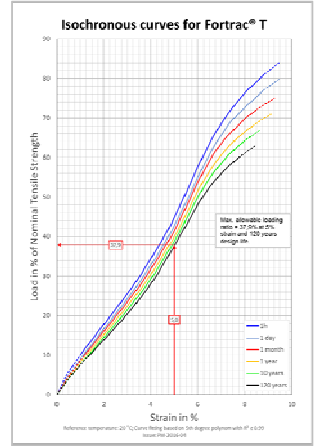
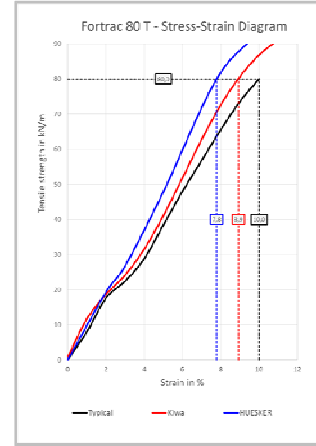
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ENVIRONMENTAL PRODUCT DECLARATION

Fortrac® T

HUESKER Synthetic GmbH

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11.07.2016

Tektoseal® Active AC



TOP: NONWOVEN

Weight can be varied to offer heavier weight fabrics for better puncture protection and pre-filtering of particles.

MIDDLE: ACTIVATED CARBON

Various types of activated carbon can be included within the composite targeting specific contaminants. The mass of carbon can also be increased by adding more layers of activated carbon.

BOTTOM: NONWOVEN

The bottom nonwoven weight can also be increased or replaced by a woven geotextiles for increased strength above soft soils.

Top layer
Polypropylene or polyester nonwoven.

Active layer
Oil absorbing polymer whose structure and surface properties make it particularly suitable for separating oil/water mixtures.

Bottom layer
The material can be varied according to application in order to provide the required strengths or protective properties. Either wovens or nonwovens can be used, with geogrids as additional reinforcement where required.

Tektoseal Active AS	
Function	Oil absorption
Contaminants	e.g. oil, diesel, petrol, kerosene
Oil-binding capacity	1 m ² binds 3.75 ltr oil
Oil release under load	0 % up to 0.1 bar imposed load
Floating capability with PP nonwoven	≥ 99 % in both oil-free and soaked condition
Certification	official oil binding agent in Germany (LTW5)

Tectoseal Active

Tectoseal AS

Oil & Petrochemical

Top layer
Polypropylene or polyester nonwoven.

Active layer
Activated carbon which, due to its fine porous structure and accordingly large internal surface area, can bind a wide range of contaminants.

Bottom layer
The material can be varied according to application in order to provide the required strengths or protective properties. Either wovens or nonwovens can be used, with geogrids as additional reinforcement where required.

Tektoseal Active AC	
Function	Adsorption of non-polar contaminants
Contaminants	e.g. VOC, TBT, PAH, PCB
Weights per unit area	Active layer: 800 to 1,600 g/m ²

Tectoseal AC

VOC's , TBT , PAH, PCB

Top layer
Polypropylene woven

Active layer
Granular natural calcium phosphate: the active substance reliably and permanently binds any dissolved heavy metals with which it comes into contact.

Bottom layer
Polypropylene woven

Tektoseal Active CP	
Function	Binding of heavy metals through four non-mutually exclusive mechanisms
Contaminants	Pb, U, Pu, Cd, Zn, Sr
Weight per unit area	Active layer: 3.6 kg/m ²

Tectoseal CP

Heavy Metals:
Pb , U, Pu , Cd , Zn ,Sr

Huesker will customise a product for your site conditions !

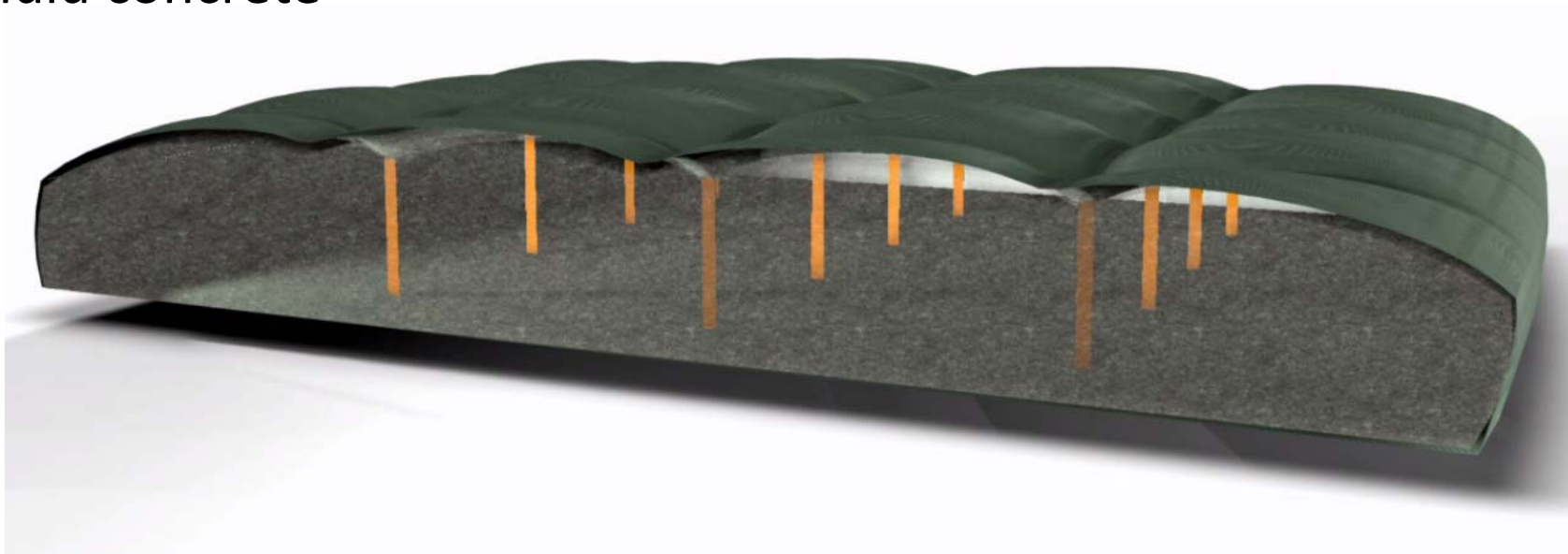


Tectoseal Active

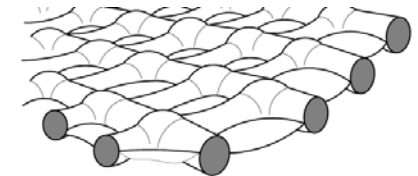
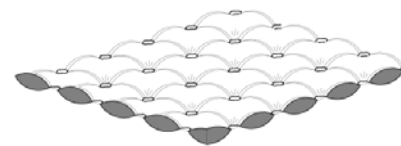
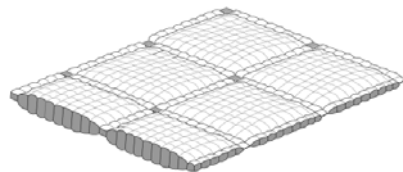
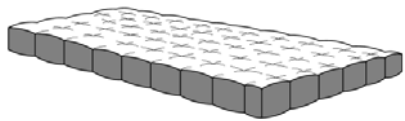
- It is a PASSIVE system that does NOT require maintenance
- It comes on rolls which are easily deployed and installed
- Applications for Tectoseal:
 - Contaminant filter in soils
 - Leachate filter of infrastructure
 - Sludge lagoon remediation
 - Active capping under water
 - Contaminant filter in case of industrial accidents
 - Leachate filter of landfills
 - Part of Gas collection system on Landfills
 - Oil Spillage etc.

A Concrete mattress...called **Incomat®**

- Two layers of geotextile fabric
- Internally connected by vertical binders/ties or interwoven areas
- Space created in between is filled in-situ with highly fluid concrete



What is Incomat ?



Incomat® Standard

- sealing & erosion protection
- constant thickness

Impermeable

Incomat® Flex

- erosion protection
- „pillow mat“ with connection webs and filterpoints

Incomat® Filterpoint (FP)

- erosion protection
- evenly distributed filterpoints

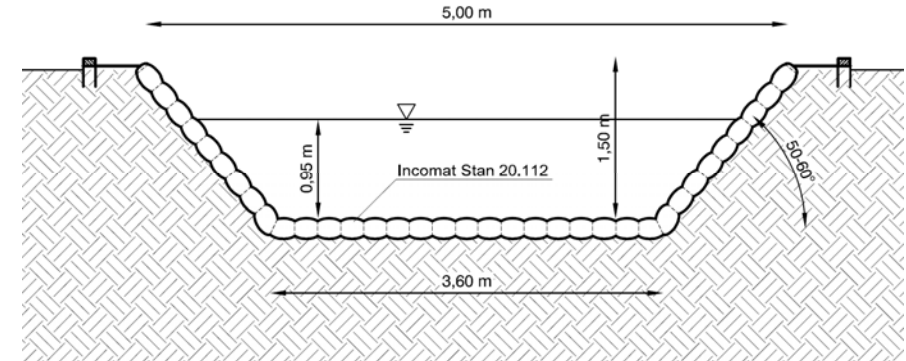
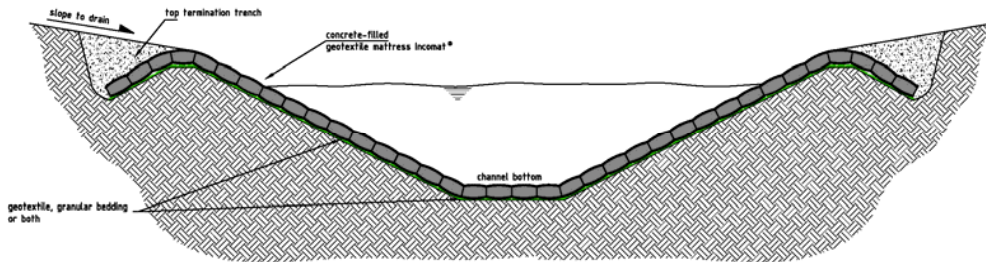
Incomat® Crib

- tech. ecological bank protection
- plantable intermedial fields

Permeable

Different concrete mattress - types with varying characteristics for various applications

Various Design Options



- Thickness varies between 60mm and 600mm
- Installation is not water sensitive
- 2000m² – 3000m² can be installed/day
- Steep slopes up to 2:1

Incomat[®] design

Two principal load cases:

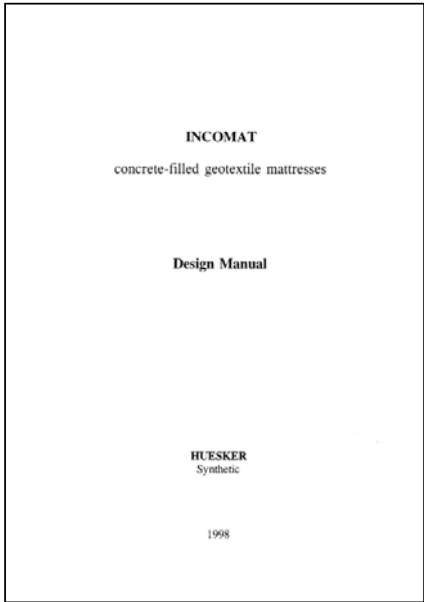
Hydraulic loading
design for



Flow loads/currents



Waves

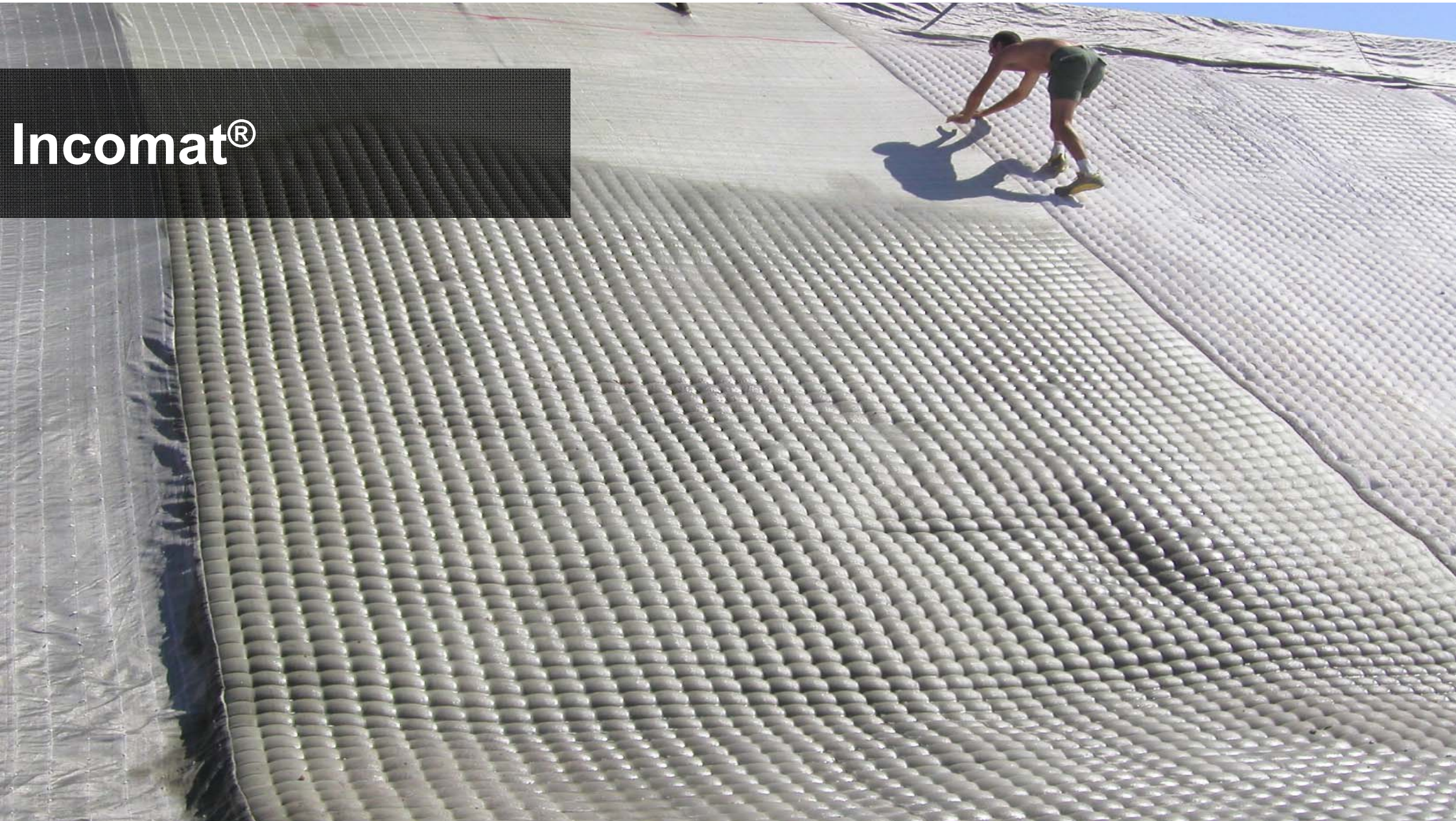
	<p>Design of flow and wave load stability according to the Incomat[®] Design Manual developed by <i>Kristian W. PILARCZYK</i> for HUESKER in 1998</p> <p>(further design references can be found in e.g. “The CUR Rock Manual”, “Handbook of Coastal and Ocean Engineering” edited by Young C. Kim, “River and channel revetments – A design manual” by Manuela Escarameia, “Revetment systems against wave attack – A design Manual” by Kirsty McConnell, etc.)</p>
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Incomat[®] case studies



Shin Lung Stream, Taiwan
Compound slope

Incomat®



Geo-Q - Software

- Live Cloud based online system, ensuring what happened on site that very same day is reflected online within hours(immediately)
- One off a kind system, developed purely for Lining systems
- Ideal for 3rd party QA/QC as it is 100% unbiased and independent
- 86 hold points – forcing the installer to comply with checks points
- Incorporates SANS 10409, as well as best practice
- Forcing the installer to do testing at the required frequencies
- All relevant parties have 24hour access
- Ensures full traceability of all materials used



Geo-Q : Guarantee

- No more:
 - Rolls without roll numbers – unlogged pre-testing
 - Unlogged panel placement
 - Over claims on waste factors
 - Unsupervised site installations!

The end

Thank you

