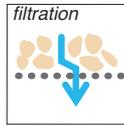
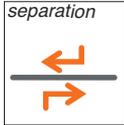




Open-air reservoirs, channels



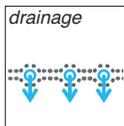
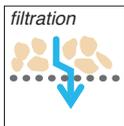
Separation and filtration of material layers

▲ to separate, filter, and improve bearing capacity, the layers of granular material shall be separated by a thermally bonded, needle-punched nonwoven geotextile of the **Bontec NW optim** type, with an optimal 40% to 50% elongation at break, and a modulus of resistance 20 kN/m for 100 grams at failure, as per NFE-NISO 10319.

▲ thanks to the thermally bonded structure, the pore size in the soil shall be stable for controlled filtration.

▲ the surface of the product shall be slightly rough to increase the “grip” with the soil and improve the bearing capacity.

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.



Stabilizing reservoir foundations

▲ on unstable soil or soil presenting cavity risks, the geomembrane sealing system shall be strengthened on the underside with a reinforcing geotextile, a high-modulus woven polyester sheet relatively insensitive to creep such as **Bontec HS force**.

▲ it shall be in woven polyester, of ultimate tensile strength 100 to 600 kN/m as per NFENISO 10319, 10% elongation at break, and modulus of resistance 1000 to 6000 kN/m. The pore sizes shall be less than 400 µm.

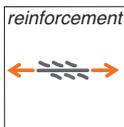
▲ in a long-term application, the design working load must not exceed one-third of the product’s nominal strength: verify the sizing in accordance with the XP G 38-064 standard.

▲ to perform the puncture resistance and reinforcement functions simultaneously, the reinforcing sheets used shall be in the form of a nonwoven geocomposite reinforced with high-modulus polyester reinforcing cables of the teraforce type. The cables shall be protected on either side by a nonwoven polypropylene sheet performing the hydraulic filtration and flow rate capacity functions, and the mechanical function of protection from puncturing and damage.

▲ the nonwoven mass shall be 400 g/m² and the elongation at break less than 10%.

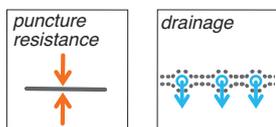
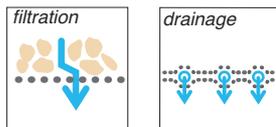
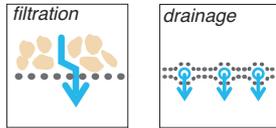
▲ the product shall be sized in accordance with the XP G38-064 standard.

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.





Open-air reservoirs, channels



Draining reservoir foundations

▲ in order to drain the geomembrane sealing system base and prevent foundation erosion, a geocomposite such as **teradrain**, consisting of a combination of needle-punched, nonwoven geotextiles and a network of regularly spaced 20 mm perforated mini-drains, shall be placed on the foundation level. The product shall have a filtration opening of 78 µm on the external filtering surfaces, supported at all points by the nonwoven draining core; the whole system shall be self-healing in the event of localized tearing.

▲ the vertical drainage capacity of a mini-drain shall be 720 litres/hour. The circular shape of the mini-drains shall enable them to resist very high pressures of 900 kPa in the soil, and not collapse in the long term.

▲ the ultimate tensile strength of the product shall be 28 kN/m with a 45% elongation at break.

▲ the mass per unit area shall be 650 g/m².

▲ the product must be sized by computation.

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.

Draining gases

▲ in order to drain the accumulation of gases rising from the subsoil and blocked by the geomembrane, a geocomposite such as **teradrain**, consisting of a combination of needle-punched, non woven geotextiles and a network of regularly spaced 20 mm perforated mini-drains, shall be placed on the foundation level. The product shall have a filtration opening of 78 µm on the external filtering surfaces, supported at all points by the nonwoven draining core; the whole system shall be self-healing in the event of localized tearing. The vertical drainage capacity of a mini-drain shall be 720 litres/hour. The circular shape of the mini-drains shall enable them to resist very high pressures of 900 kPa in the soil, and not collapse in the long term. The ultimate tensile strength of the product shall be 14 kN/m with a 45% elongation at break.

▲ the mass per unit area shall be 350 g/m².

▲ the product must be sized by computation.

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.

Puncture-resistant base for the geomembrane liner

▲ the draining, puncture-resistant, geotextile base shall be executed using a geocomposite of the **teradrain** type, consisting of a combination of needle-punched, nonwoven geotextiles and a network of regularly spaced 20 mm perforated mini-drains. The product shall have a filtration opening of 100 µm on the filtering surface on the soil side, supported at all points by the nonwoven draining core; the whole system shall be self-healing in the event of localized tearing. The vertical drainage capacity of a mini-drain shall be 720 litres/hour. The circular shape of the mini-drains shall enable them to resist very high pressures of 900 kPa in the soil, and not collapse in the long term. The ultimate tensile strength of the product shall be 50 kN/m with a 100% elongation at break.

▲ the CBR static puncture resistance shall be 9 kN, with a dynamic perforation of 0 mm, so as to perform the mechanical protection function.

▲ the mass per unit area shall be 1200 g/m².

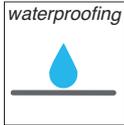
▲ the product must be sized by computation.

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.

The technical specifications may be changed at any time. Please make sure you have up-to-date technical data sheets. **teragéos** is not liable for the use of its products.



Open-air reservoirs, channels



Reservoir waterproofing by geomembrane

Runoff water, domestic sewage, raw water;
underground reservoirs, small rounded surface areas:

▲ waterproofing shall be executed with a heat-sealable geomembrane such as **teraline**, in plasticized PVC, 12/10th to 20/10th mm thick, of light grey colour, UV stabilized and having a health compliance certificate (French "ACS"), of ultimate tensile strength 16 MPa, with 300% elongation at break.

▲ joining shall be performed by a company having ISO certification for the installation of geomembranes, and Asqual-certified welding and site management personnel.

▲ the site report shall demonstrate the conformity of the work with the Asqual references for calibration of welding machines and resistance of test samples.

▲ all welds shall be inspected by compressed air and identified on an as-built drawing.

Chemically aggressive products,
large rectangular surface areas:

▲ waterproofing shall be executed with a heat-sealable geomembrane such as **teraline**, in HDPE, 15/10th to 20/10th mm thick, of black colour, UV stabilized, and with an ultimate tensile strength of 18 MPa and 11.5% elongation at the plastic yield point.

▲ joining shall be performed by a company having ISO certification for the installation of geomembranes, and Asqual-certified welding and site management personnel.

▲ the site report shall demonstrate the conformity of the work with the Asqual references for calibration of welding machines and resistance of test samples.

▲ all welds shall be inspected by compressed air and identified on an as-built drawing.

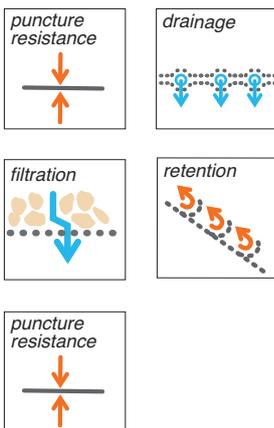
Protection of the geomembrane

▲ in order to protect the geomembrane liner from puncturing and piercing, a needle-punched, nonwoven geotextile such as **Bontec VNW protec** shall be positioned on the geomembrane. With a 130% elongation at break, it is needle-punched from 100% virgin polypropylene fibres.

The degree of protection shall be chosen according to the weight and particle size of the added materials and their method of application.

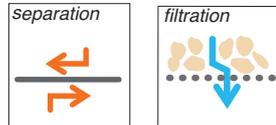
▲ for a built-up protective layer in rounded aggregate 30 cm thick, without machinery traffic over the geomembrane, the geotextile shall have a dynamic puncture resistance value of less than 12 mm and a mass per unit area of 300 g/m², while for a built-up layer requiring heavy machinery traffic, the geotextile shall have a dynamic puncture resistance value of 0 mm, a CBR static puncture resistance of 8.7 kN, and a mass per unit area of more than 1200 g/m².

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.





Open-air reservoirs, channels

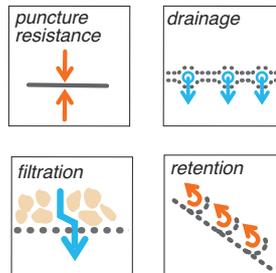


Separation and filtration of material layers

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▲ thanks to the thermally bonded structure, the pore size in the soil shall be stable for controlled filtration. The surface of the product shall be slightly rough to increase the “grip” with the soil and improve the bearing capacity.

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.



Protection of the geomembrane liner and retention of the covering on slopes

▲ In order to protect the geomembrane liner from puncturing and piercing and to stabilize the top layer on slopes, a needle-punched, nonwoven geocomposite such as **teracro** shall be applied to the geomembrane. The product shall have a filtering base reinforced by a network of polyester tensile reinforcement cables, regularly spaced, and on which are bonded twisted strips forming filtering barriers 13 cm high.

▲ the system in ready-to-use rolls shall be unrolled on the embankments and head-anchored in a trench.

▲ the materials shall be added to a minimum thickness of 15 cm, by a long-arm excavator without any traffic over the geomembrane.

▲ the roll lengths shall be appropriate for the project.

▲ the product and anchoring shall be sized in accordance with the XP G38-067 standard.

▲ the manufacturer, with ISO 9001 certification, shall have an engineering department capable of advising the designer and installer.

Joining the geomembrane liner to structures

▲ the geomembrane liner shall be joined to the engineering structures' flat surfaces in concrete with a 350 kg cement factor, by a flat stainless steel bar 4 mm thick by 40 mm wide, pierced to clamp a 10 mm dia. stainless steel stud every 12.5 cm.

▲ a closed cell neoprene foam joint 4 mm thick by 60 mm wide ensures waterproofing between the concrete and the flat stainless steel bar, by clamping.

▲ the concrete must be flat, smooth, thick and strong.

▲ the flat concrete joining surfaces must be in the plane of the substrate, on a tie beam going around the structure, for example.

▲ vertical upstands around the structures are prohibited.